Living Marine Legacy of Gwaii Haanas. III:

Marine Bird Baseline to 2000 and Marine Bird-related Management Issues throughout the Haida Gwaii Region

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Technical Reports in Ecosystem Science

Report 036

Living Marine Legacy of Gwaii Haanas. III: Marine Bird Baseline to 2000 and Marine Bird-related Management Issues throughout the Haida Gwaii Region

by

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Abstract

This is the third report in a series of baseline marine biological inventories for Haida Gwaii (Queen Charlotte Islands) including Gwaii Haanas National Park Reserve and Haida Heritage Site. We present distribution and abundance data for seabirds, marine waterfowl, shorebirds and marine raptors through April 2000. We also review traditional Haida knowledge on marine birds and discuss how marine bird issues could influence ecosystem-based management of the proposed Gwaii Haanas National Marine Conservation Area. Approximately 1.5 million marine birds breed on Haida Gwaii, including the following groups: seabirds (13 species), marine waterfowl (8 species), shorebirds (7 species) and marine raptors (2 species). These include significant proportions of the world populations of Ancient Murrelet, Cassin's Auklet, Black Oystercatcher and Peale's Peregrine Falcon. The archipelago's shorelines and marine waters support millions of non-breeding marine birds (94 additional species) during migration and over winter. Marine birds are essential to understanding Haida Gwaii's marine ecosystems and should be used as indicators of ecosystem health. The most serious threat to the breeding populations of Haida Gwaii marine birds is depredation by introduced mammals. As well, effects of pollution, commercial fisheries, forestry and tourism-recreation are conservation issues for marine birds.

Résumé

Ce rapport est le troisième d'une série de documents de référence portant sur l'inventaire biologique des espèces marines de la région de Haïda Gwaii (îles de la Reine-Charlotte), y compris la réserve de parc national et le site du patrimoine haïda Gwaii Haanas. Nous y présentons des données recueillies en avril sur la répartition et l'abondance des oiseaux de mer, des sauvagines marines, des oiseaux de rivage et des oiseaux de proie marins. Nous examinons également les connaissances traditionnelles des Haïdas sur les oiseaux marins, et nous discutons de la façon dont les enjeux liés aux oiseaux marins pourraient influer sur la gestion écosystémique de l'aire marine nationale de conservation Gwaii Haanas proposée. Environ 1,5 million d'oiseaux marins se reproduisent dans Haïda Gwaii, notamment les groupes suivants : oiseaux de mer (13 espèces), sauvagines marines (8 espèces), oiseaux de rivage (7 espèces) et oiseaux de proie marins (2 espèces). De ce nombre, on compte une part importante de la population mondiale de guillemots à cou blanc, de stariques de Cassin, d'huîtriers de Bachman et de la sous-espèce pealei du faucon pèlerin. Durant la migration et la saison hivernale, le littoral des îles de l'archipel et les eaux avoisinantes abritent des millions d'oiseux marins non nicheurs (94 espèces additionnelles). Il est essentiel de connaître les oiseaux marins pour bien comprendre les écosystèmes marins de Haïda Gwaii. Ces oiseaux devraient servir d'indicateurs de la santé des écosystèmes. Les dommages causés par les mammifères qui ont été introduits dans l'archipel constituent la plus importante menace que subissent les populations d'oiseaux nicheurs de Haïda Gwaii. Les incidences de la pollution, de la pêche commerciale, de l'exploitation forestière et de l'activité touristique constituent également une préoccupation pour ce qui est de la conservation des oiseaux marins.

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Preface

The diversity of the biosphere faces enormous threats from our rapid acquisition of most of the earth's resources. We now consume roughly half of all the biological production created by the planet and that proportion can only rise as our population and affluence continue to increase.

Thanks to the continuous conversion of natural ecosystems to human uses, lands and waters set aside as protected areas are becoming increasingly important as oases of original flora and fauna. However, even within such oases, many factors are at work to erode biodiversity. Only by the utmost vigilance can we keep track of these threats and counter them as they arise. An essential component in any such endeavour is an adequate knowledge of the baseline situation. This report sets out to provide such a baseline.

Haida Gwaii supports one of the most important concentrations of marine birds on the Pacific coast of North America. Considering their numbers and diversity, it is amazing how recent much of our information on marine birds in the archipelago is. The first systematic attempt to assess the distributions and populations of marine birds in Haida Gwaii was carried out by the B.C. Provincial Museum only in the 1970s and approximate totals for the main colonial species could be estimated only in the 1980s. The first information on population trends became available only in the 1990s and even now is available for only a handful of species. In contrast, marine bird populations in Quebec have been regularly monitored since the 1930s and even those in the high arctic have been tracked since the 1970s.

The relative dearth of information on marine birds in Haida Gwaii can be attributed in part to the remoteness of the archipelago, but probably more importantly, stems from the nocturnal colony visits of many of the most abundant species. Sailing among the islands of Haida Gwaii by day, the forest clad slopes give no hint of seabirds burrowing within. Only painstaking searching through dense cover and over highly inhospitable terrain can reveal the extent and density of burrows. Our knowledge of the colonial, burrow-nesting auks and petrels owes an enormous debt to the Canadian Wildlife Service team led by Gary Kaiser, Mike Rodway and Moira Lemon in the 1980s. These workers carried out one of the most intensive remote colony inventories ever attempted, visiting, mapping and counting almost every colony in Haida Gwaii. This remarkable and copiously documented baseline provides a tremendous resource on which to draw.

Sadly, our information on distributions of birds at sea off Haida Gwaii falls far short of that for the breeding colonies. Although information on numbers at sea is generally too variable to be used for the monitoring of population trends, we need to have a firm grasp of what species are present, where and in what numbers, if we are to make sensible predictions about the likely impact of oil spills or other pollution events. This is a topic where much more effort will be required in the future to enable us to make a proper assessment of the environmental costs of offshore oil development.

It is common to bemoan the fragility of nature and its susceptibility to interventions by people. In my own view, we are ungenerous in our appreciation for nature's resilience. If nature were really so fragile, the biosphere would surely have shrivelled and died long ago under our assault. Given the enormous demands that we place on the marine environment as the ultimate receptacle for every waste and toxin that we produce, it is nothing short of a miracle that we still enjoy places so brimming with production and diversity, so deserving of both study and contemplation, as the waters surrounding the Haida Gwaii archipelago. Long may they so remain.

Dr. Anthony J. Gaston
National Wildlife Research Centre, Canadian Wildlife Service
Ottawa

Executive Summary

This is the third in a series providing baseline marine biological inventories for the Haida Gwaii (Queen Charlotte Islands) archipelago including the proposed marine component of Gwaii Haanas National Park Reserve and Haida Heritage Site. An assessment of biodiversity is central when addressing Parks Canada Agency's marine policy to protect representative samples of Canada's marine areas by maintaining ecosystem structure and function while enabling multiple sustainable uses such as fisheries and tourism.

Haida Gwaii is of high marine ornithological interest as it represents important nesting, feeding and staging sites. We review breeding and seasonal occurrence of the marine bird species, divided into four broad groups (seabirds, marine waterfowl, shorebirds, marine raptors). The breeding colonies and nesting sites are mapped using all data available through April 2000. Our 10 geographic information system (GIS) databases of marine birds contain ~3,700 records, comprising 46 marine bird species recorded from 1,748 localities among the islands. Establishing a georeferenced knowledge-base is a necessary first step towards linking species diversity with habitat type and eventually understanding regional ecosystem roles of marine birds. Essentially, marine birds are critical to both scientific and cultural aspects of regional marine conservation.

Beside the species diversity inventory, seasonal occurrence and breeding location data, this report also includes the following:

- a review of Aboriginal (Haida) knowledge of, and words for, marine birds;
- an overview of regional marine ornithological history;
- a discussion of threats to marine birds such as pollution;
- three case studies recounting problems between conservation intent and delivery;
- an analysis of marine bird issues relevant to future marine area management; and
- a detailed bibliography of source publications to enable further inquiry.

We describe regional marine bird knowledge, synthesise this into an accessible and technically sound overview to aid conservation management, and identify key knowledge gaps warranting attention. This volume should function as a technical reference defining marine bird issues in forthcoming public consultations on declaration of the Gwaii Haanas National Marine Conservation Area. We have tried to explain the complexities of marine birds, their protection under overlapping, multi-agency mandates and their attendant management issues for a wide readership (Aboriginal and other coastal communities, fishery and tourist sectors, non-governmental organizations, agencies, universities). As well, the databases facilitate the addition of new information. As regional marine knowledge improves, so should the quality of our conservation decision-making.

INTRODUCTION

"*The sea around the Queen Charlotte Islands provides rich feeding grounds for marine birds. There are large areas of shallow seas, sharp changes in depth, strong currents, great tidal range and several areas where current-driven turbulence results in upwelling. The combination of tidal flats, shallow seas over shelving shores, abrupt cliff-girt coastline, an abundance of islands, islets and rock stacks and the adjacent expanse of open ocean, lead to a rich assembly of marine birds around the Islands*." (Cowan 1989)

"*Hecate Strait is the most important body of water for seabirds on the Canadian Pacific coast*." (Kaiser 2002)

The marine waters surrounding Haida Gwaii (Queen Charlotte Islands) support a diverse and abundant bird fauna (avifauna). Populations of national and international significance depend on the intertidal, inshore and offshore areas for food when breeding, migrating and wintering (Campbell *et al.* 1990 a). Further, marine birds have received more scientific and naturalists' attention that any other single marine animal group in Haida Gwaii (Campbell *et al.* 1990 a, b; Vermeer and Morgan 1997; Hamel and Hearne 2001). Marine birds relate to all aspects of marine area conservation and Aboriginal (Haida) culture. This report is intended to advise a broad readership on current knowledge of status of local marine birds and connect this knowledge to marine bird-associated management issues relevant to public consultation towards establishing Gwaii Haanas National Marine Conservation Area surrounding Gwaii Haanas National Park Reserve and Haida Heritage Site.

We focus on the distribution and abundance of the most common of the 124 marine bird species reported from Haida Gwaii. Marine birds include seabirds, marine waterfowl, shorebirds and marine raptors dependant on marine prey. Our marine bird species diversity inventory is in a series of geographic information system (GIS) databases. In the future, some of the 10 marine bird inventory databases may be layered over habitat, predator distribution, human use or other data sets to address technical questions in aid of management.

We very briefly review the biology of Haida Gwaii species and we provide guidance to the more detailed literature on their life histories. Information on the habitats, diet, reproductive biology, vocalisations and other aspects of species' ecology throughout their global ranges are reviewed elsewhere (Poole and Gill 1997; Gaston and Jones 1998; http://seaduckjv.org).

Establishing a georeferenced inventory is a necessary first step towards linking species diversity with habitat type and eventually understanding the ecosystem role of marine birds in this region, including the proposed Gwaii Haanas National Marine Conservation Area. As well as the georeferenced species inventory, we include the following:

- a review of Aboriginal (Haida) knowledge, words and uses for marine birds;
- a brief overview of regional marine ornithological history;
- a discussion of threats to marine birds such as pollution;
- three case studies recounting problems between conservation intent and delivery;
- an analysis of marine bird issues relevant to future marine area management; and
- a detailed bibliography of the source materials to facilitate further inquiry.

This is the third report in a series providing baseline marine inventories of Haida Gwaii with special reference to the living marine legacy of Gwaii Haanas. The first report was on marine plants (Sloan and Bartier 2000), the second on marine invertebrates (Sloan *et al.* 2001) and proposed future

reports will cover physical oceanography, shoreline biophysical inventory, marine fishes and marine mammals.

A marine mandate for Parks Canada Agency (PCA), in the *Canada National Marine Conservation Areas Act* (passed June, 2002), is protection and conservation of representative samples of marine regions. The mandate includes maintaining ecosystem structure and function while permitting multiple sustainable uses, such as fisheries and tourism, within protected areas. Knowledge of individual species supports PCA's recently defined overall mandate of maintaining ecological integrity as parks strive to become "*centres of ecological understanding*" (Parks Canada Agency 2000).

Our area of coverage is the Haida Gwaii archipelago and contiguous regional waters including Dixon Entrance, western Hecate Strait, Queen Charlotte Sound and westward into the Northeast Pacific (Figure 1). Hereafter we call this area the Haida Gwaii region. The extent of the Haida Gwaii region reflects Parks Canada's policy on understanding regional marine attributes not just those within conservation area boundaries (Parks Canada 1994). Habitat coverage is terrestrial (nesting sites) to the open ocean, including estuarine habitats. Temporal coverage dates mostly from the first published zoological and archaeological reports of the late 19th century to April 2000. We acknowledge, however, that the archaeological record itself dates back ~10,000 years BP (before present).

Three provincial ecosections divide the lands of Haida Gwaii longitudinally in a northwest to southeast orientation (Figure 1). The Queen Charlotte Lowlands is represented on northeast Graham Island. The Skidegate Plateau and the Windward Queen Charlotte Ranges extend further south and are represented in Gwaii Haanas. The archipelago is exposed to powerful, saline sea winds and heavy rains which strongly influence the biogeoclimatic zones found here. There are three biogeoclimatic zones in Haida Gwaii (Green and Klinka 1994). The Coastal Western Hemlock zone is subdivided into two subzones. The Very Wet Hypermaritime Coastal Western Hemlock subzone represents the windward west coast, and is dominated by boggy woodlands. The Wet Hypermaritime Coastal Western Hemlock subzone represents the leeward eastern side of the archipelago and is the typical coastal temperate rainforest dominated by large hemlock, spruce and cedar trees. The Mountain Hemlock and the Alpine Tundra zones are found at higher elevations (550 to 600 m and 650 to 800 m, respectively). Several peaks in the Queen Charlotte Range exceed 1,100 m in elevation; these larger peaks are concentrated on north central Moresby Island and southern Graham Island (Golumbia 2001).

Physical oceanography can provide critical insights into marine bird distribution within the Haida Gwaii region. Reviews on regional oceanography are provided in Thomson (1989), Robinson *et al.* (1999), Crawford (1997, 2000) and an updated overview of the physical oceanography of the Haida Gwaii region is in preparation for the series to which this volume belongs. Thus, only a brief overview is presented here. The interactions between marine birds and oceanographic processes are little studied in British Columbia, but distribution and abundance are likely influenced by the features affecting primary (phytoplankton) and secondary (zooplankton) productivity. Using mainly data from other coastal regions, Burger *et al.* (1997) briefly reviewed some of those features including bathymetry, the continental shelf break, upwelling plumes, seamounts, tides and currents. On a finer scale, processes that concentrate plankton and small fish such as eddies and tidal slicks are likely related to bird distribution (Burger *et al.* 1997). Robinson *et al.* (1999) provide a recent review of knowledge of

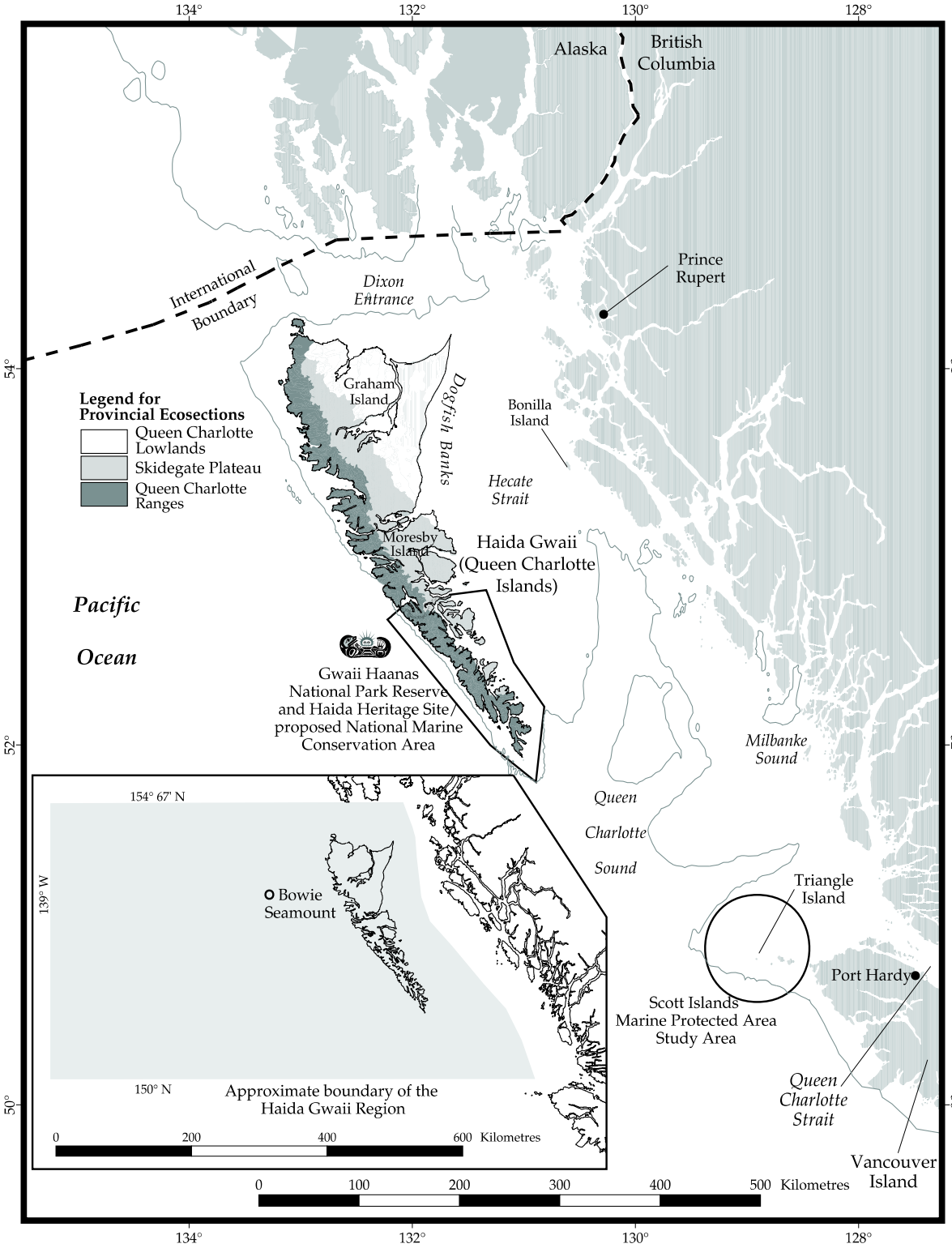

Figure 1. Map of the Haida Gwaii region including Gwaii Haanas National Park Reserve and Haida Heritage Site and the proposed Gwaii Haanas National Marine Conservation Area. Provincial ecosections are also included. The 200 m depth contour (isobath) is shown and demarcates the edge of the continental shelf before the steep decline of the continental slope into the deep ocean. Where the isobath touches the land is an artifact from this uncharted section of coast; these are the best data available from the Canadian Hydrographic Service.

phytoplankton, zooplankton and fishes of Haida Gwaii.

Thomson (1989) divided the region's "*diverse oceanographic setting*" characterized by transition linking open ocean and coastal runoff processes into three oceanographic domains as follows:

- Oceanic – along the west coast where offshore processes dominate;
- Eastern Coastal – including Hecate Strait and Queen Charlotte Sound where offshore and estuarine processes are equally influential; and
- Northern Coastal – consisting of Dixon Entrance and adjoining channels in which runoff from large rivers (e.g., Nass and Skeena) yields estuarine flow patterns.

Thomson (1989) stated that physical oceanographic knowledge of this very diverse region is rudimentary; "*… we have a limited understanding of the basic spatial and temporal variability of the water properties and circulation.*" Further, the nearshore oceanography within the Haida Gwaii region is even less well understood than the larger-scale offshore oceanographic processes. Despite the imperfect oceanographic understanding, thinking about marine birds in the context of oceanographic setting is fundamental.

Haida Gwaii's west coast is exposed to the full force of the Northeast Pacific's weather. This coast has a limited continental shelf (<200 m water depth) ~30 km wide off Langara Island narrowing to ~5 km wide for much of the west coast of Gwaii Haanas (Figure 1). Seaward of the continental shelf is a steep continental slope descending to >2,500 m depth within 30 km offshore of Gwaii Haanas (Barrie and Conway 1996). The 200 m isobath demarcating the edge of the continental shelf is often referred to as the shelf break. The east coast of Haida Gwaii faces Hecate Strait, which extends ~75 km to the northern British Columbia mainland, and is mostly shallower than 150 m (Fedje and Christensen 1999).

Gwaii Haanas comprises the southern end of Moresby Island and associated islands in southern Haida Gwaii (Figure 1). Gwaii Haanas itself incorporates ~1,470 km^2 of land, ~3,400 km^2 of proposed sea space and ~1,700 km of shoreline. Gwaii Haanas' coastal zone is a highly incised, mostly rocky (~75%) shoreline. Approximately 10% of the shoreline is course sediment (pebble, cobble, boulder), <10% is sandy and ~6% is level, estuarine wetlands. The shoreline has received preliminary biophysical classification (Harper *et al.* 1994) and is in Gwaii Haanas' GIS database. Gwaii Haanas represents the National Marine Conservation Area Natural Regions of Queen Charlotte Islands Shelf to the west, Hecate Strait to the east and borders the Queen Charlotte Sound region to the south (Mercier and Mondor 1995). Place names referred to in the text are shown in Figures 1, 2 a and 2 b.

In summary, this volume is intended as a technical reference for a wide readership on marine bird issues in aid of forthcoming public consultations on declaration of the proposed Gwaii Haanas National Marine Conservation Area. We try to clarify the complexities of marine bird-related issues and their attendant management concerns in an accessible and technically sound document. To that end, we provide the following:

- guidance on what is known about regional marine birds;
- synthesis into an integrated overview relevant to regional marine conservation;
- identification of noteworthy knowledge gaps; and
- recommendations for marine bird science in support of future management.

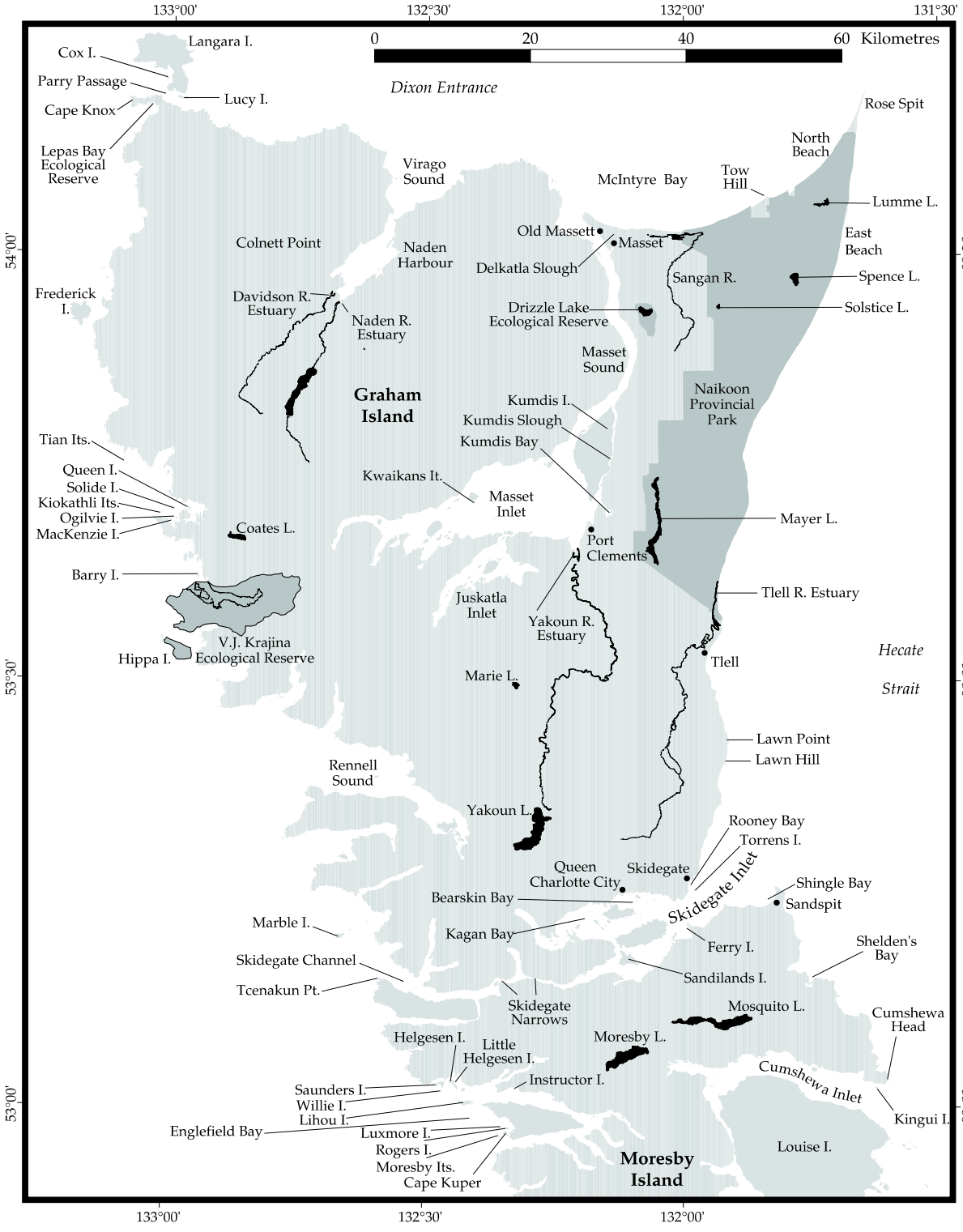

Figure 2 a. Map of the northern Haida Gwaii region showing place names mentioned in the text.

Figure 2 b. Map of the southern Haida Gwaii region showing place names mentioned in the text.

DEFINITION OF MARINE BIRDS

Any scheme for categorizing species as marine or not is arbitrary (Dale 1997). In part, this is because there is no precise boundary between either terrestrial and marine ecosystems or freshwater and saltwater ecosystems. In addition, some species use both freshwater and saltwater habitats. And some species, predominantly associated with freshwater over much of their ranges, include individuals found in marine waters.

We have chosen a taxonomic approach to defining marine birds. The higher taxonomic levels of the species included herein are listed in Table 1. We list families, such as albatrosses, in which all species are associated almost exclusively with saltwater during both breeding and non-breeding seasons. We also list families and a tribe, sea ducks, whose species are primarily associated with saltwater habitats except when nesting. Other avian families are comprised of species that vary considerably with respect to the degree to which they use marine waters. We include those families in which most species are found primarily on saltwater along coastal British Columbia. For example, all Gaviidae (loons) are included, whereas the Ardeidae (bitterns, herons) and Strigidae (owls) are excluded although Great Blue Heron (*Ardea herodias*) and Northern Saw-whet Owl (*Aegolius acadicus*) often forage in intertidal areas of Haida Gwaii (Sealy 1999; Harfenist *personal observation*). There are three exceptions to our taxonomic definition of marine birds. We include Brant, the only species of goose exclusively associated with marine waters, because it has played a critical role in nearshore development issues in Haida Gwaii. We also include the two raptors intimately connected to local marine ecosystems. The common and scientific names of the 124 marine bird species of the Haida Gwaii region are given in Appendix A. The species are listed in taxonomic order according to the American Ornithological Union (AOU) *Check-list of North American Birds* (AOU 2000). We use the nomenclature and classification of the AOU throughout this report.

Marine birds of the Haida Gwaii region comprise four groups as follows:

- **Seabirds** are a diverse group of species that spend most of the year on marine waters and, in general, come to land only to breed. Most breed colonially on small islands and disperse offshore during the non-breeding season. They are characterized by deferred sexual maturity, small clutch size and high adult survival.
- **Marine Waterfowl** is used here to describe loons, grebes, Brant and sea ducks. They comprise a diverse group which tends to breed in association with freshwater and overwinter in marine waters. Their nest sites vary from tree cavities to emergent vegetation on wetlands to open tundra. Following the breeding season, birds move to the coast where they congregate to moult and over-winter. Sea ducks tend to moult in the late summer, whereas loons and grebes tend to moult in winter. They are characterized by delayed sexual maturity, low recruitment and high adult survival.
- **Shorebirds** are a highly migratory group. Most species breed in arctic, sub-arctic or northern boreal habitats and winter in more southerly areas as far as Central and South America. They depend on stopover sites that provide adequate resources along their migration routes. Many species migrate and overwinter in large aggregations. Shorebirds are unique among these marine bird groups in their mating system diversity. Their adult survival is generally lower than that of seabirds or marine waterfowl.
- **Marine Raptors** is used here to describe the Bald Eagle (*Haliaeetus leucocephalus*) and Peale's Peregrine Falcon (*Falco peregrinus pealei*) that, respectively, rely

Table 1. Broad groups and higher taxonomic levels (orders, families) within which the marine birds of the Haida Gwaii region belong.

Seabirds
Order **Procellariiformes** (Tube-nosed Swimmers)
Family Diomedeidae (Albatrosses)
Family Procellariidae (Fulmars, Petrels, Shearwaters)
Family Hydrobatidae (Storm-petrels)
Order **Pelecaniformes** (Totipalmate Swimmers)
Family Phalacrocoracidae (Cormorants)
Family Fregatidae (Frigatebirds)
Order **Charadriiformes** (Gulls, Auks)
Family Laridae (Jaegers, Skuas, Gulls, Terns)
Family Alcidae (Auks, Murres, Puffins)
Marine Waterfowl
Order **Gaviiformes** (Loons)
Family Gaviidae (Loons)
Order **Podicipediformes** (Grebes)
Family Podicipedidae (Grebes)
Order **Anseriformes** (Geese, Ducks)
Family Anatidae (Geese, Ducks)
Tribe Mergini (Sea Ducks)
Shorebirds
Order **Charadriiformes** (Shorebirds)
Family Charadriidae (Plovers)
Family Haematopodidae (Oystercatchers)
Family Scolopacidae (Sandpipers, Phalaropes and allies)
Marine Raptors
Order **Falconiformes** (Diurnal Birds of Prey)
Family Accipitridae (Ospreys, Eagles, Hawks)
Family Falconidae (Falcons)

heavily or exclusively on marine resources.

The marine birds of Haida Gwaii can be divided into three categories (after Kaiser 2002):

- birds that breed locally;
- birds that breed in the arctic, sub-arctic or other regions of the Northern Hemisphere but migrate along, or winter on, the coast; and
- birds that breed in the southern hemisphere and migrate north during the austral winter.

HISTORICAL OVERVIEW OF REGIONAL MARINE ORNITHOLOGY

The avifauna of Haida Gwaii was first listed by Keen in 1891 (Hamel and Hearne 2001). This was updated by Osgood (1901) for the United States Bureau of Biological Survey. There were few early contributions from European explorers in the 1700s and 1800s for this region (Pearse 1968). Campbell *et al.* (1990 a) called the contribution by early Europeans "*essentially nil*". Munro and Cowan (1947) inventoried all the data on bird specimens held in museums and private collections to the mid-1900s.

Most marine bird work in Haida Gwaii in the last half of the 20th century involved seabirds. Much of the early work was carried out by the British Columbia Provincial Museum (now the Royal British Columbia Museum; Munro and Campbell 1979). Drent and Guiget (1961) completed a preliminary inventory of seabird colonies for the entire archipelago which was updated by Campbell and Garrioch (1979) who mapped the distribution of seabird colonies with rough estimates of numbers of the breeding populations at each colony. More systematic surveys of nesting seabirds in Haida Gwaii were done by the Canadian Wildlife Service (CWS) in the 1980s. Teams led by Kaiser, Lemon, Rodway and Vermeer checked almost all islands in the archipelago for evidence of nesting and populations were counted when feasible. The results are compiled in a series of colony catalogues giving colony extent and population estimates for burrow-nesting seabirds (Rodway *et al.* 1988, 1990, 1994; Vermeer *et al.* 1993 a) and surface-nesting seabirds (Rodway 1988; Vermeer *et al.* 1991 a). During the late 1980s and 1990s, the CWS focus switched to studying the ecology of seabirds (Vermeer and Lemon 1986; Gaston 1992 a; Bertram *et al.* 1997; Gaston and Smith 2001; Harfenist and Smith 2001), as well as documenting the effects and planning eradications of introduced mammalian predators (Bertram 1989; Gaston and Masselink 1997; Kaiser *et al.* 1997; Harfenist *et al.* 2000).

In comparison to seabirds, nesting marine waterfowl and shorebirds of Haida Gwaii are not well studied. Reimchen and Douglas have collected most of the marine waterfowl nesting records during their research and inventories of freshwater ecosystems (Reimchen and Douglas 1980; Douglas and Reimchen 1988 a; Reimchen 1992 a, b, 1994 a; Reimchen *et al.* 1994). Studies of nesting shorebirds were summarized in Cooper and Miller (1997).

Surveys of marine birds at sea have been conducted by CWS as part of the environmental assessment associated with the prospect of offshore oil and gas exploration and development in the 1970s and 1980s as well as by NGOs and individuals (Savard 1979, 1988; Vermeer and Rankin 1984, 1985; Gaston 1996; P. Hamel, Delkatla Sanctuary Society, *personal communication*). Information on aggregations of birds on the ocean was compiled and mapped by Hatter (1977) and the British Columbia Ministry of Environment (B.C. MoE 1981). Marine birds feature in regional environmental evaluations by the petroleum industry (Anonymous 1982, 1983; McPhee 1982; WCOEEAP 1986).

Study of marine raptors has a relatively long history locally. Naturalists and ornithologists have periodically counted or estimated the population of Peregrine Falcons nesting on Langara Island since 1916 (Nelson and Myres 1976). Broader scale inventories in Haida Gwaii were begun by Beebe (1960) and continued by the British Columbia Ministry of Water, Land, and Air Protection (MoWLAP - formerly Ministry of Environment, Lands and Parks) and Parks Canada Agency (PCA; Schultze 2000). Since 1968, Nelson has continued to monitor the productivity of Peregrine Falcons on Langara Island (R.W. Nelson 1990, *personal communication).* Bald Eagle nests on offshore islands were surveyed in the 1980s during the CWS seabird colony inventories (Rodway *et al.* 1988, 1990, 1994). Targeted surveys were conducted by the Islands Protection Society (Harris 1978) and as part of the terrestrial inventory of Gwaii Haanas (Westland Resources Group 1994). Gwaii Haanas warden D. Burles (*unpublished data)* has monitored eagle productivity along sections of the Gwaii Haanas coast.

Non-governmental organizations (NGOs) have had a key role in regional marine ornithology. The NGOs have done more for marine birds than for any other group of marine animals in Haida Gwaii. The mandates and contributions of NGOs to

knowledge and protection of marine birds in Haida Gwaii are listed in Table 2. Three of those NGOs are or were based in Haida Gwaii. In 1989, the Laskeek Bay Conservation Society (LBCS) was established with a commitment to coastal environmental monitoring, research and education. The society now has the longest time series of monitoring data for nesting seabirds in British Columbia (Gaston 1998) – longer even than anything developed by government agencies. Further, LBCS is a leader in dealing with introduced predators on seabird colonies. Members of the Delkatla Sanctuary Society organized the restoration of critical marine bird habitat at Delkatla Slough. In addition, they opened the Nature Interpretive Centre at Delkatla in 2002. P. Hamel and M. Hearne of the society have gathered extensive records on populations of migrating and wintering coastal birds. They also organize and compile various surveys as listed in Table 2. The Islands Protection Society (now defunct) conducted one of the first broad-scale Bald Eagle surveys on the archipelago (Harris 1978) and was central to the closure of Peregrine Falcon capture.

Much of the above work up to 1987, along with data from museum specimens, observational records of naturalists and additional published and unpublished reports, was summarized in *The Birds of*

Table 2. The most prominent non-government organizations that have contributed to marine bird knowledge and protection in the Haida Gwaii Region, listed in alphabetical order[1].

Non-government Organisation	Haida Gwaii Marine Bird Contributions
Delkatla Sanctuary Society, Masset	Restoration and protection of Delkatla Slough area; seabird, marine waterfowl and shorebird surveys; public education; development of an interpretive centre for the Slough; organization and compilation of Christmas Bird Counts, Breeding Bird Surveys and Coastal Waterbird Surveys
Ducks Unlimited, Surrey	Waterfowl surveys; assessment of important coastal wetland habitats
Friends of Ecological Reserves, Victoria	Lobbied for habitat protection through Ecological Reserves; support of research on marine birds in Drizzle Lake Ecological Reserve
Islands Protection Society, Masset (no longer active)	Campaigned to protect the South Moresby area; instrumental in halting harvest of Peregrine Falcons; conducted Bald Eagle surveys; supported need for surveys of nesting Ancient Murrelets at Dodge Point in the face of logging plans
Laskeek Bay Conservation Society, Queen Charlotte City	Seabird, marine waterfowl and shorebird surveys and monitoring; seabird research; habitat restoration; introduced species management; public education
Nature Trust of British Columbia, North Vancouver	Acquisition of important habitat in Kumdis Slough
Tlell Watershed Society, Tlell	Protection of Tlell Watershed; Marbled Murrelet habitat assessment
World Wildlife Fund Canada, Toronto	Marbled Murrelet habitat assessment

1 Many additional NGOs and individuals were involved in the campaign to protect marine bird habitat in South Moresby (now Gwaii Haanas National Park Reserve and Haida Heritage Site)

British Columbia, a 4-volume series by the Royal British Columbia Museum, Victoria in cooperation with the CWS, Delta, British Columbia. Additional published and unpublished data have been incorporated into a checklist of the birds of Haida Gwaii compiled on contract to Gwaii Haanas (Hamel and Hearne 2001) and subsequently published by the Delkatla Sanctuary Society (Hamel and Hearne 2002). This updates the checklists of Morris (1989, 2001) and provides monthly relative abundance charts for each species.

METHODS

To review the distribution and abundance of marine birds in Haida Gwaii, we consulted the following sources:

- accessible records from museum collections;
- internationally peer-reviewed scientific literature (e.g. journal articles, books);
- secondary ("grey") literature including government documents;
- unpublished consultants' reports;
- Laskeek Bay Conservation Society annual reports;
- Coastal Waterbird Inventory File (hard copy; MoWLAP, Smithers, British Columbia);
- websites of government agencies and non-government organizations involved in bird study and/or conservation;
- Christmas Bird Counts (CBCs) as described later in the monitoring section;
- Conservation Data Centre, Victoria, British Columbia listings;
- British Columbia Coastal Waterbird Survey as described later in the monitoring section; and
- local naturalists and biologists (see Acknowledgements).

Two data sets were unavailable for this report. Firstly, the British Columbia Nest Record Scheme is enmeshed in ownership issues and legal proceedings. Most of the nest records were located in other sources, but our inability to access Nest Record Scheme data affected the detail with which we could map nesting locations for the mergansers, Semipalmated Plover, Spotted Sandpiper, and, possibly, Pelagic Cormorant. Secondly, the unpublished observations of P. Hamel and M. Hearne. Their personal records include over 20 years of bird surveys in the Haida Gwaii region, primarily around northeastern Graham Island and Skidegate Inlet/ Sandspit (P. Hamel, Delkatla Sanctuary Society, *personal communication)*. Inclusion of their data would augment some of the species accounts in the Results section (P. Hamel, Delkatla Sanctuary Society, *personal communication).*

Whenever possible, original documents were used. However, if original sources were unavailable, we used information from secondary sources such as review documents and we cite these accordingly. Survey data on breeding populations of marine birds have been compiled in databases at Gwaii Haanas' office. The breeding colony database includes an assessment of the quality of the survey protocol used. As many of the early population estimates for seabird colonies involved rough guesses of population size, these results are not included in the database unless no other information is available for that site. Published reports by individuals that were later discredited (see Kaiser's 1996 comments on Darcus 1927, 1930) were not included.

The Gwaii Haanas databases used in support of this report are listed in Table 3. Databases either were newly created or were updated and extended from existing databases. In addition to the characteristics listed in Table 3, all databases share the following properties:

- all database records are fully referenced (e.g., a literature citation);
- all database records are spatial and, where appropriate, temporal;

Table 3. Characteristics of Haida Gwaii region marine bird databases either created, or updated, for this report.

Database	Taxa	Features[1]	Attributes
Marine areas important to seabirds	Seabirds excluding Marbled Murrelet and Pigeon Guillemot	Areas	Presence[2]; species
Marine areas important to Marbled Murrelets	Marbled Murrelet	Areas	Presence
Breeding colonies	Black Oystercatcher; seabirds excluding Marbled Murrelet	Points	Presence; species; population size
Marine waters important to waterfowl	Loons; grebes; sea ducks	Points	Presence; species
Pacific herring spawn, 1947-1997[3]	Pacific herring (*Clupea pallasii*)	Areas	Presence
Salmon Escapement	Salmon (*Oncorhynchus* spp.)	Points	Presence; species; numbers
Moulting sea duck areas	Sea ducks	Points; areas	Presence; species
Marine areas important to Brant	Brant	Points; lines; areas	Presence
Coastal areas important to shorebirds	Charadriidae, Scolopacidae	Points; lines	Presence; species
Eagle nests	Bald Eagle	Points	Presence; status
Falcon eyeries	Peale's Peregrine Falcon	Points	Presence; status
Nesting marine waterfowl	Marine waterfowl	Points; areas	Presence; species

1 In our geographic databases, locations are represented by points, lines or polygons, each with well-defined boundaries. In some cases, these shapes accurately represent the location being described, e.g., lines represent linear segments of coastline. Polygons represent "indeterminate" areas without well-defined boundaries, e.g., "all around Marble Island." Points represent either sites with definite boundaries such as islands, or areas identified by a narrative description just too vague to ascribe a polygon to, e.g., "offshore of Renell Sound."
2 Absence in these datasets is not implied; *i.e.*, absence of proof is not proof of absence
3 DFO database completed on contract to Gwaii Haanas

- all databases are georeferenced to a standard format (a spatial coordinate system);
- each database has information on the quality of location and thematic content; and
- each database contains standardized metadata.

A number of documents were used in the development of the databases that are not otherwise cited in the text of this report (Patch 1922; Gaston and Lawrence 1993; Blood *et al.* 1994; Gaston 1994 b; Gaston and Heise 1994). Information in popular press articles was not incorporated.

To describe areas that are important to marine birds, we created databases containing sites that are repeatedly used by species or groups of species during specific seasons. Development of these databases and their associated figures involved compilation of survey results from a variety of published and unpublished documents as well as verbal descriptions of birds' uses of areas. Because the areas rarely had well-defined boundaries and the process combined the results of different types of surveys with different levels of accuracy and precision, the databases incorporate subjective decisions about which areas to include and how to describe their shapes.

These databases reflect the current state of available marine bird knowledge for the region and will remain works-in-progress as new information is collected.

Volumes 1 and 2 of *The Birds of British Columbia* (Campbell *et al.* 1990 a, b) were used extensively. The authors reviewed

thousands of entries (to 1987) in various databases, specimen records, nest records, field notebooks, diaries and the scientific literature. We did not attempt to duplicate this effort and have accepted their judgments about the reliability of the records to 1987. Hypothetical species, those for which the records are questionable, were excluded from this report.

Listed in Appendix B are the museums contacted for their Haida Gwaii region marine bird specimen records. The numbers of records supplied according to museum are provided in Table 4.

We did not attempt to collate information from unpublished surveys by individuals other than marine bird biologists or local naturalists. Misidentification of flying birds or distant birds on the water is common and numerical estimates may be off by orders of magnitude. Assessing the reliability of reports by unknown observers was beyond our scope.

Biases exist in the data reported and mapped herein. Because much of the information was not gathered as the result of systematic surveys, coverage is weighted toward locations and seasons frequented by observers. For example, ~50% of the records for marine birds in the *Birds of British Columbia* (Volumes 1 and 2) are from April to July (Campbell *et al.* 1990 a). Christmas Bird Counts, the only surveys regularly conducted during the winter in Haida Gwaii for which the results are available, are done at only six locations. The known distribution of a species may be, therefore, more indicative of the distribution of observers than that of marine birds.

Table 4. The number of Haida Gwaii region bird specimen records according to institutional collection.

Collection	Records[1]	Notes
Royal Ontario Museum, Toronto, ON	351	
Canadian Museum of Nature, Ottawa, ON	270	
Royal British Columbia Museum, Victoria, BC	65	Incomplete listing of records received
University of British Columbia Bird Collection, Vancouver, BC	27	Records from 1946 to 1960, data from G. Kaiser
Museum of Vertebrate Zoology, University of California at Berkeley, CA	799	
University of Michigan Museum of Zoology, Ann Arbour, MI	526	
Field Museum of Natural History, Chicago, IL	310	
National Museum of Natural History, Washington, DC	53	
Slater Museum of Natural History, Tacoma, WA	31	
Western Foundation for Vertebrate Zoology, Camarillo, CA	18	
Peabody Museum of Natural History, New Haven, CT	9	
Cornell University Museum of Vertebrates, Ithaca, NY	8	
Los Angeles County Museum of Natural History, CA	4	Incomplete listing of records received

1 Records included all birds from Haida Gwaii, not just marine birds

ABORIGINAL USES AND NAMES OF MARINE BIRDS

"*Sea-fowl of many kinds are articles of food on occasion, though the gull, the loon and some others are exempt on account of their exceptionally rank flavor. The eggs of sea-birds, and especially those of the large white gull, are collected in great quantity in the early summer. Every lonely and wave-washed rock on which these birds deposit their eggs is known to the natives, who have even these apportioned among the families as hereditary property.*" (Dawson 1880)

"*Some time was spent among the natives whom we found to be intelligent and well versed in the birds about them*." (Cumming 1931)

"*A full and accurate account of the importance of birds in the pre-contact Haida life is now beyond anyone's memory, and many bird names are forgotten.*" Ellis (1991)

"*In order for Traditional Ecological Knowledge and Wisdom* (TEKW) *to be incorporated appropriately into current ecosystem-based management strategies, the complete context of TEKW, including its philosophical bases, must be recognized and respected.*" (Turner *et al.* 2000)

Various human cultures have occupied the Haida Gwaii region from at least 10,000 years before present [BP](Ackerman 1996; Josenhans *et al.* 1997). This region is important to theories about coastal human migration from the northeastern Asian land link (Beringia) to Pacific North America between 14,000 to 10,000 years BP (Mandryk *et al.* 2001). As well, Gwaii Haanas alone is very rich in archaeological sites with 604 in the GIS database of the *Gwaii Haanas Archaeological Resource Description and Analysis* (Fedje *et al.* 2001 a).

Coast-wide in the British Columbia area, by ~6,000 years BP, there were well-established human populations using a wide array of marine foods including marine birds (Hebda and Frederick 1990). Further, by ~3,000 years BP, the great abundance of coastal middens throughout British Columbia indicated to Hebda and Frederick (1990) that there was a marked population expansion with increasingly sedentary settlement patterns and the development of food preservation technology.

Until the early 20th century, hunting marine birds and gathering their eggs were important to indigenous peoples in Haida Gwaii. Within documented Haida history, birds are of immense symbolic importance, for example, all Haida persons are either of the eagle or raven moieties. Moreover, knowledge and stories of marine birds in particular are a significant part of traditional Haida knowledge (Ellis 1991). Kaiser (2002) speculated that old village sites in pre-contact times were also sites for seabird colonies, suggesting that "…. *there may have been some competition for space between human and avian populations …*".

Besides being eaten, birds' parts were used for adornment (e.g. puffin beaks were used as dancing rattles), as tools (e.g., bones as drinking straws) or in ceremonies. For example, Ellis (1991) recounted that Bald Eagle down was placed on chiefs' headdresses so that during chiefly dances, down would flutter to the ground from the headdress's sea lion bristles and scatter dramatically about. MacDonald (1994, p. 148, plate 201) shows an 1880s photo of Masset chiefs and shamans in ceremonial dress sprinkled with down. Although the ceremonial uses of bird parts have continued to the present, few marine birds are now hunted. Other past uses included hunting small flocking shorebirds for marten bait on traplines (Ellis 1991). In summary, marine birds and their eggs are much less hunted and gathered now by the Haida than in pre-contact times.

The marine bird species or groups used by the indigenous peoples in Haida Gwaii according to the literature on traditional knowledge or from archaeological

Table 5. Marine birds and their eggs either reported as hunted and gathered by indigenous peoples or recorded from midden excavations in Haida Gwaii (data from Blackman 1979, 1990; Ellis 1991; Acheson 1998; Fedje *et al.* 2001 b).

Group	Species	Comments
Seabirds		
	Albatross species[1]	
	Northern Fulmar	
	Shearwater species[1]	
	Double-crested Cormorant	
	Pelagic Cormorant	Birds commonly eaten; some eggs taken
	Glaucous-winged Gull (main species in "large gull" group)	The most important species providing eggs; adults occasionally taken
	Small gull species	Eggs eaten
	Common Murre	
	Pigeon Guillemot	Adults and eggs eaten
	Ancient Murrelet	Adults and eggs eaten; sometimes dried or salted for later use
	Cassin's Auklet	Adults and eggs eaten
	Parakeet Auklet	
	Rhinoceros Auklet	Adults and eggs desirable but rare, so infrequently hunted
	Tufted Puffin	Adults and eggs rarely eaten because difficult to access
Marine Waterfowl		
	Common Loon	Rarely eaten because unpalatable
	Loon species	
	Horned Grebe[2]	
	Red-necked Grebe	
	Western Grebe	
	Brant	
	Harlequin Duck	Edible but rarely taken
	Surf Scoter	
	White-winged Scoter	According to the late Percy Brown, scoters were eaten by Alaska Haida, but not by Masset Haida
	Black Scoter	
	Long-tailed Duck	
	Bufflehead	Edible but rarely hunted because too small
	Goldeneye species	
	Common Merganser	Birds often eaten; eggs sometimes collected
	Red-breasted Merganser	
Shorebirds		
	Black Oystercatcher	Eggs eaten; adults not taken
	Black Turnstone (main species in "small flocking shorebird" group)	Edible but rarely eaten
Marine Raptors		
	Bald Eagle	

1 Albatross and shearwater were not mentioned as food species by Skidegate Elders (Ellis 1991)

2 Horned Grebe was listed as traditionally of economic importance although not eaten, and with no indication of why they were hunted (Blackman 1979)

excavations are provided in Table 5. Over 30 species or groups representing all marine bird types were taken. Ellis (1991) suggested that certain species became a large portion of the diet when they were abundant and easy to harvest. Apparently, when other food sources such as salmon were abundant, birds added variety to the diet. The predominance of small alcids, primarily Ancient Murrelet and Cassin's Auklet, and waterfowl in the diet was mentioned by both northern and southern Haida Elders (Blackman 1979; Ellis 1991). arious species of geese, including Brant, were seasonally important food to both Skidegate and Masset Haida. This use likely reflected the proximity of these

villages to major staging and wintering areas for geese.

Blackman (1990) reported that men hunted birds with snares, bows and arrows or guns. While most species of ducks and geese were caught with snares, goldeneye and loons were hunted with bow and arrow (Blackman 1979). Apparently, women and children cooperated with men in clubbing ground-nesting seabirds as well. Birds were eaten cooked (boiled, steamed or roasted). Blackman (1979) stated that birds were not preserved or served as high-status foods during potlatches and feasts by northern Haida. However, Ellis (1991) claimed that southern Haida would preserve (dried or salted) alcids.

Lists of Haida names for birds were begun in the 19th century separately by Swanton and Keen (Blackman 1979; Ellis 1991). Haida dialects from the northern and southern areas of Haida Gwaii differ appreciably (Enrico 1989). Listed in Appendix C are the recorded northern and southern Haida words for marine birds. The southern Haida words have been revised in 2001 and 2002 courtesy of the Skidegate Haida Language Authority, Skidegate Haida Immersion Program (SHIP) on contract to Gwaii Haanas. Southern (Skidegate) Haida words generally are under review by SHIP to clarify spelling and pronunciation (B. Wilson, Gwaii Haanas, *personal communication*). The SHIP words represent all the species for which words could be recalled and agreed upon, working from the list of all regional marine bird species. There is another source of Haida words for birds not listed in Appendix C. It is John R. Swanton's hand-written Haida words put throughout a copy of the bird species check list of the *Preliminary Catalogue of the Collections of Natural History and Ethnology in the Provincial Museum, Victoria, British Columbia* from 1898. The notes are in the archives (item No. 4117-a [3]) of the Bureau of American Ethnology, Smithsonian Institution, Washington, D.C. The writing did not reproduce well, so we could not include these words.

Marine birds and their eggs were hunted and gathered according to seasonal availability. Listed in Table 6 are some species and seasons of exploitation speculated or observed in Haida Gwaii. The eggs of Glaucous-winged Gulls were the most heavily harvested. Their breeding colonies were well known and became lineage property (Dawson 1880; Ellis 1991). Egg-gathering at Glaucous-winged Gull colonies still occurs on islands in Skidegate Inlet (Vermeer *et al.* 1991 a; B. Wilson, Gwaii Haanas, *personal communication*).

Current shorelines represent only a part of the history of coastal occupation of Haida Gwaii due to sea-level fluctuations (Fedje and Christensen 1999). Midden sites, often with abundant marine bird remains, are common features along the Haida Gwaii coast, with 369 recorded from the Gwaii Haanas area alone (I. Sumpter, Parks Canada, *personal communication*).

The oldest archaeological site excavated to date from Haida Gwaii is the midden site Kilgii Gwaay, dating ~9,400 years BP, in the intertidal near the warden operations station on Ellen Island (Figure 3) in Gwaii Haanas (Fedje *et al.* 2001 b). Preliminary assessment of the 178 bird bones (44% identifiable) revealed that alcids accounted for 64% and albatross (likely Short-tailed) 20% of the identifiable bones. The alcids dominated with Cassin's Auklet and Rhinoceros Auklet accounting for 38.5 % and 10.3% of identified bird remains, respectively.

The largest regional archaeological survey with detailed marine bird information is by Acheson (1998) from digs at 18 (17 randomly selected) of 114 archaeological sites he mapped in southern Gwaii Haanas (Figure 3). These represent part of the last 1600 years of pre-European occupation. Over 40 species or groups of terrestrial and marine birds were identified from midden

Table 6. Notes on observed or speculated seasonality of hunting and gathering of marine birds and/or their eggs by indigenous peoples of Haida Gwaii.

Author(s)	Species or Type	Month or Season	Notes
Dawson (1880)	Ducks, Geese	Fall	Masset to Virago Sound area; hunted ducks and geese by flint-lock trade musket and bow and arrow; location of egg gathering not mentioned
	Gull[1] ("large white") eggs	Early Summer	
Green (1916)	Ancient Murrelet	May - August	Langara Island; seasonal gathering of adults and eggs
Blackman (1979, 1990)	Cassin's Auklet, Ancient Murrelet	March[2], June	Northern Graham Island and Langara Island areas; waterfowl were best (fattest) in the fall; gulls provided the most important egg source; ducks and geese taken by spruce-root snares where branches hung over the water
	Ducks, Geese	October – December	
	eggs of Gulls, Ducks, Geese, Auklets, Murrelets, Black Oystercatcher	Late Spring	
Ellis (1991)	Ancient Murrelet Brant	Late Spring	Southern Haida Gwaii area; murrelets taken only while nesting, Brant highly regarded for eating and present in great numbers during spring migration
Acheson (1998)	Alcids	Early Spring	Southern Haida Gwaii including Kunghit Island area; midden sites (~1,600 years BP); alcids hunted during nesting season
	Albatross, Shearwater	Summer	
Fedje *et al.* (2001 b)	probably Short-tailed Albatross	Summer	Northern end of Kunghit Island; midden site (~9,400 years BP)

1 likely the Glaucous-winged Gull
2 this is unlikely as Cassin's Auklets are not yet incubating in March

Table 7. The percentage of the number of identifiable remains of all birds represented by selected marine species or groups excavated from 18 Kunghit Island-area Haida sites in southern Gwaii Haanas (extrapolated from data in Acheson 1998).

Species or Group According to Acheson	Number of Sites with Bird Remains	Percent of all Bird Remains at all Sites	
		Mean	Range
Alcid[1]	13	46.1	0.0 – 96.8
Bald Eagle	12	5.0	0.0 – 25.0
Gull[1]	11	3.9	0.0 – 27.8
Shearwater	9	3.8	0.0 – 50.0
White-winged Scoter	4	3.4	0.0 – 60.0
Cormorant[1]	10	2.9	0.0 – 25.0
Albatross	11	2.0	0.0 – 6.2
Rhinoceros Auklet	9	1.7	0.0 – 9.9
Northern Fulmar	7	1.6	0.0 –16.7
Goose[1]	8	1.5	0.0 –11.1
Duck[1]	9	1.3	0.0 – 9.3
Common Loon	7	0.8	0.0 – 6.2

1 "small", "medium" and "large" combined

and dwelling (house pit) soil strata. The most common marine bird species or groups are listed in Table 7. Alcids, particularly small species, dominated strongly and the sites at which they accounted for >69% of total bird remains are indicated in Figure 3. Acheson (1998) speculated that alcids were gathered while nesting in spring because no bones of immature birds were found. Perhaps hunting was confined to spring and early summer before the chicks had fledged or perhaps only adults were hunted. The extent to which the midden deposits represent historical diets is, of course, speculative, but Acheson's and Fedje's works are starting points.

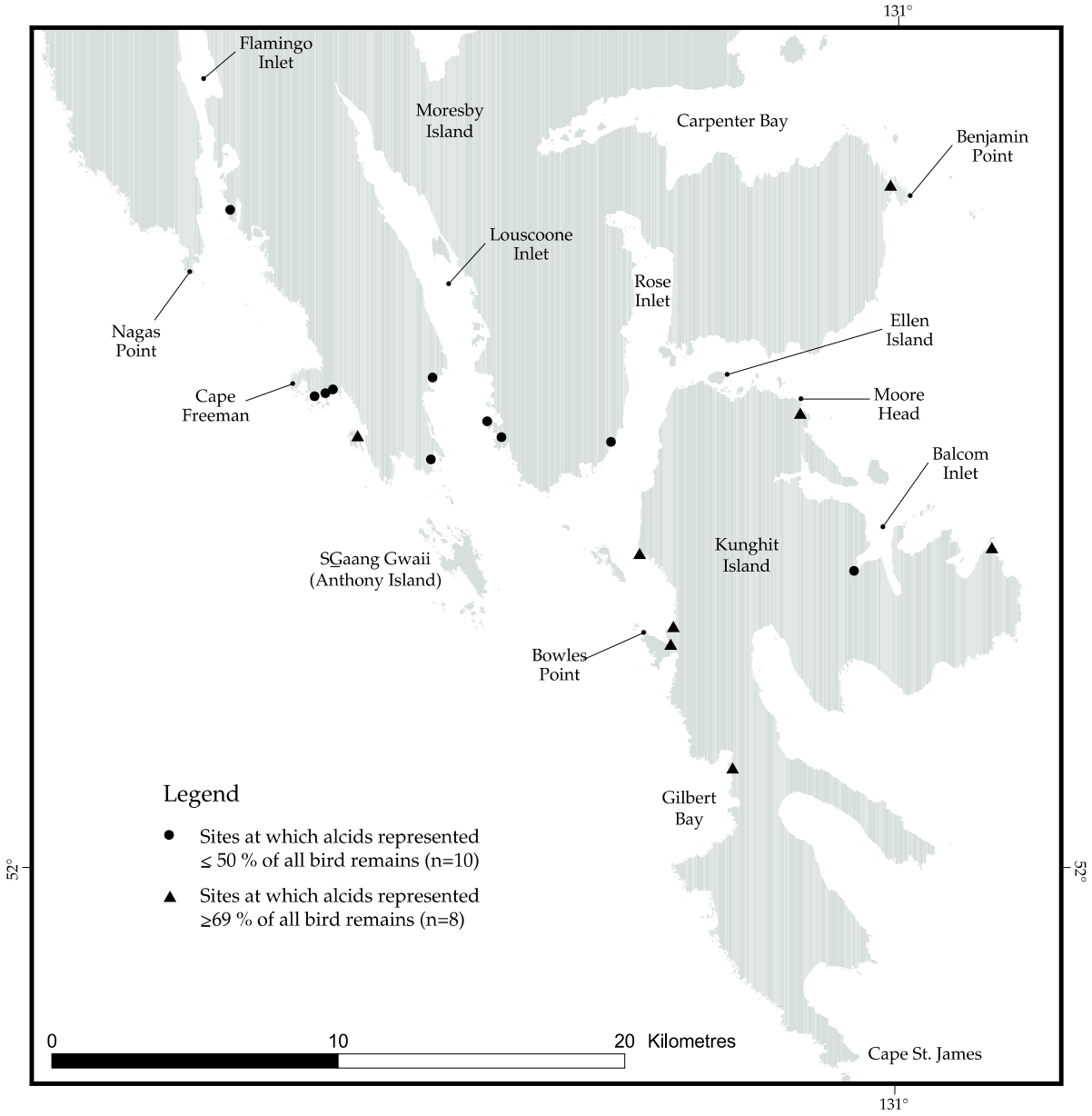

Figure 3. Locations of 18 Kunghit Island-area Haida archaeological excavation sites in southern Gwaii Haanas mapped by Acheson (1998).

HAIDA GWAII REGION MARINE BIRD OVERVIEW

The 124 marine bird species of the Haida Gwaii region are given in Appendix A. None of these species were first described using specimens from the Haida Gwaii region. Further, none are endemic, that is, known only from this region. Where applicable, designations of special status are provided from provincial (Conservation Data Centre [CDC], Victoria), national (Committee on the Status of Endangered Wildlife in Canada [COSEWIC], Ottawa) or international (World Conservation Union [IUCN], Gland) organizations.

On a species-by-species basis for the 77 relatively common marine bird species of the region we review life-history knowledge that covers the following topics:

- distribution and abundance of nesting marine birds on Haida Gwaii;
- distribution and seasonality of birds at sea in the Haida Gwaii region; and
- distribution and seasonality of coastal birds.

Population trend information is presented if available. Species summaries are arranged in taxonomic order within each group (seabirds, marine waterfowl, shorebirds, marine raptors; Table 8). The remaining 47 species are relatively uncommon in the Haida Gwaii region. The seasonal occurrence of those species is given in Table 9.

Survey effort for marine birds varies widely across species and groups of species. For example, systematic surveys of most species of breeding seabirds have been conducted throughout Haida Gwaii since 1980 (Rodway 1988; Rodway *et al.* 1988, 1990, 1994). In contrast, nesting sea ducks have only been incidentally surveyed. Even among the seabird species, logistical difficulties have hindered some surveys so that the precision and accuracy of population estimates varies with species from reliable and replicable estimates to rough approximations. In summarizing nesting data below, we focus on the best estimate(s) available rather than attempting to present all historical survey results.

Survey data of birds at sea or along shorelines are far more difficult to interpret than those of nesting birds and, therefore, some caveats are relevant when considering the results:

- survey effort has been extremely uneven (see Burger *et al.* 1997 for maps depicting survey effort by season) and few winter surveys have been conducted in most regions or off the west coast in any season - Savard (1988) commented that the "*absence of sightings in an area may reflect more the absence of observers than the absence of birds*";
- large daily, seasonal and/or annual fluctuations in numbers characterize many species - Gaston (1996) analysed the results of marine surveys conducted by the Laskeek Bay Conservation Society twice a month between April and July, 1990 to 1995 and found notable inter-year variations in the numbers of all of the common species - Savard (1979) saw seven times as many birds along the Hecate Strait shoreline from Tlell to Skidegate in January 1978 than had been counted during a similar survey in the previous year (Hatler *et al.* 1977);
- different types of survey protocol are best suited to certain species groups or habitats and the seasonal distribution recorded during pelagic (open-water) boat surveys, for example, will be extremely different from that recorded during land-based or aerial surveys - Savard (1979) noted, for example, that aerial surveys do not survey cormorants well because the birds are cryptically coloured on rocky shorelines;
- survey protocols were not always appropriate to the clumped distribution of flocking species - Blood and Bentley

Table 8. Common marine bird species in the Haida Gwaii region arranged by group and breeding status.

Group	Breeding Species	Non-breeding Species
Seabirds	Fork-tailed Storm-petrel	Black-footed Albatross
	Leach's Storm-petrel	Northern Fulmar
	Pelagic Cormorant	Pink-footed Shearwater
	Mew Gull	Buller's Shearwater
	Glaucous-winged Gull	Sooty Shearwater
	Common Murre	Short-tailed Shearwater
	Pigeon Guillemot	Double-crested Cormorant
	Marbled Murrelet	Pomarine Jaeger
	Ancient Murrelet	Parasitic Jaeger
	Cassin's Auklet	Ring-billed Gull
	Rhinoceros Auklet	California Gull
	Horned Puffin	Herring Gull
	Tufted Puffin	Thayer′s Gull
		Sabine's Gull
		Black-legged Kittiwake
Marine Waterfowl	Red-throated Loon	Pacific Loon
	Common Loon	Yellow-billed Loon
	Harlequin Duck	Horned Grebe
	Barrow's Goldeneye	Red-necked Grebe
	Hooded Merganser	Western Grebe
	Common Merganser	Brant
	Red-breasted Merganser	Surf Scoter
		White-winged Scoter
		Black Scoter
		Long-tailed Duck
		Bufflehead
		Common Goldeneye
Shorebirds	Semipalmated Plover	Black-bellied Plover
	Killdeer	American Golden Plover
	Black Oystercatcher	Pacific Golden Plover
	Spotted Sandpiper	Greater Yellowlegs
	Least Sandpiper	Lesser Yellowlegs
	Short-billed Dowitcher	Wandering Tattler
	Common Snipe	Whimbrel
		Marbled Godwit
		Ruddy Turnstone
		Black Turnstone
		Surfbird
		Red Knot
		Sanderling
		Western Sandpiper
		Baird's Sandpiper
		Pectoral Sandpiper
		Rock Sandpiper
		Dunlin
		Long-billed Dowitcher
		Red-necked Phalarope
		Red Phalarope
Marine Raptors	Bald Eagle	
	Peregrine Falcon	

Table 9. Occurrences of uncommon marine birds listed according to season for the Haida Gwaii region (data from Campbell *et al.* 1990 a,b; Gaston and Jones 1991; Morgan *et al.* 1991; Morgan 1997; Hamel and Hearne 2001; K. Morgan, CWS, *unpublished data*).

		Seasons[1] in which Recorded			
Group	**Species**	**Spring**	**Summer**	**Fall**	**Winter**
Seabirds	Laysan Albatross	x	x	x	x
	Short-tailed Albatross[2]		x	x	x
	Murphy's Petrel		x		
	Mottled Petrel	x	x		
	Flesh-footed	x	x	x	
	Manx Shearwater		x	x	
	Black-vented		x	x	
	Brandt's Cormorant[3]	x	x	x	x
	Red-faced Cormorant	x			
	Magnificent		x		
	South Polar Skua		x	x	
	Long-tailed Jaeger	x	x	x	
	Franklin's Gull	x	x		
	Bonaparte's Gull	x	x	x	x
	Heermann's Gull	x			
	Slaty-backed Gull		x		
	Western Gull	x	x	x	x
	Glaucous Gull	x	x	x	x
	Red-legged Kittiwake				x
	Caspian Tern	x	x	x	
	Arctic Tern	x	x	x	
	Aleutian Tern	x	x		
	Thick-billed Murre[4]	x	x	x	x
	Kittlitz's Murrelet			x	
	Xantus' Murrelet		x	x	
	Parakeet Auklet	x		x	
Marine	Pied-billed Grebe[5]	x	x	x	x
	Eared Grebe	x		x	
	Steller's Eider			x	
	King Eider	x	x		x
	Common Eider	x			
Shorebirds	Mongolian Plover		x		
	Snowy Plover		x		
	Wood Sandpiper			x	
	Solitary Sandpiper		x		
	Upland Sandpiper	x	x	x	
	Hudsonian Godwit	x	x	x	
	Bar-tailed Godwit	x	x		
	Semipalmated	x	x	x	
	Red-necked Stint		x		
	White-rumped		x		
	Sharp-tailed		x	x	x
	Curlew Sandpiper		x		
	Stilt Sandpiper	x	x	x	
	Buff-breasted		x	x	
	Ruff			x	
	Wilson's Phalarope	x	x		

1 Seasons are: spring = March - May; summer = June - August; fall = September - November; winter = December - February.
2 Short-tailed Albatross was historically the dominant nearshore albatross and has been found in middens in Gwaii Haanas, Nootka Sound and elsewhere along the coast (McAllister 1980; Fedje 2001 b; P. Martin, U.S. National Park Service, *personal communication).*
3 Brandt's Cormorant are seen in ~50% of the Skidegate Inlet Christmas Bird Counts.
4 Listed as breeding species for Haida Gwaii by Cowan (1989) but there are no confirmed nest sites.
5 Breeds on Haida Gwaii

(1992) noted that daily counts of species that occurred in large flocks were quite variable depending on whether a flock was in or out of the study area on a particular day;

- many of the surveys were done on an opportunistic basis on boats for which marine bird surveys were not the main focus, therefore the areas surveyed and timing of the trips were not under the surveyors' control (Morgan *et al.* 1991);
- multiple species counts are often less accurate than single species counts - less common or conspicuous species are often overlooked among large numbers of other birds, for example, gulls are easily observed but paler sea ducks and grebes may be missed (Savard 1982);
- large moving flocks are difficult to count accurately - for example, many records for Sooty Shearwaters simply mention "thousands";
- because of the speed of aircraft used during aerial surveys, groups greater than five must be estimated most of the time and a percentage of birds that forage underwater are missed (Savard 1979);
- often during aerial and occasionally during boat-based surveys, birds are not identified to species which masks species differences in distribution within groups like the loons (Savard 1982);
- presence and numbers in an area are influenced by tidal cycles and time of day which affects the comparability of results (Savard 1979);
- variation in observer skill at identifying birds at a distance affects results (Morgan *et al.* 1991);
- results may be weather-dependant – for example, Gaston and Jones (1991) found that numbers of some species of offshore birds recorded during land-based surveys increased during strong southeast winds; and
- knowledge of turnover rate at a site used by migratory or transient species is essential for estimating the number of individuals using that area (Goudie and Hearne 1997), but is rarely known.

Thus, although survey results provide valuable information about species diversity and distribution for some areas in some seasons, the numbers recorded in these surveys should not be considered population estimates. They are almost all inadequate as baseline data for monitoring population trends. Gaston and Jones (1991) concluded that "*The unpredictability of seabird numbers, both within and between years, emphasizes the fact that we cannot rely on surveys made over a short period, or in only a single year, to provide an adequate basis from which to assess the impact of potential developments*."

We do not map seasonal densities at sea or along the shoreline for each species because of the caveats listed above. Rather, we have expanded on the work of Burger and others (Burger *et al.* 1997) by mapping pelagic and coastal areas around Haida Gwaii known to be important for marine birds. This approach is, however, biased toward areas used by flocking species. For example, waters regularly supporting large flocks of Western Grebes are more likely to be noted than those used by Red-throated Loons which tend to spread-out in groups of one or two individuals. We emphasize that only areas where concentrations of a species have been repeatedly observed and documented during surveys conducted over several years are depicted; more detailed information on numbers and species can be found in the source documents. Due to the uneven distribution of survey effort and all of the other caveats listed above, the maps of important marine and coastal areas should not be interpreted as showing the distributions of species. Instead, they should be considered as noting the minimum of important regional marine and coastal areas. We do not want to mislead the reader into thinking that we have a greater depth of knowledge than we do. In addition, we emphasize the inexact

nature of the boundaries of many of the areas depicted (see Methods).

Burger *et al.* (1997) also mapped marine areas in British Columbia where the fish and invertebrate prey of marine birds are concentrated. Most of the data they used were from southern waters and comparable information from Haida Gwaii exist only for Pacific herring (*Clupea pallasii)* spawn and salmonid (*Oncorynchus* spp.) escapement. Burger *et al.* (1997) noted that the distribution and densities of the majority of non-commercial prey species are poorly described. For example, there are few data on Pacific sandlance (*Ammodytes hexapterus*) - probably the most important prey species for most piscivorous seabirds. Data on the distribution of suitable sandlance habitat are insufficient to provide a good predictor of seabird foraging areas (Burger *et al.* 1997).

Distributions of birds at sea are described in reference to four main bodies of marine water that surround Haida Gwaii: Hecate Strait, Dixon Entrance, Queen Charlotte Sound and the open Pacific Ocean off the west coast of Haida Gwaii, hereafter called "the west coast" (after Morgan 1997). Two slightly different conventions are used to define seasons in the main sources of information for this section: "spring" in *The Birds of British Columbia* is March to May (Campbell *et al.* 1990 a, b), whereas others have defined "spring" as 16 March to 15 June (Morgan *et al.* 1991; Morgan 1997); the other seasons follow accordingly. This 15-day shift in the season boundaries may lead to slight inaccuracies in the seasonal distributions described in the following sections.

Seabirds

"*Of immediate urgency is exploratory work involving seasonal distribution, abundance, and flight lanes of pelagic seabirds along the coast of British Columbia – especially the northern portion.*" (Munro and Campbell 1979)

Thirteen species of seabirds from four families breed on Haida Gwaii as follows:

- 2 storm-petrels (Fork-tailed Storm-petrel, Leach's Storm-petrel);
- 1 cormorant (Pelagic Cormorant);
- 2 gulls (Mew Gull, Glaucous-winged Gull); and
- 8 alcids (Common Murre, Pigeon Guillemot, Marbled Murrelet, Ancient Murrelet, Cassin's Auklet, Rhinoceros Auklet, Horned Puffin, Tufted Puffin).

Breeding population size and nest site locations are described in the species accounts that follow. The at-sea distributions of these species are also presented in the species accounts.

The global breeding distribution of the majority of these species is confined to the Pacific Ocean. On Haida Gwaii, colonies of nesting seabirds are found on islands concentrated off the east, south and northwest coasts of Moresby Island and off the northwest side of Graham Island.

Trend data are available for many seabird colony sites after the 1950s. Before that, seabird populations may have increased post-European contact as Haida populations declined and diets changed (Kaiser 2002). Seabirds now nest at former Haida village and summer campsites and few are hunted for food.

An additional 15 species from four families are commonly found in the marine waters of the Haida Gwaii region. The at-sea distributions of these species are described in the following species accounts. A significant portion of the at-sea distributional information presented reviews Morgan *et al.* (1991) and Morgan (1997); other sources are cited in the text. Noteworthy records from Campbell *et al.* (1990 a, b) or Christmas Bird Counts (CBCs; data available at http://birdsource.tc.cornell.edu/cbcdata/) are included for most species to present relative

scale. For example, a noteworthy record for an albatross species refers to many fewer birds than a similar designation for a gull species. Two species pairs were often indistinguishable during surveys and have been grouped for discussion: Sooty and Short-tailed Shearwaters, and Herring and Thayer's Gulls (Morgan 1997).

General patterns of seabird distribution from surveys are as follows:

- total number of birds increases from January to May before decreasing again through September; for Hecate Strait, estimates are tens of thousands in January, millions in May and tens of thousands in September (Vermeer and Rankin 1984, 1985);
- populations of the most common species show substantial inter-year variations (Gaston and Jones 1991; Gaston 1996);
- highest densities of birds occur over the continental shelf in all seasons (Morgan *et al.* 1991);
- in fall and winter, bird densities are higher along shorelines than in open water, along sandy shorelines than rocky shorelines and along sheltered rocky shores than exposed shores (Savard 1979); and
- Sooty and Short-tailed Shearwater and Herring and Thayer's Gull species pairs dominate the seabird community from April through December; in the fall, Black-legged Kittiwakes are also abundant (Morgan *et al.* 1991).

Marine areas and roosting sites known to be important to seabirds, except Marbled Murrelets and Pigeon Guillemots, during the breeding season are shown in Figure 4 and listed in Table 10. As noted earlier, this figure should not be interpreted as showing the distributions of the species at sea (see caveats on pp. 19 and 22). Pigeon Guillemot distribution at sea is described below. East Limestone and Reef Islands have been the sites of field camps from which extensive at-sea surveys have been conducted and that extraordinary effort is reflected in the diversity of seabirds that are known to feed or stage in high numbers in the waters of Laskeek Bay (Table 10). Marine areas known to be important to Marbled Murrelet are illustrated in Figure 5 (see caveats on pp. 19 and 22). Abundance and spatial distribution of the major fish and zooplankton prey species (Burd and Jamieson 1991; Robinson *et al.* 1999) of seabirds in Haida Gwaii are not well enough described to be useful predictors of seabird concentrations.

Estimates of the at-sea populations of seabird species in the Haida Gwaii region are not available. Morgan (2002) provides seasonal estimates for some of the larids within the 166,500 km^2 Exclusive Economic Zone (within the 200 n mile limit) off the British Columbia coast.

A summary of the habitat, breeding chronology, breeding performance and diet for nesting seabirds on Haida Gwaii is given in Vermeer *et al.* (1997 c). Gaston and Jones (1998) provide a review of information on alcids throughout their ranges.

Black-footed Albatross

Black-footed Albatross breed on islands in western Hawaii and Japan and are completely marine during the non-breeding season. They are surface-feeding scavengers and are often found in flocks feeding on discards from fishing vessels.

Black-footed Albatross are observed in offshore waters around Haida Gwaii in all seasons. They are seen more frequently off the west coast than in Hecate Strait or Queen Charlotte Sound. In Hecate Strait, they are found almost exclusively south of Juan Perez Sound (A. Gaston, CWS, *personal communication).* These albatrosses tend to be found in waters >100 m depth. In spring and summer, they are most common at the

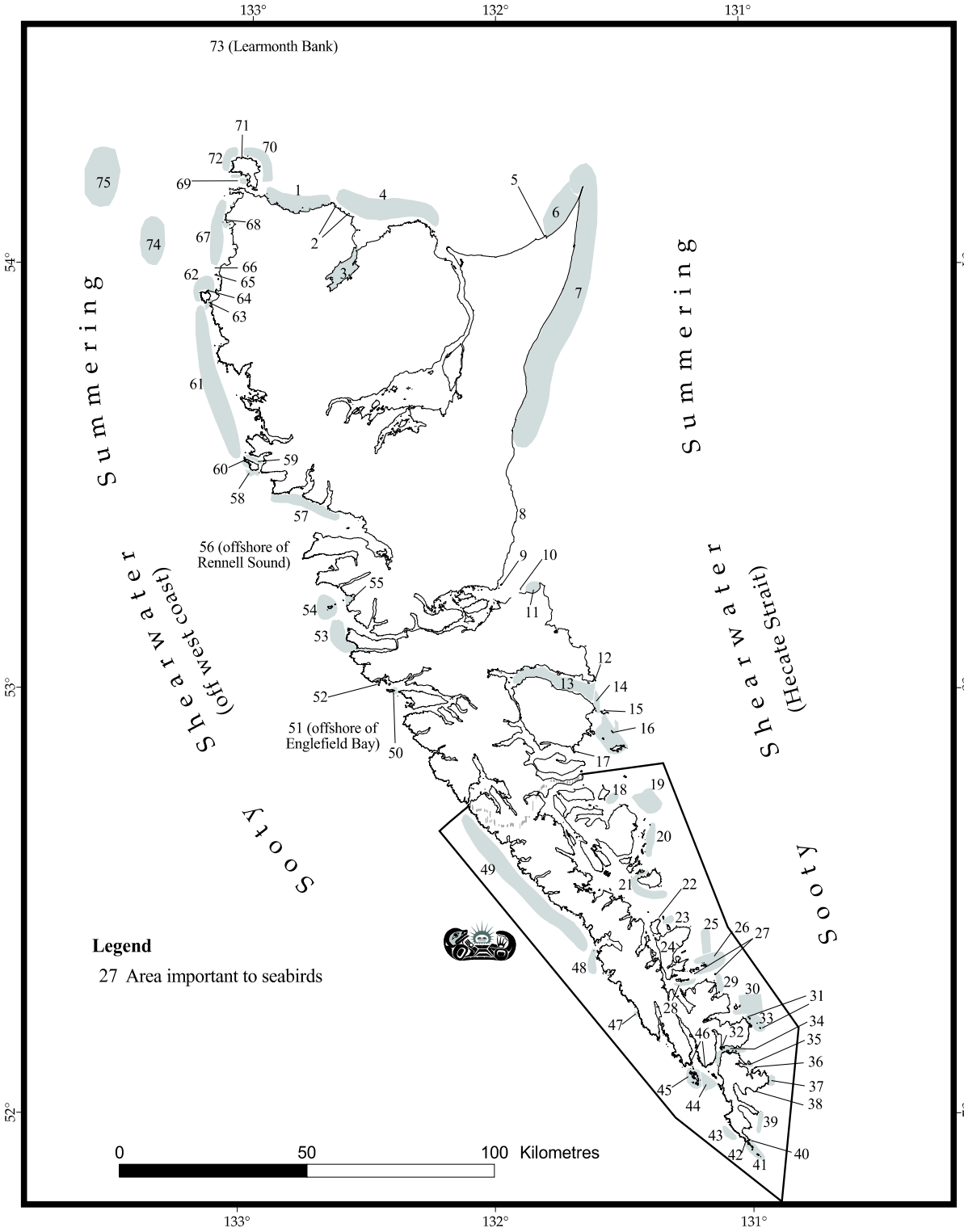

Figure 4. Marine waters and roost sites around Haida Gwaii known to be important to sea birds, except Marbled Murrelets and Pigeon Guillemots, during spring and summer (data from Hatter 1977; Coastal Waterbird Inventory File 1980; Vermeer *et al.* 1985; Rodway *et al.* 1988, 1990, 1994; Gaston and Jones 1991; Gaston 1992 b; Burger *et al.* 1997; D. Burles, *personal communication;* B. and K. Rowsell, *personal communication;* C. Tarver, *personal communication*; K. Vermeer, *unpublished data*). Table 10 lists the species associated with each area. An absence of data does not indicate an absence of birds (see caveats on pp. 19 and 22).

Table 10. Marine waters and roosting sites in the Haida Gwaii region known to be important to seabirds, except Marbled Murrelet and Pigeon Guillemot, during spring and summer.

No.[1]	Species	Comments
1	cormorant spp.	
	Black-legged Kittiwake	immatures
	Common Murre	
	Rhinoceros Auklet	feeding
2	Pelagic Cormorant	immatures roosting
	Glaucous-winged Gull	immatures roosting
3	cormorant spp.	
	Black-legged Kittiwake	
	alcids	
4	Black-legged Kittiwake	immatures
	gull spp.	
	Rhinocerous Auklet	
	Common Murre	
	small alcids	
5	Pelagic Cormorant	roosting
6	Black-legged Kittiwake	immatures
	gull spp.	
7	gull spp.	
	Black-legged Kittiwake	
	Rhinocerous Auklet	
	alcids	
8	Pelagic Cormorant	feeding
9	Pelagic Cormorant	immatures roosting
10	Pelagic Cormorant	adults and immatures roosting
11	gull spp.	
12	Pelagic Cormorant	immatures roosting
	Glaucous-winged Gull	immatures roosting
13	alcids	
14	Pelagic Cormorant	feeding
	Rhinoceros Auklet	feeding
15	Pelagic Cormorant	immatures roosting
16	Pelagic Cormorant	roosting
	shearwater spp.	feeding, moulting
	Herring Gull	primarily immatures, feeding
	Black-legged Kittiwake	immatures and adults
	Ancient Murrelet	gathering
	Cassin's Auklet	feeding
	Rhinoceros Auklet	feeding
17	Glaucous-winged Gull	roosting
18	Rhinoceros Auklet	
19	Ancient Murrelet	gathering
20	Rhinoceros Auklet	
21	Ancient Murrelet	gathering
22	Pelagic Cormorant	roosting
23	Ancient Murrelet	gathering
24	Pelagic Cormorant	immatures roosting
25	alcids	
26	Ancient Murrelet	gathering
	Cassin's Auklet	gathering
27	Glaucous-winged Gull	roosting
28	Ancient Murrelet	gathering
	Common Murre	late summer
29	Rhinoceros Auklet	feeding
30	Ancient Murrelet	gathering
31	Glaucous-winged Gull	roosting
32	Pelagic Cormorant	roosting
	Glaucous-winged Gull	immatures roosting
33	Rhinoceros Auklet	
34	Rhinoceros Auklet	feeding
35	Rhinoceros Auklet	feeding
36	Glaucous-winged Gull	roosting
37	Rhinoceros Auklet	feeding
	Tufted Puffin	gathering
38	Pelagic Cormorant	roosting
39	Rhinoceros Auklet	feeding
40	Rhinoceros Auklet	feeding
41	Common Murre	
	Tufted Puffin	feeding, gathering
42	Pelagic Cormorant	roosting
43	Rhinoceros Auklet	feeding
44	Rhinoceros Auklet	feeding
45	Rhinoceros Auklet	gathering
46	Pelagic Cormorant	roosting
47	Tufted Puffin	
48	Rhinoceros Auklet	feeding
49	Pelagic Cormorant	
	Cassin's Auklet	feeding
50	Rhinoceros Auklet	feeding
51	albatross spp.	
	Northern Fulmar	
52	Pelagic Cormorant	roosting
53	Ancient Murrelet	
	Cassin's Auklet	
54	Pelagic Cormorant	
	Glaucous-winged Gull	
	Black-legged Kittiwake	
	Common Murre	
	Ancient Murrelet	
	Cassin's Auklet	
	Rhinoceros Auklet	
	Tufted Puffin	
55	Glaucous-winged Gull	
56	albatross spp.	
	Northern Fulmar	
57	Ancient Murrelet	March
58	Rhinoceros Auklet	feeding
	Tufted Puffin	gathering
59	Black-legged Kittiwake	feeding
	Ancient Murrelet	gathering
60	Glaucous-winged Gull	immatures roosting
61	alcids	
62	Ancient Murrelet	gathering
63	Glaucous-winged Gull	feeding
	Rhinoceros Auklet	feeding
64	Pelagic Cormorant	immatures and adults, roosting
	Glaucous-winged Gull	roosting
65	Pelagic Cormorant	roosting
66	Glaucous-winged Gull	immatures roosting
67	shearwater spp.	feeding
	Rhinoceros Auklet	feeding
68	Pelagic Cormorant	feeding
	Cassin's Auklet	feeding
69	Ancient Murrelet	gathering
70	Ancient Murrelet	gathering
	Rhinoceros Auklet	feeding
71	Pelagic Cormorant	immatures and adults, roosting
	Glaucous-winged Gull	immatures and adults, roosting
72	Gull spp.	
	Rhinoceros Auklet	feeding
73	Ancient Murrelet	feeding
	Cassin's Auklet	feeding
74	Cassin's Auklet	feeding
75	Cassin's Auklet	feeding

1 These locations are illustrated in Figure 4.

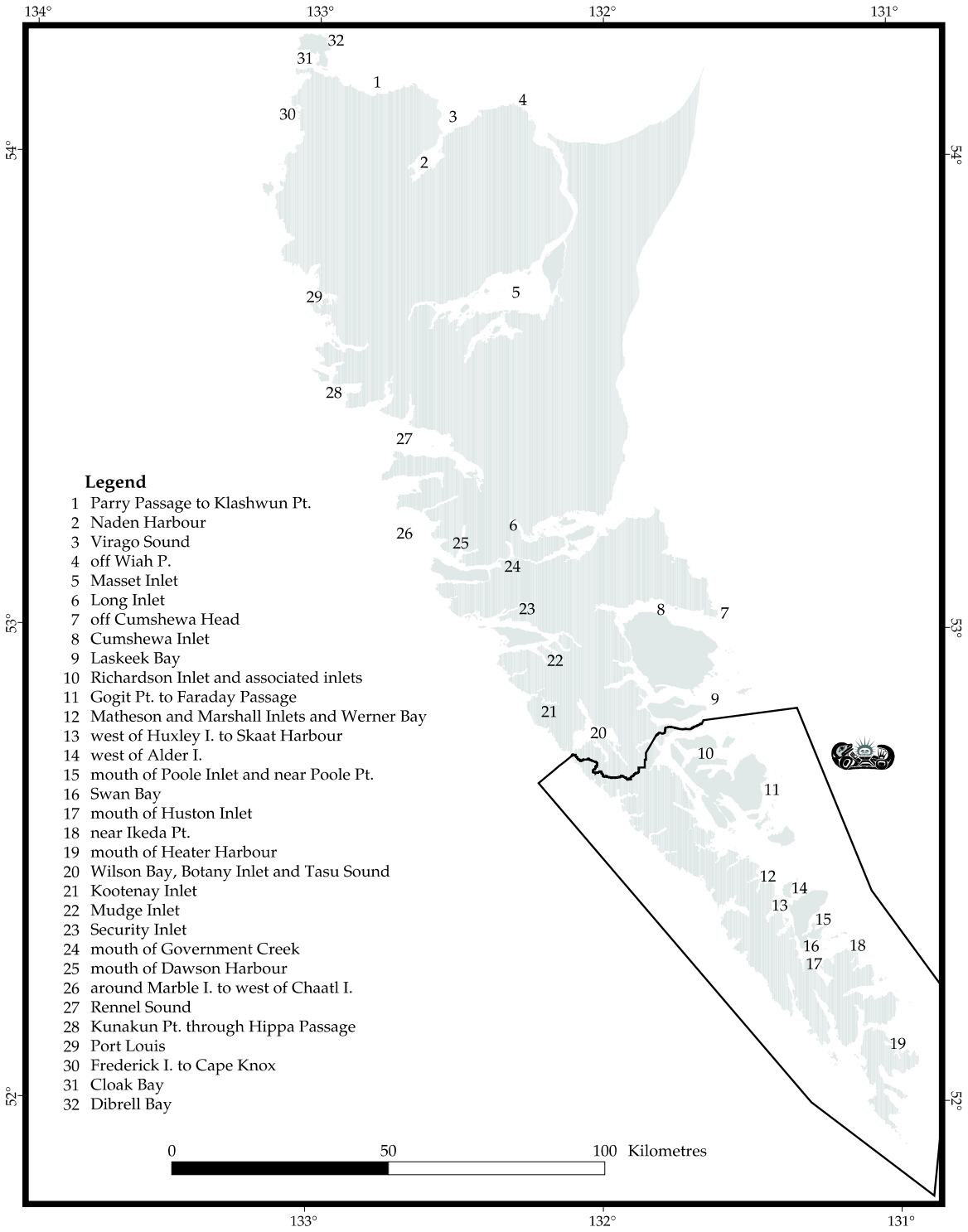

Figure 5. Coastal marine waters around Haida Gwaii known to be important to Marbled Murrelets in spring and summer (data from Sealy 1975 a; Coastal Waterbird Inventory File 1980; Rodway *et al.* 1988, 1991; Lawrence and Backhouse 1991; French 1992; Gaston 1992 b; Burger *et al.* 1997; Materi *et al.* 1998; Burger 2002; D. Burles, *unpublished data;* M. Chutter, *unpublished data;* A. Gaston, *unpublished data;* A. Harfenist, *unpublished data;* D. Hatler, *unpublished data;* G. Kaiser, *unpublished data*; K. Vermeer, *unpublished data*). Burger *et al.* (1997) maps all marine waters off the east coast of Moresby Island as important. An absence of data does not indicate an absence of birds (see caveats on pp. 19 and 22).

continental shelf break. High numbers were also recorded during spring and summer near the Moresby Eddy off Cape St. James (not shown on Figure 2 because of marked interannual variability in location and persistence). May records include 287 and 40 observed feeding 50 km east of Kunghit Island and 2 km west of Louscoone Inlet, respectively (Campbell *et al.* 1990 a). Numbers peak in Hecate Strait and Queen Charlotte Sound in mid-May and in Dixon Entrance and off the west coast in early July. None were recorded in Hecate Strait or Queen Charlotte Sound in the fall. In the winter, the few birds recorded within any marine region near the archipelago are found seaward of the continental shelf. In other parts of their range, birds tend to associate with areas of strong upwelling (Sanger 1974).

Northern Fulmar

In the North Pacific Ocean, Northern Fulmars breed on islands in Alaska and on Triangle Island in British Columbia. Non-breeding birds are found in marine waters. They are surface feeders and their main prey is jellyfish.

Northern Fulmars occur in all offshore marine regions in all seasons. The highest densities have been recorded at or seaward of the shelf break, but this species has occasionally been observed near land during spring (Gaston and Jones 1991), fall (A. Gaston, CWS, *personal communication)* and in CBCs. Densities peak in May in Hecate Strait and Queen Charlotte Sound and in July off the west coast. Eighteen birds were recorded in April 1976 in Queen Charlotte Sound; 200 were counted north of Rose Spit in July 1974 (Cannings 1975; Campbell *et al.* 1990 a). Hamel and Hearne (2001) consider them briefly abundant at the end of September to early October. Hundreds were observed within approximately five kilometers of shore between Englefield Bay and Tcenakun Point in November 1993 (A. Gaston, CWS, *personal communication)*.

Pink-footed Shearwater

Pink-footed Shearwaters breed on islands off the coast of Chile and winter in marine habitats. They are surface feeders.

Pink-footed Shearwaters are infrequently observed in marine waters around Haida Gwaii in spring and summer. They are more commonly recorded in the fall when small numbers occur primarily off the west coast. The birds tend to be found well offshore and are rarely observed in waters <90 m in depth along the British Columbia coast (Guzman and Myres 1983). Their distribution may be related to water temperature. Off California, birds prefer warmer waters (Ainley 1976).

Buller's Shearwater

Buller's Shearwaters breed on islands in New Zealand and migrate to northern Pacific waters during their non-breeding season. They prey on fish at or near the water surface.

Buller's Shearwaters are primarily found offshore at the continental shelf edge. They are rarely seen in Hecate Strait, Dixon Entrance or Queen Charlotte Sound in any season, but are regularly seen off the west coast in the fall. Single birds have been sighted north of Masset and east of Sandspit in August of 1985 and 1984, respectively (Campbell *et al.* 1990 a). Morgan (1997) suggested that the distribution of this species could be explained by their preference for colder surface waters.

Sooty and Short-tailed Shearwaters

Sooty Shearwaters breed on islands off the coast of Australia, New Zealand and the southern coasts of South America. Short-tailed Shearwaters nest on islands off

Australia. Both species are associated with marine waters during their non-breeding season. They feed on small fish and squid.

Distributional data for Sooty and Short-tailed Shearwaters in the Haida Gwaii region are confounded by the difficulty in differentiating between these two offshore species during surveys. Sooty Shearwaters are by far the more common species. Morgan (1997) estimated that 90 to 95% of the shearwaters in Hecate Strait and Dixon Entrance in late June were Sooty Shearwaters. During the winter in Queen Charlotte Sound, however, the ratio of Short-tailed to Sooty Shearwaters was ~15:1 (Morgan *et al.* 1991).

Sooty and Short-tailed Shearwaters dominate the pelagic bird community in spring. The birds are always abundant in Hecate Strait in May and June; sometimes tens or hundreds of thousands are present (A. Gaston, CWS, *personal communication)*. Huge flocks of shearwaters, primarily Sooty, have been recorded in Hecate Strait and off the west coast during the spring (Figure 4): 500,000 east of Ramsay Island in May 1977; 250,000 to 500,000 east of Reef Island in April/May 1985; 300,000 near Houston Stewart Channel during a six hour period in May 1989 (Campbell *et al.* 1990 a; A.G. Whitney *personal communication* cited in Campbell *et al.* 1990 a; Gaston and Jones 1991). Vermeer and Rankin (1984) estimated that >4,000,000 passed through Hecate Strait and Queen Charlotte Sound in May 1983. Smaller numbers are found in Dixon Entrance. Gaston and Jones (1991) noted that feeding flocks were closely associated with euphausiids and suggested that inter-annual fluctuations in numbers could relate to varying prey abundance. Although numbers drop in all regions in the summer and fall, large flocks have been recorded during southward migration in Hecate Strait (where they are again the most numerous seabird) and off the west coast. Approximately 5,000 birds were counted near Tian Islets in August 1957 (Campbell *et al.* 1990 a). Savard (1979) noted that they are found over the deeper portions of open water in Hecate Strait from September through November. Numbers are lowest during winter (Savard 1979).

Fork-tailed and Leach's Storm-petrels

Storm-petrels nest in burrows found primarily on small, forested islands (Campbell *et al.* 1990 a). Although there is considerable inter-species overlap in habitat use, Leach's Storm-Petrels tend to burrow in more open ground (Vermeer *et al.* 1988). Both species lay a single egg and the adults return to the burrows at night to feed their chick with larval fish and invertebrates. Both species are surface feeders. The breeding biology of the two species on Hippa Island is compared by Vermeer *et al.* (1988).

Rodway (1991) estimated the combined breeding population of Fork-tailed and Leach's Storm-Petrels at ~156,400 pairs. The locations and sizes of Fork-tailed and Leach's Storm-petrel colonies are shown in Figures 6 and 7, respectively. Storm-petrels tend to nest in mixed species colonies and surveys of some of the colonies on the east and west coasts of Moresby Island failed to determine the proportion of each species. These colonies are shown in Figure 8. To estimate Haida Gwaii totals for each species, the total number of storm-petrels was multiplied by the ratio of Fork-tailed to Leach's found on colonies for which such data exist (Rodway 1991). The resulting estimates were ~53,400 pairs of Fork-tailed Storm-Petrels and ~103,000 pairs of Leach's Storm-Petrels. The archipelago supports ~21% of the British Columbia storm-petrel population (Rodway 1991). Rodway's (1991) estimations represent ~3% of the North American breeding population of Fork-tailed Storm-Petrels and <5% of the northeastern Pacific breeding population of Leach's Storm-Petrels (Campbell *et al.* 1990 a).

Breeding population trend data on a regional scale are not available for either

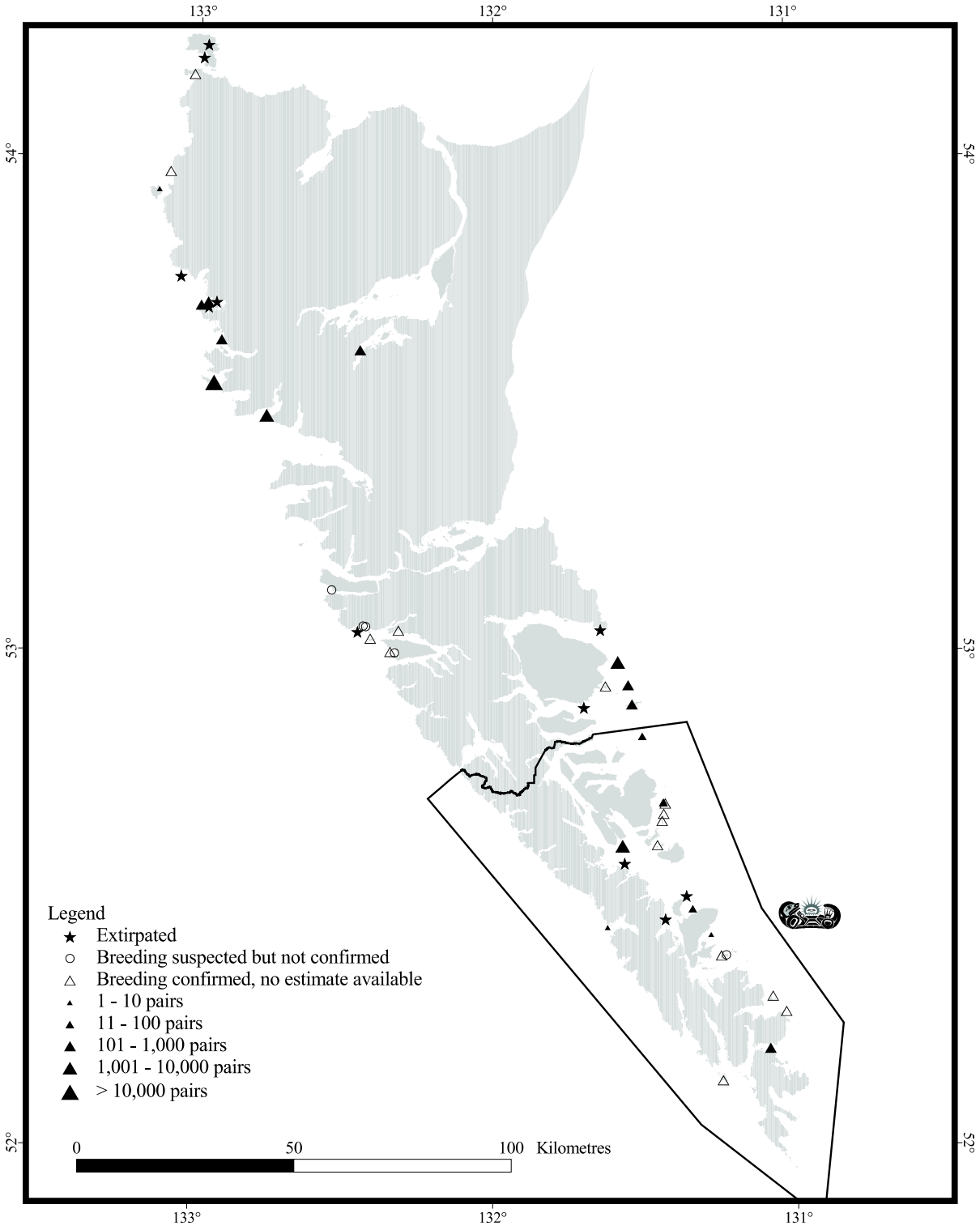

Figure 6. Locations and relative sizes of breeding colonies of Fork-tailed Storm-petrels in Haida Gwaii (data from Summers 1974; Hatter 1977; Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Lemon 1997; Smith 1998; A. Harfenist, *unpublished data*).

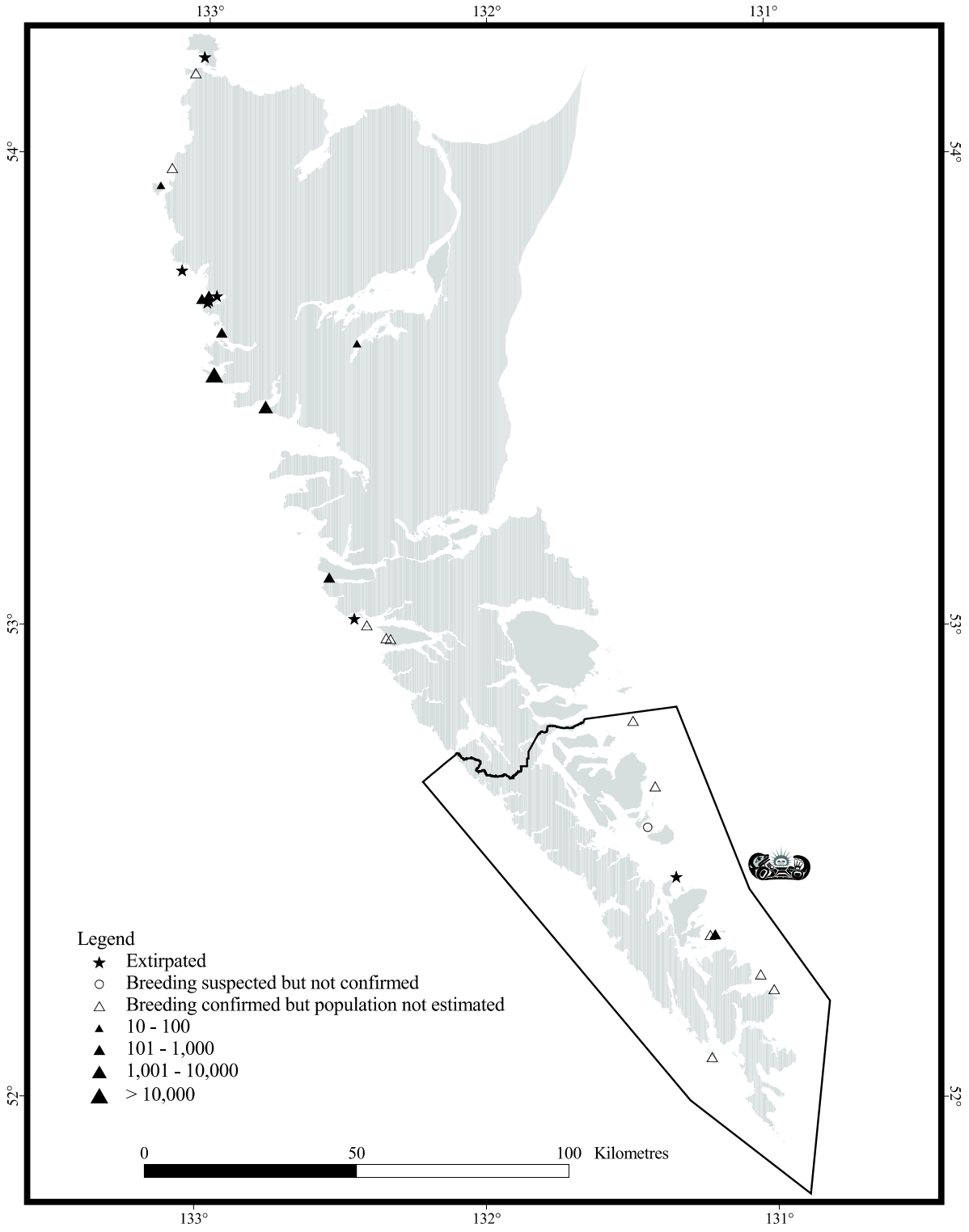

Figure 7. Locations and relative sizes of breeding colonies of Leach's Storm-petrels in Haida Gwaii (data from Summers 1974; Hatter 1977; Gaston and Noble 1985; Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Lemon 1997; A. Harfenist, *unpublished data*).

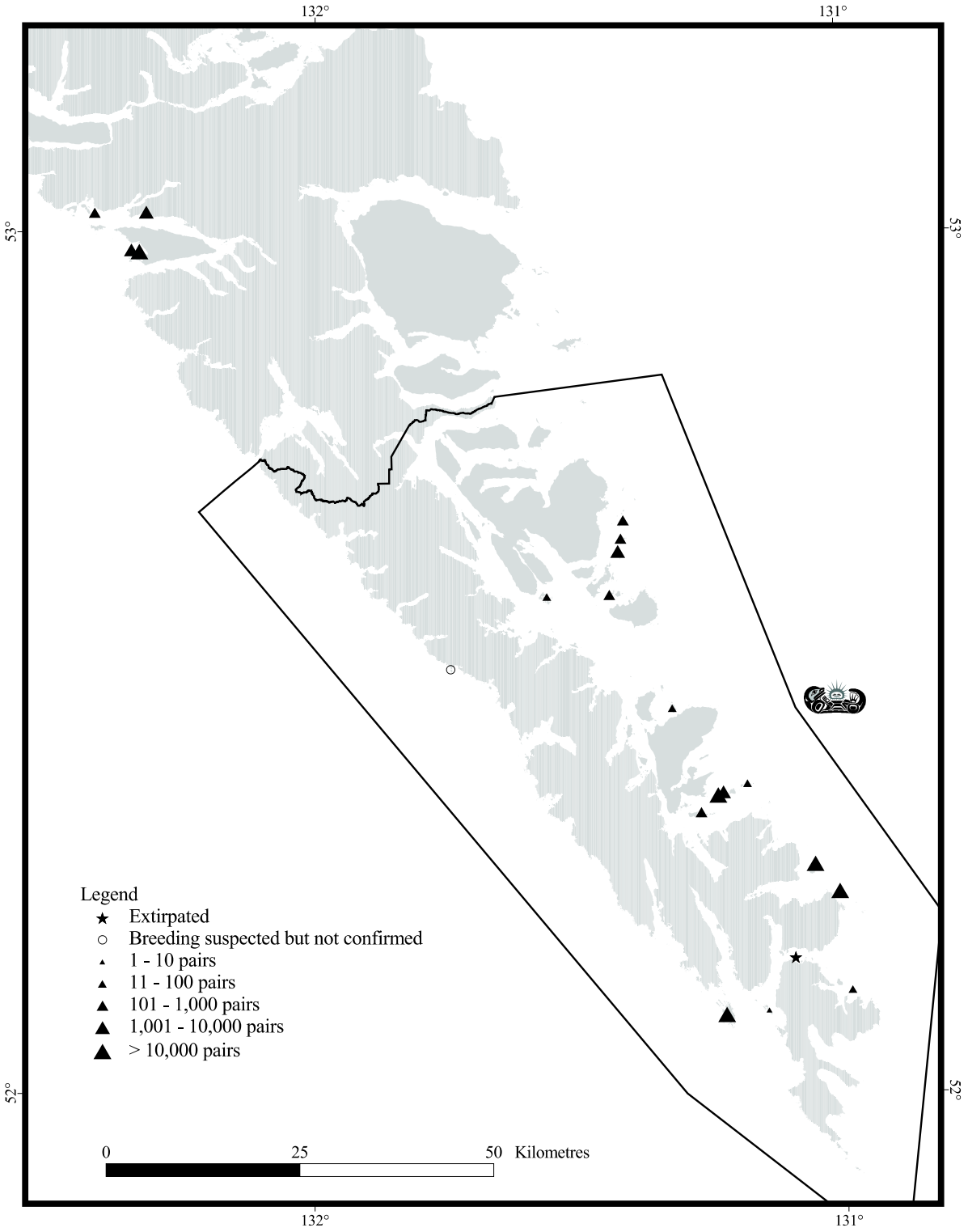

Figure 8. Locations and relative sizes of breeding colonies of storm-petrels in Haida Gwaii at which nests were not identified to species (data from Rodway 1988; Rodway *et al.* 1988, 1990; Harfenist 1994; Lemon 1997; Gaston and Masselink 1997).

species. Thirteen colonies have been abandoned, but the historical numbers of birds and species composition at those sites are unknown. The desertions of Langara and Cox Islands have been attributed to predation by introduced rats (Rodway 1991; Bertram and Nagorsen 1995) and colonies on Queen, Ogilvie and McKenzie Islands were destroyed by bears (Drent and Guiget 1961). Abandonment of Tian and Hoskins Islets and Ellen, Sels, Arichika, Kingui, Haswell and Willie Islands remain unexplained. Small storm-petrel colonies have appeared on Frederick and George Islands since the mid-1980s (Lemon 1997; A. Harfenist *unpublished data*); the latter colony was listed as "extinct" by Rodway (1991). The colony on the Charles Islands increased between 1986 and 1993 (Harfenist 1994).

The Fork-tailed Storm-petrel is an offshore species found in marine waters all around Haida Gwaii in spring and summer and everywhere except the west coast in the fall. None have been reported in the winter. Birds are generally less common off the west coast than in the other three regions. Although significant numbers breed in Haida Gwaii from April through September and can be seen flying above their colonies at night, they are rarely seen on the water near their breeding colonies during the day. However, Gaston and Jones (1991) did observe small numbers near Low Island during strong southeast winds. The highest concentrations occur at the edge of the continental shelf in spring in Hecate Strait and southeast of Cape St. James, and in summer west of Langara Island and midway between Cape St. James and Milbanke Sound. In August 1986, 130 were counted 30 km east of the Cape (Campbell *et al.* 1990 a). Fork-tailed Storm-petrels do not undergo major north-south migrations, but instead disperse into adjacent deeper waters following the breeding season (Boersma and Silva 2001). Few are seen in the fall; most of those in the area are found seaward of the continental shelf.

The Leach's Storm-petrel is an offshore species found in Queen Charlotte Sound, Hecate Strait and Dixon Entrance in spring through fall. None have been recorded off the west coast or in winter in any region. Birds occur mostly in waters >100 m depth. The highest densities are found beyond the continental shelf southwest and southeast of Cape St. James. Numbers sighted in Hecate Strait and Dixon Entrance have been low. A count of 100 birds encountered between Garcin Rocks and Rankine Islands in June 1987 was considered a noteworthy record (Campbell *et al.* 1990 a). Although significant numbers breed in Haida Gwaii in June through November and are commonly seen flying above their colonies at night during those months, they are rarely seen on the water nearby their colonies.

Double-crested Cormorant

Double-crested Cormorants breed through much of North America; along the Pacific coast they breed in southwestern Alaska and southwestern British Columbia. They became established as a breeding species in British Columbia within the last 60 years (Campbell *et al.* 1990 a). The birds winter in marine and freshwater habitats. They dive to catch their small fish prey that is comprised primarily of non-commercial species such as gunnels and perch. The Pacific subspecies is on the COSEWIC Candidate List as defined in Appendix A.

Small numbers of Double-crested Cormorants are found in inshore marine waters around Haida Gwaii in all seasons. Noteworthy records include 100 in Masset Inlet in April 1935 and 24 at Queen Charlotte City in September 1981 (Campbell *et al.* 1990 a). Low numbers are recorded during CBCs at Skidegate Inlet and Masset in all years. Goudie and Hearne (1993) found that numbers in Shingle Bay increased through December before peaking in January after which numbers declined again. Haida Elders

claimed that Double-crested Cormorants used to be much more abundant in the past than now (Ellis 1991).

This species occurs on freshwater as well as marine waters in the Haida Gwaii region. Birds were observed making daily trips between the ocean and Drizzle Lake where they were commonly seen foraging (Reimchen and Douglas 1984 b).

Pelagic Cormorant

Pelagic Cormorants nest on cliff ledges or crevices of forested islands and in caves. They build nests and lay one to eight eggs (Campbell *et al.* 1990 a). Unlike some other cormorant species, Pelagic Cormorants are exclusively marine. They are bottom feeders that prey on and provision their chicks with fish.

A 1986 survey of Pelagic Cormorants yielded 253 active nests on cliffs or in crevices at 10 sites in Haida Gwaii (Rodway 1988). Surveyors were unable to get to five previously active sites and Rodway (1988) suggested a maximum of 280 pairs at 15 sites. However, ~430 birds were flushed from caves at 16 locations previously unidentified as breeding sites during Peregrine Falcon surveys in 2000 (M. Chutter, MoWLAP, *unpublished data)*. Thus, the breeding population is probably considerably higher than estimated by Rodway (1988). Confirmed and possible breeding sites are shown in Figure 9. Using Rodway's (1988) population figures, Campbell *et al.* (1990 a) estimated that Haida Gwaii supports <7% and ~1% of the British Columbia and North American populations, respectively.

The timing of cormorant surveys and protocols used (whether nests or breeding pairs are counted) can have a major impact on the results obtained. For example, in 1988 at Murchison Island, D. Burles (Gwaii Haanas, *unpublished data*) counted 11 nest structures of which nine had birds in them on June 5. Eight days later, 15 nests were occupied and two were empty. By June 30, only 12 birds were incubating and six nests stood empty and during the final survey, on July 16, no cormorants were present and most of the nests looked wet and broken down. The surveys reported by Rodway (1988) were conducted from May through July and the colony totals likely depended on the timing of the counts. Population estimates are not indicated in Figure 9 because of the high intra- and inter-year variability in survey results.

It is difficult to determine breeding population trends for Pelagic Cormorants because the birds move among breeding sites causing wide variability in local population size (Hobson 1997). In Haida Gwaii, declines or abandonments have been documented at some sites, but it is unknown whether the birds shifted to new sites that were not checked in subsequent surveys. A site on Reef Island that was active in 1971 was not used in 1977 (Royal British Columbia Museum data cited in Rodway 1988) but was used again in 1986 (A. Gaston, CWS, *unpublished data* cited in Rodway 1988). In addition, counts of cave-nesting cormorants are unreliable because nesting caves are easily missed during surveys and the numbers of nests within the caves usually cannot be determined. Thus, the declines in number of breeding sites as well as total number of nests between 1971 and 1986 suggested by Rodway (1988) may reflect inadequate survey design rather than decreasing populations. Approximately 341 pairs were reported nesting at 23 sites in 1977 and a maximum of 280 active nests were observed at 15 sites in 1986 (Rodway 1988). Most of the losses occurred on the west coast of Moresby Island. Summers (1974) reported ~180 pairs at five sites off the east coast of Moresby Island in 1971 whereas Rodway (1988) found 48 pairs nesting at four sites on east Moresby in 1986. Local increases have also been recorded. Summers (1974) reported that numbers at Murchison Island

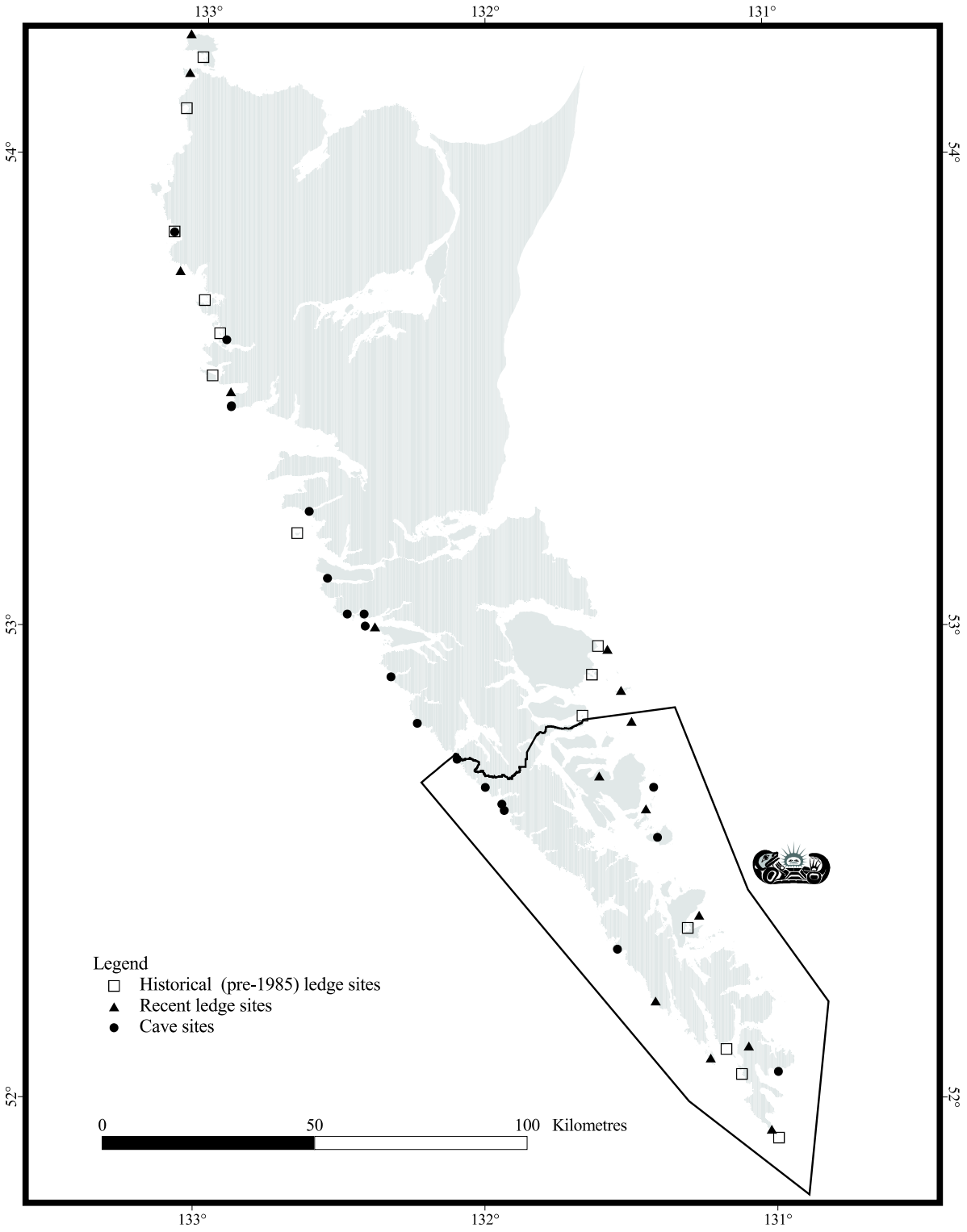

Figure 9. Locations of breeding colonies of Pelagic Cormorants in Haida Gwaii (data from Summers 1974; Hatter 1977; Rodway 1988; Rodway *et al.* 1988, 1990, 1994; D. Burles, *unpublished data*; M. Chutter, *unpublished data;* A. Gaston, *unpublished data*).

increased from 12 pairs in 1969 to 100 pairs in 1971.

The Pelagic Cormorant is an abundant inshore species observed year-round in all Haida Gwaii marine waters. Highest densities generally occur in waters <100 m depth and along rocky shorelines (Savard 1979; Vermeer and Rankin 1984). Vermeer and Rankin (1984) noted that 63% of the cormorants recorded during pelagic surveys in Hecate Strait and Queen Charlotte Sound were Pelagic Cormorants. The percentage rose to 99% for the west coast. A group of 350 was seen associated with Pacific herring in spring at Lawn Point and they are also abundant along the north coast of Graham Island during this season (Savard and Kaiser 1982). Of the up to 350 individuals that roosted regularly on the south end of Reef Island in spring and summer 1987 to 1989, > 90% were immatures (Gaston and Jones 1991). This and other roosting and feeding sites during spring and summer are shown on Figure 4 and listed in Table 10. Savard (1979) noted that cormorants were abundant in all surveys from September 1977 to February 1978 in southern Dixon Entrance and northern Hecate Strait; Pelagic Cormorants were also abundant in the waters off the east coast of Moresby in the fall (K. Vermeer, CWS, *unpublished data)*. Goudie and Hearne (1993) found that Pelagic Cormorants were the most abundant cormorant in the winter in Skidegate Inlet where numbers increased through December to peak in January before declining again. Approximately 100 to 300 are recorded in most years during the Skidegate Inlet and Masset CBCs. During the 1990 Rose Spit CBC, a high of 932 was noted. Haida Elders claimed that the birds were more common in the past that they are today (Ellis 1991).

Pomarine and Parasitic Jaegers

Both Pomarine and Parasitic Jaegers breed in Alaska and Arctic Canada and winter at sea. Although both species eat fish, Parasitic Jaegers acquire much of their food by kleptoparasitism - stealing fish from other birds.

Pomarine and Parasitic Jaegers are common migrants that have been sighted in all marine waters around Haida Gwaii. They are usually found offshore seaward of the continental shelf off the west coast in late summer and early fall. They are far less abundant in spring and early summer and have not been recorded in winter. These species are also occasionally seen close to shore. Four Parasitic Jaegers were observed 2 km north of Gowgaia Bay in May 1987 (Campbell *et al.* 1990 b).

Mew Gull

Mew Gulls nest in the British Columbia interior as well as along the coast. On the coast, the birds nest singularly or in small colonies at sites associated with freshwater lakes (Campbell *et al.* 1990 b). Mew Gulls are primarily surface nesters, but occasionally nest in trees. A pair lays one to three eggs. They forage on small fish and invertebrates on the ocean surface or shoreline.

The first breeding records in Haida Gwaii were reported in 1992 (Rodway *et al.* 1992 a). Five nests were found on three islets on Yakoun Lake and one nest was found on Mosquito Lake (Figure 10). The total breeding population for the archipelago is unknown.

The Mew Gull is a common inshore species during spring and fall migration and in winter. They are less frequently seen in summer (Hamel and Hearne 2001). The numbers recorded are lower off the west coast than in Dixon Entrance and Hecate Strait; none have been recorded in Queen Charlotte Sound. Goudie and Hearne (1993) reported that numbers near Sandspit declined in March after peaking in the previous two months. Forty and three,

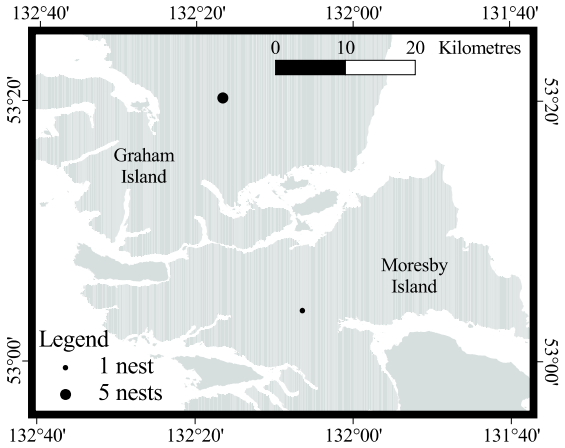

Figure 10. Locations of breeding sites of Mew Gulls in Haida Gwaii (data from Rodway *et al.* 1992 a).

counted in Skidegate Inlet in April 1972 and July 1977, respectively, were considered noteworthy records for spring and summer (Campbell *et al.* 1990 b). Mew Gulls have been observed with other gull species concentrated in the Bag Harbour estuary during salmonid migration (Reimchen 1992 c). They left the area two weeks after the salmonid run was complete (Reimchen 1994 b). More than 50 are counted during most CBCs in Skidegate Inlet. The high count was 432 in 1995.

Ring-billed Gull

Ring-billed Gulls breed in the interior of British Columbia and across North America. They are omnivores that winter in marine, freshwater and terrestrial habitats.

The Ring-billed Gull is primarily an inshore species, but is found in all marine waters around Haida Gwaii from April through mid-December. The species has not been recorded during the winter. Three and six were counted near Cape St. James in April and June1982, respectively, and a single individual has been seen in mid-December in both Masset and Skidegate Inlet (Campbell *et al.* 1990 b).

Ring-billed Gulls have increased in British Columbia since the 1950s, a trend probably related to increasing accessibility of garbage (Cannings *et al.* 1987).

California Gull

California Gulls breed in inland North America including a site in southern British Columbia. They winter primarily along the coast. They are omnivores and forage in aquatic (marine and freshwater) and terrestrial habitats.

The data on California Gulls in Haida Gwaii probably describes a minimum distribution and abundance because this species may be overlooked in flocks of other similar-looking gulls (Gaston and Jones 1991). Small numbers have been recorded in Hecate Strait and Dixon Entrance in spring and summer. Several hundred were counted in Skidegate Inlet in July 1990 and 40 were observed at both Low Island Sound and Naden Harbour in May and August 1984, respectively (Vermeer *et al.* 1983; Campbell *et al.* 1990 b; Gaston and Jones 1991; Morgan 1997). Morgan (1997) points out that there is no evidence to support the claim made by Campbell *et al.* (1990 b) that California Gulls are common during fall migration. They are considered rare in winter and have not been recorded in CBCs.

Campbell *et al.* (1990 b) suggested that the population increase along the southern coast of British Columbia could relate to an increase in availability of garbage.

Herring and Thayer's Gulls

Herring Gulls breed throughout North America including the interior of British Columbia and winter in both marine and interior locations. Thayer's Gulls breed on islands in the Canadian Arctic and winter mainly at marine sites. Both species are omnivores.

Data on these species are often grouped together as it can be difficult to distinguish between them during boat-based or aerial surveys. These gulls are abundant in all seasons in the marine waters around the archipelago (Campbell *et al.* 1990 b). In spring, concentrations of 400 to 600 have been recorded in Hecate Strait, Dixon Entrance and west of Kunghit Island (Campbell *et al.* 1990 b). Gaston and Jones (1991) noted that numbers near Reef Island were quite variable between years. For example, numbers were low in April 1984, but 4,000 to 5,000 were counted in April 1987. In the summer and fall, these species were most abundant near or beyond the shelf break off the west coast. Together the two species made up ~30% of the birds off the west coast in September. However, Herring Gulls are also seen close to shore during these seasons. Cannings (1975) reported ~250 adults and ~250 immatures feeding off the tip of Rose Spit in July 1974 and Reimchen (1992 c) observed congregations at Bag Harbour during salmon migration. In winter most Herring and Thayer's Gulls were observed in shallow waters of Hecate Strait and numbers were lower. Hearne and Goudie (cited in Morgan 1997) found that Herring Gulls were much more common than Thayer's Gulls at Sandspit in spring, but noted that the ratio was reversed in winter. Most CBCs have recorded more Thayer's Gulls than Herring Gulls. While CBC totals in Port Clements and Rose Spit are usually <10 for each species, totals at the Skidegate count varied up to 49 and 126 for Herring and Thayer's Gulls, respectively. Evidence from surveys off the west coast of Vancouver Island suggests that Herring Gulls are more pelagic than Thayer's Gulls (Vermeer *et al.* 1989).

Breeding Bird Survey (BBS) results indicate a positive, but not significant, trend in Herring Gull numbers in British Columbia from 1966-2000 (BBS website: http://www.mbr-pwrc.usgs.gov/bbs/bbs00.html).

Glaucous-winged Gull

Glaucous-winged Gulls tend to nest on treeless sections of small, low, offshore islands or on rocky headlands (Campbell *et al.* 1990 b). They build nests and lay up to three eggs. The chicks are fed during the day, mainly on fish and invertebrates. The adults are surface feeders. Their reproductive success in Skidegate Inlet was studied by Vermeer *et al.* (1991 a).

Approximately 2,800 pairs breed in small colonies or solitarily on Haida Gwaii (Rodway 1988; Vermeer *et al.* 1991 a, 1997 c). The locations of known breeding sites are shown in Figure 11. The archipelago supports ~11% of the British Columbia population and <2% of the breeding population of the northeastern Pacific (Campbell *et al.* 1990 b).

The breeding population in Haida Gwaii appears to be stable or increasing. Although a complete resurvey of all sites has never been done, Rodway (1988) reported a 30% increase between 1977 and 1986 on the islands that he rechecked. The total breeding population on five islands in Laskeek Bay remained relatively stable between 1992 and 1997, at a level slightly higher than that recorded in 1986 (Rodway 1988; Smith 2000). Some shifting between sites was noted (Gray 1999). A large increase in the Laskeek Bay population in 1998 was followed by a large decrease in 1999, but the latter result is confounded by an incomplete survey (Gray 1999). In 1990, Vermeer *et al.* (1991 a) found 178 breeding pairs when they resurveyed 13 colonies in Skidegate Inlet where 116 pairs had been recorded in 1986 (Rodway 1988). However, the difference in the results of the two studies probably reflects more a difference in methodologies than a large increase in the gull population (Vermeer *et al.* 1997 c). The population along the entire coast of British Columbia increased ~350% from 1940-1990 (Campbell *et al.* 1990 b).

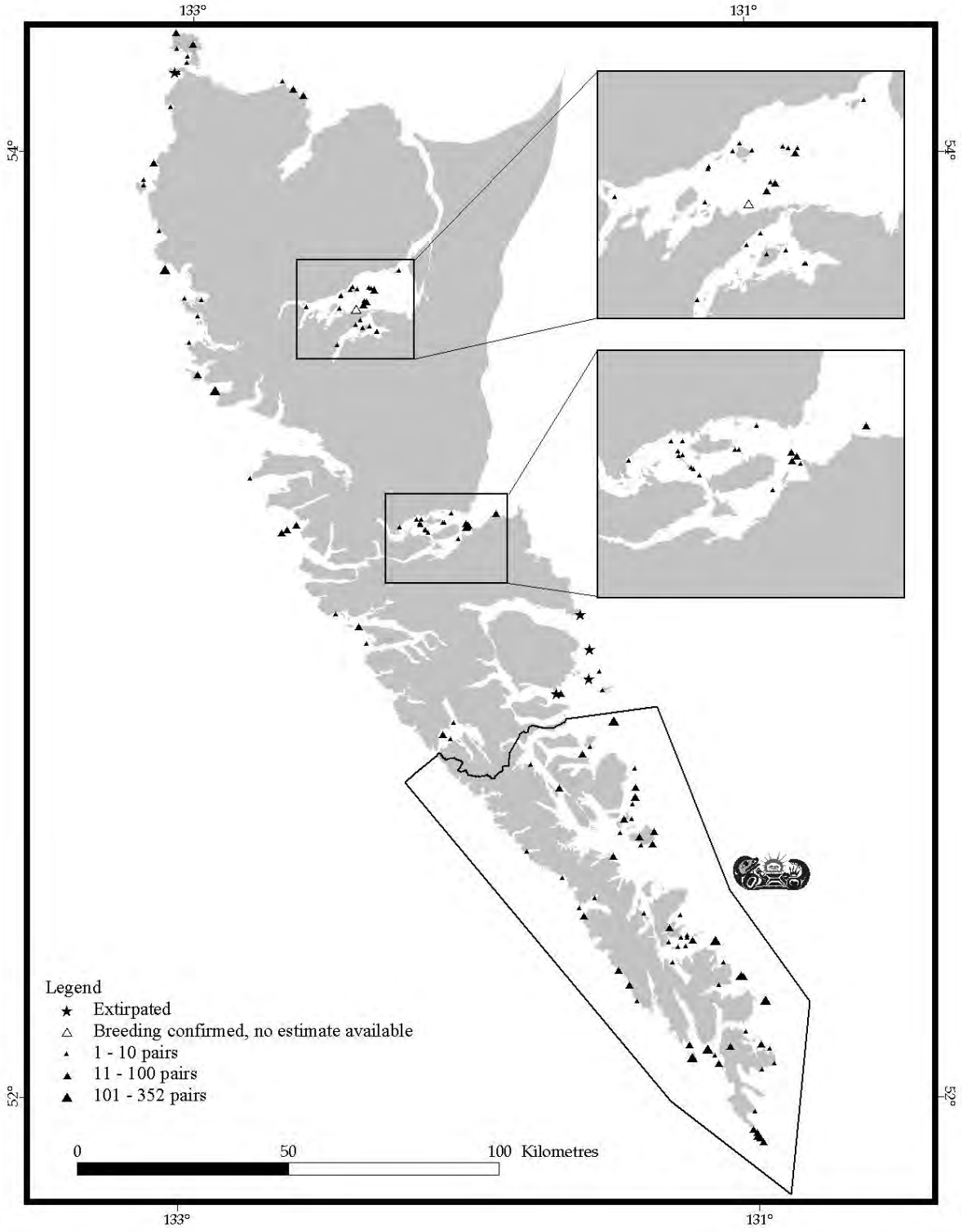

Figure 11. Locations and relative sizes of breeding colonies of Glaucous-winged Gulls in Haida Gwaii (data from Summers 1974; Campbell 1975; Hatter 1977; Hatter and Stordeur 1978; Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Vermeer *et al.* 1991 a; Gaston 1992 b; Gray 1999, 2000; A. Gaston, *unpublished data*).

The Glaucous-winged Gull is abundant year-round on all marine waters around Haida Gwaii. Numbers offshore (maximum in April and May) decline as the birds move to their nesting sites. Relatively few birds are found beyond the continental shelf from the beginning of breeding through the winter. Spring counts of 600, 400 and 800 were made at Burnaby Island, Sandspit and Rose Spit, respectively (Savard and Kaiser 1982; Campbell *et al.* 1990 b). In spring of some years, large flocks of hundreds of immatures were recorded near Reef Island where they were observed feeding with adults on Pacific herring shoals (Gaston and Jones 1991). These and additional roosting and feeding sites are shown on Figure 4 and listed in Table 10. Glaucous-winged Gulls are seen on or around their colonies during the breeding season and tend to roost on unvegetated islands (Butler 2000). In fall, this species congregates in estuaries to feed on salmon carcasses (Reimchen 1992 a, c, 1994 b). High numbers are frequently reported from sites around the archipelago in winter. Christmas Bird Count totals of 3365 at Rose Spit in 1988 and 1150 at Skidegate Inlet in 1991 were the highest recorded. Glaucous-winged Gulls made up 9% of the marine bird population and were the most abundant species in the winter of 1991-1992 in Skidegate Inlet (Blood and Bentley 1992).

These gulls use freshwater as well as marine waters on Haida Gwaii. Reimchen and Douglas (1984 b) observed gulls making daily migrations between the ocean and Drizzle Lake. Birds were primarily night residents on the lake and were never observed foraging.

Sabine's Gull

Sabine's Gulls breed in the Arctic and spend the non-breeding season at sea. They prey on fish from surface waters.

Sabine's Gulls migrate in large flocks well offshore (Campbell *et al.* 1990 b) and most sightings in the waters around Haida Gwaii occur >30 km offshore. When flocks are observed in nearshore waters, they usually number <100 birds (Campbell *et al.* 1990 b). Low numbers have been recorded from spring through fall in Queen Charlotte Sound and Hecate Strait and year-round in Dixon Entrance (Campbell *et al.* 1990 b). The largest flock seen near Reef Island numbered 30 to 40 in May 1985 (Gaston and Jones 1991); M. Hearne (cited in Morgan 1997) observed >200 in May 1991 off Masset. No Sabine's Gulls have been recorded during CBCs.

Black-legged Kittiwake

In North America, Black-legged Kittiwakes breed on islands in Alaska, Quebec and Newfoundland. They are piscivorous surface feeders and winter in marine habitats.

Black-legged Kittiwakes are abundant in all offshore waters during spring and fall migration. Birds are also frequently observed in inshore waters and are abundant from March through October (Hamel and Hearne 2001). Extremely large interannual variations in spring numbers in Hecate Strait are known (Vermeer and Rankin 1984; Gaston and Jones 1991). Gaston and Jones (1991) recorded up to 10,000 near Reef Island in May 1985 (Figure 4), but observed none in 1984. They also noted that while the majority seen in March and April were in adult plumage, >90% of those seen in May and June were immatures. Hundreds are seen in Laskeek Bay in June and July of most years (A. Gaston, CWS, *personal communication)* and summer records of hundreds of kittiwakes have been reported from other marine waters around the region including Hippa Island, Naden Harbour and Rose Spit (Campbell *et al.* 1990 b). By September, numbers were highest off the west coast where they were estimated to have the

second highest standing stock of marine birds (Vermeer and Rankin 1984). Kittiwakes are encountered on ~50% of the Rose Spit counts and <50% of the Masset CBCs, but totals are usually <10. The maximum count during the winter of 1991-1992 in Skidegate Inlet was two (Blood and Bentley 1992).

Common Murre

Common Murres nest colonially on cliff ledges and surfaces of rocky islands. Campbell *et al.* (1990 b) suggested that Common Murre breeding sites may be limited by the lack of suitable habitat in British Columbia. Adults forage by pursuing fish underwater and provision their single chick during the day. The species' natural history from British Columbia to California was reviewed by Manuwal and Carter (2001). The Pacific subspecies is on the COSEWIC Candidate List as defined in Appendix A.

The Kerouard Islands are the only confirmed breeding site of Common Murres in Haida Gwaii. The breeding population on the Kerouards exhibits significant annual variation: an estimate of 400 breeding birds was based on a 1987 count (Rodway *et al.* 1990; Rodway 1991), but in 1977 only 90 breeding birds were recorded (Campbell *et al.* 1990 b) and none nested on the cliffs in 1986, 1992 to 1993 and 1997 (Rodway *et al.* 1990; R.W. Campbell *unpublished data* cited in Carter *et al.* 2001). Birds have been observed at other islands in Haida Gwaii, but the close observation required to determine whether the attending murres were incubating or brooding was not conducted. Following the convention of Carter *et al.* (2001), such sites are noted as "rock attended without confirmed breeding" in Figure 12. Carter *et al.* (2001) give a breeding population estimate of ~164 for the archipelago.

The Common Murre is abundant in all seasons in Dixon Entrance and Hecate Strait, but occurs significantly less frequently, and in smaller numbers, off the west coast. Birds are generally found in higher densities in waters <100 m depth. Numbers in Queen Charlotte Sound, Hecate Strait and Dixon Entrance peak in spring and fall. Noteworthy records include flocks of 100 to 600 at Cape St. James, Langara Island and Rose Spit in the spring, 900 in Hecate Strait in the summer and >500 in Skidegate Inlet in the fall (Campbell *et al.* 1990 b). During fall and winter, Common Murres were the most common alcid in inlets (Savard 1979). Large numbers are regularly found in Skidegate Inlet in winter (Robertson 1974; Hatler *et al.* 1977) where Blood and Bentley (1992) counted a maximum of 439 near Sandspit in winter 1991-1992. The birds are also abundant from Masset to Rose Spit in winter (Savard 1979; Coastal Waterbird Inventory File 1980; B.C. Coastal Waterbird Survey website: www.bsc-eoc.org/bcwaterbirds.html; K. Vermeer, CWS, *unpublished data)*; a high of 7,492 were counted during the Masset CBC in 1993.

Pigeon Guillemot

Pigeon Guillemots nest solitarily or colonially usually in burrows or crevices, or among large boulders; they also nest at industrial sites along the shore such as pilings (Campbell *et al.* 1990 b; Vermeer *et al.* 1997 c). Pairs lay one to two eggs and carry small, near-bottom fish to their chicks throughout the day (Vermeer *et al.* 1993 b). The nesting biology and diet of birds in Skidegate Inlet are described by Vermeer *et al.* (1993 b).

No accurate estimate of the breeding population exists for Haida Gwaii because nests are difficult to find. Counts on the waters around probable nesting islands produced an estimate of ~5,100 birds for 1986 (Rodway 1991). However, Rodway (1988) cautioned against attempting to derive a breeding population estimate from that total because bird attendance at

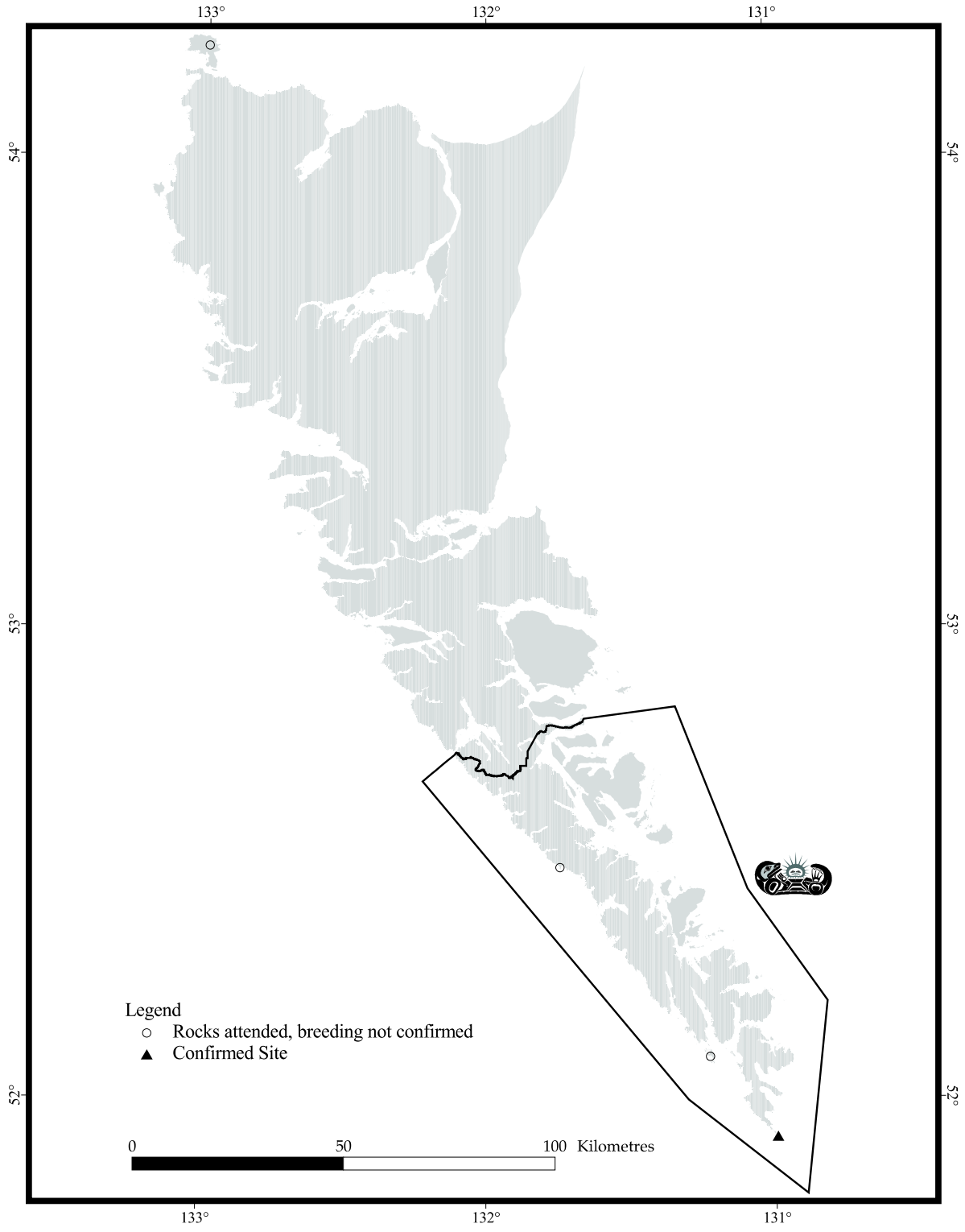

Figure 12. Locations of known and possible Common Murre breeding colonies in Haida Gwaii (data from Carter *et al.* 2001).

colonies varies with time of day, season and tide (Vermeer *et al.* 1993 a). The largest concentrations were found off the east coast of Moresby Island (Figure 13). The total for the archipelago represents ~50% of the British Columbia total (Rodway 1991) and ~6% of the world total (Ewins *et al.* 1993).

Although the 1986 total was higher than a 1977 total of 4,350 guillemots, Rodway (1988) noted that the difference should not be interpreted as a population trend because of the problems with the survey methodology outlined above. It is likely that local populations on islands with rats and/or raccoons underwent at least a temporary decline as the more easily accessible nests were destroyed. Raccoon predation on nests has been recorded on islands in Skidegate Inlet (Vermeer *et al.* 1993 b).

Pigeon Guillemots are widely distributed in the inshore waters of Haida Gwaii in spring and summer. The known at-sea distribution during the breeding season is similar to that shown in Figure 13 because the survey methodology used to census breeding populations involves counts of birds on the water, but the birds are also found in the inlets of Graham and Moresby Island for which breeding populations have not been assessed (K. Vermeer, CWS, *unpublished data)*. In six years of surveys in Laskeek Bay (April through July, 1990 to 1995), almost all guillemots were found within 2 km of shore and considerable inter-year variation was recorded (Gaston 1996). Pigeon Guillemots are commonly seen feeding in the waters nearby their colonies during the day. Following the breeding season, few birds are seen in most marine water bodies. Twenty was considered a noteworthy October record for Skidegate Inlet by Campbell *et al.* (1990 b). Blood and Bentley (1992) reported that birds were not common in winter in Skidegate Inlet until February/March. Low numbers are often observed during the Masset CBC.

Marbled Murrelet

Marbled Murrelets are unique among breeding seabirds of Haida Gwaii in that they nest solitarily on branches of old-growth trees. Pairs lay a single egg on a large-diameter, moss-covered tree branch. An early attempt to find their nests in Haida Gwaii by Darcus (1927) incorrectly reported Marbled Murrelets nesting in burrows and among boulders up mountainsides (Kaiser 1996). Small fish such as Pacific sandlance dominate the prey species and most provisioning trips for chicks are flown in darkness or low light conditions. Their ecology has been studied near Langara Island by Sealy (1975 a, b). Burger (2002) reviewed the species' ecology in British Columbia and Ralph *et al.* (1995) reviewed their ecology throughout their global range.

Marbled Murrelets have important species-at-risk values, being federally listed by COSEWIC as "*threatened*" and provincially red-listed by the CDC as "*endangered-threatened*". This is primarily because of the loss of their old-growth forest nesting habitat due to logging (Rodway 1990; Hull 2000). Mortalities in fishing nets and oil spills were also considered in the listing processes.

It is extremely difficult to census breeding Marbled Murrelets due to the locations of their nests. Extrapolating from local at-sea survey and count results, Burger (2002) estimated that Haida Gwaii supported ~6,800 Marbled Murrelets. Using Sealy's (1975 b) estimate that 85% of the birds seen on the water are breeding adults gave a breeding population estimate of ~5,800. Many of the at-sea data used to produce the breeding population estimate are from two surveys conducted in Gwaii Haanas. French (1992) estimated ~2,550 birds in Juan Perez Sound in 1992 and Lawrence and Backhouse (1991) estimated ~1,200 in Skincuttle Inlet in 1991. However, large daily, seasonal, and annual variations in

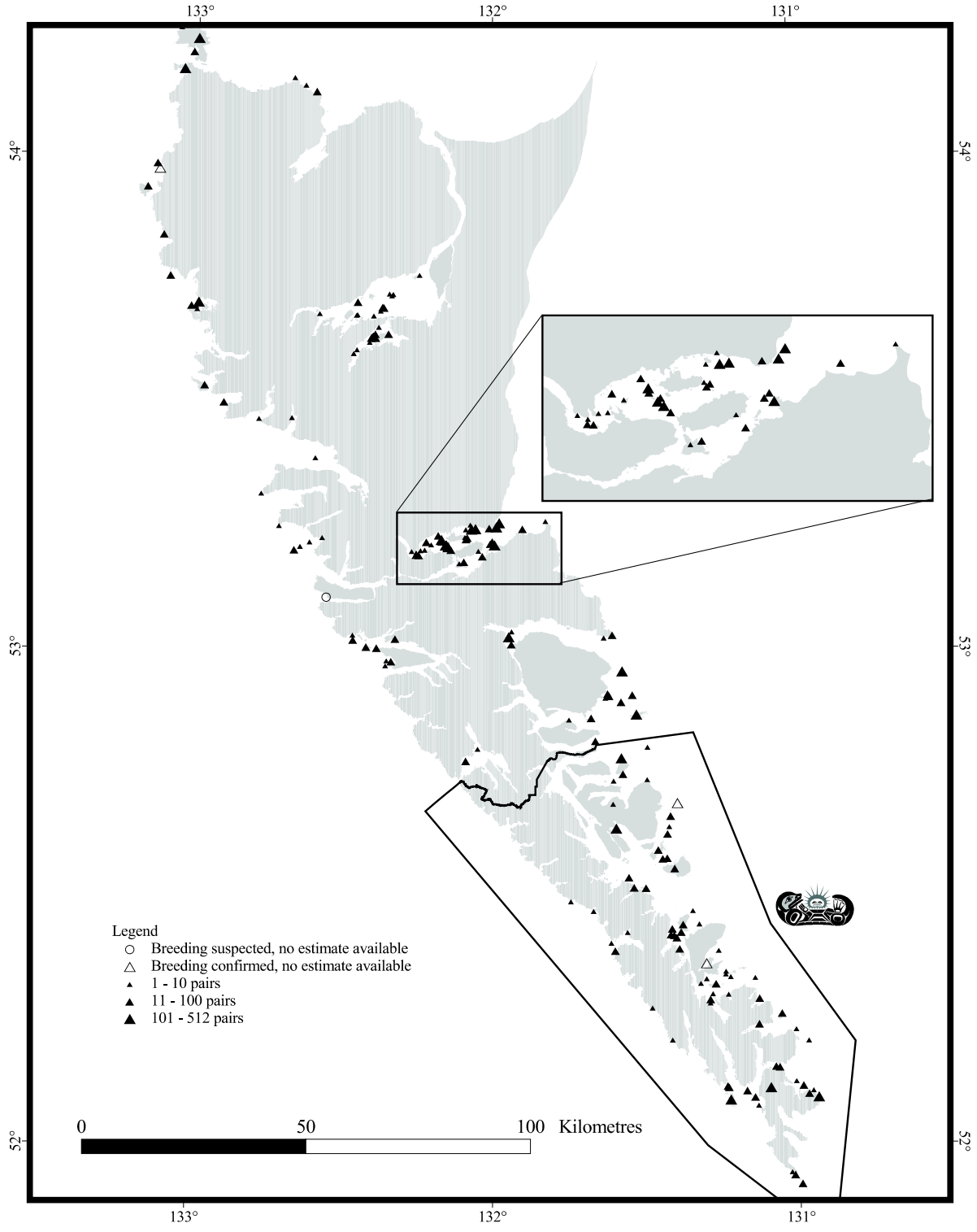

Figure 13. Numbers of Pigeon Guillemots counted on the water around probable nesting islands in Haida Gwaii (data from Campbell 1975; Hatter 1977; Hatter and Stordeur 1978; B.C. MoE 1981; Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Vermeer *et al.* 1993 a, 1993 b).

counts on the water make it difficult to derive accurate and precise estimates from marine surveys without appropriate and intensive long-term surveys. For example, Materi *et al.* (1998) counted 101 and 50 in Botany and Fairfax Inlets respectively, in mid-June 1997. Counts in mid-July, 1998 were nine and 22. A promising survey technique using radar has been used in other regions of the coast (Burger 1997 a; Schroeder *et al.* 1999; Manley 2000), but not on Haida Gwaii. Haida Gwaii probably supports ~10% of the British Columbia breeding population. Most of the world population breeds in south-east and south-central Alaska where estimates vary from 280,000 to >1,000,000 (Piatt and Naslund 1995; Alger *et al*.1998). Burger (2002) concluded that census data in British Columbia are insufficient to detect population trends. Christmas Bird Count data may suggest a declining trend (Rodway *et al.* 1992 b), but CBC survey sites do not tend to overlap significant winter marine waters for the species (Burger 2002).

Marbled Murrelets probably nest where suitable habitat exists throughout the old-growth forests of Graham and Moresby Islands and on some of the larger offshore islands. Activity surveys in the forest have been used as indices of Marbled Murrelet habitat use, with the presence of certain "occupied" behaviours used to suggest a likelihood of nesting (Ralph *et al.* 1995). In a study of activity levels on Haida Gwaii, Rodway *et al.* (1991, 1993) reported that most detections were found in low elevation old-growth forests. Similarly, Dechesne and Smith (1997) found that on northwest Graham Island the numbers of occupied detections were greatest in valley bottom stands forested with old-growth western hemlock or western hemlock/Sitka spruce mix. However, no quantitative relationship has been established between the number of birds or the number of "occupied" detections counted during such surveys and nesting density. Using data from Oregon, Jodice *et al.* (2001) showed that the results of activity surveys cannot reliably be used to indicate habitat preferences. Furthermore, Burger (1997 a) noted that activity surveys may miss a significant number of birds and suggested that the method may be biased toward the detection of non-breeding prospecting birds. Radar surveys overcome the latter concern. In a radar study of 18 watersheds in Clayoquot Sound, Vancouver Island, Burger (2001) found the strongest significant correlation between bird number and total area of mature forest at <600 m elevation. Trees along the shoreline edge (to 250 m inland) are considered suboptimal because the thinner epiphyte cover found on large tree branches in this zone is less suitable for nesting (Burger *et al.* 2000). The birds are known to often forage at distances >60 km from their nest sites and, on a fine scale, the on-water numbers have no known relationship to the numbers nesting nearby.

Habitat suitability maps have been developed for Haida Gwaii based on an algorithm developed from data on Marbled Murrelet nesting habitat requirements in southern British Columbia and revised following ground-truthing on Graham and Moresby Islands (McLennan *et al*. 2000). Habitat suitability maps have also been developed for the Tlell River watershed (Chytyk *et al.* 2000), but, according to a report that provided a qualitative assessment of the various habitat capability/suitability models used in the province, the reliability of the Tlell model is low (Tripp 2001). In contrast, the model developed by McLennan *et al.* (2000) received the highest rating. However, the relationship between habitat quality, nesting density and nesting success is still unknown for Haida Gwaii.

The Marbled Murrelet occurs in all marine water bodies during all seasons with peak numbers usually in June and July (Lawrence and Backhouse 1991; Rodway *et al.* 1991; French 1992; Morgan 1997). In winter and spring, numbers are highest in Hecate Strait and Dixon Entrance. Figure 5 shows marine areas where concentrations

of Marbled Murrelets have been regularly noted during the breeding season. The on-water numbers vary greatly daily, seasonally and interannually (Rodway *et al.* 1991; French 1992; Gaston 1996; Smith 1998). In Laskeek Bay, peak survey counts were 1,686, 635, 275, 492, and 183 in 1993 through 1997, respectively (Smith 1998). The birds are usually found close to shore where they tend to forage in waters < 30 m in depth (Burger 2002). Targeted at-sea surveys conducted in Juan Perez Sound in 1991 and 1992 and in Skincuttle Inlet in 1991 yielded consistently higher murrelet numbers on coastal compared to open water transects (Lawrence and Backhouse 1991; French 1992). Further, birds in Laskeek Bay were almost always found within ~2 km of Louise Island and Gaston (1996) suggested that distance from the mainland (Louise Island in this context) was a much more important factor than water depth in determining the distribution. In fall, most birds are recorded at the edge of the continental shelf. Totals from CBCs are usually <10. Throughout British Columbia, Marbled Murrelets prefer colder marine waters and tend to be found over sandy sea beds and close to estuaries (Yen *et al. submitted)*. Burger (2000) also found a significant negative correlation between sea water temperature and murrelet numbers off southwestern Vancouver Island.

Marbled Murrelets have been reported flying over Haida Gwaii lakes, but tend not to land. Of 49 lakes that were surveyed during twilight between May 25- July 25 of various years, nine had extensive flight activity (Reimchen 1991). Most of the activity was at lakes in old-growth forests in the Coates Lake area of western Graham Island (Reimchen 1991); the birds were rarely observed flying over lakes in Naikoon Park (Reimchen 1992 b). Birds were seen on a lake surface only once and no foraging was observed (Eisenhawer and Reimchen 1990).

Ancient Murrelet

"The Ancient Murrelets, with their unusual biology and their attachment to some of the most visually spectacular parts of the archipelago, are one of the jewels in the islands' crown."
(Gaston 1992 a)

The Ancient Murrelet is one of the outstanding wildlife species of Haida Gwaii and the object of A. Gaston's (1992 a) monograph. Haida Gwaii is their only breeding location in Canada and the local population represents ~50% of the world population (Gaston 1994 a). Further, the Ancient Murrelet is federally listed as a "*species of special concern"* by COSEWIC primarily because much of the breeding population is threatened by introduced predators (Gaston 1994 a); it is also provincially listed by the CDC as "v*ulnerable*". The species is to be reassessed by COSEWIC, but a status change is not anticipated (A. Gaston, CWS, *personal communication*).

All Ancient Murrelet colonies on Haida Gwaii are situated on forested islands where nests are in burrows at the base of trees, stumps or logs (Vermeer and Lemon 1986; Gaston 1992 a). Birds tend to nest within 300 m of the shoreline and usually inland of Cassin's Auklets where the two species co-occur (Gaston 1992 a). Most breeding pairs lay two eggs and the chicks run to sea at only a few days of age without being fed in the burrow. Adults arrive and depart from the colony at night. The birds dive for their zooplankton and larval fish prey. Gaston (1992 a) provides a detailed description of the species' ecology in Haida Gwaii and more recent information can be found in the annual reports of the Laskeek Bay Conservation Society (Gaston 1997; Gaston and Adkins 1998; Smith 1998). Vermeer and Lemon (1986) described aspects of the breeding biology on Frederick Island and Sealy (1975 a) examined diets near Langara Island. Timing of breeding on the east and west

coasts of the archipelago is compared in Gaston and Harfenist (1998). The extent of gene flow within British Columbia is described by Pearce *et al.* (2002).

Approximately 256,000 pairs of Ancient Murrelets nest on 35 colonies in Haida Gwaii (Rodway 1991, Gaston 1992 a, Vermeer *et al.* 1997 c). About 50% are found on three colonies off the west coast of Graham Island (Figure 14). The breeding population has declined at six colonies and 10 colonies have been abandoned. Rats are believed responsible for decreases on Langara, Lyell and Kunghit Islands (Gaston 1994 a; Harfenist 1994; Bertram and Nagorsen 1995), whereas the declines on Helgesen, Saunders and Limestone Islands have been attributed to raccoons (Gaston 1994 a; Gaston and Masselink 1997; A. Gaston, CWS, *personal communication*). The most severe decline occurred on Langara Island where a colony that once probably numbered ~200,000 pairs (Gaston 1992 a) decreased to ~14,600 pairs by 1993 (Harfenist 1994). Birds have abandoned small colonies on Lucy, Cox, Instructor, Boulder, Sea Pigeon, Skedans, Arichika, Bischof, Tar and High Islands; introduced predators may have been a factor at some of these sites (Rodway 1991; Gaston 1994 a).

The breeding population on East Limestone Island recovered following the removal of raccoons (Gaston and Lemon 1996) and has since remained relatively stable (Gray 1999). However, the Langara population had not rebounded four years after the eradication of rats (Drever 2000).

Population increases have occurred on colonies without introduced predators such as Lihou, Reef, George, Ramsay and Frederick (Lemon 1993 a, b; Gaston and Lemon 1996; Gaston and Masselink 1997; Lemon 1997; Lemon and Gaston 1999). With the exception of Frederick Island, annual increases have ranged from 2.6% to 9.5% (Lemon and Gaston 1999). The 0.2% increase recorded for Frederick Island is probably an underestimate as other indicators suggested that the number of birds present at the colony during the year of the most recent survey, an El Niño year, was lower than in the previous four years (A. Harfenist, *unpublished data*). Some of the recorded population increases may represent a shift in the birds' distribution away from depredated islands. No trend was apparent on the Rankine Islands between 1984 and 2000 (M. Lemon, CWS, *personal communication*). Overall, it is likely that the regional population has decreased.

The Ancient Murrelet is abundant during spring and early summer in all offshore marine water bodies around Haida Gwaii. The species comprised ~47% to 74% of the total number of birds in Dixon Entrance in April and May. Numbers in Laskeek Bay peaked in May (Gaston 1996). Ancient Murrelets occur significantly more frequently in waters >100 m depth, but Gaston (1996) suggested that distance from the mainland was a more important factor in determining their distribution than water depth. In six years of surveys during spring and summer in Laskeek Bay, birds were found almost exclusively >2 km offshore (Gaston 1996). Vermeer *et al.* (1985) observed most birds at the continental shelf break off northwestern Graham Island. Large concentrations of birds are often found in the evenings during the breeding season on marine gathering grounds near colonies (Figure 4 and Table 10; Rodway *et al.* 1988, 1990, 1994; Gaston 1992 a). After the breeding season, numbers near the colonies decline and few are recorded during the fall and winter. CBC totals are usually low, however 4,650 were counted during the 1995 Rose Spit CBC.

<u>Cassin's Auklet</u>

Cassin's Auklets nest on forested or grassy islands in burrows dug into moss or bare soil in the forest or under grassy hummocks, usually within ~100 m of shore

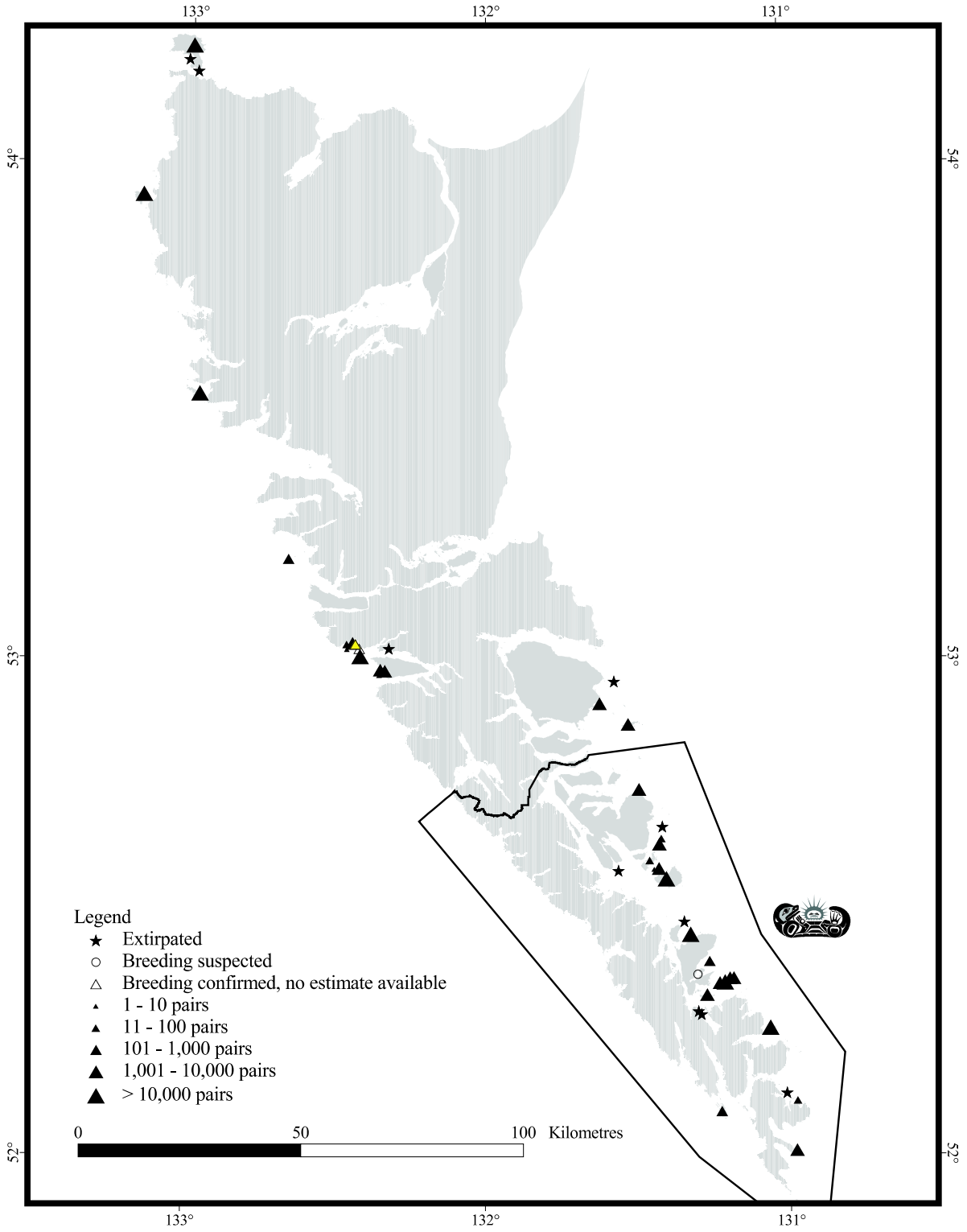

Figure 14. Locations and relative sizes of breeding colonies of Ancient Murrelets in Haida Gwaii (data from Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Harfenist 1994; Gaston and Lemon 1996; Lemon 1997; Gaston and Masselink 1997; Gray 1999; Lemon and Gaston 1999).

(Vermeer and Lemon 1986; Rodway *et al.* 1988). Pairs lay a single egg. Zooplankton are the major food supplied to the chicks during provisioning flights that occur in darkness. Additional information about their ecology in Haida Gwaii is in Vermeer and Lemon (1986) and Gaston (1992 c). As well, this species was the focus of a 6-year research project on Frederick Island whose results have been presented at conferences (Bertram *et al.* 1997; Harfenist and Smith 2001; Bertram *et al.* 2002), but are not yet published.

Cassin's Auklets are the most abundant breeding seabird in Haida Gwaii. Approximately 297,000 pairs breed at 49 sites (Figure 15; Rodway 1991; Vermeer *et al.* 1997 c). That total represents ~18% of the world population; British Columbia supports ~80% of the world population (Rodway 1991). Population declines have been noted on seven islands; Langara, Cox, St. James, Saunders, Helgesen, Arichika and Rankine (Rodway *et al.* 1990, 1994; Gaston and Masselink 1997). The abandonments of Langara, Cox and St. James Islands have been attributed to predation by introduced rats, whereas raccoons are believed responsible for the abandonment and decline on Saunders and Helgesen Islands, respectively. The population decline between 1984 and 2000 on the Rankine Islands is probably due to a radical change in the vegetation cover around the perimeter of the island where the birds nest (M. Lemon, CWS, *personal communication)*. Significant reductions in burrow density were noted in areas of Rankine where open moss habitat has been replaced by impenetrable spruce seedlings and saplings following windfall. The population estimate for Frederick Island in 1998 was lower than that in 1980 (M. Lemon, CWS, *personal communication*); however, other indicators suggest that fewer birds were present on the colony in 1998, an El Niño year, than in the previous four years (A. Harfenist, *unpublished data*). The lower 1998 figure, therefore, probably does not reflect a long-term decline. On islands without introduced predators for which there are data, populations appear stable. Data are available for George Island between 1985 and 1996 (Lemon 1997) and East Copper Island between 1985 and 1991 (Lemon 1992).

The Cassin's Auklet is abundant in all marine water bodies around Haida Gwaii in spring and summer, but is more frequently seen off the west coast than in Queen Charlotte Sound, Hecate Strait or Dixon Entrance. Birds occur significantly more frequently over waters >100 m depth. A concentration of 420 birds reported 8 km east of East Copper Island in May 1985 was a noteworthy record (Campbell *et al.* 1990 b). Morgan (1997) noted high inter-year variability in spring numbers. Birds tend to forage during the breeding season seaward of the continental shelf and over seamounts (Vermeer *et al.* 1985), however, Gaston and Jones (1991) reported hundreds feeding between Reef and Skedans in June 1984 and 1985 (Figure 4, Table 10). Adults are common in waters around their colonies during the breeding season and young-of-the-year are often seen in these waters in July and August (K. Rowsell, Queen Charlotte City, *personal communication*), up to one to two months after fledging. Numbers are relatively low in the fall and winter before they begin to increase again in March. Although few are usually encountered during CBCs, 1,398 were recorded in the 1996 Rose Spit count.

Rhinoceros Auklet

Rhinoceros Auklet colonies occur on forested islands (Rodway *et al.* 1988, 1990). The birds nest in burrows under grass hummocks, moss or bare soil. Pairs lay a single egg and feed their chick in the burrow until it fledges. Provisioning trips, during which the parents bring small fish to their chicks, occur in darkness. Birds pursue their prey underwater. Brown (1997) and Bertram *et al.* (*in press*) provide

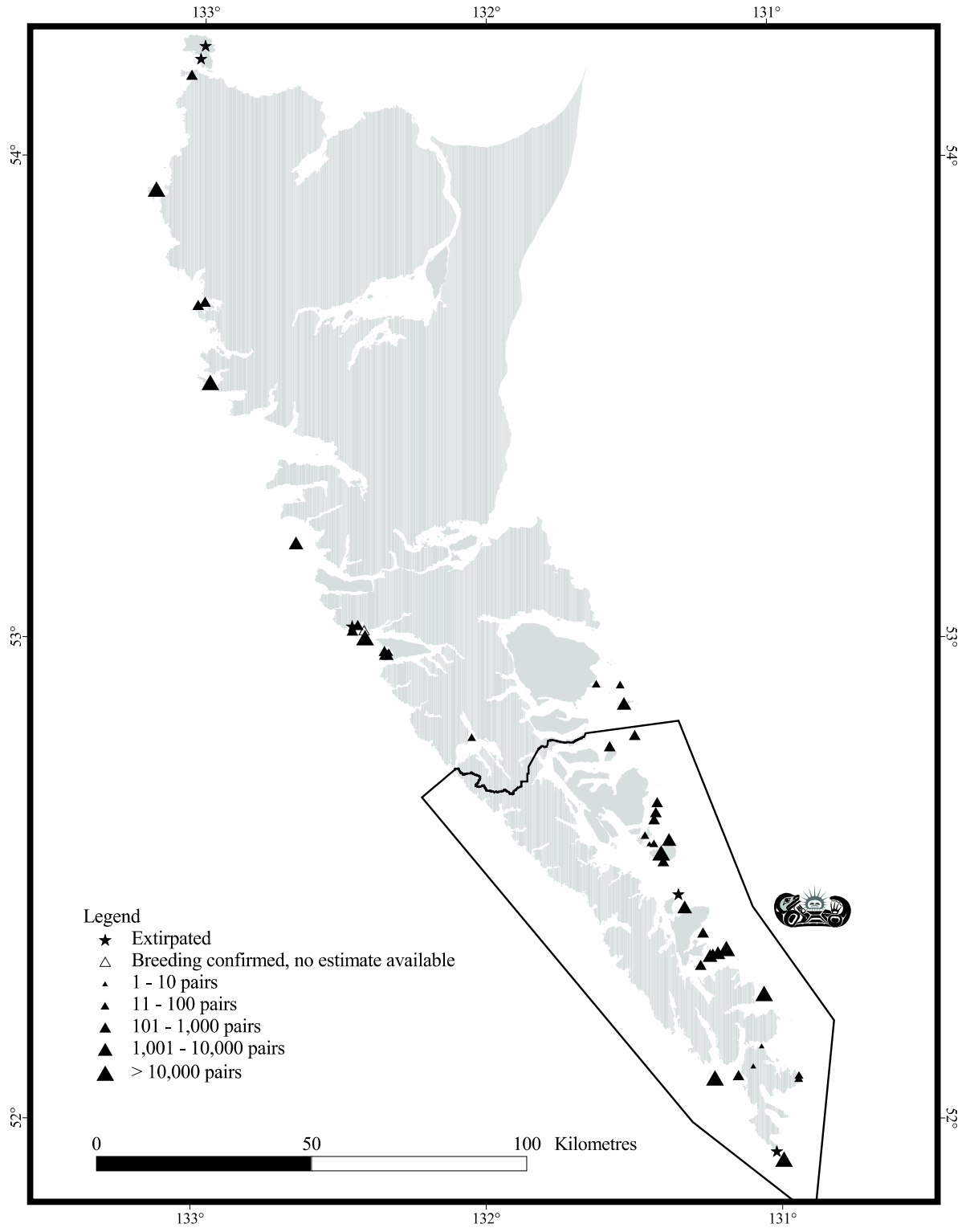

Figure 15. Locations and relative sizes of breeding colonies of Cassin's Auklets in Haida Gwaii (data from Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Bertram 1989; Lemon 1997; Harfenist 1994; Gaston and Masselink 1997; A. Harfenist, *unpublished data*).

chick growth and diet information from the colony at SGaang Gwaii (Anthony Island).

An estimated 23,900 pairs of Rhinoceros Auklets breed at 24 sites in Haida Gwaii (Gaston and Jones 1991; Rodway 1991; Vermeer *et al.* 1991 b; 1997 c). The breeding colonies are concentrated off the south and northwest coasts of Moresby Island shown in Figure 16. The archipelago accounts for ~ 4% and 7% of the world and British Columbia populations, respectively (Rodway 1991; Campbell *et al.* 1990 b).

Although Rhinoceros Auklets are increasing over most of their range (Gaston and Deschesne 1996), the breeding population on Haida Gwaii has probably declined. Gaston (*unpublished data* cited in Gaston and Dechesne 1996) reported that the numbers seen in Hecate Strait during the breeding season have increased from 1984 to1994, but suggested that the trend likely reflects an overall population increase rather than a regional one. Extirpations and local declines have been attributed to introduced rats (on Langara and Cox Islands) and raccoons (on Saunders, Helgesen and Little Helgesen Islands) (Rodway *et al.* 1990, 1994; Rodway 1991; Bertram and Nagorsen 1995; Gaston and Masselink 1997). Between 1986 and 1993, the population on Helgesen Island declined by ~10,000 pairs (Gaston and Masselink 1997). Two small sub-colonies on Kunghit Island have been abandoned, however, no evidence of rat predation has been found at the colony on Kunghit Island despite the island's long history of rats (Rodway *et al.* 1988; Harfenist 1994). Colonies on Ellen and Instructor Islands disappeared for unknown reasons (Rodway *et al.* 1988; Gaston and Masselink 1997). The small colonies on High and Charles Islands were stable between 1986 and 1993 (Harfenist 1994).

Rhinoceros Auklets are encountered in all water bodies around Haida Gwaii in all seasons. Pelagic bird surveys in the early 1980s found the highest spring densities seaward of the continental shelf east of Cape St. James and near Langara Island. Noteworthy spring records include counts of 4,000 to 5,000 and 1,900 near Frederick Island and SGaang Gwaii, respectively (Campbell *et al.* 1990 b). During April to July for six consecutive years in Laskeek Bay, Rhinoceros Auklets were usually found >2 km offshore (Gaston 1996), but Gaston and Jones (1991) observed up to 2,000 birds feeding near Low Island in spring of 1985. Numbers varied substantially between years. Several thousand have been reported during summer surveys from several areas including Houston Stewart Channel, Skedans Island and Dixon Entrance from Masset Inlet to Naden Harbour (Campbell *et al.* 1990 b). Some of the hundreds of birds regularly observed feeding near Langara Island throughout the spring and early summer probably breed in Alaska as they are seen flying northward at dusk (A. Harfenist, *unpublished observation*). Marine waters known to be important to Rhinoceros Auklets during spring and summer are shown in Figure 4 and listed in Table 10. Birds often gather near their colonies with fish in their beaks in early evening during chick-rearing (A. Harfenist, *unpublished observation*). Following the breeding season, birds move offshore and southward, but are still common off the east coasts of Moresby and Kunghit in September and October (Coastal Waterbird Inventory File 1980; K. Vermeer, CWS, *unpublished data*). The highest fall density was recorded seaward of the continental shelf south of Cape St. James. Christmas Bird Counts usually yield <10. Birds banded in British Columbia have been recovered in California (G. Kaiser, *personal communication,* cited in Gaston and Dechesne 1996).

Horned Puffin

Horned Puffins nest in burrows on slopes covered with grass hummocks or in crevices in Alaska and may nest in either habitat on Haida Gwaii. Pairs lay a single

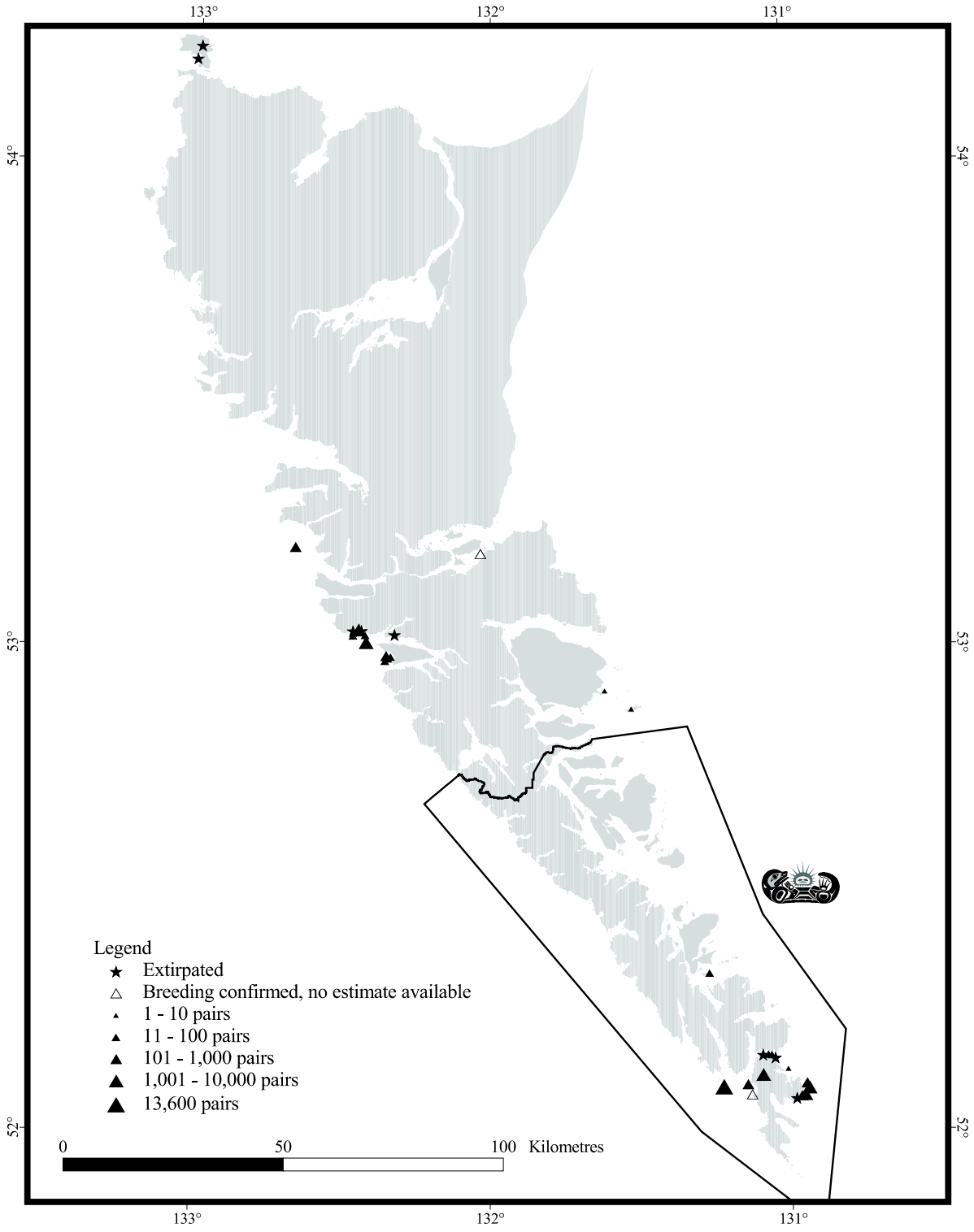

Figure 16. Locations and relative sizes of breeding colonies of Rhinoceros Auklets in Haida Gwaii (data from Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Vermeer *et al.* 1991 b; Gaston and Jones 1991; Harfenist 1994; Gaston and Masselink 1997).

egg and chicks are fed small fish in the burrow until fledging. Birds dive for their prey; provisioning of the chicks is diurnal.

There are no confirmed breeding sites for the Horned Puffin in Haida Gwaii, but pairs have been observed entering burrows at two sites: Flatrock Island and SGaang Gwaii (Figure 17; Rodway *et al.* 1990; Butler 2000). Based on the consistent presence of adults in breeding plumage on the water near Kerouard, St. James and Marble Islands, Campbell *et al.* (1990 b) suggested that the species nests at those sites as well. Rodway's (1991) estimate of 16 breeding pairs for Haida Gwaii is a rough approximation based on the number of birds observed on and around suspected breeding islands. The archipelago probably supports <0.01% of the North American population (Campbell *et al.* 1990 b).

The Horned Puffin is found in the waters of Haida Gwaii from late January to late October (Campbell *et al.* 1990 b; Morgan 1997; Hamel and Hearne 2001). Small numbers are often seen on the water around islands at the southern end of the archipelago and Marble Island during the breeding season. Birds are rarely encountered in Hecate Strait. The birds move further offshore by winter.

Tufted Puffin

Tufted Puffins nest in burrows on slopes covered with grass hummocks or in rock crevices (Campbell *et al.* 1990 b). Pairs lay a single egg and feed their chicks small fish during diurnal provisioning trips. Adults pursue their prey under water.

There are 14 confirmed or suspected breeding colonies of Tufted Puffins on the archipelago (Figure 18). Most colonies are located at the south end of Haida Gwaii. Surveys have involved counting the number of birds standing on the colony, flying by or in the water nearby. Thus, the estimated breeding population of ~560 pairs (Rodway 1991) is a rough approximation. The archipelago's population represents <0.5% of the world population (Campbell *et al.* 1990 b).

Tufted Puffins abandoned nesting on Langara Island, presumably due to rat predation (Rodway *et al.* 1994). Rats may also have restricted the population on St. James Island (Rodway *et al.* 1990). The colony on Kunghit Island is relatively inaccessible to humans so it is not known whether rats are having an impact on its nesting birds. Some of the Skidegate Haida elders interviewed by Ellis (1991) noted that the population was greatly reduced by the oil spill of 1925, especially around Hippa Island. On SGaang Gwaii, the nesting population declined from ~60 pairs to ~20 pairs between 1977 and 1986 (Rodway *et al.* 1990) and the Tuft Islets colony was abandoned (Rodway *et al.* 1988).

Tufted Puffins are seen in Haida Gwaii waters from April through November. During spring they are common in Queen Charlotte Sound, the west coast and southern Hecate Strait near their breeding colonies. Approximately 900 were counted near the Kerouards in June 1986 and 300 to 400 were noted during the breeding season near Lyman Point, Marble Island and Cape St. James (Campbell *et al.* 1990 b). They are rarely seen in the rest of Hecate Strait or Dixon Entrance. The highest numbers are found near the continental shelf edge. During the summer, birds tend to be found further offshore than in the spring. After the breeding season, Tufted Puffins move southwest and sightings in fall usually involve <10 individuals. They are not encountered in CBCs.

Marine Waterfowl

"… sea ducks … are the most poorly understood group of waterfowl. Basic natural history information is lacking for some species, and there are few reliable population indices or estimates of annual survival for most of the

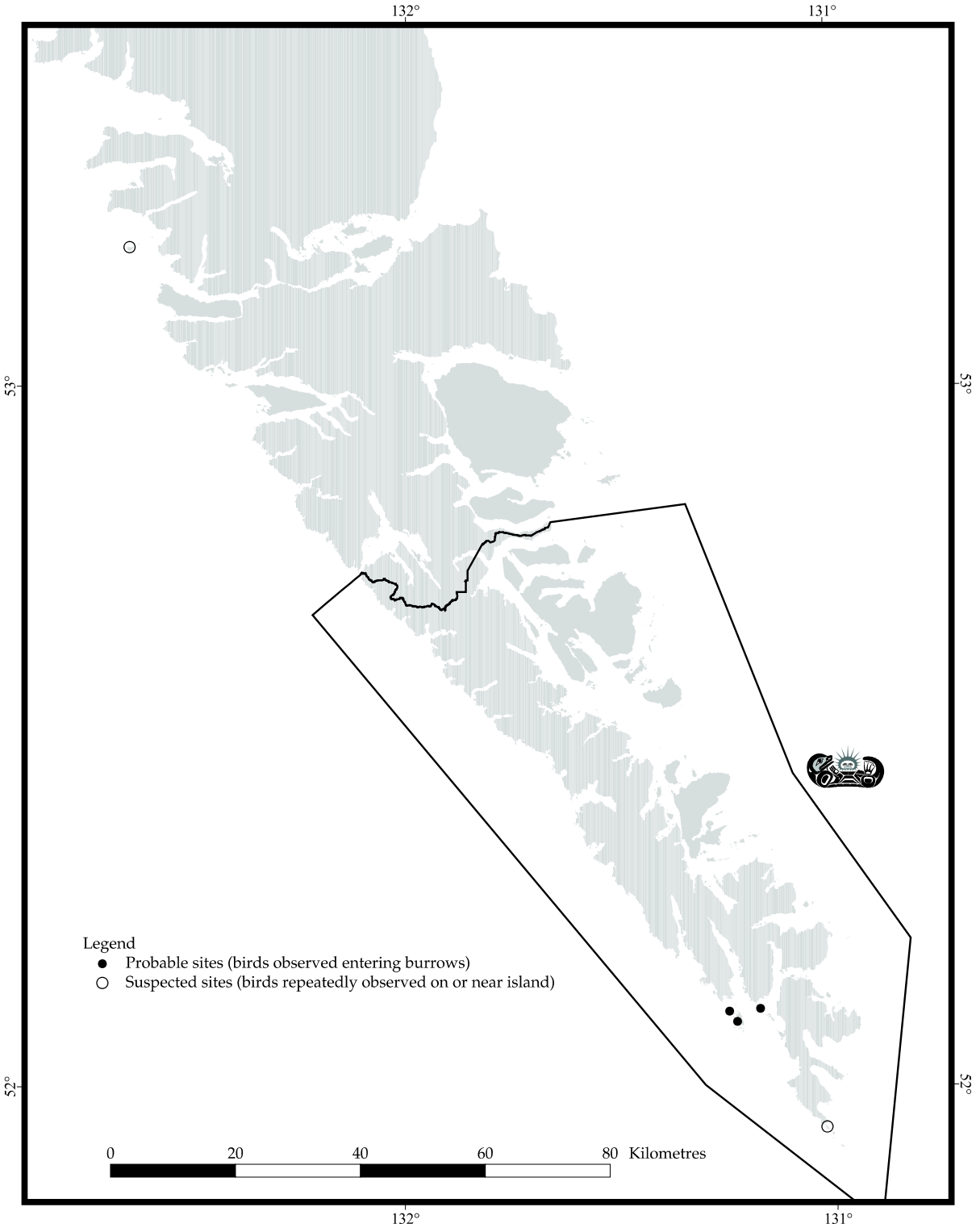

Figure 17. Locations of probable and suspected breeding colonies of Horned Puffins in Haida Gwaii (data from Rodway *et al.* 1990, 1994; Butler 2000).

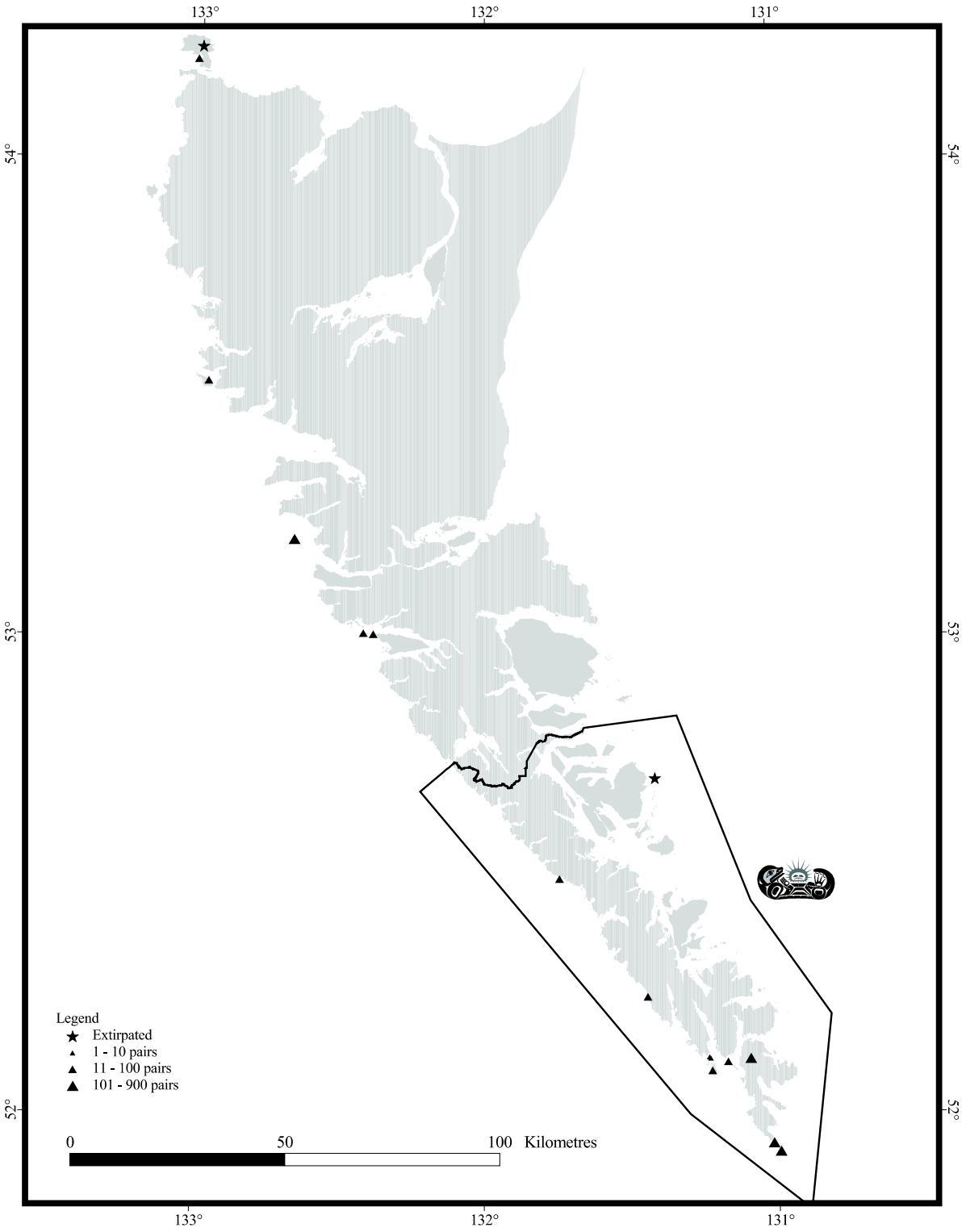

Figure 18. Locations and relative sizes of breeding colonies of Tufted Puffins in Haida Gwaii (data from Rodway *et al.* 1988, 1990, 1994).

species. However, the information we do have tells us this: most of the populations are in trouble – some in severe trouble." [SDJV Management Board 1999]

Marine waterfowl include loons, grebes, Brant and sea ducks. Eight species of marine waterfowl from three families breed on Haida Gwaii as follows:

- 2 loons (Red-throated Loon, Common Loon);
- 1 grebe (Pied-billed Grebe); and
- 5 sea ducks (Harlequin Duck, Barrow's Goldeneye, Hooded Merganser, Common Merganser, Red-breasted Merganser).

Nest site locations and the at-sea distributions of these species are described in the species accounts that follow.

Most of the data on nesting sites were collected during biophysical inventories of lakes and streams conducted by Reimchen, Douglas and coworkers in Naikoon and Gwaii Haanas (Douglas and Reimchen 1988 a; Reimchen 1992 a, b, 1994 a; Reimchen *et al*. 1994). Many of the remaining water bodies have not been surveyed. Thus, the breeding distributions described below should be considered as minimums.

An additional 12 species from three families of marine waterfowl are commonly found in the marine waters of the Haida Gwaii region. The at-sea distributions of these species are described in the species accounts below. Marine waterfowl comprise a significant component of the birds found in marine waters around Haida Gwaii outside of the breeding season. For example, scoters were abundant in all surveys and accounted for 38% of the birds observed in Dixon Entrance and Hecate Strait north of Skedans from September 1977 to February 1978 (Savard 1979).

The region-wide distribution and abundance of migrating, moulting and wintering marine waterfowl are poorly described, with the exception of Brant. Broad-scale aerial surveys have rarely been repeated with sufficient regularity to account for daily, seasonal or annual variability. The best data are from Savard's (1979) fall and winter inventories of southern Dixon Entrance and northern Hecate Strait and his summer surveys of moulting sea ducks (Savard 1988). Most species of marine waterfowl inhabit relatively shallow inshore waters and are not well surveyed during boat-based pelagic surveys (Vermeer and Rankin 1984, 1985). Intensive studies have been carried out during winter and spring in a few areas of the archipelago. For example, Skidegate Inlet populations were inventoried as part of an environmental assessment of the marina development near Sandspit (Blood and Bentley 1992; Goudie and Hearne 1997; Vermeer *et al.* 1997 a). Ducks Unlimited censused the marine birds of the Kumdis Slough area (Fry 1991) and the birds of Delkatla have also been repeatedly counted (Hamel 1989). The seasonal patterns found at these three sites may not, however, reflect patterns at other locations in the archipelago.

Remington (1993 a) collated the results of waterfowl surveys conducted throughout the north coast of British Columbia (Haida Gwaii and northern mainland coast) and assessed the importance of coastal wetlands for all waterfowl species (Remington 1993 b). Eight of the top ten ranked coastal wetlands in northern British Columbia are in Haida Gwaii (Figure 19). Other marine waters known to be important to marine waterfowl in fall and winter are also shown in Figure 19 and are listed in Table 11. The caveats on pages 19 and 22 should be kept in mind when considering this figure. Marine waters in the region with high densities of Pacific herring spawn are shown in Figure 20 because many species of marine waterfowl are known to concentrate in areas of herring spawn in spring (Savard and Kaiser 1982; Vermeer *et al.* 1997 a; Breault 2002). However, our data are

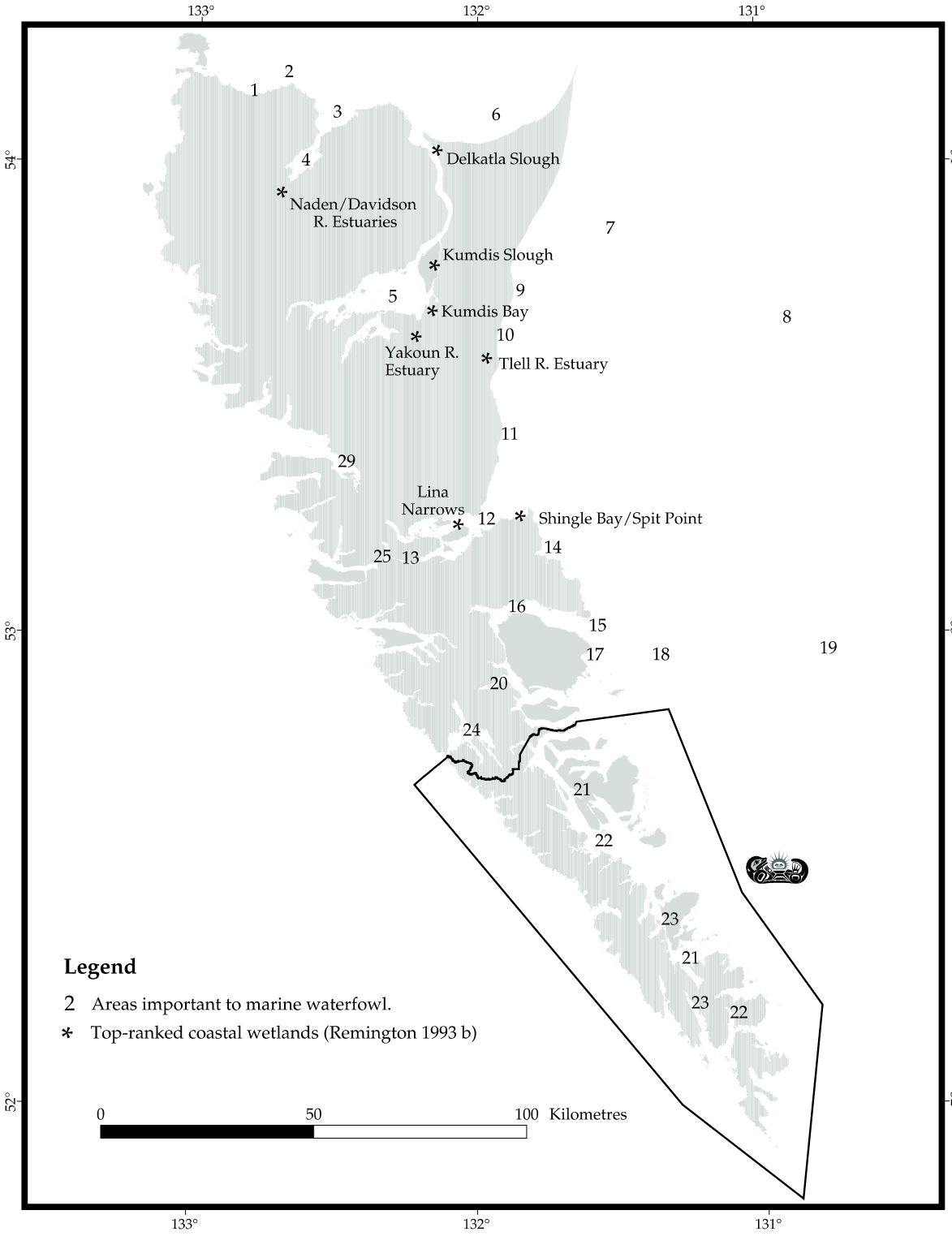

Figure 19. Coastal marine waters around Haida Gwaii known to be important to marine waterfowl in fall and winter (data from Collis 1954; Hatter 1977; Coastal Waterbird Inventory File 1980; Savard 1979; Goudie and Hearne 1993; Remington 1993 a; K. Vermeer, *unpublished data*). Table 11 lists the species associated with each area. Top-ranked coastal wetlands based on waterbird resources (Remington 1993 b) are shown. An absence of data does not indicate an absence of birds (see caveats on pp. 19 and 22).

Table 11. At-sea abundance observations of marine waterfowl in the Haida Gwaii Region in fall and winter.

No.[1]	Location	Comments on Abundant Species or Groups [2]
1	Inshore Parry Passage to Masset	Harlequin Duck (>100); Long-tailed Duck; unidentified goldeneye spp. (>100); unidentified diving ducks[3] (>1,000)
2	2 km offshore – Langara Island to Masset	Surf Scoter (>100); White-winged Scoter (>100); unidentified scoter spp. (>100)
3	Virago Sound	unidentified divers (>1,000)
4	Naden Harbour and associated estuaries including Naden and Davidson R. estuaries	Surf Scoter (>100); White-winged Scoter; unidentified scoter spp. (>100); Long-tailed Duck; Bufflehead; unidentified Goldeneye spp. (>100); unidentified merganser spp. (>100); unidentified diving ducks[3] (>1,000)
5	Masset Inlet and associated waters including Kumdis Bay and Slough, Yakoun and Mamin R. estuaries, Delkatla Slough, Masset Sound	unidentified loon spp.; Harlequin Duck; Surf Scoter (>100); Bufflehead (>100); unidentified goldeneye spp.; unidentified merganser spp.; unidentified diving ducks (>1,000)
6	McIntyre Bay to Rose Spit	Pacific Loon (>100); unidentified loon spp.; Horned Grebe (>100); White-winged Scoter; Surf Scoter (>100); Black Scoter (>100); unidentified scoter spp. (>500); Long-tailed Duck (>500); Bufflehead; Common Goldeneye; unidentified Goldeneye spp. (>1,000)
7	Dogfish Bank	unidentified scoter spp. (~2,000; primarily Surf Scoter & White-winged Scoter)
8	Hecate Strait – Tlell to Bonilla I.	unidentified loon spp.; White-winged Scoter (>100); unidentified scoter spp. (>100); Long-tailed Duck (>100)
9	Cape Ball	unidentified diving ducks[3] (>100)
10	Tlell River estuary	unidentified loon spp.; White-winged Scoter; Long-tailed Duck (>100); Bufflehead; Common Goldeneye; unidentified diving ducks[3] (>1,000)
11	Inshore Tlell to Skidegate	Unidentified Loon spp.; Western Grebe; Harlequin Duck; Surf Scoter (>100); White-winged Scoter (>100); Black Scoter; unidentified scoter spp. (>1,000); Long-tailed Duck; Bufflehead; Common Goldeneye (>1,000); unidentified goldeneye spp. (>1,000)
12	Skidegate Inlet including Shingle Bay, Spit Point, Lina Narrows, Bearskin Bay	Pacific Loon (>100); Common Loon; unidentified Loon spp. (>100); Horned Grebe; Red-necked Grebe; Western Grebe (>500); unidentified Grebe spp. (>100); Harlequin Duck (>500); Surf Scoter (>100); White-winged Scoter (>100); Black Scoter (>100); unidentified scoter spp. (>100); Long-tailed Duck; Bufflehead (>100); Common Goldeneye (>100); unidentified Goldeneye spp. (>100); Red-breasted Merganser; Common Merganser; Unidentified Merganser spp.
13	East Skidegate Narrows	Surf Scoter (>100); White-winged Scoter; Bufflehead
14	Inshore Sandspit to Cumshewa Head including Copper Bay, Shelden's Bay and Lagoon	unidentified loon spp.; Western Grebe (>100); unidentified grebe spp.; Harlequin Duck; Surf Scoter (>100); White-winged Scoter (>100); unidentified scoter spp. (>100); Bufflehead (>100); unidentified goldeneye spp. (>100); unidentified merganser spp.
15	Cumshewa Inlet	Surf Scoter; White-winged Scoter (>500); unidentified scoter spp. (>1,000)
16	McLellan I. to Aero Camp	unidentified scoter spp. (>500)
17	Skedans Bay	Surf Scoter (~900)
18	up to 30 km east of Skedans I.	unidentified scoter spp. (~4,500; primarily White-winged Scoter)
19	mid-Hecate Strait east of Skedans I.	White-winged Scoter (~4,000)
20	Sewell Inlet	Surf Scoter (>100); unidentified scoter spp. (>100); unidentified goldeneye spp.
21	Lyell Bay	unidentified Merganser spp.
22	Inlets of northern Juan Perez Sound	Pacific Loon; Red-necked Grebe
23	Burnaby Strait and associated inlets	Red-necked Grebe; Harlequin Duck
24	Inlets off Skincuttle Inlet	Horned Grebe; Red-necked Grebe; Harlequin Duck; Surf Scoter; unidentified scoter spp.
25	head of Rose Inlet	unidentified merganser spp. (>100)
26	head of Louscoone Inlet	unidentified merganser spp.
27	Tasu Sound	unidentified goldeneye spp.; unidentified merganser spp.
28	West Skidegate Narrows	Harlequin Duck; Surf Scoter (>100); Bufflehead; unidentified goldeneye spp.; Unidentified Merganser spp. (>100)
29	Shield's Bay	unidentified Merganser spp.

1 These locations are illustrated in Figure 19
2 Only counts of >1,000 noted for unidentified divers and counts of >100 noted for all other species and species groups
3 Divers include cormorants, loons & grebes; diving ducks include scaup, Harlequin Ducks, scoters, Long-tailed Ducks, Bufflehead, goldeneyes & mergansers

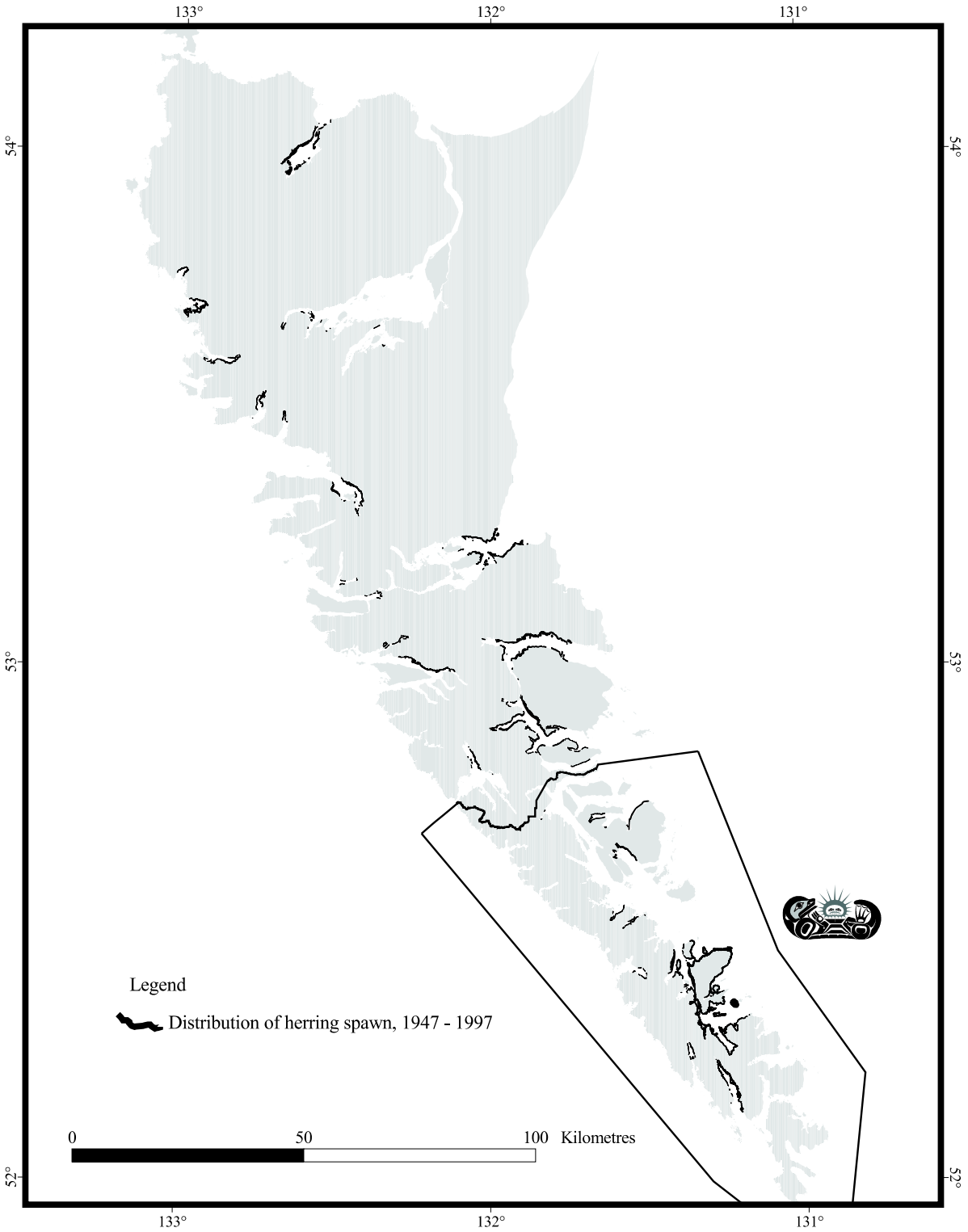

Figure 20. Distribution of combined annual Pacific herring (*Clupea pallasii*) spawn deposition in Haida Gwaii, 1947 to1997 (data courtesy of D. Hay, DFO). The bolded coastline indicates approximate linear extent and breadth of spawning areas from data overlapped from all years. Not all sections of coastline have been surveyed.

inadequate to determine whether spawn concentration is a good predictor of marine bird density in Haida Gwaii. We also show estuarine areas of salmonid-bearing streams (Figure 21) because a number of marine waterfowl species forage on out-migrating juvenile salmonids. Using mainly data from southern British Columbia, Burger *et al.* (1997) noted that waters with high juvenile salmon escapement did not consistently support high numbers of foraging marine birds, but the relationship between salmon escapement and marine bird abundance in Haida Gwaii has not been examined.

Some general patterns of marine waterfowl distribution are as follows:

- Hecate Strait serves as the passageway through which essentially the entire western Pacific populations of Pacific Loon, Common Loon, Surf Scoter, White-winged Scoter and Long-tailed Duck pass in spring (Kaiser 2002);
- Pacific Herring spawn is an extremely important factor influencing the distribution of birds in spring (Savard and Kaiser 1982; Vermeer *et al.* 1997 a) – Savard and Kaiser (1982) reported "*a spectacular concentration of fish-eating birds*" including unusually high numbers of Pacific and Common Loons, Harlequin Duck, Surf Scoter, Common Goldeneye; Long-tailed Duck and Red-breasted Merganser at a site with swarming herring;
- many species gather in estuaries during salmon runs – Reimchen (1992 c) attributed their presence to the abundance of prey associated with salmon carcasses;
- most species prefer sheltered marine waters to more open waters (Savard 1979; Campbell *et al.* 1990 a);
- birds are more abundant along sandy shorelines than rocky shorelines during fall and winter (Savard 1979);
- densities are higher (particularly of loons, scoters and Long-tailed Ducks) in the open waters of Hecate Strait than those of Dixon Entrance during fall and winter (Savard 1979); and
- all inlets and bays support large winter populations of birds (Savard 1979).

Given the extreme intra- and inter-annual variability in counts, it is unlikely that available data are sufficient to detect significant changes for most species of marine waterfowl in the region. Cooper (1993) pointed out that many species that were historically found as migrants in the Delkatla area will likely return with the restoration of tidal flow and fish populations following the breaching of the causeway in 1995. He noted that Red-throated Loon, Common Loon, Horned Grebe, Red-necked Grebe, Western Grebe, scoter species and Red-breasted Merganser were historically considered common visitors but did not occur during his studies in years when the causeway was in place.

Distributional information on birds at sea in this section is from Volume I of *The Birds of British Columbia* (Campbell *et al.* 1990 a) unless otherwise noted.

Loons

Loons nest nearby freshwater habitats such as lakes, ponds or marshes where they lay two eggs. All species winter primarily in sheltered and shallow marine coastal waters; densities are generally higher in waters <100 m depth. Red-throated and Common Loons may also winter on freshwater. All species are exclusively or primarily piscivorous.

Red-throated Loon

Red-throated Loon nests have been found on small lakes on Graham, Moresby and Langara Islands (Figure 22). On the 184 lakes surveyed by Douglas and Reimchen (1988 a), 34 breeding pairs were found. Recorded densities were 0.23, 0.007 and 0.005 pairs per km^2 in the Queen Charlotte Lowlands, Skidegate Plateau and Queen

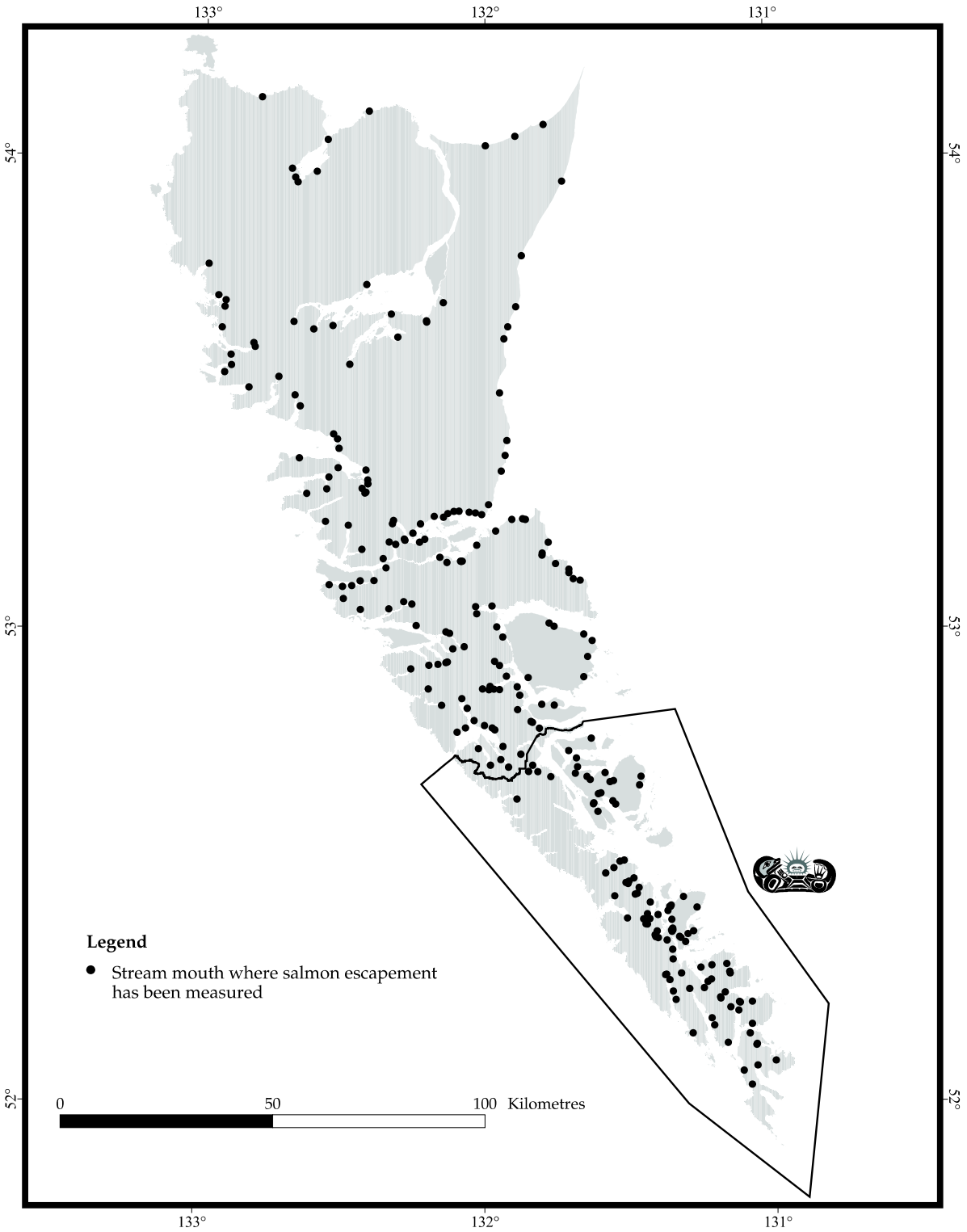

Figure 21. The streams of Haida Gwaii from which salmonid (*Oncorhynchus* spp.) Escapement has been recorded, 1947 to 1999 (data courtesy of B. Spencer, DFO).

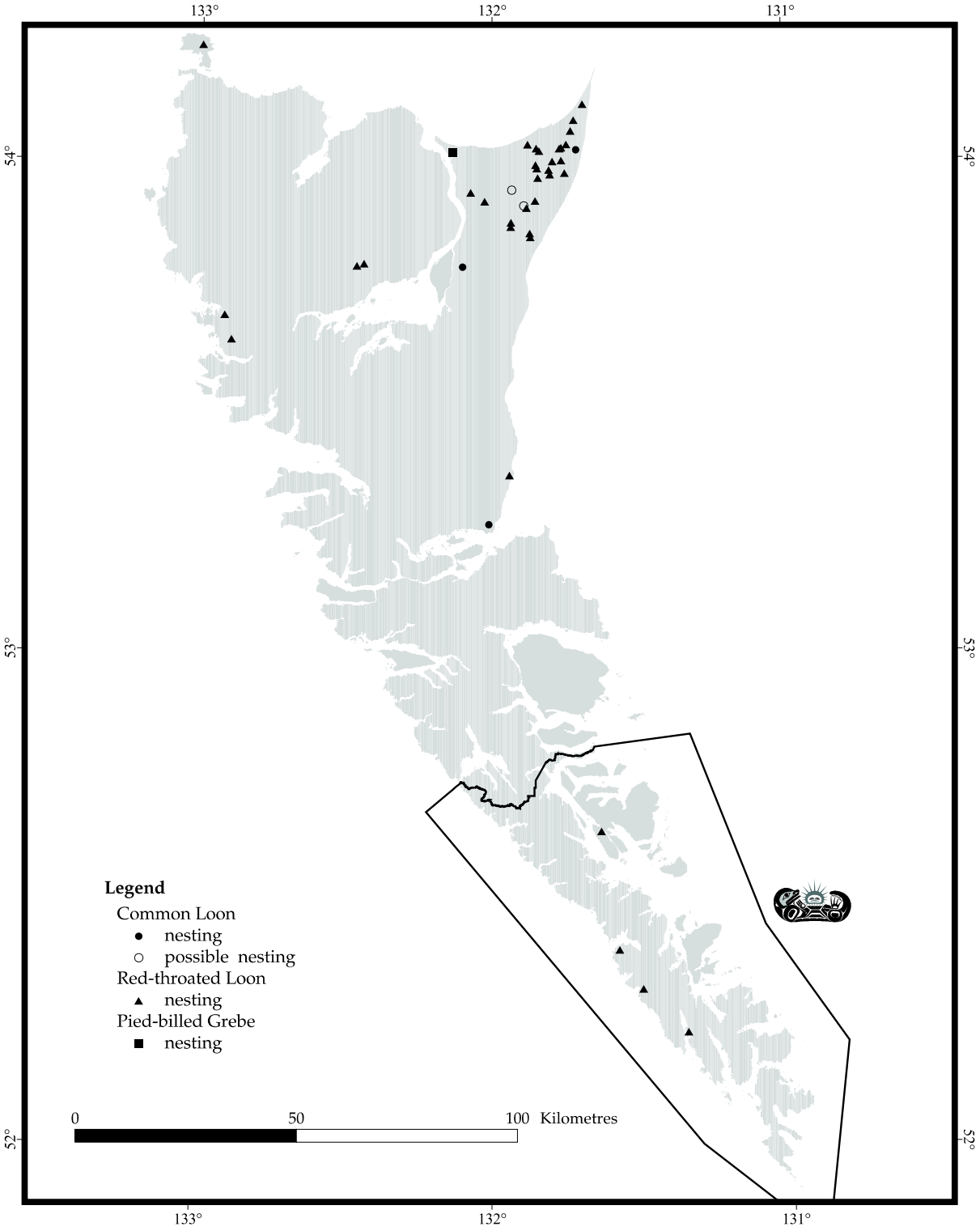

Figure 22. Locations of nesting sites of loon and grebe species in Haida Gwaii (data from Reimchen and Douglas 1980; Douglas and Reimchen 1988 a; Ellis 1991; Reimchen 1992 a, b, 1994 a; A. Harfenist, *unpublished data)*. Not all areas of the archipelago have been surveyed an absence of data does not indicate an absence of birds.

Charlotte Ranges, respectively. Extrapolating from those density figures, Douglas and Reimchen (1988 a) estimated that between 784 and 892 pairs of Red-throated Loons nest on the archipelago. In Naikoon Provincial Park, 25% of lakes >0.5 ha supported a nesting pair (Reimchen 1992 b). The birds are territorial and smaller lakes support only single pairs (Douglas and Reimchen 1988 a). Nest sites are reused: a site at Drizzle Lake was used for 10 consecutive years (Reimchen 1992 b).

Red-throated Loons are found in the coastal waters of Haida Gwaii in all seasons, but most leave the area to winter further south. Although they nest associated with freshwater, the birds forage primarily in marine waters during the breeding season. In fall and winter, birds were observed only as individuals or in groups of two by Savard (1979). Loons (not identified to species) were more abundant in inlets than on the open ocean and were found along both rocky and sandy shorelines (Savard 1979). Low numbers of Red-throated Loons are usually recorded during CBCs.

Both breeding and non-breeding Red-throated Loons may be found on inland lakes in Haida Gwaii (Reimchen and Douglas 1980; Douglas and Reimchen 1988 a). They have been observed on lakes in Naikoon Park from late March through September, usually as overnighting pairs returning from day-time marine foraging (Reimchen 1992 b). Thirty were observed on Lumme Lake. On Drizzle Lake, numbers of mainly non-breeders increased throughout April then remained relatively constant until mid-August (Reimchen and Douglas 1980). Birds were occasionally seen foraging in freshwater (Reimchen and Douglas 1984 b). In Gwaii Haanas, concentrations of non-breeders were regularly seen over night on Lower Victoria Lake (Reimchen 1992 a).

Trend data are not available for Red-throated Loons in Haida Gwaii. In Alaska, Groves *et al*. (1996) reported that populations of summering Red-throated Loons declined by 53% between 1977 and 1993. Population trends are not apparent from Canadian CBC data.

The ecology of Red-throated Loons on the archipelago is described in Reimchen and Douglas (1980, 1984 a, b, 1985) and Douglas and Reimchen (1988 b).

Pacific Loon

Pacific and Arctic Loons were considered a single species until 1985 (AOU 1985) and surveys conducted prior to that date usually refer to Arctic Loons.

Pacific Loons occur in all seasons in the marine waters around Haida Gwaii, mainly during migration (Vermeer and Rankin 1984). They are usually found in deeper waters and in larger aggregations than the other loon species. The highest numbers recorded during pelagic surveys by Vermeer and Rankin (1984) were in Hecate Strait and Queen Charlotte Sound in spring. During spring migration, Pacific Loons are often seen associated with Pacific herring spawn and in flocks numbering in the thousands. For example, ~1,700 were observed feeding on spawn at Lawn Point in March 1981 (Savard and Kaiser 1982). Gaston and Jones (1991) observed a steady northward migration past Reef Island and noted a peak in numbers in May.

Flocks of non-breeders seen in the summer tend to be smaller than those observed in spring and usually number < 50. They are widely distributed along the coast of Haida Gwaii. Savard (1988) counted 119 birds from Tow Hill to the east side of Virago Sound in July 1980. Numbers along the north and east coasts of Graham Island increased from September to October and then remained stable through February in 1977 to 1978 (Savard 1979). Although the loons were not all identified to species during these aerial surveys, concurrent

ground surveys found that ~80% were Pacific Loons (Savard 1979). The birds were feeding in groups of up to 30 birds. They were more abundant in inlets than on the open ocean and were found along both rocky and sandy shorelines (Savard 1979). Pacific Loons also congregate in estuaries during salmonid migrations (Reimchen 1992 c).

Marine areas of Haida Gwaii known to be important to Pacific Loons in fall and winter are shown in Figure 19 and listed in Table 11. These birds are often the most abundant loon species noted during CBCs. The highest count was 274 in the 1999 Rose Spit CBC. The maximum count during the winter of 1991-1992 in Skidegate Inlet was130 (Blood and Bentley 1992).

Trend data are not available for Pacific Loons in Haida Gwaii.

Common Loon

Common Loons nest on freshwater lakes in north and east Graham Island (Reimchen and Douglas 1980; Douglas and Reimchen 1988 a). According to Haida Elders, this species also used to nest on a small lake behind Skidegate Village (Ellis 1991). Common Loons are primarily confined to lakes >4 ha, probably because they require a larger surface area during take-off than do Red-throated Loons (Reimchen 1992 b). Reimchen (1992 a) found no evidence of nesting during inventories of Gwaii Haanas' lakes and streams. The few known nest sites are shown in Figure 22. Although there is no population estimate for the species in Haida Gwaii, it is clear that they are less common than Red-throated Loons.

Common Loons have been recorded in the marine waters around Haida Gwaii in all seasons, but rarely off the west coast. The highest numbers seen during pelagic surveys were inshore in Hecate Strait and Queen Charlotte Sound during spring (Vermeer and Rankin 1984). During spring migration, they are often associated with Pacific herring spawn: concentrations have been observed in areas of herring spawn in Skidegate Inlet (Vermeer *et al.* 1997 a) and >600 were noted at a spawn site off Lawn Point in March 1981 (Savard and Kaiser 1982)

In summer, small numbers of Common Loons are widely distributed along the inshore waters of the region (Savard 1988; Campbell *et al.* 1990 a; Reimchen 1992 b). A second peak in abundance occurs during fall migration (Vermeer and Rankin 1984) before numbers drop off again in the winter. In fall and winter, loons (not identified to species) were more abundant in inlets than on the open ocean and were found along both rocky and sandy shorelines (Savard 1979). Marine areas of Haida Gwaii known to be important to Common Loons in fall and winter are shown in Figure 19 and listed in Table 11. Winter flocks are usually < 20 birds. Skidegate Inlet CBCs record between 30 to 60 Common Loons in most years.

Common Loons were often observed on lakes in Naikoon Park, but not on lakes in Gwaii Haanas (Reimchen 1992 a, b). On larger lakes such as Mayer and Spence, morning counts ranged between 50 and 100 birds. In a year-round study of Drizzle Lake, numbers were low in April and May then increased rapidly in June to a peak in late July before declining sharply in August, and birds were irregularly seen until November (Reimchen and Douglas 1984 b). They moved between the ocean and lake, and were primarily day residents of the lake where they were often seen foraging.

Trend data are not available for Common Loons in Haida Gwaii. Breeding Bird Survey data indicate a significant increase in Common Loons in British Columbia and across North America from 1966 to 2000 (BBS website: http://www.mbr-pwrc.usgs.gov/bbs/bbs00.html).

The ecology of Common Loons on the archipelago is described in Reimchen and Douglas (1980, 1984 b).

Yellow-billed Loon

Small numbers of Yellow-billed Loons occur year-round in inshore Haida Gwaii waters. They are usually seen alone or in very small groups. An unusually large group of seven was observed east of Cumshewa Head. Single individuals are occasionally recorded during CBCs. The non-breeding range of this species has gradually extended southward in the Pacific over the last half century and has increased in British Columbia marine waters during that time.

Grebes

Grebes nest on lakes, ponds and freshwater marshes with emergent vegetation. Clutch sizes of two to six eggs vary between species. Horned, Red-necked and Western Grebes winter primarily in inshore coastal marine waters. Pied-billed and Eared Grebes winter on freshwater and are rare in Haida Gwaii (Table 9). The diet of grebes is comprised mainly of small fishes and crustaceans.

Pied-billed Grebe

One Pied-billed Grebe brood was found in Delkatla in 1992 (Figure 22; Hearne *unpublished data* cited in Cooper 1993). Pied-billed Grebes have been recorded year-round in Haida Gwaii, but are considered rare here (Table 9). They prefer freshwater, but may be found on sheltered marine waters.

Breeding Bird Survey data from British Columbia during 1966 to 2000 indicate a decline in Pied-billed Grebes (BBS website: http://www.mbr-pwrc.usgs.gov/bbs/bbs00.html), but the trend is not significant.

Horned Grebe

Horned Grebes are primarily seen in inshore waters around the archipelago during migration and winter, but may also be found offshore during migration. Noteworthy records during spring migration include 52 in Kagan Bay and 33 near Tow Hill. In summer, the birds move to the mainland interior to nest. During fall and winter, grebes (not identified to species) are observed along both sandy and rocky shorelines (Savard 1979). Horned Grebes are usually found alone or in pairs during these seasons (Savard 1979). In 1982, 60 were counted at Rose Spit during fall migration. Marine areas of Haida Gwaii known to be important to this species in fall and winter are shown in Figure 19 and listed in Table 11. Between 40 to 95 are counted in most years during the Skidegate Inlet CBC and moderate numbers are usually observed during the Masset count.

Trend estimates are not available for the Haida Gwaii population of Horned Grebe. Breeding Bird Survey data from British Columbia during 1966 to 2000 indicate a decline in Horned Grebes (BBS website: http://www.mbr-pwrc.usgs.gov/bbs/bbs00.html). The trend is not significant.

Red-necked Grebe

Red-necked Grebes are widely distributed in inshore marine waters year-round in Haida Gwaii. Savard and Kaiser (1982) found them most numerous in inlets during spring. Numbers decrease during the breeding season as the birds move to the mainland interior to nest. Hamel and Hearne (2001) considered the species as rare from mid-June through mid-August.

In Dixon Entrance and northern Hecate Strait, grebes (not identified to species) increase from September to October; numbers then remain relatively stable through February (Savard 1979). Red-

necked Grebes are often found in flocks composed of >100 birds during fall migration and winter. They are found along both sandy and rocky shorelines (Savard 1979). Marine areas of Haida Gwaii known to be important to Red-necked Grebes in fall and winter are shown in Figure 19 and listed in Table 11. Between 35 and 180 have been counted in most years during the Skidegate Inlet CBC.

Single birds were observed on lakes in Naikoon from September through May (Reimchen 1992 b). Numbers on the larger lakes gradually increased from February to May. Small numbers were commonly observed foraging on Drizzle Lake (Reimchen and Douglas 1984 b).

Trend estimates are not available for Red-necked Grebes in Haida Gwaii. Breeding Bird Survey data from British Columbia during 1966 to 2000 indicate a non-significant increase in Red-necked Grebes (BBS website: http://www.mbr-pwrc.usgs.gov/bbs/bbs00.html).

Western Grebe

Large flocks of Western Grebes are common in the sheltered waters around the archipelago from fall through spring. During spring migration, this species tends to be concentrate in areas of Pacific herring spawn along the coast, but a strong association with spawn was not found in Skidegate Inlet in spring 1991 (Vermeer *et al*. 1997 a). Large spring flocks numbering in the hundreds have been recorded in the inlets of eastern Moresby Island as well as in Skidegate and Masset Inlets and Naden Harbour (Savard 1979; Campbell *et al.* 1990 a; Gaston and Jones 1991; A. Harfenist, *unpublished observation*). The birds are rarely seen in Haida Gwaii during the breeding season (Hamel and Hearne 2001) as they move to the mainland to nest.

Western Grebes are the most abundant grebe in the region during fall and winter, but Savard (1979) suggested that their conspicuousness may bias surveys. Grebe (not identified to species) abundance in Dixon Entrance and northern Hecate Strait increased from September to October, then stabilized through January (Savard 1979). Western Grebes were often observed in groups of 10 to 50 and were more abundant in inlets than along exposed shorelines. A flock of 700 in Skidegate Inlet in February 1978 was the largest aggregation recorded by Savard (1979) who also noted large flocks in the inlets off eastern Moresby Island in winter. Marine areas of Haida Gwaii known to be important to this species in fall and winter are shown in Figure 19 and listed in Table 11. Several hundred birds are counted during most years during the Skidegate Inlet CBC, with a high of 2,724 in 1993. Skidegate Inlet is the only site in northern British Columbia with significant CBC counts (Burger 1997 b); Masset and Port Clements counts are usually <10.

Trend estimates are not available for the Haida Gwaii population of Western Grebes. An increase in the British Columbia population is indicated by (BBS) data during 1966 to 2000, but the trend is not significant (BBS website: http://www.mbr-pwrc.usgs.gov/bbs/bbs00.html). Burger (1997 b) examined CBC data for Western Grebes in British Columbia and tentatively concluded that there was no evidence of an increase or decline in the wintering population.

Brant

Brant are often called “sea geese” as they are associated with marine waters year-round. In North America, they nest along the coasts of Alaska and the western Canadian Arctic. Their main food around Haida Gwaii is eelgrass (*Zostera marina*), but sea lettuce (*Ulva lactuca)* is also eaten (Vermeer *et al.* 1991 b; Goudie and Hearne 1997). The ecology of Brant on Haida Gwaii is covered in Brant Working Group ([BWG];

1992 a, b) and Goudie and Hearne (1997) and eelgrass ecology is discussed in Harrison (1993).

Brant are abundant along the Haida Gwaii foreshore in the winter and during spring migration, but rare in the summer and fall migration. Use of coastal waters during spring migration is more extensive than that in winter. Brant found in eastern Haida Gwaii represent one of three main known spring concentrations of the world population (BWG 1992 a) and Shingle Bay is the most important staging area in northern British Columbia to northward migrating birds (Vermeer *et al.* 1991 b). Goudie and Hearne (1997) used data from banded birds to calculate that ~3,000 to 4,000 Brant stop over in Skidegate Inlet during spring migration. They estimated that >7,000 stage throughout the coastal waters of the archipelago during this time. The average length of stay in Shingle Bay was approximately seven days, but many birds stayed just one day (Goudie and Hearne 1997). Numbers peak in mid-April through early May and peak later on northern Graham Island than in Skidegate Inlet (Vermeer *et al.* 1991 b; BWG 1992 a). The largest count recorded in Masset Inlet was 7,000 in May 1992 (Goudie and Hearne 1997). Spring records at Rose Spit often exceeded 1,000 birds and were as high as 5,197 in May 1979. There are pre-1990 records of large aggregations of Brant in spring from Cumshewa Inlet, Naden Harbour and from Parry Passage to Tow Hill (Darcus 1927; Ellis 1991; Reminton 1993 a). Brant have been observed associated with Pacific herring spawn in Skidegate Inlet and Vermeer *et al.* (1997 a) suggested that spawn may comprise a significant portion of the diet in spring.

According to Skidegate Elders, Brant used to be common during fall migration around Sandspit and Cumshewa (Ellis 1991). Small flocks also used to be common in Masset Inlet in October (BWG 1992 a). At present, few stage in the archipelago during fall.

Haida Gwaii supports the largest known wintering population of Brant in Canada (BWG 1992 a). Areas of Haida Gwaii known to be important for Brant in winter are shown in Figure 23 and the associated distribution data are listed in Table 12. In the early 1990s, ~600 to 700 birds wintered in the area (Blood and Bentley 1992; Goudie and Hearne 1997). Throughout the 1990s, the winter population has fluctuated widely from more than 500 in 1997-1998 to <100 in 1998-1999 (K. Hagmeier *unpublished data* cited on Environment Canada's Ecosystem Information website: http://www.ecoinfo.ec.gc.ca/env_ind/region/brantgeese/). The main concentrations of Brant are found in Skidegate Inlet where the maximum counts in Shingle Bay averaged ~600 during the winters of 1991-1992 and 1992-1993 (Blood and Bentley 1992; Goudie and Hearne 1997). Goudie and Hearne (1993) found that numbers in Skidegate Inlet increased through February and March when migrants from the south joined the wintering population, and ~7,000 Brant were counted in March. Repeated

Table 12. Distribution of Brant during winter (December to March) in the Haida Gwaii region.

No.[1]	Location	Historical[2] or Recent Record
1	Parry Passage to Tow Hill	historical
2	Naden Harbour	historical
3	Masset Inlet (including Masset Sound, Kumdis Slough and Bay, Yakoun and Mamin estuaries)	recent, historical
4	Juskatla Inlet	historical
5	Mayer Lake	historical
6	Marie Lake	historical
7	Tlell to Skidegate	historical
8	Skidegate Inlet (including east end of Skidegate Narrows)	recent, historical
9	Sandspit area	recent, historical
10	McCoy Cove	recent, historical
11	Cumshewa Inlet	recent
12	Crescent Inlet	historical
13	Mitchell Inlet	recent
14	Peel Inlet	recent
15	West end of Skidegate Narrows	recent

1 These locations are illustrated in Figure 23
2 historical = observations made before 1990

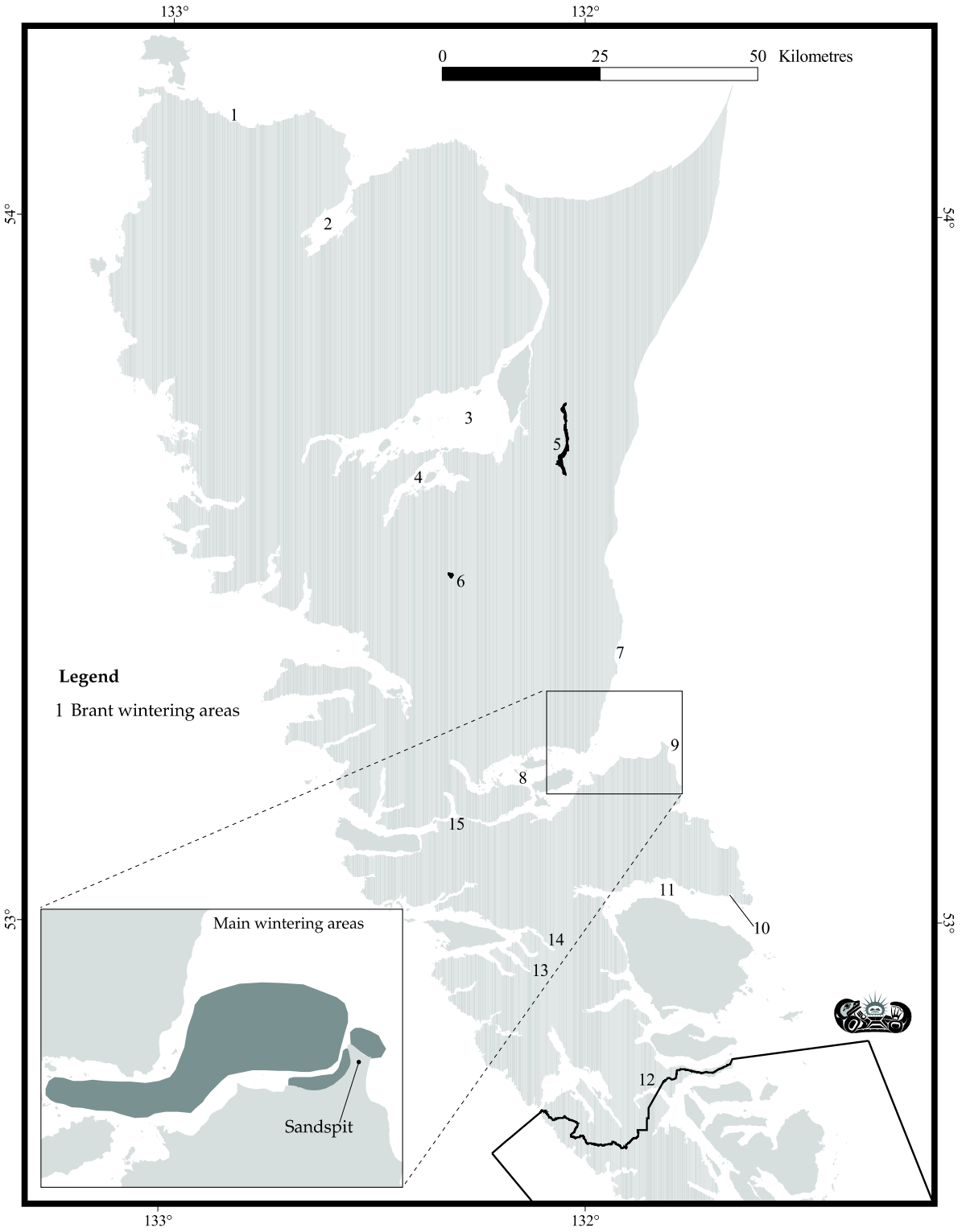

Figure 23. Coastal marine waters around Haida Gwaii known to be important to Brant in winter (December to March; data from Campbell *et al.* 1990 a; Ellis 1991; Blood and Bentley 1992; Remington 1993 a; Goudie and Hearne 1997). The inset of the Sandspit area shows the main current winter distribution. Table 12 lists each area as a historical or recent wintering site.

sightings of banded birds suggests that many of the same individuals are present throughout the winter (Blood and Bentley 1992). Up to 50 Brant winter in Cumshewa Inlet and Masset Inlet supports 40 to 50 birds (Blood and Bentley 1992). Observations of Brant between Langara Island and Tow Hill have primarily occurred in late March and may have involved early spring migrants rather than wintering birds (Blood and Bentley 1992). Very few Brant winter around Gwaii Haanas or on the west coast.

The wintering population is mainly associated with eelgrass meadows in Shingle Bay (Blood and Bentley 1992, Goudie and Hearne 1997). Brant were specifically associated with those eelgrass beds growing at higher than usual levels on the foreshore, possibly because the birds can feed for longer periods of time during high winter tides at these sites (ESL 1991). Between 40 and 100 birds, primarily juveniles, foraged at nearby Sandspit airport in winter 1991-1992 (Blood and Bentley 1992).

Brant are infrequently observed on interior lakes in Haida Gwaii. Totals of 180 and four were recorded on Marie and Mayer Lakes, respectively, in the winter of 1991-1992 (Blood and Bentley 1992).

The winter population of Brant in British Columbia has declined "*drastically*" over the last century (Campbell *et al.* 1990 a). The Pacific Flyway wintering population has declined >30% since the 1960s (Ward *et al.* 1997). Haida Gwaii supported almost 900 wintering Brant in 1965 (*unpublished data* cited in Blood and Bentley 1992), but numbers dropped to ~600 to 700 by 1992 (Blood and Bentley 1992). In the 1960s, several hundred Brant wintered in the Masset Inlet area (including Masset Sound, Kumdis Slough, Juskatla Inlet and associated estuaries) whereas 40 to 50 birds wintered in the same area in the early 1990s (Blood and Bentley 1992). Although counts in Skidegate Inlet have increased since the 1950s (Goudie and Hearne 1997), numbers remain lower than in historical times according to Haida Elders (Ellis 1991). Possible explanations for the decline offered by the Brant Working Group include loss of eelgrass foraging habitat, hunting and disturbance (BWG 1992 a). Brant hunting has been closed on Haida Gwaii since 1987 (Goudie and Hearne 1997).

Sea Ducks

Sea ducks spend most of the year in marine habitats and move inland to nest and rear their young near wetland or open water habitats. Harlequin Ducks nest on the ground along the edges of fast-flowing rivers or streams. Scoters also nest on the ground, in a variety of freshwater habitats. Goldeneye, Bufflehead and Hooded Mergansers nest in tree cavities near freshwater. Common and Red-breasted Mergansers nest associated with either fresh or salt water, the former in either cavities or on the ground and the latter only on the ground. Moulting habitats are not known for all species and may differ between males and females or adults and juveniles of the same species (Goudie *et al.* 1994). All species winter in coastal marine habitats. Diets consist primarily of small fish and aquatic invertebrates.

Haida Gwaii supports relatively large populations of migrating and wintering sea ducks (Savard 1979, 1988; Campbell *et al.* 1990 a). Many thousand are found off the east coast of the archipelago and in Skidegate Inlet in the spring – the waters south of Alder Island were identified as an area of special note for staging Harlequin Ducks and other sea ducks by Burger *et al.* (1997). Three species, Harlequin Duck, Surf Scoter and White-winged Scoter, moult in significant numbers in the region (Savard 1988). Figure 24 shows areas of coastal marine aggregations of moulting sea ducks and Table 13 lists the species associated

with each area (see caveats on pp. 19 and 22). Marine areas known to be important to sea ducks in fall and winter are shown in Figure 19 and listed in Table 11. Small numbers winter in many of the protected inlets and bays around the archipelago (Hatter 1977; Coastal Waterbird Inventory File 1980).

The Sea Duck Joint Venture (SDJV) was developed to promote the conservation of North American sea ducks. Limited available evidence suggests that populations of 10 of 15 species of sea duck in North America are in decline (SDJV Management Board 1999). Breault (2002) noted that there was no assessment of size or trends for any of the sea duck populations wintering along the British Columbia coast. In the absence of finer-scale data, trend information is presented below for Pacific coast or western populations of sea ducks. The SDJV website [SDJV; http://seaduckjv.org] includes life history and population status summaries for each species, as well as links to recent sea duck research.

Harlequin Duck

Two nesting sites have been recorded locally for Harlequin Ducks (Figure 25), Kwaikans Island (Rodway 1988) and Moresby Lake (Breault and Savard 1991). There is evidence from other parts of the species' range that the birds return annually to the same breeding area (Breault and Savard 1991). No evidence of nesting Harlequin Ducks was found during inventories of lakes and streams in Gwaii Haanas and Naikoon (Reimchen 1992 a, b, 1994 a; Reimchen *et al.* 1994).

Harlequin Ducks are present in local marine waters year-round and are abundant from fall through spring (Hamel and Hearne 2001). During spring and summer, this species is abundant along the north and east coasts of Haida Gwaii (Savard and Kaiser 1982; Breault and Savard 1991). Spring concentrations have been observed associated with Pacific herring spawn in Skidegate Inlet, Rooney Bay and near Lawn Point (Savard and Kaiser 1982; Vermeer *et al.* 1991 b, 1997 a). During surveys off the east coast of Moresby Island in May 1992, Butler (2000) found 64 of 69 Harlequin in estuaries. Gaston (A. Gaston, CWS, *personal communication*) noted that groups of 5 to 20 birds are common among the islets throughout Laskeek Bay and the east coast of Gwaii Haanas all summer.

Harlequin Ducks tend to use traditional moulting and wintering sites (Breault and Savard 1999). They moult in July and August, usually in groups of 20 to 200 along rocky shorelines (Figure 24, Table 13; Savard 1988). This species is abundant from September through February 1977-1978 along exposed rocky shorelines of Dixon Entrance and Hecate Strait: > 100 were counted from Parry Passage to Masset Harbour in September during the late 1970s (Savard 1979; Breault and Savard 1991; Goudie and Hearne 1993). Northern Haida Gwaii is considered a major wintering area for the species (Figure 19, Table 11). Harlequins were the most abundant sea duck observed in Skidegate Inlet in winter 1991-1992 comprising 6% of all birds (Blood and Bentley 1992). Figure 19 shows marine waters known to be important to Harlequins in fall and winter; the areas are listed in Table 11.

There is no reliable index of population size or trend for the western population of Harlequin Ducks (SDJV Management Board 1999). The eastern population is listed as "*endangered*" by COSEWIC.

Surf Scoter

Surf Scoters are common year-round throughout the inshore marine waters of Haida Gwaii. In spring, the birds concentrate at areas with Pacific herring spawn. Aggregations of up to several

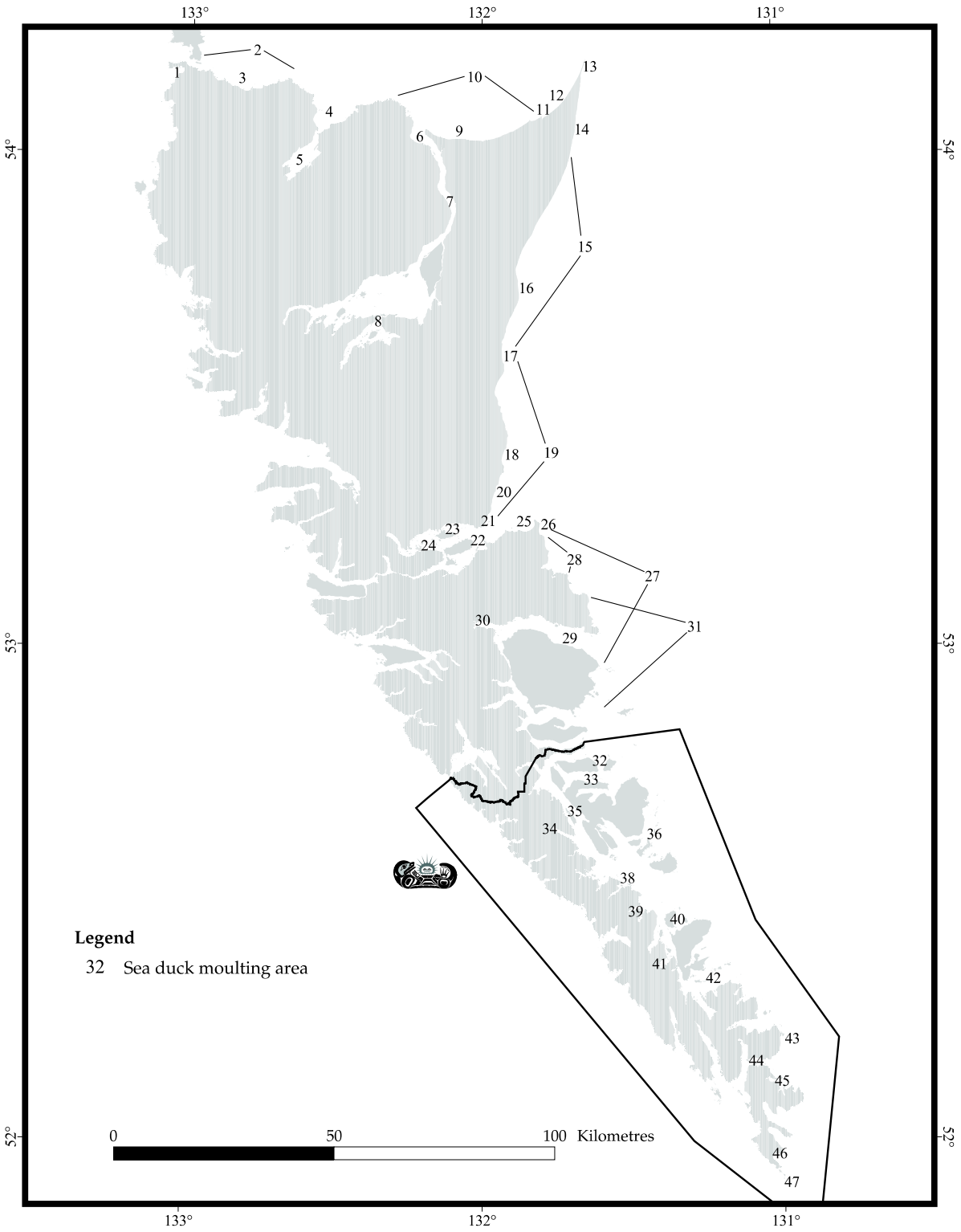

Figure 24. Coastal marine waters around Haida Gwaii with concentrations of moulting sea ducks in July and August (data from Coastal Waterbird Inventory File 1980; Savard 1988; Lawrence and Backhouse 1991; Remington 1993 a; D. Burles, *personal communication;* A. Harfenist, *unpublished data*). Table 13 lists the species associated with each area. Only records of >5 individuals/species are included. An absence of data does not indicate and absence of birds (see caveats on pp. 19 and 22).

Table 13. Distribution of moulting sea duck concentrations in the Haida Gwaii Region in July and August. Only sites with >5 individuals/species are shown.

No.[1]	Location[2]	Birds[3]
1	Lepas Bay	White-winged Scoter; unidentified scoter spp.
2	Langara I. to 7 mile (~ 5 km offshore)	Surf Scoter; White-winged Scoter; unidentified scoter spp.
3	Cape Knox to west of Virago Sound	White-winged Scoter; unidentified scoter spp. (107); Common Merganser
4	Virago Sound	Surf Scoter; Surf Scoter; White-winged Scoter (329); Harlequin Duck; unidentified scoter spp.
5	Naden Harbour	Surf Scoter; White-winged Scoter; unidentified scoter spp.
6	Masset Harbour	Harlequin Duck
7	Masset Sound	Surf Scoter
8	Ohala Islets	Surf Scoter; White-winged Scoter
9	Virago Sound (nearshore) to Tow Hill	Harlequin Duck (156); Surf Scoter; White-winged Scoter (202); unidentified scoter spp.
10	7 mile to Tow Hill (8-13 km offshore)	Surf Scoter; White-winged Scoter (698); unidentified scoter spp.
11	Tow Hill	White-winged Scoter (1,000)
12	west of Rose Spit to Tow Hill (nearshore)	Surf Scoter; White-winged Scoter; unidentified scoter spp.
13	Rose Spit	Surf Scoter (1,000); White-winged Scoter (200)
14	East Beach (off Kumara L.)	White-winged Scoter (155)
15	Cape Fife to Tlell	Surf Scoter; White-winged Scoter
16	Cape Ball	Surf Scoter; White-winged Scoter (240)
17	Tlell	White-winged Scoter (140); Common Merganser
18	Halibut Bight to Lawn Point	Harlequin Duck; White-winged Scoter
19	Skidegate to Tlell	White-winged Scoter
20	Skidegate to Lawn Point	Surf Scoter; White-winged Scoter (112); Harlequin Duck; Black Scoter; unidentified scoter spp.
21	Skidegate	White-winged Scoter
22	Skidegate Inlet (Alliford Bay to Skidegate)	Surf Scoter; White-winged Scoter (312); unidentified scoter spp. (423)
23	Queen Charlotte Sity area (Gooden I. To Kagan Bay)	Harlequin Duck; Surf Scoter (>600); White-winged Scoter (>300); unidentified scoter spp. (>200)
24	western Skidegate Inlet	Harlequin Duck; Surf Scoter (1,400); White-winged Scoter; unidentified scoter spp.
25	Gillatt Island to Sandspit	Harlequin Duck; Surf Scoter (100); White-winged Scoter (>100); Black Scoter
26	Sandspit	Surf Scoter; White-winged Scoter (200)
27	Skedans to Sandspit	White-winged Scoter
28	Dogfish Bay to Cape Chroustcheff	Surf Scoter; White-winged Scoter (108); unidentified scoter spp.
29	Cumshewa Inlet	White-winged Scoter; Harlequin Duck
30	Davey Islets	White-winged Scoter (100)
31	south of Louise I. to Gray Pt.	White-winged Scoter (155)
32	Klue Passage	Harlequin Duck
33	Kul Rocks	Harlequin Duck
34	Head of Bigsby Inlet	Harlequin Duck
35	Shuttle Passage	Harlequin Duck
36	Windy Bay to Ramsay I. To Bischof Is.	Harlequin Duck
37	Head of De la Beche Inlet	Harlequin Duck
38	Marco I. and Marco Rock	Harlequin Duck
39	Head of Matheson Inlet	Harlequin Duck
40	Kat Rock (N. of Kat I.) To Alder I.	Harlequin Duck
41	Head of Island Bay	Harlequin Duck
42	Skincuttle Inlet and associated waters	Harlequin Duck; White-winged Scoter; unidentified Scoter spp.; Common Merganser
43	off Benjamin Pt.	unidentified scoter spp.
44	Houston Stewart Channel	Harlequin Duck
45	Heater Harbour to High I.	Common Merganser
46	Woodruff Bay	White-winged Scoter
47	Cape St. James (south of)	Surf Scoter

1 These locations are illustrated in Figure 24
2 Some locations are particular sites, while others are segments of shoreline or offshore areas
3 Only counts >100 individuals are noted

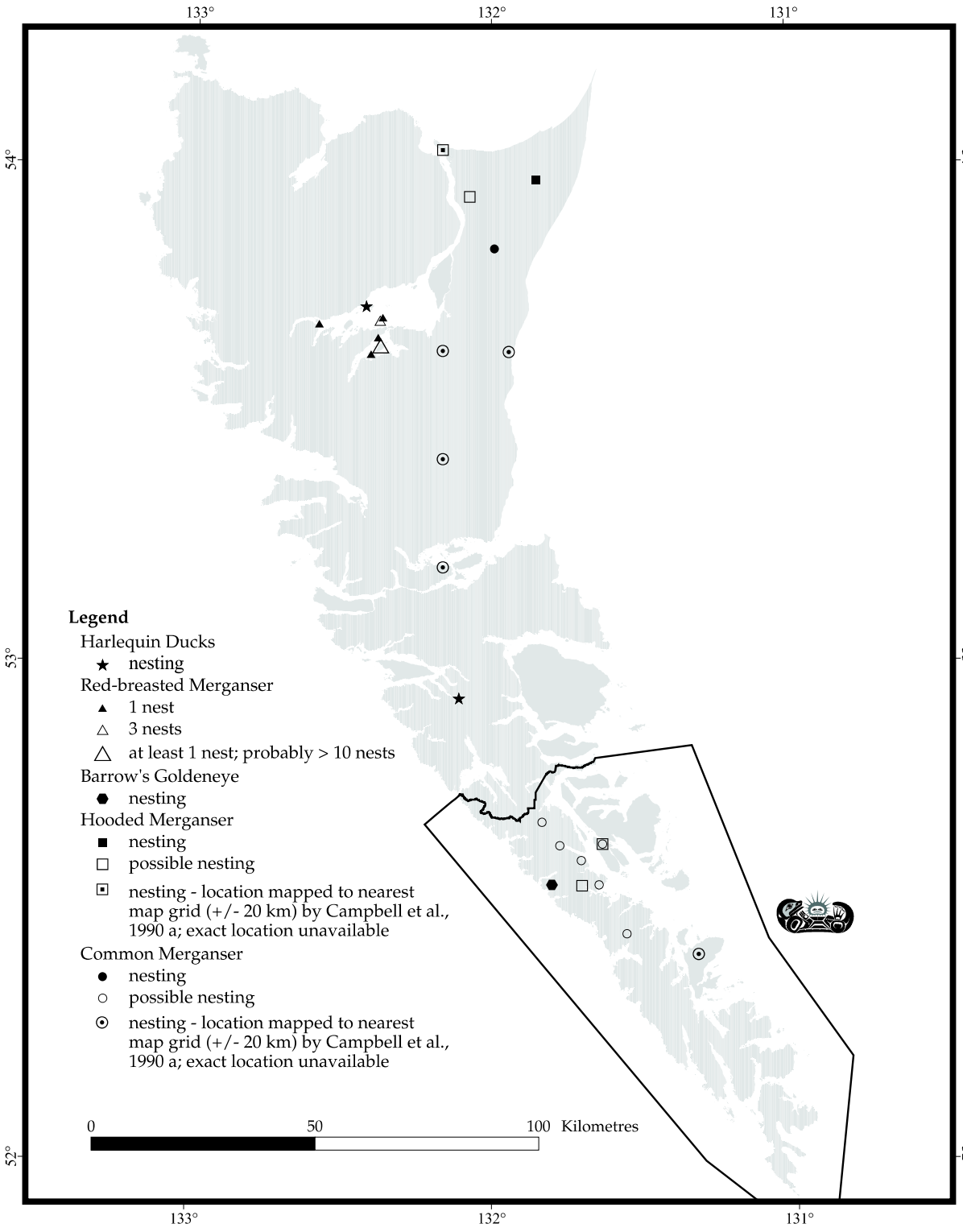

Figure 25. Locations of nesting sites of sea ducks in Haida Gwaii (data from Reimchen and Douglas 1980; Rodway 1988; Campbell *et al.* 1990 a; Breault and Savard 1991; Reimchen 1992 a, b, 1994 a; Cooper 1993). Not all areas of the archipelago have been surveyed - an absence of data does not indicate an absence of birds.

thousand have been recorded at spawn sites in Rooney Bay, Skidegate Inlet and off Lawn Point and major spring aggregations have also been reported at McIntyre and Shingle Bays (Savard and Kaiser 1982; Vermeer *et al.* 1991 b, 1997 a; Goudie and Hearne 1993).

In late summer, Surf Scoters moult in flocks numbering between 100 to 5,000 (Savard 1988). More than 2,000 Surf Scoters were counted during aerial surveys for moulting sea ducks in July and August: > 500 birds at Rose Spit and flocks of up to 400 birds in Skidegate Inlet in1980 and 1986 (Savard 1988). The locations of these and other moulting sites are listed in Table 13 and shown in Figure 24. Surf Scoters commonly occurred along rocky, cobble or sandy shores during moult, but not over muddy substrates (Savard 1988).

Habitats used by Surf Scoters during fall and winter are similar to those used during moult (Savard 1979; Goudie *et al.* 1994). Although scoters are more common in inlets than in more open waters during these seasons, Savard (1979) noted that they were among the few sea duck species that occurred in significant numbers in open marine waters during fall and winter. Reimchen (1992 c) reported that scoters were numerous near Bag Harbour during salmon migration. Following aerial surveys, Savard (1979) concluded that the Haida Gwaii region includes two of three known major wintering concentrations of scoters in northern British Columbia (Figure 19, Table 11). Although the scoters were not identified to species during the aerial surveys, Savard (1979) suggested that Surf Scoters were approximately half as numerous as White-winged Scoters, and Black Scoters were relatively rare.

Although quantitative data on Surf Scoter population size and trends are few, it appears that numbers breeding in western Canada and possibly Alaska are declining (SDJV Management Board 1999).

White-winged Scoter

White-winged Scoters are the most abundant sea duck in the marine waters around Haida Gwaii and are widely distributed (Vermeer and Rankin 1984, 1985; Savard 1979, 1988). They made up >50% of the sea ducks counted during boat surveys in Dixon Entrance, Hecate Strait and Queen Charlotte Sound (Vermeer and Rankin 1984, 1985).

In spring, White-winged Scoters are abundant along the north and east coasts of the archipelago. Thousands occur over the shallow water all down the east coast of Moresby between Sandspit and Skedans (A. Gaston, CWS, *personal communication)* and >5,000 were counted off Cumshewa Head in March 1976 (Campbell *et al.* 1990 a).

In late summer, moulting birds occur in flocks of >500 and were the most abundant moulting sea duck in the archipelago in 1980 (Figure 24, Table 13; Savard 1988). Over 2,000 were counted during aerial surveys in July and August. White-winged Scoters are found primarily along sandy shores during moult, although they also frequent rocky shores, but none were found over muddy substrate (Savard 1988).

White-winged Scoters are abundant during fall and winter as well. They are among the few sea duck species that occur in significant numbers in open marine waters during these seasons, but are most common in inlets (Savard 1979). They were numerous near Bag Harbour during salmon migration (Reimchen 1992 c). Savard (1979) reported that the wintering concentrations near Skedans and Rose Spit represented two of three known major wintering concentrations of scoters in northern British Columbia (Figure 19, Table 11). Although the scoters were not identified to species during his surveys, Savard (1979) suggested that White-winged Scoters were approximately twice as common as Surf Scoters, and Black Scoters were relatively

rare. White-winged Scoters are the most abundant scoter in most years during CBCs.

White-winged Scoters also occur on freshwater in Haida Gwaii. Reimchen and Douglas (1984 b) observed birds commuting daily between Drizzle Lake and the ocean.

Few quantitative data are available on White-winged Scoter population size and trends, but numbers breeding in western Canada and possibly Alaska may be declining (SDJV Management Board 1999). According to Skidegate Haida Elders, the birds were more numerous in previous times; the Elders speculated that the population has been depleted by oil spills (Ellis 1991). Hundreds of moulting birds with elevated body burdens of cadmium died in southeast Alaska in the early 1990s, but the cause of death was not determined (Rosenberg and Petrula 1998).

Black Scoter

The Black Scoter is the least common scoter in marine waters around Haida Gwaii. They are associated with Pacific herring spawn in spring and concentrations have been reported from spawn areas in Skidegate Inlet and Rooney Bay (Vermeer *et al*. 1991 b, 1997 a). Savard and Kaiser (1982) noted a large aggregation of 687 Black Scoters ~10 km off Tlell in May, 1979. In Shingle Bay in 1992-1993, numbers increased from ~ 500-600 in winter to 1,262 in April before dropping to 233 in May (Goudie and Hearne 1993). Black Scoters are rarely seen along the coast during the breeding season.

Savard (1988) reported a few small flocks of Black Scoters during moulting sea duck surveys in July to August (Figure 24, Table 13). In Shingle Bay, numbers increased from 97 in December, 1992 to ~500-600 in January through March, 1993 (Goudie and Hearne 1993). The birds are recorded in most years in CBCs. A high count (at Masset) was 394 in 1983. Marine areas known to be important to the species in winter are shown in Figure 19 and listed in Table 11. Black Scoters winter mostly in marine coastal waters of <10 m over rocky substrates (Goudie *et al.* 1994).

Few quantitative data are available on Black Scoter population size and trends, but numbers breeding in western Alaska are probably declining (SDJV Management Board 1999).

Long-tailed Duck (formerly named Oldsquaw)

Long-tailed Ducks are commonly seen in moderate numbers during spring and fall migration and in winter, but rarely in summer in the Haida Gwaii region (Campbell *et al.* 1990 a, Hamel and Hearne 2001). In spring they are widespread; birds are found both inshore and offshore, but are more common offshore (Savard and Kaiser 1982). They are usually found in flocks of <50 except when aggregated at sites of Pacific herring spawn. Hundreds were recorded associated with spawn in Skidegate Inlet and just off Lawn Point (Savard and Kaiser 1982; Vermeer *et al*. 1997 a) and Gaston (A. Gaston, CWS, *personal communication)* noted that hundreds are always present off the coast of Moresby Island from Sandpit to Cumshewa during March-April. A springtime high of 741 was recorded in McIntyre Bay in 1978.

Moulting and migration habitats are poorly known (Goudie *et al*. 1994). Only one Long-tailed Duck was recorded from Savard's (1988) moulting sea duck surveys in July and August in the region. He suggested that the birds may have been missed because his survey did not cover the deeper open waters that the species tends to frequent. Long-tailed Ducks are late fall migrants and did not arrive in Dixon Entrance and Hecate Strait until November (Savard 1979). The north coast of Haida Gwaii is considered a major wintering area

for the species (Figure 19, Table 11). Numbers in Dixon Entrance and Hecate Strait fluctuated widely from November through February, probably indicating significant winter movements within the region (Savard 1979). A high winter count was of 20,380 flying east off Rose Spit over a 75 min period during December 1987. This species was the only sea duck that was more abundant in open water than in inlets in fall and winter.

Long-tailed Ducks also use freshwater habitats and moderate numbers have been recorded from Drizzle Lake. The birds were often seen foraging on the lake (Reimchen and Douglas 1984 b).

Breeding Bird Surveys indicate a 5.3% annual rate of decline from 1973 to1997, but much of the nesting area in Canada and Alaska is not covered in the survey (SDJV Management Board 1999). The SDJV Management Board (1999) concluded that there was insufficient information to assess population size or trends.

Bufflehead

Bufflehead are common in sheltered Haida Gwaii marine waters during spring and fall migration and winter, but rare in the summer. The birds are usually found in flocks of < 10. In spring, birds concentrate where Pacific herring spawn (Campbell *et al.* 1990 a, Vermeer *et al*. 1997 a). Spring records include 155 at Kumdis Island in 1977. During the breeding season, most bufflehead move away from the marine environment and into the British Columbia interior to nest.

Moulting habitats are poorly described for this species (Goudie *et al*. 1994). Females and subadults moult on interior lakes, but the moulting habitats of males are unknown. Bufflehead returned to the Haida Gwaii region in a single wave by November in Dixon Entrance and Hecate Strait and numbers remained stable throughout the winter (Figure 19, Table 11; Savard 1979). At Shingle Bay, numbers peaked in January before declining (Goudie and Hearne 1993). This species has been observed in all years at all locations of the CBC and the Skidegate Inlet and Masset counts are usually >100, with a high count of 532 in Skidegate Inlet in 1992. Bufflehead prefer to winter in waters <5 m in depth (Goudie *et al.* 1994) and along protected rocky shorelines (Savard 1979).

Moderate numbers of Bufflehead occur on freshwater at Drizzle Lake. They were commonly seen foraging at the lake (Reimchen and Douglas 1984 b).

In British Columbia, breeding populations of Bufflehead may be in decline (Breault 2002). Populations in Alaska and the prairie parklands also appear to be declining. Breeding and wintering populations of Bufflehead have been surveyed at a few sites in the interior of British Columbia, but the results have not been extrapolated to the species' full range (SDJV Management Board 1999).

Common Goldeneye

Common Goldeneye are common in protected marine waters around Haida Gwaii during spring and fall migration and winter, but rare in the summer. In spring, they concentrate at Pacific herring spawning sites (Campbell *et al.* 1990 a; Vermeer *et al*. 1997 a): 368 were observed feeding on spawn off Lawn Point in 1981 (Savard and Kaiser 1982). In summer, most birds move into the British Columbia interior to nest.

Moulting habitats are poorly known (Goudie *et al.* 1994). Males may moult in marine waters whereas females and subadults moult on interior lakes. In Dixon Entrance and Hecate Strait, a major influx of goldeneye, predominantly Common Goldeneye occurs in mid-November (Savard 1979). At Shingle Bay, fall numbers

increased through December before peaking in January at 646; counts remained in the low 500s in February and March before declining again (Goudie and Hearne 1993). The northern coast of Haida Gwaii is considered a principal wintering area for this species (Figure 19, Table 11). Common Goldeneye tend to winter in protected waters <5 m in depth (Goudie *et al*. 1994), but showed no preference for rocky or sandy shorelines (Savard 1979). Numbers recorded on CBCs are usually >100 in Skidegate Inlet, but <50 at Masset and Port Clements.

In British Columbia, breeding populations of Common Goldeneye may be in decline (Breault 2002). Population sizes and flyway trends are unknown (SDJV Management Board 1999).

Barrow's Goldeneye

Barrow's Goldeneye nest near freshwater throughout the interior of British Columbia and, less frequently, on the coast. Evidence of nesting was found on one lake during inventories of freshwater habitats in Gwaii Haanas and Naikoon (Figure 25; Reimchen 1992 a, b, 1994 a; Reimchen *et al*. 1994).

Barrow's Goldeneye are common in protected Haida Gwaii marine waters during spring and fall migration and in winter, but rare in summer. Along the coast, they are often found near sources of freshwater and in areas with extensive mussel beds. In spring, they tend to concentrate where Pacific herring spawn (Campbell *et al.* 1990 a, Vermeer *et al.* 1997 a). Spring records include 144 birds in Juskatla Inlet in 1977. Numbers along the coast decline in summer as the birds move into the British Columbia interior to nest.

Moulting habitats are poorly known. Goudie *et al.* (1994) suggested that females and subadults moult on interior lakes, but male moulting sites are not known. Barrow's Goldeneye were included in a major influx of goldeneye noted by Savard (1979) in mid-November in Dixon Entrance and Hecate Strait, although the birds were predominantly Common Goldeneye. The archipelago is a significant wintering area. In CBCs, Barrow's Goldeneye are recorded most often at Port Clements where 1 to138 have been observed, but rarely at Masset.

In British Columbia, breeding populations of Barrow's Goldeneye may be in decline (Breault 2002). The status of the western population of Barrow's Goldeneye is considered uncertain (SDJV Management Board 1999). Surveys of breeding and wintering birds have been conducted in some areas of the British Columbia interior, but the results have not been extrapolated to produce a population estimate.

Hooded Merganser

Hooded Merganser nests have been found along the northeast coast of Graham Island (Figure 25; Campbell *et al.* 1990 a). No evidence of nesting was found during inventories of freshwater habitats in Gwaii Haanas and Naikoon (Reimchen 1992 a, b, 1994 a; Reimchen *et al.* 1994). Total breeding population is unknown.

Small numbers of Hooded Mergansers are found year-round on shallow, protected inshore marine waters of Haida Gwaii. The majority of records are from marine waters north of Gwaii Haanas and most are during migration. Summer populations are low and the moulting habitats are unknown (Goudie *et al.* 1994). Reimchen (1992 c) reported that diving birds including mergansers were numerous near Bag Harbour during salmon migration. Noteworthy fall records include 39 in Masset and 48 in Delkatla (Hamel 1989; Campbell *et al.* 1990 a). Hooded Mergansers are seen on ~50% of the CBCs in Skidegate and Port Clements (totals usually <10) with counts from Masset slightly higher.

Hooded Mergansers are also found in freshwater habitats on Haida Gwaii. They were observed at 12 lakes in Naikoon Provincial Park during spring through fall (Reimchen 1992 b). They mainly occurred on smaller lakes and nearby streams; no aggregations were observed. From April through October, small numbers occurred at Drizzle Lake where they were often seen foraging (Reimchen and Douglas 1984 b).

No reliable information on population size or trends is available (SDJV Management Board 1999).

Common Merganser

Common Mergansers nest along the shores of lakes and rivers on both Graham and Moresby Islands (Figure 25). Cannings (1975) often observed females with young on the rivers in Naikoon Provincial Park and Gaston (A. Gaston, CWS, *personal communication)* noted that several broods are present each July on the Tlell River. Their nests are more widely distributed throughout the archipelago than those of other species of sea duck.

Common Mergansers are commonly seen in sheltered estuaries and bays of Haida Gwaii throughout the year. The birds are often found in brackish water without aquatic vegetation. They tend to aggregate in areas with Pacific herring spawn in spring. Spring records include 23 at Kumdis Island and 47 at Tlell. Their moulting habitats are unknown (Goudie *et al.* 1994). Savard (1979) noted that relatively few mergansers (Common and Red-breasted were not distinguishable during the surveys) were observed from September through November, followed by an influx of the birds in December. However, mergansers were numerous at Bag Harbour during salmon runs (Reimchen 1992 c). Densities were higher in inlets and along rocky shorelines than along sandy shorelines in fall and winter (Savard 1979). Less than 50 have been reported in Skidegate Inlet and Masset CBCs. Marine waters known to be important for mergansers during fall and winter are shown in Figure 19 and listed in Table 11.

Common Mergansers are also found on freshwater in Haida Gwaii. They were common on lakes in Naikoon in spring and fall, but rare in summer (Reimchen 1992 b). In Gwaii Haanas, they were the most widely distributed bird found on lakes in summer, although they were not numerous (Reimchen 1992 a). At Drizzle Lake, birds were observed making daily trips between the ocean and lake, and were occasionally seen foraging on the lake (Reimchen and Douglas 1984 b). In fall, large flocks of sub-adults overnight on lakeshores, such as groups of up to 120 on Drizzle Lake (Reimchen and Douglas 1984 b).

Few data are available on population size or trends (SDJV Management Board 1999).

Red-breasted Merganser

Masset Inlet supports one of only two known nesting sites of Red-breasted Mergansers in British Columbia. Rodway (1988) found seven nests on islands in the inlet (Figure 25) and estimated ~20 nesting pairs.

Red-breasted Mergansers are common in Haida Gwaii during migration and winter, but uncommon in summer (Campbell *et al.* 1990 a; Hamel and Hearne 2001). They tend to be found on more open and deeper marine waters in bays and inlets than are Common Mergansers. At Shingle Bay in 1993, numbers increased during spring migration, peaking at 474 in April before declining to 254 in May (Goudie and Hearne 1993). Savard and Kaiser (1982) recorded >100 feeding on spawning Pacific herring off Lawn Point in March 1981 (Savard and Kaiser 1982).

Moulting habitats are poorly described for Red-breasted Mergansers (Goudie *et al.*

1994). Numbers in regional marine waters increase following the breeding season during a gradual fall migration. Mergansers were numerous near Bag Harbour during salmon migration (Reimchen 1992 c). According to Campbell *et al.* (1990 a), most individuals leave the archipelago for the south during winter. However, Savard (1979) found higher numbers of mergansers (Red-breasted were not distinguished from Common) in January to February than in September to November in Dixon Entrance and Hecate Strait. Red-breasted Mergansers tend to winter on coastal marine waters <10 m in depth (Goudie *et al.* 1994) and more commonly in inlets and along rocky shorelines than along sandy shorelines (Savard 1979). Christmas Bird Counts from Skidegate Inlet and Masset yielded usually <60 birds, but Blood and Bentley (1992) counted up to 123 birds in Skidegate Inlet in the winter of 1991-1992.

No reliable information on population size or trends is available. Existing population estimates are considered inaccurate because Red-breasted Mergansers nest later than other waterfowl and so are often missed during multi-species surveys (SDJV Management Board 1999).

Shorebirds

"… the evidence points consistently towards widespread declines in shorebird populations, which appear to have taken place over the past three decades." [Morrison 2001]

"The importance of smaller estuaries (e.g., Masset and Skidegate Inlets, Tlell) to migratory and wintering shorebirds has not been well documented, however, all estuarine habitats along the B.C. coast are likely part of an important network of staging sites for migratory shorebirds." [CWS 2002]

Seven species of shorebird nest on Haida Gwaii: Semipalmated Plover, Killdeer, Black Oystercatcher, Spotted Sandpiper, Least Sandpiper, Short-billed Dowitcher and Common Snipe; Greater Yellowlegs may also nest there (Hamel and Hearne 2001). Only Black Oystercatchers are abundant and widespread. This species is endemic to the northwest Pacific coast of North America.

Haida Gwaii shorelines provide important migratory stopover and/or wintering sites for many species. At least 42 species of shorebird have been sighted along the coasts (Hamel and Hearne 2001) and Red and Red-necked Phalaropes have been observed at sea (Morgan 1997). In addition to the Black Oystercatcher, mentioned above, Black Turnstone and Rock Sandpiper are endemic to the North Pacific region and significant portions of their world populations reside in British Columbia (Campbell *et al.* 1990 b; CWS 2002). Wandering Tattler and Surfbird are almost exclusively found in the North Pacific. As well, the majority of the world population of Western Sandpipers and of two subspecies, the *pacifica* subspecies of Dunlin and *caurinus* subspecies of Short-billed Dowitcher, migrate along the coast of British Columbia (Campbell *et al.* 1990 b; CWS 2002). Most of the species use a diversity of coastal habitats, but can be grouped according to their preferred habitats (CWS 2002):

- coastal lowlands including tidal flats, estuaries, grassy uplands and golf courses, airports and other human-made environments (the majority of species);
- rocky shorelines (including Black Oystercatcher, Wandering Tattler, Ruddy Turnstone, Black Turnstone, Surfbird, Rock Sandpiper); and
- open ocean (Red Phalarope, Red-necked Phalarope).

When considering distributional or abundance data on shorebirds in Haida Gwaii, it is important to realize that no broad-scale systematic survey of the

archipelago for nesting, migrating or wintering shorebirds has been conducted. In addition, there are the following considerations:

- numbers at a site often vary widely on a daily, seasonal and annual basis - at Sandspit numbers increased relative to migration, high tide, low barometric pressure and strong north winds in spring (Vermeer *et al.* 1997 b);
- coverage is poor or non-existent for most areas of the archipelago for most seasons - survey effort has been concentrated at three areas where birds congregate on extensive intertidal mudflats and/or sandflats: (Sandspit area, Masset Inlet including Delkatla Slough, and the Masset to Rose Spit shoreline);
- most species are too small to be adequately surveyed from boats or planes and are often not identified to species (Savard 1979; Remington 1993 a); and
- data on turnover rates for species at all areas are lacking.

As we are unable to calculate the total migratory or wintering populations for any of the shorebird species in the Haida Gwaii region, we provide instead a description of seasonal relative abundances, using broad imprecise categories, for regularly occurring coastal lowland species (Table 14) and rocky shoreline species (Table 15). In the absence of wide spatial coverage in the shorebird survey data, we show shoreline classifications (Figure 26) to indicate where the preferred habitats of the different groups of shorebirds are located. British Columbia and Yukon regional population estimates (CWS 2002) are given in Tables 14 and 15 as the finest-scale estimates available. Canadian, North American and global estimates are given in Morrison *et al.* (2001). The seasonal at-sea distributions of the open ocean species, Red and Red-necked Phalaropes, are described below.

The CWS regional shorebird plan (CWS 2002) lists the following areas of the Haida Gwaii region as sites of provincial importance for shorebirds: Masset Inlet (including Kumdis and Delkatla Sloughs, Yakoun River estuary), Skidegate Inlet (including Sandspit), Naden Harbour, the beaches along northeastern Graham Island (including Rose Spit), Shelden's Bay and the Tlell River estuary (Figure 26). Further, Delkatla Slough has been proposed as a potential Western Hemisphere Shorebird Reserve Network site of regional significance. In 1983, shorebird numbers peaked in Delkatla on May 3 with 3,963 shorebirds counted (Hamel 1989). Reimchen and Douglas (1984 b) noted that few shorebirds were observed at any time of year at nearby Drizzle Lake despite the proximity of the lake to the ocean and a major migration flyway.

Although the available data are insufficient to determine population trends for migratory or wintering shorebirds in the Haida Gwaii region, trends on a site-specific or provincial basis are known for some species. Significant negative trends have been reported for migrating Least and Western Sandpipers between 1991 to 1998 in coastal British Columbia (Butler and Lemon 2001). The results of limited monitoring suggest that Black-bellied Plover, Killdeer and Rock Sandpiper may be declining in British Columbia (CWS 2002). There has been a decline in the number of Rock Sandpipers recorded during CBCs (one survey per year in mid-late December) since 1983 at Skidegate, but no trend at Masset (Buchanan 1999). Donaldson *et al.* (2000) noted that ~66% of Canadian shorebird populations are in decline, but almost all of the Canadian national trends are derived from counts in central, eastern or Arctic Canada.

In addition to the reports on Haida Gwaii shorebird ecology mentioned in the sections below, there is a study of stomach contents of shorebirds migrating through Tlell in 1935 (Munro 1936).

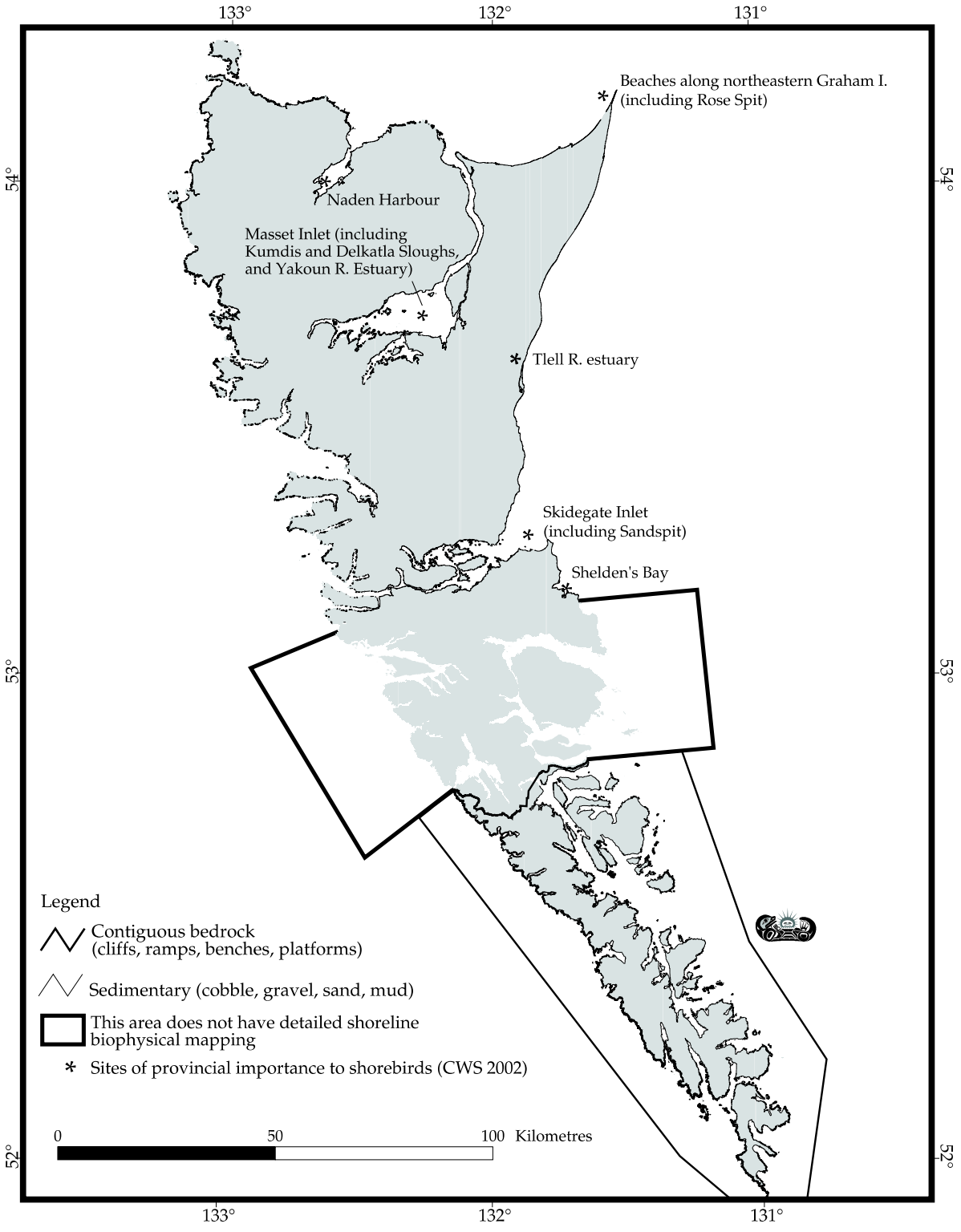

Figure 26. Coastal areas of Haida Gwaii of provincial significance to shorebirds (CWS 2002). The shoreline classification of Gwaii Haanas is based on Harper *et al.* 1994 and for northern Haida Gwaii is based on unpublished work by J.R. Harper completed in 1998 for the B.C. Land Use Coordination Office. Unlined shores of northern Haida Gwaii correspond to data gaps.

Table 14. Shorebird species that regularly occur in coastal lowland habitats of Haida Gwaii (data from Campbell *et al.* 1990 b, Hamel and Hearne 2001; Christmas Bird Counts).

Species	Species Occurrence [2]				British Columbia & Yukon Region Population Estimates[3]	Population Trends [4]	Comments[5]
	Spring Migration	June	Fall Migration	Winter			
Black-bellied Plover	H	L	M	L	5,250	NW - increase BC - possible decline NA - significant decline	314 observed at Rose Spit April 1979 Maximum count in August 1991 at Sandspit = 52
American Golden Plover	L	NR	M	L	1,000	NA - probable decline	At Sandspit in 1991 to 1992, not seen in spring migration; adults migrated in July/August and juveniles in Sept.; 35 counted at Sandspit, Aug. 1985
Pacific Golden Plover	M	NR	L	L	100	NA - stable or unknown	At Sandspit in 1991, vast majority of fall migrants were juveniles
Semipalmated Plover[1]	H	M	M	L	13,500	NA - probable decline	2100+ observed Tow Hill to Rose Spit in May 1983; at Sandspit in 1991 fall migration occurred at end of July through Aug.; primarily juveniles during second half Aug.
Killdeer[1]	M	L	M	M	20,000	BC - possible decline NA - significant decline	Spring counts include 15 and 32 at Moresby Camp in 1985 and Masset in 1977, respectively
Greater Yellowlegs?	M	L	M	L	50,000	NA - possibly declining or stable (CWS 2002), positive & negative trends reported (Donaldson *et al.* 2002)	66 counted on May 3 1983 in Delkatla
Lesser Yellowlegs	L	NR	M	NR	50,000	NA - probable decline	50 counted at Delkatla in July 1987
Spotted Sandpiper[1]	L	L	L	L	2,000+	NA - probable decline	
Whimbrel	H	L	L	NR	25,000	NA - significant decline (CWS 2002), positive & negative trends reported (Donaldson *et al.* 2000)	Most numerous species at Sandspit by early May 1992; maximum count was 265
Marbled Godwit	L	L	L	L	100	NA - possible decline	23 and 9 counted at Delkatla and Rose Spit in April 1987, respectively
Red Knot	M	L	L	NR	200	NA - significant decline	90 seen at Rose Spit in April 1979. More common in spring (maximum = 22) than fall (maximum = 2) at Sandspit 1991/92
Sanderling	H	L	H	H	51,000	NA - significant decline	Second most abundant species at Sandspit during spring migration 1992; 356 was May maximum; 1,300 and 2,000 (largest # in B.C.) seen on North Beach in spring and fall 1982, respectively; 730 on Masset CBC in 1991
Western	H	L[6]	H	NR	3,600,000-4,000,000	BC - significant decline in spring & juvenile	Most numerous shorebird on Pacific coast of North America.

Species	Species Occurrence [2]				British Columbia & Yukon Region Population Estimates[3]	Population Trends [4]	Comments [5]
	Spring Migration	June	Fall Migration	Winter			
Sandpiper						fall migrants; decline in fall adult migrants	Most abundant species at Delkatla during spring and fall migrations; 2,500 and 3,000+ counted in May and July 1983, respectively. Also most numerous migrants at Sandspit where maximum count was 1,418 in July/August 1991; adults passed through in July followed by juveniles
Least Sandpiper[1]	H	M	H	L	150,000	BC - possible decline NA - significant decline	Up to several hundred counted on tidal flats at Tlell in May 1935; 200 seen in Naden Harbour in Nov. 1974; at Sandspit, juveniles migrated through after adults
Baird's Sandpiper	L	L	L	NR	300-3,000	NA - stable or unknown	Common fall migrants at Sandspit with peak in August; maximum count = 9, all juveniles
Pectoral Sandpiper	M	NR	M	NR	5,000	NA - positive & negative trends recorded	At Sandspit in 1991 to 1992 maximum spring and fall counts were 60 and 52, respectively; juveniles were more common than adults in fall; almost all birds after July were juveniles
Dunlin	H	L	H	H	450,000-600,000	NW - decline NA - significant decline	Most abundant species during March/April 1992 at Sandspit; 3,000 seen in March 1977 at Naden Harbour; 1,200 in May 1983 at Delkatla; 1,080 in April 1983 at Yakoun estuary. Maximum count in Skidegate Inlet in winter 1991/92 was 410; 1987 CBC in Port Clements counted 1,769
Short-billed Dowitcher[1]	M	L	M	NR	30,000-150,000	NA - significant decline	33 counted on May 3 in Delkatla
Long-billed Dowitcher	M	L	M	L	100,000 - 200,000	NA - possible increase	In Delkatla, 124 and 32 counted on May 3 and July 1 1983, respectively
Common Snipe[1]	L	L	L	L	50,000-100,000	NA - significant decline	Legally hunted in Canada

1 Breeds on Haida Gwaii; Greater Yellowlegs may nest on Haida Gwaii (Hamel and Hearne 2001).

2 Species relative abundance described by broad imprecise categories: H = high (> 100 frequently recorded); M = moderate; L = low (species rarely recorded); NR = not recorded
Fall migration = July through November / Winter migration = December through February / Spring migration = March through May.

3 Estimates from CWS (2002).

4 Trend information from Paulson (1993), Donaldson *et al.*(2000), Butler and Lemon (2001), CWS (2002). Abbreviations used are: "BC" = British Columbia; "NA" = North American; "NW" = winter population of Pacific northwestern United States as indicated by Christmas Bird Count data.

5 Count data from Munro (1936), Hamel (1989), Campbell *et al.* (1990 b), Blood and Bentley (1992) and Vermeer *et al.* (1997 b). "CBC" = Christmas Bird Count.

6 Influx of birds in late June in some years probably represents beginning of fall migration.

Table 15. Shorebird species that regularly occur in rocky shoreline habitats of Haida Gwaii (data from Campbell et al. 1990 b, Hamel and Hearne 2001; Christmas Bird Counts).

Species	Species Occurrence [2]				British Columbia & Yukon Regional Population Estimate [3]	Population Trends [4]	Comments [5]
	Spring Migration	June	Fall Migration	Winter			
Black Oystercatcher[1]	H	H	H	H	3,500	BC - stable NA - stable or unknown	177 counted during 1993 CBC at Skidegate Inlet (Canadian high); 140 in 1982 Masset CBC. 150 recorded in spring at Naden Harbour
Wandering Tattler	L	L	L	L	4,500-5,000	NA - stable or unknown	29 recorded in De la Beche Inlet in September, 1976
Ruddy Turnstone	H	L	H	L	1,000	NA - probable decline	Maximum counts at Sandspit in 1991 to 1992 were 125 in spring and 133 in fall
Black Turnstone	H	L	H	H	80,000	NW - decline NA - possible decline	Second most abundant species at Sandspit during fall migration (maximum count = 267) and winter (maximum count = 90). Up to 1,000 counted at Tlell in spring 1936; 1,093 recorded during Skidegate Inlet CBC in 1995
Surfbird	L	L	L	L	70,000	NA - possible decline	150 seen in April 1920 near Masset
Rock Sandpiper	H	NR	M[6]	H	10,000	NW - decline NA - stable or unknown Skidegate Inlet - decline in winter	One of the most numerous species on tidal flats at Tlell in May 1935: up to 200 seen per day; 1992 CBC in Masset recorded 193; 1983 CBC in Skidegate recorded 161

1 Breeds on Haida Gwaii.

2 Species relative abundance described by broad imprecise categories: H = high (> 100 commonly recorded); M = moderate; L = low (species uncommon or usually ≤ 10 recorded); NR = not recorded. Fall migration = July through November / Winter migration = December through February / Spring migration = March through May.

3 Estimates from CWS (2002).

4 Trend information from Paulson (1993), Buchanan (1999), Donaldson *et al.* (2000), CWS (2002). Abbreviations used are: "BC" = British Columbia; "NA" = North American; "NW" = winter population of Pacific northwestern United States as indicated by Christmas Bird Count data.

5 Count data from Munro (1936), Hamel (1989), Campbell et al. (1990 b), Blood and Bentley (1992) and Vermeer et al. (1997 b). "CBC" = Christmas Bird Count.

6 Seen in November, are likely wintering birds.

Semipalmated Plover

Semipalmated Plovers nest on sand dunes and gravel shores, among drift logs above the high tide line or, less frequently, in gravel pits (Campbell *et al.* 1990 b; Cooper and Miller 1997). Nests are scrapes lined with vegetation, shells or stones; median clutch size is four eggs. The birds prey on sediment-dwelling invertebrates and are chiefly visual (surface-picking) rather than tactile (probing) feeders. Timing of breeding and reproductive success at Delkatla are given in Cooper and Miller (1997).

Nesting has been recorded along the sand beaches from Masset east to Rose Spit and southward to northern Moresby Island and on Solstice Lake in Naikoon Park (Figure 27; Campbell *et al.* 1990 b; Reimchen 1992 b). Concentrations are found around Sandspit and Masset and at the mouth of the Tlell River. Cooper and Miller (1997) counted ~30 pairs along a 7.5 km section of sand beach from near Masset to the Sangan River, but that density cannot necessarily be extrapolated to the rest of the range. They also found one to four pairs nesting in gravel pits near Masset. Young (1927) found 14 nests between Masset and Rose Spit and estimated that 25 to 50 pairs nested along that stretch of beach. Cooper (1993) counted one to two pairs in Delkatla but noted that the birds did not nest in all years. Vermeer *et al.* (1997 b) found four nests near Sandspit.

Killdeer

Killdeer nest on small patches of gravel and short grass or in gravel pits (Cooper and Miller 1997). Nests are shallow scrapes lined with vegetation (Campbell *et al.* 1990 b); median clutch size is four eggs (Cooper and Miller 1997). The birds pick invertebrates from the sediment surface. Timing of breeding and breeding success at Delkatla are given in Cooper and Miller (1997).

Killdeer are almost certainly more common nesters on the archipelago than is indicated in Figure 27. Most nests have been found incidental to surveys for other species of nesting shorebirds (Cooper and Miller 1997). Campbell *et al.* (1990 b) show nesting only in the Masset/Delkatla area, but it was not difficult to find a nest near Tlell (A. Harfenist, *personal observation)* or solicit information about a nest site in Port Clements (F. Doyle, *personal communication).* Five to eight nests were found annually in the Masset area between 1984 to 1988; one to three of those were in the Delkatla Slough area (Cooper and Miller 1997). Four nests, one of which flooded, were located in a 1995 resurvey of Delkatla following the causeway breaching (Cooper 1995).

Black Oystercatcher

Black Oystercatchers build nests on sandy or gravel beaches or on rocky shores. Clutch size is two to three eggs. Birds feed mostly on rocky shore invertebrates. Information on the breeding chronology, reproductive success and/or diet of birds nesting in Haida Gwaii can be found in Vermeer *et al.* (1992), Leduc (1993), Smith (1995) and Cooper and Miller (1997).

The presence and nesting of Black Oystercatchers (Figure 28) were recorded during seabird colony inventories (Rodway 1988; Rodway *et al.* 1988, 1990, 1994) and in surveys of Skidegate, Masset and Juskatla Inlets (Campbell 1975, 1977; Hatter and Stordeur 1978; Vermeer *et al.* 1992). Rodway (1991) used the former survey numbers to calculate a breeding population of 384 pairs on the islands offshore of Graham and Moresby Islands. The actual breeding population is higher because much of the coastline of Moresby and Graham and some offshore islands and islets were not censused. Furthermore, targeted surveys may find more nests. In dedicated oystercatcher surveys, Vermeer *et al.* (1992) recorded 53 pairs nesting on the islands in Skidegate Inlet, whereas Rodway

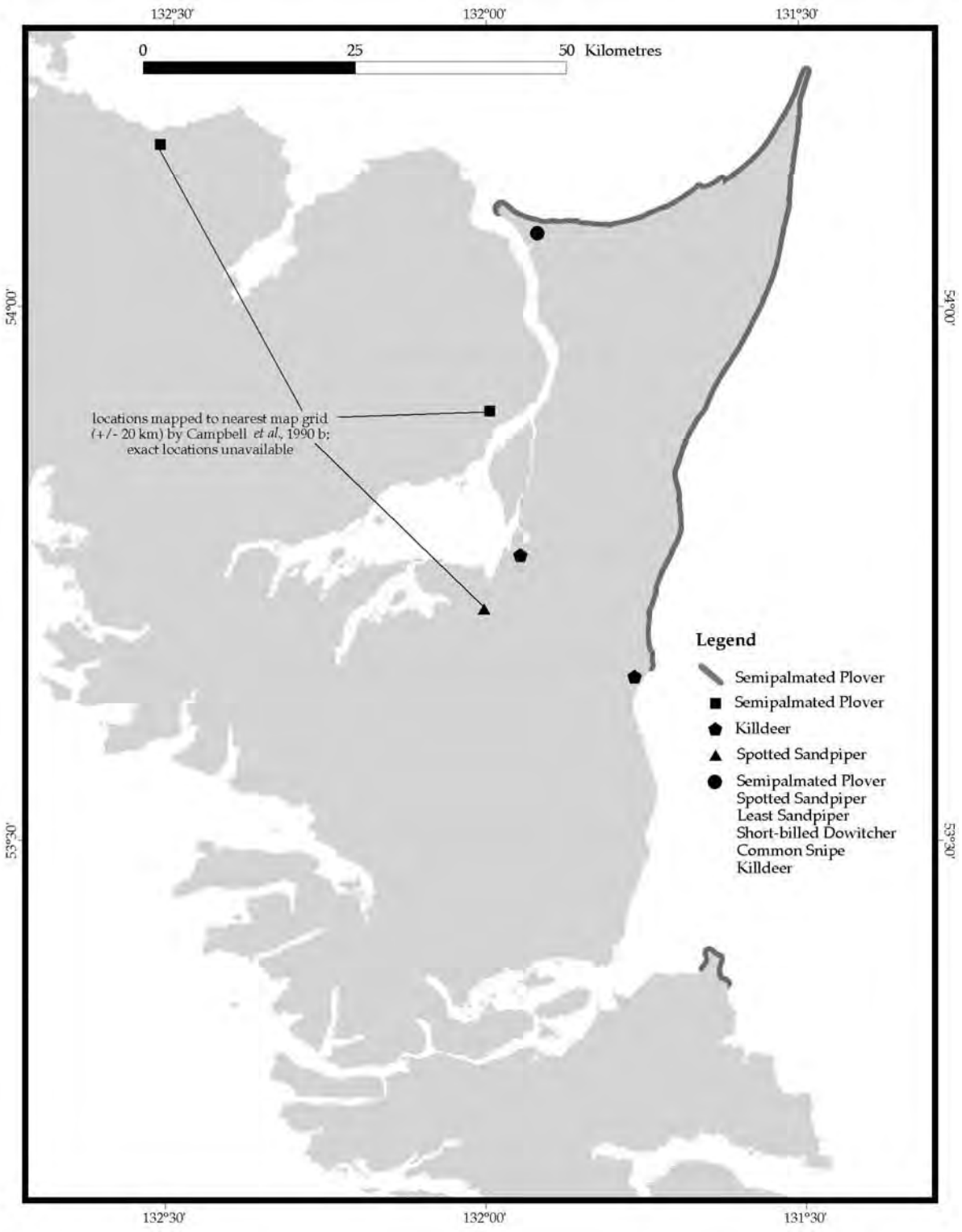

Figure 27. Distribution of nest sites of breeding shorebirds from the families Charadriidae and Scolopacidae in Haida Gwaii (data from Hamel 1989; Campbell *et al.* 1990 b; Reimchen 1992 b; Cooper and Miller 1997; F. Doyle, *unpublished data;* A. Harfenist, *unpublished data*). Not all areas of the archipelago have been surveyed - an absence of data does not indicate an absence of birds.

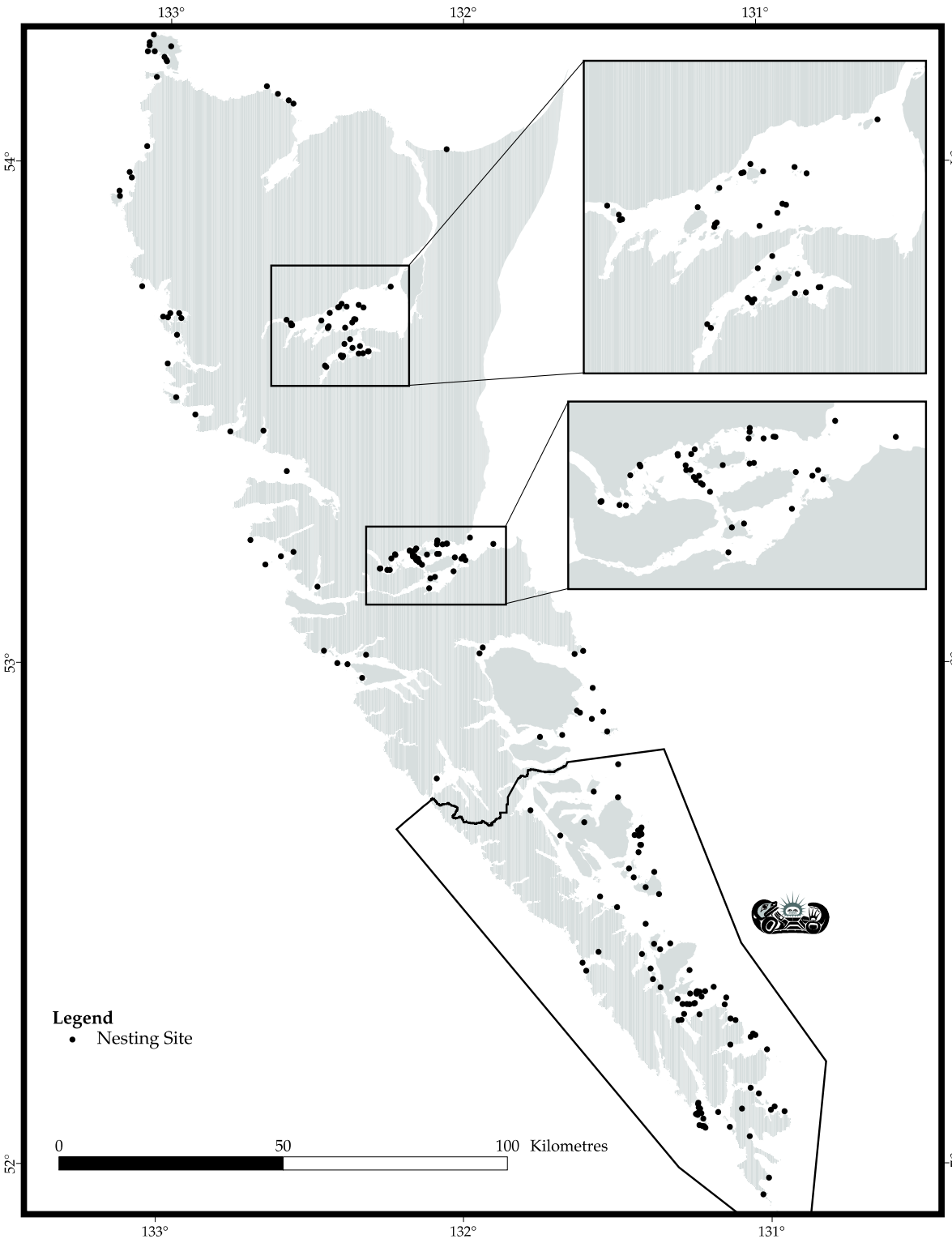

Figure 28. Locations of nest sites of Black Oystercatchers in Haida Gwaii (data from Hatter and Stordeur 1978; Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Lawrence and Backhouse 1991; Vermeer *et al.* 1992; Gaston 1992 b; Lemon 1997; Cooper and Miller 1997; Gray 1999; D. Burles, *unpublished data;* A. Harfenist, *unpublished data;* N. Sloan, *unpublished data).* Most of the Moresby and Graham Island coastlines have not been surveyed.

(1988) had recorded only 26 pairs in that region. It is possible that the population changed between the two sets of surveys, but it is more likely that the later surveys were more complete. Cooper and Miller (1997) described as unusual the single nest they found along North Beach as it was on one of the main islands rather than on an offshore island. However, nests are not uncommon on Graham and Moresby Islands in the inlets off Skidegate Narrows and in Englefield Bay (A. Harfenist, *unpublished observations*). The reported Haida Gwaii population is ~37% of the British Columbia population (Rodway 1991). Approximately 33% of the global population breeds in British Columbia (Campbell *et al.* 1990 b).

There are few quantitative data available to assess population trends of Black Oystercatchers nesting or wintering on Haida Gwaii. The best breeding population trend data comes from the work of the Laskeek Bay Conservation Society that reported that the breeding population in Laskeek Bay has remained relatively stable at 30 pairs since the early 1990s (Gaston and Heise 1994; Smith 1998). Rodway (1988) found little change in the numbers nesting at sites around the archipelago that were surveyed in both 1977 and 1986. CBC data over 16 years from Skidegate Inlet show no change in the wintering population (Hazlitt 2001), but high inter-annual variability in count results means that the ability to detect a trend is likely low. The apparent decline suggested by Masset CBC data reflects weather conditions on the count days rather than a population decline (P. Hamel, Delkatla Sanctuary Society, *personal communication*).

Spotted Sandpiper

Spotted Sandpipers nest along river and lake edges and some coastal grassy beaches (Campbell *et al.* 1990 b). Nests are scrapes lined with vegetation and median clutch size is four eggs. The birds are adept at capturing flying insects and will also pick invertebrates from the surface of both water and sediment. Birds have been recorded nesting in Delkatla Slough (Hamel 1989) and near Masset Inlet (Campbell *et al.* 1990 b) as shown in Figure 27. There are no population estimates for Haida Gwaii.

Least Sandpiper

Least Sandpipers nest in upland vegetation usually within 30 m of the ocean (Cooper and Miller 1997). Median clutch size is four eggs. Birds use their bills to peck at the substrate surface for invertebrates. The breeding biology of birds nesting in Delkatla is given in Cooper (1993) and Cooper and Miller (1997).

Delkatla and its environs is the only Least Sandpiper nesting area on Haida Gwaii (Figure 27; Campbell *et al.* 1990 b). Haida Gwaii is the southernmost breeding location on the Pacific Coast for this species. Hamel (1989) and Cooper (1993) suggested that the population became established only after the construction of a causeway in 1964 significantly altered the habitat in Delkatla Slough from a tidal marsh to a brackish marsh. In the mid-late 1980s, 85 to 90 pairs nested in Delkatla Slough and another 10 to 12 pairs nested in areas nearby (Cooper and Miller 1997). In June 1993, the Delkatla population consisted of 60 to 70 pairs, representing a decline of 20 to 30% (Cooper 1993). Cooper (1993) speculated that the decline was due, in part, to changes in the vegetation in some previously dense nesting areas. In May-June 1995, following the breaching of the causeway, only 36 Least Sandpiper nests were found. Cooper (1995) noted that the main impact of the restoration of tidal flow into the marsh was on brood survival (24 of 36 nests found flooded) and suggested that the population decline was related to continued changes in the vegetation.

Short-billed Dowitcher, Common Snipe

Short-billed Dowitchers nest in upland areas of Delkatla, whereas Common Snipe nest in wetter sections (Cooper and Miller 1997). Median clutch size is four eggs for both species. Both species use their bills to probe in the ground for invertebrates. Timing of breeding and breeding success at Delkatla are given in Cooper and Miller (1997).

The only recorded nesting sites for Short-billed Dowitcher and Common Snipe on Haida Gwaii are at Delkatla Slough (Figure 27). Most nests have been found incidental to surveys for other species of nesting shorebirds (Cooper and Miller 1997). The site represents the southern limit of Short-billed Dowitcher nesting and one of only three known nesting locations in British Columbia. (Campbell *et al.* 1990 b). One to two pairs of Short-billed Dowitchers nested in each year of a 1984-1988 study (Cooper and Miller 1997). Hamel (1989) suggested that this species may have become established only after the changes that occurred following the building of the causeway. During a 1995 survey of Delkatla following the causeway breaching, Cooper (1995) noted that although no Short-billed Dowitcher nests were found, adults were present in the area. Several pairs of Common Snipe also nested in each year of the 1984-1988 study. During the 1995 resurvey, Cooper (1995) estimated four to five nesting pairs of Common Snipe. Cooper (1995) suggested that the restoration of tidal flow to Delkatla might eventually negatively impact nesting Common Snipe.

Red Phalaropes, Red-necked Phalaropes

Red and Red-necked Phalaropes are circumpolar Arctic breeders. They are found on marine waters during the non-breeding season. Both species are surface feeders and prey on insects and crustaceans.

Red and Red-necked Phalaropes are not distinguished during most pelagic surveys and so are presented together here. Phalaropes are most common around the Haida Gwaii region over the inner shelf during spring migration (Morgan *et al.* 1991). Flocks of 150 to 250 have been observed close to shore in Hecate Strait off Reef Island (Gaston and Jones 1991). Almost all of the phalaropes observed during the spring are believed to be Red-necked Phalaropes as most Red Phalaropes migrate well offshore (Martin and Myers 1969). In spring of 1982, 540 phalaropes, estimated to be ~98% Red-necked, were seen 10 km east of Reef Island (Morgan et al. 1991). However, a flock of ~250 Red Phalaropes was recorded near Reef Island during a gale in May 1984 (Gaston and Jones 1991). In summer, small numbers of primarily Red-necked Phalaropes are found in all waters of the region over and beyond the continental shelf (Morgan *et al.* 1991). Fraser (1938) reported large numbers of phalaropes in June and July off Cape St. James, up the west coast of Kunghit and at the entrance of Houston Stewart Channel near SGaang Gwaii. During fall migration, numbers and flock size decrease and the birds tend to be found beyond the shelf break in Dixon Entrance and off the west coast (Morgan *et al.* 1991). Phalaropes are very rare in the winter, but Red Phalaropes are occasionally seen during CBCs.

Although there are no population estimates for the Haida Gwaii region, estimates of 200,000 to 400,000 Red Phalaropes and >75,000 Red-necked Phalaropes have been given for British Columbia and the Yukon (CWS 2002). North American populations of both species are probably in decline (Donaldson *et al.* 2000). According to Haida Elders, phalaropes were once common in eastern Skidegate Narrows, but the seasonality of those concentrations was not recorded (Ellis 1991).

Marine Raptors

Bald Eagles and Peale's Peregrine Falcons are heavily dependant on marine resources around Haida Gwaii.

Bald Eagle

Bald Eagles nest associated with marine or freshwater habitats. In Haida Gwaii, most nests are in live spruce trees near the seashore on offshore islands and in estuaries (Harris 1978; Campbell *et al*. 1990 b). Median clutch size is two eggs. Productivity data has been collected from sites in Gwaii Haanas and on Langara Island (Kaiser *et al*. 1997; Elliott *et al*. 1998; D. Burles, Gwaii Haanas, *unpublished data*). Habitat and landscape features associated with nest productivity have been studied in nearby southeast Alaska (Gende *et al.* 1997). Limited diet information for Haida Gwaii is presented in Harris (1978) and Elliott *et al*. (1998).

Dedicated coastal surveys for breeding Bald Eagles have been conducted along most of the coast of Gwaii Haanas, off the east coast of Moresby Island from Ramsay Island to Louise Island and along the south shore of Masset Inlet (Harris 1978; Westland Resources Group 1994; D. Burles, Gwaii Haanas, *unpublished data*). Data have also been collected opportunistically during seabird colony inventories (Rodway 1988; Rodway *et al.* 1988, 1990, 1994) and other fieldwork (M. Chutter, MoWLAP, *personal communication;* A. Harfenist, *unpublished observations*). In addition, eagle nest locations are marked in older forest development plans. However, much of the coast and interior of Graham Island and northern Moresby Island have not been surveyed. In all of the inventories mentioned above, attempts were made to differentiate between unoccupied nest structures and those being actively used. Some nests are classified as "possibly active" if a pair of adults was observed near the nest, but time constraints did not permit confirmation of nesting; the status of a small proportion of nests is unknown. The 638 known nest sites in Haida Gwaii are shown in Figure 29 and the activity status of each is entered in the Parks Canada database.

A Parks Canada aerial survey along the coast of Gwaii Haanas in April 1992 yielded 250 nests, among which 132 were active, 97 were unoccupied but in good repair and 21 were unoccupied dilapidated nests (Westland Resources Group 1994). The survey covered 78% of the coast of Gwaii Haanas including 75% of the west coast of Moresby Island, 50% of the east coast of Moresby and all of the smaller islands. The density of active nests was 0.33 per km for small islands, 0.13 per km for large islands excluding Moresby and 0.03 to 0.07 per km for Moresby Island. Extrapolating from their results, Westland Resources Group (1994) estimated that Gwaii Haanas supported a total of 296 Bald Eagle nests of which 153 were active. An additional 43 nests were found in Gwaii Haanas during aerial surveys in 1994 to 1999 (D. Burles, Gwaii Haanas, *unpublished data*). Of these, 19 were active in at least one of the survey years, six were possibly active and 18 were unoccupied. Bowman and Schempf (1999) estimated that, due to perception and availability biases, only ~62% and 40% of adult and immature eagles, respectively, are seen during aerial surveys in coniferous coastal forests. Thus, the actual breeding population in Gwaii Haanas is likely considerably higher than the Westland Group's estimate.

In areas outside of Gwaii Haanas, 33 active, 35 possibly active and 35 unoccupied nests have been recorded during seabird surveys; 10 nests of unknown status were also noted (Rodway 1988; Rodway *et al*. 1988, 1990, 1994; M. Chutter, MoWLAP, *personal communication;* A. Harfenist, *unpublished observations*). Harris (1978) located 142 nests from Ramsay Island to Louise Island and three nests in southern Masset Inlet. Of the 145 total nests, 75 were active and 38

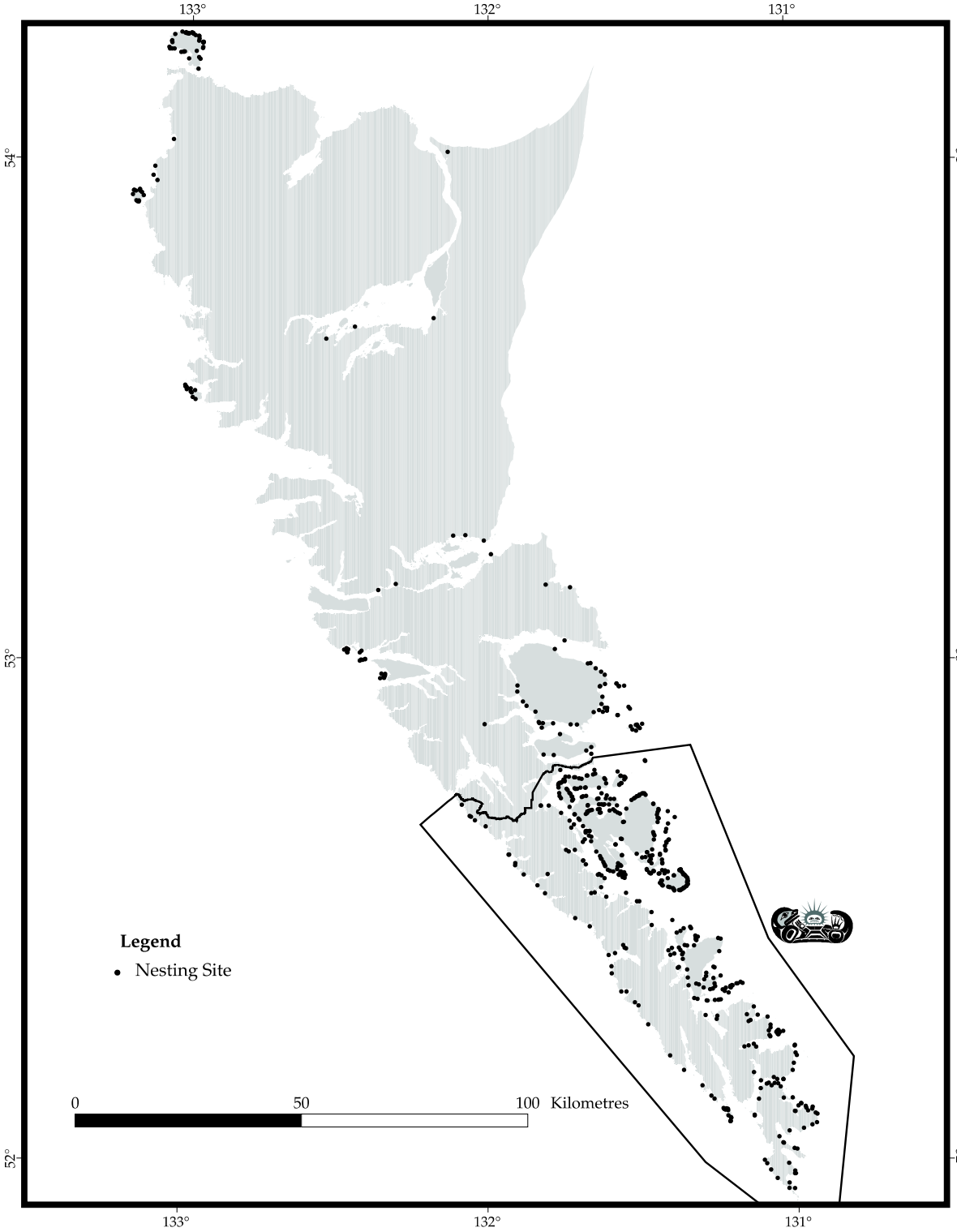

Figure 29. Distribution of recorded Bald Eagle nest sites in Haida Gwaii (data from Harris 1978; Rodway 1988; Rodway *et al.* 1988, 1990, 1994; Westland Resources Group 1994; D. Burles, *unpublished data;* M. Chutter, *unpublished data;* A. Harfenist, *unpublished data;* Laskeek Bay Conservation Society, *unpublished data).* The status (active, inactive, unknown) of each site is listed in Gwaii Haanas' Bald Eagle database.

were possibly active. Unfortunately, although Harris (1978) mapped all of the nests that he found, he did not provide activity status for each. It is, therefore, difficult to integrate his results with those of the larger aerial or seabird surveys. The population of coastal British Columbia was ~9,000 adults in spring 1980 (Hodges *et al.* 1987).

Bald Eagles are common year-round on Haida Gwaii (Hamel and Hearne 2001), but their non-breeding distribution is poorly documented (Campbell *et al.* 1990 b). They prefer rocky shorelines (Savard 1979). The birds concentrate near Pacific herring spawn in spring and herring shoals in spring and summer (Campbell *et al.* 1990 b; Ellis 1991; Gaston and Jones 1991; Butler 2000). Most of the eagles observed by Butler (2000) during May 1992 off the east coast of Moresby were in two large flocks feeding on schools of Pacific herring at Shingle Bay (86 eagles) and Skedans Point (196 eagles). Haida Elders mentioned that >200 eagles traditionally roosted at Burnaby Narrows (a.k.a. Dolomite Narrows) during spring (Ellis 1991). Other major spring and summer roosting sites include Reef, Skedans, Low, East Copper, St. James, Frederick and Langara Islands (Fraser 1938; Rodway *et al.* 1988; Gaston and Jones 1991; A. Harfenist, *unpublished observations*). In the fall, eagles are widely and frequently observed at the mouths of salmonid rivers and streams feeding on post-spawn carcasses (Campbell *et al.* 1990 b; Reimchen 1992 c). Savard (1979) saw more eagles in winter than in fall along the north and east coasts of Graham Island and suggested that the birds left that area to feed on salmon in the fall. The birds are recorded in almost all CBCs including Skidegate Inlet where >40 are often observed. Although some of the birds that winter on the archipelago are almost certainly resident here, some of British Columbia's wintering population migrates down from Alaska (Hodges *et al.* 1987) and it is likely that some of the Alaskan birds come to Haida Gwaii.

The only trend information for Bald Eagles on Haida Gwaii is anecdotal. Cooper (1995) observed less hunting activity in Delkatla following the breaching of the causeway and suggested that the significant hunting opportunity once provided by the hundreds of waterfowl gathered at the "lake" formed by the causeway had disappeared. Along the British Columbia coast, the breeding population of Bald Eagles has increased at an annual rate of 6.0 % since the 1960s and the wintering population has increased at an annual rate of ~8% during the same time period (Environment Canada 2002). These increases may be a reflection of the species' continent-wide recovery after years of decline due to hunting, habitat destruction and pesticide poisoning (Blood and Anweiller 1994; Environment Canada 2002).

<u>Peale's Peregrine Falcon</u>

"*Nowhere else in the world can one stand in one spot* (on Langara Island) *and be within view of six peregrine eyrie sites at once*."
(Hancock1968)

Throughout their range, Peregrine Falcons nest associated with marine or freshwater habitats. The subspecies found on Haida Gwaii is Peale's Peregrine Falcon which is a marine subspecies found in coastal areas from the Aleutian Islands to southern Vancouver Island (Kirk and Nelson 1999). These birds are rarely observed inland (Campbell *et al.* 1990 b). Peale's Peregrine Falcons nest on island cliff ledges, usually near seabird colonies (Kirk and Nelson 1999). They hunt over water within several km of their nest sites (Kirk and Nelson 1999). On Langara Island, where the falcon population has been well studied, Ancient Murrelets dominate the prey species during the breeding season (Nelson 1990). Falcon productivity has been intensively studied on Langara Island since 1968 (Nelson 1990; *personal communication*) and has been examined at 27 eyries (nests) along the east side of Moresby and Kunghit Islands (Burles and Cowpar 1997). The natural

history of falcons nesting on Langara Island is reported in Beebe (1960) and Nelson and Myres (1976).

Peale's Peregrine Falcons have important species-at-risk values. They were reconfirmed as a *"species of special concern"* by COSEWIC in 1999 because they are limited by the availability of their seabird prey that has declined due to predation by introduced mammals, oil spills and global warming (Kirk and Nelson 1999). As well, the CDC rated the subspecies as being of *"special concern"* in late 2001.

Approximately 800 km of coastline from Skidegate Inlet south around Cape St. James and then north to Langara Island has been surveyed for Peregrine Falcons from 1971 to 2000 at ~5 year intervals (Schultze 2000). Population estimates have been extrapolated to areas that were not fully surveyed (Edie 1995). The estimated number of active sites has varied between 56 and 79 (Table 16). The approximate distribution of the eyries according to coastal segment is shown in Figure 30. The exact locations of eyries are in the Gwaii Haanas database, but kept secret for the security of the eggs and young from poachers. These data cannot be shared without written permission of the British Columbia Ministry of Water, Land and Air Protection. The Haida Gwaii total probably represents at least 75% of the British Columbia population of Peale's Peregrine Falcon (van Drimmelen 1986).

Table 16. Number of active Peregrine Falcon eyries (nests) from surveys, 1971-2000 (adapted from Schultze 2000). The results presented have not been corrected for detection error.

Year	Number of Eyries
1971	62
1975	66
1980	79
1986	56
1990	71
1995	69
2000	69

The Haida Gwaii population of nesting Peregrine Falcons declined from a high of 108 pairs in the 1950s to 56 pairs in 1975 (B.C. MoEP 1988; Munro and van Drimmelen 1988). The most complete information comes from Langara Island where the breeding population declined from an estimated 21 to 23 pairs in the 1950s to five to seven pairs between the late 1960s and the 1980s (Cade and Fyfe 1970; Nelson 1990). In the 1990s, the population increased again and was 10 pairs in 1998 and 1999 (W. Nelson, *personal communication*). There has been no long-term trend in population numbers on a regional scale since regular surveys began in 1971, but local populations have shown significant changes (Schultze 2000). Nelson (1990) suggested that a concurrent decline in the number of breeding Ancient Murrelets, the falcon's primary prey, was at least partly responsible for the falcon's decline at Langara. Eggshell thinning as a result of pesticide poisoning may also have been a contributing factor (Blood 1968; Nelson and Myres 1976) as it was for Peregrine Falcon populations in other parts of North America and Europe in the late 1950s and early 1960s (Hickey 1969). Nelson and Myres (1976) reported that the degree of eggshell thinning of Langara Island falcons was greater than half that at which populations failed to maintain themselves elsewhere in the world.

Shelford (1988) reviewed the management of the Haida Gwaii falcon population. Removal of nestlings by falconers was unregulated until the 1960s and was controlled under a permit system until the last major harvest in 1972. At least 133 nestlings were taken from Haida Gwaii between 1963 to 1967 (Blood 1968). In some years, >40 birds were harvested (B.C. MoEP 1988). The take was dismissed as a possible factor in the population decline by Blood (1968) and Nelson and Myres (1976). Both

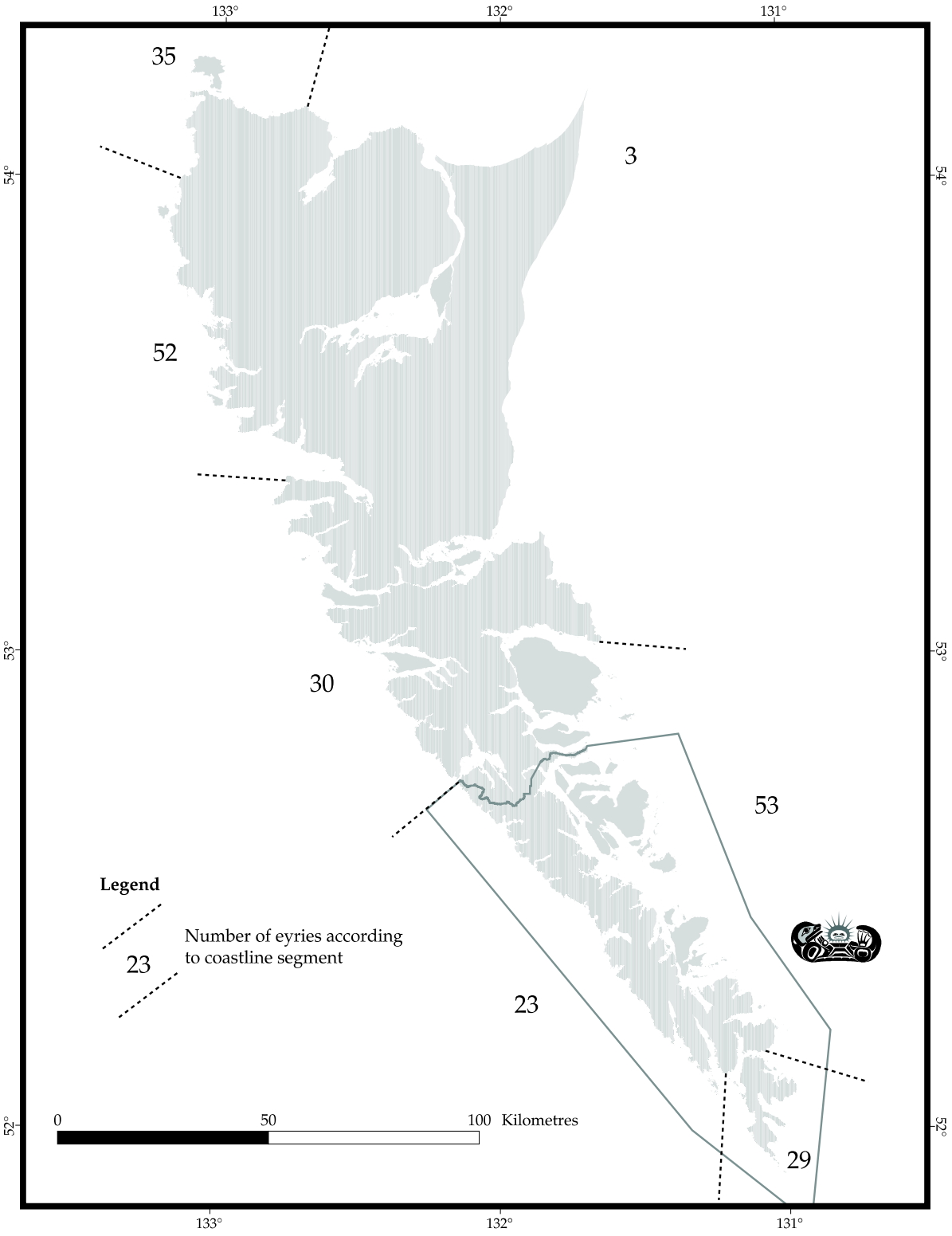

Figure 30. The number of all known Peregrine Falcon eyries according to coastline segment of Haida Gwaii (data from Beebe 1960; Schultze 2000; museum specimen records). In any given year, not all eyries are occupied and some may have been unoccupied for years. Specific eyrie locations are protected data.

the Haida and the Islands Protection Society were instrumental in stopping the harvest on Haida Gwaii and local opposition was a significant factor in preventing attempts to re-open the legal take in 1987. Birds have been illegally removed following the closure of the legal harvest (K. Moore, Moore Resource Management, *personal communication*). Haida Elders noted that Peregrine Falcons used to nest on Torrens Island and around Skidegate, but are no longer found there (Ellis 1991).

Peale's Peregrine Falcon is considered resident year-round, but uncommon, on Haida Gwaii (Campbell *et al.* 1990 b; Hamel and Hearne 2001). Their non-breeding distribution is poorly documented. Several are seen during most CBCs at Rose Spit and Masset and in ~50% of the Port Clements and Skidegate Inlet CBCs.

MARINE BIRD ISSUES IN REGIONAL MARINE AREA CONSERVATION

Agency Mandates for Marine Bird Conservation in the Haida Gwaii Region

"… our efforts are best directed at helping to conserve ecosystems that bear at least a passing resemblance to those which might have occurred naturally …" (Gaston 1992 a)

The marine birds of Haida Gwaii are protected by a complex suite of agency mandates and area designations. Generally, the public is confused about which government agencies have marine conservation mandates and how these mandates protect species and habitats. The situation is exacerbated for marine birds as their lives straddle land and sea - they nest on land but otherwise live associated with the sea. Overviews of relevant federal and provincial mandates applicable to marine birds in Haida Gwaii are presented in Tables 17 and 18, respectively. Listed according to agency is the legislation providing the mandates, a definition of those mandates and notes on relevance of the mandate to this region. Another level of governance involves international regulations in the north Pacific that protect marine birds (Harrison *et al.* 1992). These authors concluded that protected areas managers should cooperate on monitoring and research to protect populations that straddle national boundaries.

A useful way to look at governance is through terrestrial and marine habitat protection. On land, some marine bird nesting areas on Haida Gwaii have layers of federal or provincial protection. For example, Gwaii Haanas' lands come under the *Canada National Parks Act* that strictly protects nesting sites and breeding colonies through maintaining ecological integrity as defined in the act (Table 17). Further, all seabirds, marine waterfowl and shorebirds along with their nests and eggs wherever they occur in Haida Gwaii are protected under the federal *Migratory Birds Convention Act (MBCA)*. It should be noted that the *MBCA* definition of "migratory" is a legal one and does not necessarily correspond to whether a species undergoes significant post-breeding movement away from the breeding grounds. For example, many raptor species migrate but none are covered under the *MBCA*. All of the marine bird species included in this report are covered by the *MBCA* with the exception of Bald Eagles and Peregrine Falcons. The *MBCA* also regulates hunting on land or sea and Parks Canada Wardens and British Columbia Ministry of Water, Land and Air Protection Conservation Officers are designated federal game officers under the *MBCA*. Gwaii Haanas' Wardens are also designated Deputy Conservation Officers and, thus, can enforce provincial conservation legislation. Individuals and nests of all COSEWIC-listed species, such as the Marbled and Ancient Murrelet and Peale's Peregrine Falcon, will also be

Table 17. The marine bird protection mandates of federal agencies and their relevant acts in the context of the Haida Gwaii region.

Agency	Act	Mandate	Relevance to Marine Birds of the Haida Gwaii Region
Parks Canada Agency (PCA)	*Canada National Parks Act* (1930 - major amendments 1988, 2000)	First priority in National Park management is maintenance or restoration of Ecological Integrity[1] through the protection of natural resources and natural processes	Within Haida Gwaii, applies only to the land mass (down to the high tide line) of Gwaii Haanas National Park Reserve and Haida Heritage Site; on those lands there is a strict Ecological Integrity[1] mandate that compels recognition of the important ecological roles of marine birds besides protecting their breeding colonies and nesting sites
	Canada National Marine Conservation Areas Act (2002)	Within representative marine regions, National Marine Conservation Areas (NMCAs) can be created for protection, conservation and sustainable management, including living natural resource extraction - provided that long-term marine ecosystem structure and function are not compromised	Within the Haida Gwaii region, applies only to the proposed sea space of Gwaii Haanas NMCA; marine birds will be protected by virtue of their roles in marine ecosystem structure and function and for restoration of species with special ("listed") status
Fisheries and Oceans Canada (DFO)	*Fisheries Act* (1867 - repealed and amended many times)	First priority is conservation of fish stocks and their habitats – then allocation to Aboriginal peoples according to their subsistence (food/social/ceremonial) rights under the *Constitution Act* [section 35] (1982) – then allocation to commercial and recreational fishery sectors; the act enables declaring closed areas (temporary to permanent) for stock conservation, Aboriginal allocation, seafood safety or other purposes	Applies to all the tidal and marine waters of Haida Gwaii region, with some specific applications to marine birds, e.g., the CWS-DFO Pacific Halibut Advisory Board cooperation to minimize bird by-catch in the hook-and-line halibut fishery where introducing gear avoidance devices was subsumed under codes of best-practice for general by-catch minimization under the *Fisheries Act,* rather than invoking the *Migratory Birds Convention Act* (K. Morgan, CWS, *personal communication*)
	Oceans Act (1996)	The relevant mandates within the "Oceans Management Strategy" are (1) developing integrated coastal zone management plans [ICZMPs] and (2) establishing marine protected areas (MPAs)[2] for protection of marine biodiversity, commercial and non-commercial fisheries, marine mammals and their habitats, species at risk, representative ecosystems and unique marine features	The creation of an ICZMP has not yet been done on the Pacific coast, but this could be a way to coalesce marine conservation issues within the Haida Gwaii region, including Gwaii Haanas; marine bird conservation could be a criterion for planning, likely including technical advice from CWS and PCA; if marine birds were the main criterion, DFO would likely defer to CWS (see below)

Agency	Act	Mandate	Relevance to Marine Birds of the Haida Gwaii Region
Environment Canada (EC) – Canadian Wildlife Service (CWS)	*Canada Wildlife Act* (1985 - marine amendments 1994)	The lead federal act for protection of wildlife on federal lands such as National Wildlife Areas; as well, MPAs can be created under this act for marine "wildlife"[3] conservation and research including protection of endangered wildlife; under this mandate, CWS is proposing a MPA off northern Vancouver Island (Scott Group Islands, see Figure 1) because of its marine birds (2.2 M birds - 13 species)	There are no National Wildlife Areas in Haida Gwaii, therefore this act has little local application – concerning MPAs, CWS has no plans to create one in the Haida Gwaii region at this time, but it could be feasible for CWS to attach a MPA onto the area seaward of Gwaii Haanas' marine boundary out to the Exclusive Economic Zone boundary [~370 km offshore] (Zurbrigg 1996; CWS MPAs Working Group 1999)
	Migratory Birds Convention Act (1994)	Implements a Canada-U.S. convention for migratory birds, their nests and eggs wherever they occur in Canada; the act also allows for prescribing "protection areas" for migratory birds and nests (in Migratory Bird Sanctuaries where hunting is prohibited) including area management; protects all migratory seabirds in Canada from hunting with the exceptions of Aboriginal peoples according to their subsistence rights under the *Constitution Act* [section 35] (1982) and citizens of Newfoundland and Labrador for hunting Murre species	CWS is mandated to protect all migratory birds, their nests and eggs in this region, including breeding colonies and nesting habitats of all migratory marine bird species - there are no Migratory Bird Sanctuaries in Haida Gwaii
	Species at Risk Act[4] [passed the Commons June, 2002]	Protection and recovery of all COSEWIC-listed species (applies directly to federally-listed species and species on federal lands, and indirectly to all other listed species via cooperation with provincial agencies and, if necessary, via Governor-in-Council [safety net provision]) and protection of their critical habitats (applies directly to federal lands, and indirectly to provincial and private lands via cooperation with provincial agencies and individuals and, if necessary, via the safety net provision)	In the archipelago, the federal (Parks Canada) focus will be on Gwaii Haanas lands; nesting Marbled Murrelets are listed as "threatened" with a multi-agency recovery plan for the Haida Gwaii region already in place. Ancient Murrelet and Peale's Peregrine Falcon are listed as "special concern" that compels management plan creation within 3 years - the *anatum* subspecies of Peregrine Falcon (not found on Haida Gwaii) is listed as "threatened"

1 with respect to a park, Ecological Integrity is defined in the act as "a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes."

2 examples of nearby DFO MPAs are: Bowie Seamount [in pilot stage] and the Hecate Strait/Queen Charlotte Sound sponge bioherms [proposal stage]

3 "wildlife" under the amended act includes all marine organisms from marine plants to marine mammals (McBurney 1995)

4 the first act in Canada that will have three Ministers (EC, DFO, Heritage [Parks Canada]) as responsible, although EC is the lead

protected under the *Species at Risk Act* (*SARA)*. *SARA* includes protection of species' critical habitat once it is designated in a recovery strategy or action plan.

On provincial crown lands, which include most of Haida Gwaii lands outside of Gwaii Haanas, there are differing levels of marine bird protection (Table 18). The most protected areas are the Ecological Reserves (Figure 31) where strict preservation is in force; comparable to Gwaii Haanas. The *Park Act* provides protection to birds and their nests in Naikoon Provincial Park (a class-A provincial park), but there is waterfowl hunting, particularly in the Tlell River area, within the park. Not all class-A provincial parks permit hunting. Wildlife Management Areas have been established to protect breeding colonies (Figure 31) under the *British Columbia Wildlife Act*. As well, the *Land Act* has been used to establish different reserve designations in areas important to waterfowl and shorebirds. Other *Land Act* tenures and Protected Area Strategy (PAS) study areas, not explicitly established for the protection of marine bird habitat, may also benefit the birds. A number of seabird breeding colonies have been submitted for protection under the *Forest Practices Code of British Columbia Act*. Finally, marine birds on other provincial crown lands of Haida Gwaii are covered by the *British Columbia Wildlife Act*. Hunting is regulated provincially under the *British Columbia Wildlife Act* as well as under the federal *MBCA* (see Hunting section below). A summary of federal and provincial protection of seabird nesting colonies and sites is provided in Table 19. A minimum of 112 island and islet sites have no explicit protection.

In summary, there is overarching protection of all species of marine birds regardless of location in the Haida Gwaii region through the *MBCA* and/or, on non-federal lands, through the *British Columbia Wildlife Act*. However, there is a complicated mosaic of protection levels for lands occupied by breeding sites ranging from strict preservation through to some areas receiving no explicit protection beyond the small areas containing nests and eggs during the breeding season. Different legislative routes have been followed to protect colonies yielding a confusing and incomplete protection scenario on Haida Gwaii. For marine birds at sea, indirect protection of birds through conserving ecosystems seems possible in the proposed marine area of Gwaii Haanas through the *Canada National Marine Conservation Areas Act*. Outside of Gwaii Haanas, perhaps the *Oceans Act* and *Canada Wildlife Act* could provide protection through integrated ocean planning or creating new regional MPAs. Provincial legislation does not provide at-sea protection for marine birds.

Complications remain because marine bird conservation represents cross-agency issues. An example is the condition of licensing recommended by the Pacific Halibut Advisory Board that all hook and line vessels above a minimum size must use seabirds avoidance devices. Here, bird-protecting devices were subsumed under codes of best-practice for general bycatch minimization to retain use of the *Fisheries Act*, rather than invoking the *Migratory Birds Convention Act* (K. Morgan, CWS, *personal communication*). Another example is the failure of the *MBCA* to protect active Marbled Murrelet nests from being destroyed during provincially-regulated logging operations.

Another type of marine bird habitat protection that involves federal and/or provincial government agencies is provided by lands acquired by conservation organizations and held by the Nature Trust of British Columbia, a NGO. The Trust then leases the land to government agencies under the condition that each area's conservation values are preserved. The Nature Trust owns 26.5 ha at Kumdis Slough for conservation of waterfowl and fish. The Delkatla Wildlife Sanctuary, one of the most important areas on the archipelago for marine waterfowl and

Table 18. The marine bird protection mandates of provincial British Columbia agencies and their relevant acts in the context of the Haida Gwaii region.

Agency	Act	Mandate	Relevance to Marine Birds of the Haida Gwaii Region
British Columbia Ministry of Water, Land and Air Protection	*Park Act* (1965)	The principal act for provincial park management and protecting the resources therein; a natural resource, other than fish and wildlife extracted in accordance with the *Wildlife Act*, cannot be removed or damaged except as authorised by a park-use permit which can only be issued if necessary for preserving park recreational values	Facilitates protection of marine birds, their nests and eggs in Naikoon Provincial Park
	Ecological Reserves Act (1971)	Applies only to Ecological Reserves; affords strict protection to important, unique or representative ecosystems and natural phenomena with research and education as the principal uses - all natural resource extraction is prohibited	Marine bird breeding colonies, nesting sites and their eggs within Ecological Reserves[1] are fully protected
	Wildlife Act (1992)	Applies to wildlife protection on all British Columbia lands (except federal lands such as national parks), but the mandate is more specific than the *Park Act* for wildlife protection; enables establishment of provincial Wildlife Management Areas; regulates hunting of marine birds	Reef I., Low I., Sout Low I., Limestone Is. and Skedans I. are within a Wildlife Management Area - all established in the *South Moresby Agreement* (1988) to protect seabird breeding colonies; four marine bird species are hunted in Haida Gwaii as regulated under this act (see Hunting section in the text)
	Protected Areas of British Columbia Act (amended 2000)	Enables the establishment of provincial parks and ecological reserves; other provincial legislation is used for conservation management	Naikoon Provincial Park and the local Ecological Reserves were established under this act
	Forest Practices Code of British Columbia Act (1994)	Focuses on long-term sustainable forestry with an ethic of respect for the land, balancing socioeconomic and cultural values, biodiversity conservation and forest ecosystem restoration	Wildlife Habitat Areas, under the act's Identified Wildlife Management Strategy, are limited to three species of marine birds and in progress for Ancient Murrelet and Cassin's Auklet (for 19 islands)
Land and Water British Columbia, Inc. (a Crown Corporation reporting to the Minister of Sustainable Resource Management)	*Land Act*	Administers British Columbia Crown lands including creating reserves of different types and for a range of purposes including protecting marine birds or their habitats	Section 15 Order-in-Council Reserves (5 years or longer – alterable only by another Order–in-Council) established by Cabinet to protect marine bird breeding areas Section 16 Map Reserves (5-year term – renewable) established to protect waterfowl habitat in 15 locations, e.g., Delkatla Slough, Bearskin Bay and Shelden's Bay lagoon Section 17 Designated Use Reserves (5-year term – renewable), *e.g.*, Naden Harbour wetlands to protect migratory marine bird staging areas

1 two of the five current Haida Gwaii region Ecological Reserves were established explicitly to protect seabird breeding colonies: Vladimir J. Krajina (No. 45 ~7,800 ha) and Lepas Bay (No. 93 ~1 ha) - two others are also coastal (Rose Spit [No. 10 ~210 ha] and Tow Hill [No. 9 ~450 ha]) and they occur within Naikoon Provincial Park, and one (Drizzle Lake [No. 52 ~690 ha] is inland and nearby, but outside Naikoon. Three other Ecological Reserves (No. 44 – East Copper Island and Rankine Islands / No. 95 - Anthony Island [SGaang Gwaii] / No. 96 – Kerouard Islands [Cape St. James]) were established explicitly to protect seabird breeding colonies, and all were subsumed into Gwaii Haanas through the federal-provincial *South Moresby Agreement* (1988).

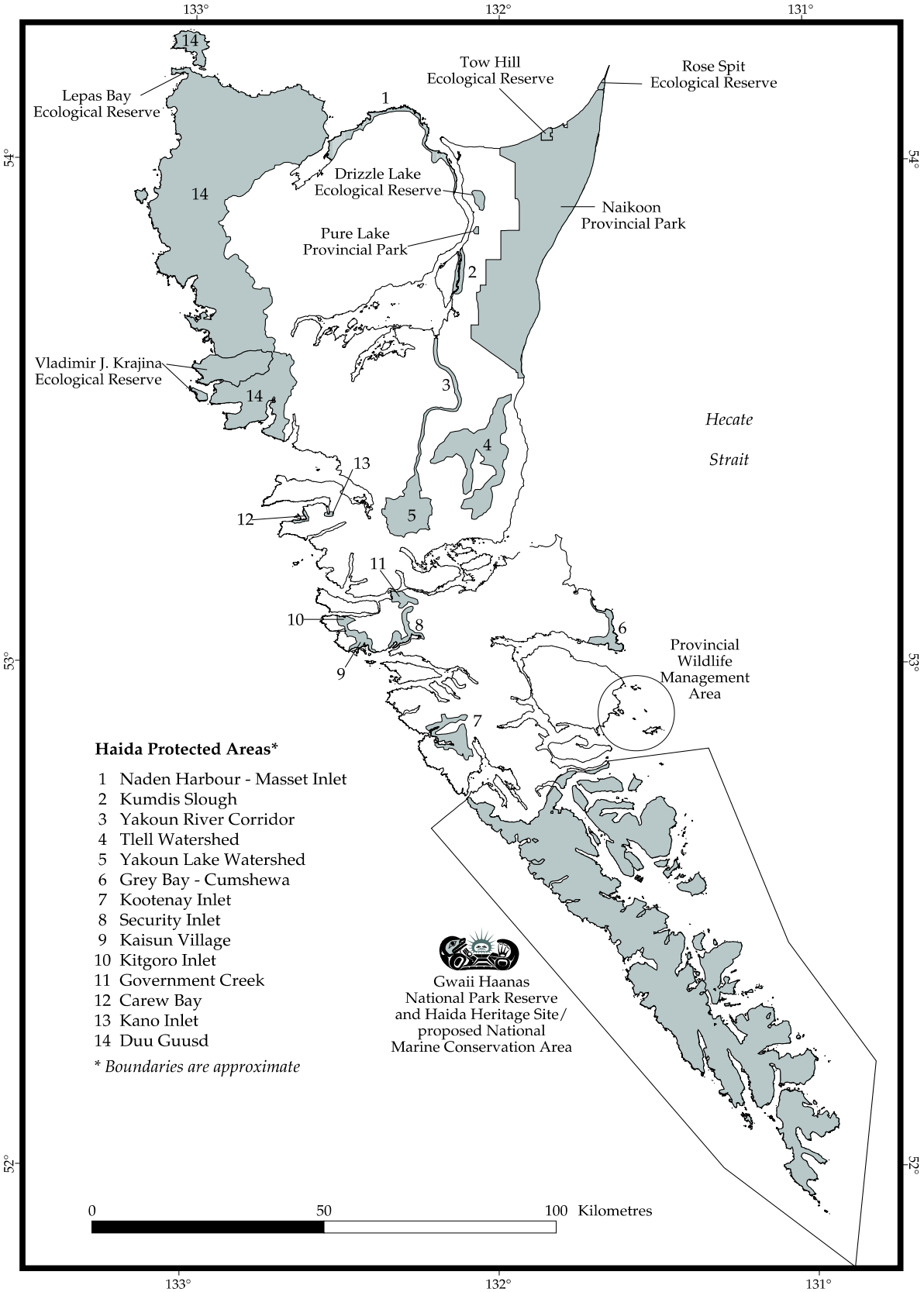

Figure 31. Locations of Haida and federal protected terrestrial areas as well as provincial parks, ecological reserves and wildlife management areas in Haida Gwaii. Important Bird Areas are also shown.

Table 19. Types of area and levels of protection for seabird breeding sites in the Haida Gwaii region.

Type of Area Protection	Number of Islands or Island Groups	Locations	Levels of Protection
Gwaii Haanas National Park Reserve	at least 86	All Gwaii Haanas lands	Strict preservation - all species
Ecological Reserves	2	Lepas Bay and Hippa Is.	Strict preservation - all species
Wildlife Management Areas	3	Reef, Limestone, Low, South Low and Skedans Islands	Permits required for activities at sites
proposed Wildlife Habitat Areas	18	Frederick, Barry, Low, Marble, Solide, Carswell, Helgesen, Little Helgesen, Luxmoore, Rogers, Saunders, Instructor, Lihou and Willie Is.; Moresby, Tian and Kiokathli Its; Cape Kuper	Managed according to the Identified Wildlife Management Strategy guidelines
British Columbia Crown lands excluding Naikoon Provincial Park[2]	at least 112[1]	Throughout Haida Gwaii outside of Gwaii Haanas	Currently no explicit protection within these localities beyond their nests and eggs during the breeding season

1 Most are islets or rocks with <5 pairs of Black Oystercatchers, Glaucous-winged Gulls or Pigeon Guillemots.
2 No seabird breeding sites are located within Naikoon Provincial Park

shorebirds, is on neither federal or provincial crown land, rather it is owned by the Village of Masset. The Sanctuary is managed for conservation and education by the Delkatla Sanctuary Society.

Important marine bird nesting and feeding areas are within Duu Guusd, the largest (149,000 ha; Figure 31) of the 14 proposed "Haida Protected Areas" which total ~250,000 ha. Duu Guusd is protected by temporary provincial cabinet order until 2002, while the other 13 proposed areas currently have no explicit legal protection status. Many of these areas include valley bottom, old-growth forest used by nesting Marbled Murrelets.

Finally, Haida Gwaii has sites designated as Important Bird Areas (IBAs) under a Bird Life International program to identify areas supporting significant populations of breeding or non-breeding birds. To date, all Haida Gwaii IBAs were designated based on their importance to marine birds, but an IBA does not provide legal protection. Bird Life International is a global alliance of national conservation organizations; in British Columbia, cooperating in the IBA program are Bird Studies Canada, a NGO dedicated to conserving wild birds and their habitats, and the Canadian Nature Federation, a NGO whose overarching goal is to protect nature. Descriptions of the flora and fauna of each IBA can be found at: http://www.bsc-eoc.org/iba.

Precautionary Approach

"A more complete and open presentation from scientists on the current limitations in understanding of environmental risks will encourage the acceptance on the part of government decision-makers and the public of the idea that precautionary action is a prudent and effective strategy when potential risks are large and uncertainties are large as well." (Anonymous 2002 - Lowell statement on science and the precautionary principle. Appendix 20. In: British Columbia offshore hydrocarbon development – Report of the

scientific review panel. Vol. II (Appendices): 143-145.)

The precautionary approach is pivotal to the future of marine conservation in Canada. Both the *Canada National Marine Conservation Areas Act* and the *Oceans Act* are explicitly committed to this approach. Further, the CWS invokes precaution in migratory bird management (R. Elner, CWS, *personal communication*) and in their marine protected areas policy (CWS MPAs Working Group 1999). The many unknowns concerning marine birds compels precautionary conservation decision-making.

The precautionary approach embodies conservative (risk-averse) action in the absence of certainty - not waiting for full scientific proof prior to decision-making and thinking about the legacy to future generations (Hilborn *et al.* 2001). Garcia (1996) described the precautionary approach as a set of agreed, cost-effective measures and actions including future courses of action, which ensures prudent foresight and reduces or avoids risk to the resources, the environment, and the people, to the extent possible taking explicitly into account existing uncertainties (i.e., lack of full scientific certainty) and the potential consequences of being wrong. Other components of the precautionary approach are:

- that proponents for change from conservative, risk-averse action should assume the burden of proof that their proposed actions are not damaging (Dayton 1998) and, therefore, fund science to support any such change; and

- applying the approach to the protection of both humans and other organism populations through managing risks of resource management decisions to coastal communities (Hilborn *et al.* 2001).

Case Studies

Although the legislation for conservation of marine birds is in hand, the implementation is not always rigorous. Furthermore, such shortcomings do not respect the spirit of the precautionary approach. We present three species case studies that illustrate that conservation is not always being met, despite the legislation's appearance of adequate protection and the precautionary approach.

Marbled Murrelet

Marbled Murrelets are listed as *threatened* federally and provincially. The main threat to sustainable populations is removal and degradation of old-growth forest nesting habitat by logging (Rodway 1990; Hull 2000). To date, in the absence of federal or provincial endangered species legislation, "listing" has conferred little protection.

Marbled Murrelets are covered by the *Migratory Bird Convention Act* (*MBCA*) which prohibits the disturbance, destruction or removal of a nest or egg without a permit. However, Environment Canada has not invoked the *MBCA* to halt logging in areas with known active Marbled Murrelet nests. A similar failure to effectively enforce the *MBCA* in areas affected by logging is the subject of a recent submission by the Sierra Legal Defense Fund on behalf of Canadian and U.S. NGOs to the Commission for Environmental Cooperation, a panel set up to deal with environmental issues arising from free trade agreements in North America [http://www.cec.org]. Marbled Murrelets are also an identified wildlife species under the *Identified Wildlife Management Strategy* (IWMS) of the *Forest Practices Code*. The IWMS includes a set of guidelines for establishing Wildlife Habitat Areas (WHAs) and calls for stands of old growth forest equivalent to 10 to 12% of original (prior to industrial logging) suitable murrelet nesting habitat to be set aside. The IWMS

was released in February 1999; to date, no WHAs have been established for Marbled Murrelets in Haida Gwaii. Furthermore, government policy dictates that WHAs incorporate forests in the non-contributing land base (land unsuitable or unavailable for logging) when possible, even if the forests are sub-optimal for the species. The failure of the British Columbia Ministry of Forests to adequately conserve Marbled Murrelets has been the subject of recent appeals to the Forest Review Board [www.fpb.gov.bc.ca/reports/arguments/2001-09/index.htm and www.fpb.gov.bc.ca/reports/complnt/summary/2001/RC57s.htm]. In November 2001, the Forest Practices Board recommended that the government move more quickly to establish WHAs for threatened and endangered species. In addition, the British Columbia Supreme Court recently ruled against a British Columbia District Forest Manager who had approved a logging plan that would remove critical Marbled Murrelet nesting habitat [http://www.courts.gov.bc.ca].

The forthcoming federal endangered species legislation, *SARA*, may alleviate the threat to Marbled Murrelets from logging activities. As a COSEWIC-listed species, the Marbled Murrelet will receive full protection against harm to individuals and destruction of nests and eggs when *SARA* passes. Once designated, critical murrelet habitat will be protected on federal land. *SARA* also requires the federal Minister of the Environment to recommend safety net provisions in the bill that would lead to protection of critical habitat on non-federal lands (including provincial crown land which comprise the vast majority of Haida Gwaii forests) if s/he is of the opinion that provincial legislation does not provide effective protection. As *SARA* has not yet been enacted, it remains to be seen how well the safety net provisions will work.

Thus, despite the Marbled Murrelet's status as a threatened species and a myriad of available legislation through which conservation efforts could be implemented, conservation is inadequate. In reference to murrelets nesting on Haida Gwaii, a common argument is that the old growth forests of Gwaii Haanas are sufficient to sustain the nesting population. It is critical for the management of this species that the population nesting within Gwaii Haanas and throughout the rest of Haida Gwaii be determined. Currently efforts are underway to determine habitat supply through modeling with the intent to follow up with ground-truthing surveys.

Habitat Protection via *Land Act* Designations

"The significance of the biological resources in Naden Harbour, and the conflicting land and marine developments occurring in the area, indicate the need for inter-agency land use planning and for stronger protective designation for critical wetland habitats." (Remington 1993 b).

The Naden Harbour area has been identified as provincially significant and critical habitat for migratory waterbirds by the British Columbia Waterfowl Technical Committee (Hayes *et al*. 1993). Sufficient data are available to underscore the importance of the major estuaries in the harbour for marine waterfowl and shorebirds during spring and fall migration as well as winter (Remington 1993 a). The Naden and Davidson River estuaries were top-ranked north coast wetlands when use by waterfowl and red- and blue-listed species were the ranking criteria (Remington 1993 b). In recognition of its importance to waterbirds and at the request of the CWS, southern Naden Harbour was designated as a Section 12 Reserve in 1968. With changes in the *Land* Act, the area is now a Section 17 Designated Use Area for wildlife protection. Such a designation is expected to protect the habitat from incompatible land uses. However, in 1969 a log boom operation was given a lease to operate within the Reserve in the waters

around Colnett Point. The CWS was consulted and offered no objection (R.D. Harris, CWS, *unpublished letter)*. Since then, the "*intertidal foreshore has been infilled and modified for the creation of a log dump and eventually a dryland sort log handling and watering facility. A considerable volume of timber has been processed … not without the consequence of excessive wood debris loss necessitating marine dredging programs. Various environmental incidents have occurred … such as several large volume fuel spills into the marine environment*." (A. Cowan, DFO, *unpublished letter).* An application to replace (renew) the log handling operation lease was recently approved, back-dated to 2000 (L. Johnstone, Lands and Water B.C., *personal communication).* In addition, a land-based sport fishing lodge and wharf have been permitted within the Reserve (Remington 1993 b) despite the destruction of habitat involved in such an operation. Clearly, the protection conferred to this critical habitat by the *Land Act* is inadequate. Remington *et al.* (1997) identify 17 other estuaries within Haida Gwaii where existing or impending development of the foreshore is in conflict with important wildlife habitat; marine bird use of some of these estuaries is unstudied.

Seabird Bycatch

British Columbia marine waters support a number of marine bird species that are listed as a conservation concern internationally, nationally and/or provincially (see Appendix C). Many of these species are vulnerable to the fishing gear used in either long-line or gillnet fisheries. For example, the Black-footed and Short-tailed Albatrosses are considered *"vulnerable"* by the World Conservation Union (IUCN 2000). The primary threat to the recovery of both species is mortality in longline fisheries (Bird Life International 2000). Albatrosses follow fishing boats and are caught on hooks as they attempt to grab bait as the lines are set. Black-footed Albatross may be the most common bird species caught in Canadian longline fisheries (Smith *in press*). Deterrent devices have been developed that decrease seabird bycatch with a negligible effect on the efficiency of the gear (Melvin *et al.* 2001). This year, use of such devices became a condition of licensing for large boats in the halibut long-line fishery in some Canadian waters. As this is a new regulation and there is no policing, full compliance is unlikely. Furthermore, there is no requirement for the use of deterrents in other Pacific longline fisheries. We can return to the Marbled Murrelet for an example of a species whose recovery is likely impeded by mortality in gill net fisheries. In a preceding case study, we noted how legislation was failing to adequately protect the Marbled Murrelet's terrestrial habitat; the marine habitat is also inadequately protected. Mortality in gill nets was a factor in listing this species (Rodway 1990), yet no regulations have been put in place in Canada to address this threat, despite the availability of modified gear and techniques that have been used successfully to reduce bycatch of Marbled Murrelets in the U.S. (Melvin *et al.* 1999).

Resolutions to reduce seabird bycatch have been adopted by international organizations such as the IUCN and the Food and Agriculture Organization of the United Nations (see Smith *in press*). With the prospect of establishment of Gwaii Haanas National Marine Conservation Area, Parks Canada will likely be cooperatively managing fisheries within the conservation area with DFO, the Council of the Haida Nation and other stakeholders. This will provide Parks Canada with an excellent and important opportunity to adopt the precautionary approach to the issue of managing seabird bycatch. A focused fisheries observer program will be required to determine whether the conservation needs of albatrosses, Marbled Murrelets and other species are being met.

Threats to Marine Birds in the Haida Gwaii Region

The main environmental hazards faced by marine birds in British Columbia are reviewed in detail elsewhere (Vermeer *et al.* 1997 c; SDJV Management Board 1999; Breault 2002; CWS 2002; Hipfner *et al.* 2002; Morgan 2002), so threats faced while in the Haida Gwaii region are only briefly described below. Migratory species will encounter some of these threats while in Haida Gwaii as well as additional ones in other parts of their ranges. For example, disturbance from jet skis is not a significant local issue at this time, but poses a risk to some marine waterfowl that nest on interior mainland lakes and winter in the Haida Gwaii region. Although most marine birds are vulnerable to the anthropogenic (human-caused) threats presented, the degree of risk depends on the specific habitats occupied by birds and their life-history characteristics. Long-lived species with low annual reproductive output are expected to be more heavily impacted at the scale of populations by factors affecting adult survival than those affecting reproductive success (Burger 2002). Aspects of seabird biology relevant to vulnerability to anthropogenic threats were reviewed by Warheit *et al.* (1997) and many of their points are pertinent to other groups of marine birds as well. Our biological knowledge varies considerably between species and is, for example, poor for sea ducks. Most of the overview below focuses on seabirds because they are the best studied group.

Introduced Species

Introduced mammalian predators pose the most serious immediate threat to nesting marine birds in Haida Gwaii (Gaston 1994 a; Bertram and Nagorsen 1995). Harfenist and Kaiser (1997) have reviewed their effects on seabirds. Raccoons (*Procyon lotor*) and Rats (*Rattus* spp.) are known to have seriously damaged more than 10 seabird colonies and are suspected of destroying others. The Ancient Murrelet was listed as a species of special concern by COSEWIC on the basis of the threat posed by introduced predators (Gaston 1994 a).

Raccoons were introduced to Haida Gwaii in the 1940s to promote trapping and have since spread throughout the archipelago (Hartman and Eastman 1999). Islands within 0.6 km of a source area are considered vulnerable (Gaston and Masselink 1997). Raccoons have reached at least nine and possibly 12 islands that support(ed) >50 pairs of nesting seabirds (Table 20; Harfenist and Kaiser 1997; Harfenist, *unpublished observation*). They have also reached a number of islands such as Centre Islet with small numbers of breeding birds (D. Burles, Gwaii Haanas, *personal communication)*. Gaston and Masselink (1997) reported >80% declines over seven years in breeding populations of Ancient Murrelets, Cassin's Auklets and Rhinoceros Auklets on Helgesen Island which supported eight to 12 raccoons over the same period. The devastating impact of raccoons on seabird colonies has also been documented on the Limestone Islands (Hartman *et al.* 1997) and on islands in Skidegate Inlet (Vermeer *et al.* 1993 b). In 1993, a working group including members of Parks Canada, Canadian Wildlife Service, British Columbia Parks, British Columbia Ministry of Environment, Lands and Parks and Laskeek Bay Conservation Society developed a strategy for monitoring and controlling raccoons on seabird colony islands (Harfenist *et al.* 2000). Annual monitoring of vulnerable seabird colonies and control of detected raccoons have been carried out ever since.

Although studies and management action have focused on the relationships between introduced predators and seabirds, raccoons also negatively affect nesting marine waterfowl and shorebirds. Loon, merganser and Black Oystercatcher nests are susceptible to raccoon predation (Douglas and Reimchen 1988 b; Reimchen

Table 20. Islands in the Haida Gwaii region that support, or have supported, more than 50 nesting pairs of seabirds where introduced predators (rats and/or raccoons) have occurred (data from Bertram and Nagorsen 1995; Harfenist and Kaiser 1997; A. Harfenist, *unpublished data*).

Island/Islet[1]	Rat and/or Raccoon	Seabird Species Historically Present
Langara	Rat	Fork-tailed Storm-petrel, Glaucous-winged Gull, Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet, Rhinoceros Auklet, Tufted Puffin
Cox	Rat	Fork-tailed and Leach's Storm-petrel, Pigeon Guillemot, Ancient Murrelet, Tufted Puffin
Lucy	Rat	Ancient Murrelet
Helgesen	Raccoon	Fork-tailed and Leach's Storm-petrel, Ancient Murrelet, Cassin's Auklet, Rhinoceros Auklet
Saunders	Raccoon	Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet, Rhinoceros Auklet
Instructor[2]	Raccoon	Fork-tailed and Leach's Storm-petrel, Pigeon Guillemot, Ancient Murrelet, Rhinoceros Auklet
St. James	Rat	Pelagic Cormorant, Glaucous-winged Gull, Pigeon Guillemot, Cassin's Auklet, Tufted Puffin
Kunghit	Rat, Raccoon	Pelagic Cormorant, Glaucous-winged Gull, Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet, Rhinoceros Auklet, Tufted Puffin
Rock[2]	Raccoon	Fork-tailed and Leach's Storm-petrel, Pigeon Guillemot, Cassin's Auklet
Skincuttle	Raccoon	Fork-tailed and Leach's Storm-petrel, Ancient Murrelet, Cassin's Auklet
George[2]	Raccoon	Storm-petrel spp., Ancient Murrelet, Cassin's Auklet
Alder	Raccoon	Storm-petrel spp., Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet
Ramsay	Raccoon	Pelagic Cormorant, Glaucous-winged Gull, Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet
Bischof	Rat	Storm-petrel spp., Pigeon Guillemot, Ancient Murrelet
Murchison	Rat	Glaucous-winged Gull, Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet
Lyell	Rat	Pigeon Guillemot, Ancient Murrelet
East Limestone	Raccoon	Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet
West Limestone	Raccoon	Pigeon Guillemot, Ancient Murrelet
Skedans	Raccoon	Fork-tailed Storm-petrel, Glaucous-winged Gull, Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet

1 Rats and raccoons have also been reported from islands or islets with few, or an unknown number of, nesting seabirds including: Sea Pigeon, Park, Swan, Ferry and Sandilands. (Rodway *et al*. 1988; Vermeer *et al*. 1993 b; Bertram and Nagorsen 1995).

2 Evidence from these islands is questionable.

1992 a; Vermeer *et al.* 1992). Raccoon scats were found on Kwaikans Islet, one of only two known Harlequin Duck nesting sites in Haida Gwaii (Rodway 1988).

The history of the introduction of rats to the archipelago is less clear than that of raccoons. Bertram and Nagorsen (1995) suggested that rats may have first arrived

on European ships during the early post-contact era (late 1700s to early 1800s). However, the oldest specimen from Haida Gwaii is of a Black Rat (*R. rattus*) from 1919 and the first Norway Rat (*R. norvegicus*) was collected in 1981. Rats have been found on eight active seabird colonies in Haida Gwaii (Table 20; Bertram and Nagorsen 1995). The best example of the destructive potential of rats on breeding seabirds is from Langara Island. By 1988, Fork-tailed and Leach's Storm-petrels, Cassin's Auklets, Rhinoceros Auklets and Tufted Puffins had been extirpated from Langara (Bertram 1995). Further, Ancient Murrelets declined from historical levels of ~200,000 pairs (Gaston 1992 a) to ~14,600 pairs by 1993 (Harfenist 1994). In 1995, rats were eradicated from Langara Island (Kaiser *et al.* 1997), but the Ancient Murrelet population has not yet shown evidence of recovery (Drever 2000). Parks Canada removed the rats from St. James Island in 1999 (Golumbia 2002).

Other introduced species likely have affected marine birds on Haida Gwaii. Breeding, migrating or wintering shorebirds can be negatively affected by the spread of exotic aquatic invertebrates and plants if foraging habitats are destroyed (CWS 2002) and marine waterfowl could be similarly affected. Grazing by Black-tailed Deer (*Odocoileus hemionus*), introduced in 1878, may indirectly affect nesting marine birds by altering their breeding habitats. By removing understory vegetation, deer may leave nests and chicks more vulnerable to visual predators such as crows and ravens. But, by grazing back salal (*Gaultheria shallon*), deer may increase the amount of habitat available for burrowing seabirds. The effects of deer grazing on island ecosystems is the subject of an on-going study by the Research Group on Introduced Species (Golumbia 2000).

Oil and Gas-associated Effects

"*Accidents are inevitable companions of the offshore oil and gas production and transportation*." (Patin 1999)

"*… safeguarding seabirds in B.C. is currently not really possible …*" (Huettmann 2002 - Appendix 16B. In: British Columbia offshore hydrocarbon development – Report of the scientific review panel. Vol. II (Appendices): 119-126.)

Oil and gas exploration and extraction may pose a threat to regional marine birds if the federal and provincial moratoria are lifted and exploration and production ensue. If production proceeds, marine birds would face an increased risk of oil contamination as well as increased nighttime mortalities due to collisions with lines near oil platform lights (Montevecchi *et al.*1999). The above quotes emphasize, firstly, the fundamental need for a spill-prevention ethos underlying potential development for the Hecate Strait - Queen Charlotte Sound areas. Secondly, if a spill occurs along the rugged isolated coasts of Haida Gwaii, its environmental effects will be difficult to assess and remediate, and we cannot state with certainty whether marine bird protection would be achievable.

Oil is particularly threatening at locations where birds congregate. Productive foraging areas such as the continental shelf edge, upwelling areas and sites where other ocean processes concentrate fish and plankton are of concern (Burger 1993 a, b). These oceanic processes can concentrate oil as well. Other locations where birds congregate include sheltered, inshore feeding, moulting and resting areas and waters near colonies. In his overview of the environmental impacts of the offshore oil and gas industry, Patin (1999) concluded that it was important to map "productive and ecologically vulnerable" areas to be excluded from oil and gas activities. The federal-provincial West Coast Offshore

Exploration Environmental Assessment Panel report (WCOEEAP 1986, p. 67) recommended that a minimum 20-km wide "buffer zone" be established along the coast between potential production areas and the shore for "protection of nearshore waters." This may prove important to marine birds.

Various reviews have addressed lethal and sublethal effects of marine oil pollution on birds and the need of models to evaluate these effects (Sloan 1999). Oil has the potential to cause mass mortalities (Sloan 1999; Peterson 2001). Birds can die as oil clogs the feathers, leading to ingestion of toxic oil from attempts to preen, hypothermia stress and drowning from reduced buoyancy. Stress is worsened when oiled birds increase their metabolic rate to counteract decreasing body temperature. Secondary poisoning of scavengers such as Bald Eagles and Glaucous-winged Gulls is also a concern. The data that best quantify oil spill-induced mortality of seabirds are counts of dead oiled birds on beaches and live oiled bird counts (Camphuysen and van Franeker 1991; Camphuysen 1998).

Oil can also affect reproductive parameters and cause nesting failure (Eppley and Rubega 1990). Field studies on oiled seabirds have shown reduction and delay in egg laying, reduced hatching success, reduction in fledgling success and slowed nestling growth rates (Boersma *et al.* 1988). Breeding adults oiled at sea can transfer oil to their eggs or chicks leading to death of the embryo or nestling. Oiling of adults can also change their breeding behavior. Exposed birds may abandon breeding attempts, decrease pair-bonding or neglect nestlings (Eppley and Rubega 1990). Effects on the timing of reproduction have serious implications because timing is important to successful nesting in seabirds.

Population-level effects are difficult to establish given the large natural interannual fluctuations of seabird populations. Wells *et al.* (1995) concluded that "…. *great variability in seabird numbers and breeding success due to natural factors is a common natural event, making detection of the degree of oil effects difficult if not impossible*." Evidence for population level effects are reviewed by Piatt *et al.* (1990). Nur *et al.* (2002) estimated that the mortality experienced by Common Murres in central California as a result of chronic oiling was of sufficient magnitude to significantly lower population growth rates and represent a serious threat to the viability of the population.

The behaviour of species influences their likelihood of being oiled. Characteristics rendering birds more susceptible to oiling include: roosting at night or otherwise spending lengthy periods on the water, weak flying ability and frequent diving (Speich *et al.* 1991). Thus, diving birds, such as auklets and murres, are generally more vulnerable than surface feeders such as fulmars and gulls (Burger 1993 a, b; Irons *et al.* 2000). Marine waterfowl are considered highly vulnerable as they spend much time floating on nearshore waters (Esler 2002). Vulnerability of waterfowl increases when they are moulting because they are flightless and have high energy demands at that time (Savard 1988).

Acute post-spill marine bird mortalities generate intense public attention. Chronic, low-level pollution from ship operations (e.g., from bilge-flushing or leaking tanks) may, however, have a greater effect on bird populations than episodic spills (Burger and Fry 1993; Wiens *et al.* 1996; Burger *et al.* 1997). Although acute spill effects shock the public, experts need to better communicate their concerns over the impacts of chronic, low-level oil contamination.

The *Exxon Valdez* Oil Spill (EVOS) of 1989 illustrates the highly controversial nature of post-spill assessments for marine birds. Among the cold-water spills, EVOS has

been the most studied (Wells *et al.* 1995; Rice *et al.* 1996; Peterson 2001) and, for marine birds, has the best recorded time-series of post-spill data world-wide (Wiens *et al.* 1996, 2001; Irons *et al.* 2000, 2001; Peterson 2001). Spies *et al.* (1996) suggested a best estimate of 250,000 (range: 100,000 to 645,000) seabirds killed. Mortality estimates varied widely (Ford *et al.* 1996) as did opinions on long-term, sublethal effects on breeding (Hartung 1995; Wiens 1995; Spies *et al.* 1996; Wiens *et al.* 1996, 2001; Irons *et al.* 2000, 2001). It is critical to state that poor pre-spill, baseline data from the spill-effected region have seriously marred comparisons between pre-spill and post-spill population estimates. For example, although Common Murres accounted for ~74% of all mortalities, investigators could not differentiate between spill effects and natural marine environmental effects on murre populations (Wiens 1995; Piatt and Anderson 1996). On the other hand, there is greater certainty about effects on Bald Eagle populations with alleged recovery by 1995 (Bowman *et al.* 1997).

The long-term findings from EVOS are particularly important. Some of the bird-related science, however, reveals irreconcilable differences between interpreters of the long-term, post-spill studies. Populations of cormorants, Harlequin Duck, goldeneyes, mergansers, Pigeon Guillemot and murres continued to show negative effects up to 11 years post-spill (Esler *et al.* 2000; Irons *et al.* 2000, 2001). Irons *et al.* (2000, 2001) had completed a pre-spill (1984-85) marine bird survey in the region and suggested that long-term negative effects may be due to slow recovery from the early acute mortalities or from continued damage to habitat or feed stocks. Contrary to this, Wiens *et al.* (1996, 2001) concluded from community-level research that effects on marine bird populations diminished rapidly (by 1991) and that early concerns about colony devastation and decadal recovery periods were premature and overstated. In a pair of opposing opinions over a decade after EVOS, Wiens *et al.* (2001) and Irons *et al.* (2001) disagreed broadly on appropriate analytical design, interpretation of results and explanation of the underlying causes of marine bird population levels in oiled versus unoiled areas. At the end of the day, both groups of scientists agreed that their results were equally equivocal and each supported different interpretations. So, where does this leave the public as they desire the truth in the face of arguing scientists? What can we learn from this polarity of technical opinions? A key lesson is - science cannot necessarily yield an answer unless, firstly, we establish a marine bird population baseline and, secondly, we monitor population well-being at regular intervals to establish a time-series as a reference for facilitating post-accident comparisons. Oil spills are essentially unrepeatable experiments from which causation of outcomes cannot be verified without a solid baseline to compare pre- and post-spill states. It is for this reason that the CWS, with money from the *Nestucca* oil spill trust fund, began to collect baseline, time-series data on marine bird abundance and distribution along the west coast of Vancouver Island in 1999.

Chlorinated Hydrocarbons and Heavy Metals

Chlorinated hydrocarbon and heavy metals are potential ecosystem contaminants. Reviews of contaminants in Canadian seabirds discuss their sources, dynamics in marine ecosystems and residue levels in and effects on birds (Noble and Elliott 1986; Noble 1990; Elliott and Noble 1993). Effects on sea ducks are largely unknown, but contaminants are believed to have contributed to population declines in this group (SDJV Management Board 1999). Chlorinated hydrocarbons, also referred to as organochlorines, include first generation synthetic pesticides such as DDT (and its metabolite DDE) and dieldrin as well as industrial chemicals such as polychlorinated biphenyls (PCBs) and

dioxins. The pesticides were mainly used to control forest and agricultural pests and were transported to marine waters via runoff. PCBs are used in transformers and a variety of other industrial uses. PCBs reach the marine ecosystem directly in effluent or when waste is dumped at sea, or indirectly if waste is incompletely incinerated. Chlorinated dioxins and furans are by-products of industrial processes such as the bleaching of wood pulp using chlorine. The use of many of these contaminants has been severely restricted in both Canada and the United States for several decades because of their persistence and detrimental effects to the environment (including effects on human health). Heavy metals occur naturally in the environment. Industrial sources include mercury-based compounds used by pulp mills and cadmium and lead emissions from smelters and power plants. Lead shot used in hunting has also been a significant source of lead contamination in some estuarine systems.

Direct mortality of marine birds in the North Pacific from organochlorine poisoning has rarely been documented (Noble 1990). However, most mortality of marine birds goes undetected (Elliott and Noble 1993). Levels of heavy metals in seabirds of the northeast Pacific are not considered high enough to cause acute toxicity (Ohlendorf 1993). However, lead shot and lead fishing weights are known to cause mortality in waterfowl and, secondarily, in Bald Eagles (Scheuhammer and Norris 1999). The sublethal effects of organochlorine pesticides, PCBs and dioxins on reproduction and physiology are well documented (Elliott and Noble 1993). DDE-induced eggshell-thinning leading to reproductive failure is the most well known effect. Chronic effects of heavy metal contamination on physiology, reproduction and behaviour of seabirds are reviewed by Ohlendorf (1993). Scheuhammer and Norris (1999) review environmental impacts of lead shot and lead fishing weights.

Levels of organochlorine pesticides and PCBs in seabird eggs have been monitored on Haida Gwaii since the 1990s as part of a CWS program using seabirds as indicators of marine ecosystem contamination on Canadian coasts (Elliott *et al.* 1997). The Haida Gwaii data show that eggs of Fork-tailed Storm-petrels tend to have the highest residue levels, eggs of Leach's Storm-Petrels and Ancient Murrelets are intermediate and eggs of Cassin's Auklets and Rhinoceros Auklets contain the lowest levels. Elliott *et al.* (1997) related contaminant levels to species' feeding modes. In general, the mean residue levels of chlorinated hydrocarbons have declined in food chains of seabirds that forage inshore or on the continental shelf. However, levels in species that forage in offshore areas of the northeast Pacific did not decline significantly between the late 1960s and late 1980s (Elliott *et al*. 1992). The results may reflect the long-range transport of some insecticides and PCBs from Asia where they are still in use (Elliott *et al.* 1997). Differences in organochlorine levels in eggs from Haida Gwaii and those collected coast-wide were minor.

Bald Eagle exposure to dioxins and furans has been studied along the coast of British Columbia to determine whether levels were affecting productivity of the birds (Elliott and Norstrom 1998). Langara Island, distant from point sources, was used as a reference site. Mean concentrations of dioxin and furan contaminants were significantly lower in eagle chicks from Langara than from nests near mills. However, no significant relationship between productivity and contaminant levels in eggs was found.

Heavy metals concentrations in nesting seabirds of Haida Gwaii have been determined in five focal species (Elliott and Scheuhammer 1997). Leach's Storm-petrels nesting on Hippa Island had the highest cadmium levels and one of the highest levels reported in any wild animal. The significance of these results is unknown

however. Cadmium is being considered as a possible cause of population declines in several species of sea ducks in Alaska including White-winged Scoters and Long-tailed Ducks after elevated cadmium concentrations were found during major die-offs (Henny *et al.* 1995; Elliott and Scheuhammer 1997). Mercury levels found in Haida Gwaii seabirds were not high enough in any species to be of concern. The use of small lead fishing weights was banned in National Parks and National Wildlife Areas in 1997 due to the high numbers of waterfowl poisoned each year; a national prohibition against lead shot for hunting most species of migratory game birds followed in 1999.

Plastics

Contamination of the northern Pacific Ocean by plastics is increasing and plastic debris appears in the diets of many seabird species (Day *et al.* 1985; Day and Shaw 1987; Robards *et al.* 1997). Sources, fates and impacts of plastics in aquatic ecosystems are reviewed by Battelle Ocean Sciences (1992). The incidence of plastic ingestion by seabirds increased between the early 1970s and the late 1980s (Robards *et al.* 1997). Effects on birds of ingested plastic may include decreased bird mass and fat indices in adults and depressed fledging weights in chicks (Connors and Smith 1982; Furness 1985; Sievert and Sileo 1993). Blight and Burger (1997) examined the stomach contents of northeast Pacific pelagic seabirds caught in fishing nets and found that the stomachs of all species of surface-feeders contained plastic. Horned and Tufted Puffins also contained plastic, but three other species of divers examined (Common Murre, Rhinoceros Auklet, Xantus' Murrelet) did not. In a study of 24 seabird species in the north Pacific, Robards *et al.* (1997) reported plastic debris in all species of procellarids and puffins as well as Black-legged Kittiwakes and Parakeet Auklets. They found no plastic in Glaucous-winged Gulls, Ancient Murrelets, Marbled Murrelets or Rhinoceros Auklets. Although no data exist on the incidence of plastic in marine birds in Haida Gwaii, the ubiquity of plastic pollution suggests that local marine birds are susceptible.

Commercial Fishing and Mariculture

Coast-wide, the main issues of concern for marine birds from the fishing and mariculture industries are bird bycatch (incidental catch of non-targeted species) in finfisheries and net entanglement and habitat disruption by mariculture operations (Burger et al. 1997; Bendell-Young and Ydenberg 2001; Smith in press). Other potential problems include over-fishing of bird prey stocks and injuries to birds related to attraction to boat lights. In Haida Gwaii, marine birds are little affected by commercial invertebrate fisheries at their present level (Bourne 1997), but there may be interactions with finfisheries.
Few data exist on the extent of the bycatch problem in British Columbia, but the scope of this issue is well documented for gillnet and longline fisheries elsewhere in the North Pacific (DeGange et al. 1993; Melvin and Parrish 2001; NMFS 2001). Smith (in press) compiled seabird bycatch information for British Columbia and concluded that the data are too few to properly estimate bycatch rates or the total number of birds affected. Participants in a recent workshop on seabird bycatch in British Columbia estimated that as many as 25,000 marine birds may be killed annually in fishing gear (Morgan et al. 1999). Salmon gill net fisheries are of concern for diving seabirds and marine waterfowl (Morgan et al. 1999; Smith in press). Ancient Murrelets and Cassin's Auklets have been caught in gill nets near Langara Island during the breeding season (Vermeer and Sealy 1984; Bertram 1995) and 26 Red-throated Loons were found in winter entangled in a gill net on Haida Gwaii (D. Burles, Gwaii Haanas, personal communication). Rhinoceros Auklets and Common Murres dominated bycatch in test fisheries conducted in the late 1990s around Vancouver Island and Common and Pacific Loons were also

caught (Morgan unpublished observation, Smith in press). Marbled Murrelet was the main species caught in a 1979-1980 gillnet fishery off Vancouver Island (Carter and Sealy 1984). Longline fisheries have been associated with significant bycatch of surface feeders such as albatrosses and shearwaters. The Black-footed Albatross may be the most common bird caught in longline fisheries off British Columbia (Smith in press). Bycatch in the salmon troll and herring gillnet fisheries are considered much less serious (Morgan et al. 1999).

Entanglement in nets, alteration of habitat and disturbance have been identified as the main threats to marine birds in assessments of their interactions with mariculture operations (Rueggeberg and Booth 1989; Vermeer and Morgan 1989). For example, many species of diving ducks and shorebirds become entangled in submerged or aerial nets used in salmon culture. Mariculture operations tend to be located in sheltered bays which may overlap moulting and wintering grounds of sea ducks (Savard 1988) and feeding areas of Marbled Murrelets (Burger 2002). There is evidence of the interference with high tide feeding of wintering marine waterfowl by intertidal bivalve culture netting on beaches along the east coast of Vancouver Island (Bendell-Young and Ydenberg 2001). The pesticides used as anti-foulants in net pens are also of concern because they may be toxic to or contaminate the prey of marine birds (Duff 1988; Vermeer and Morgan 1989).

Commercial and recreational fishing of rockfish may lead to a decrease in the availability of juvenile rockfish to marine birds (Burger *et al.* 1997). Over-fishing of forage species such as Pacific herring is a concern for the many species dependent on this prey during herring spawn in the spring. Expansion of the Strait of Georgia euphausiid fishery could effect planktivorous species such as Cassin's Auklets (Vermeer and Morgan 1989; Burger 2002).

Nocturnal seabirds are attracted to lights on commercial and recreational fishing boats. Collisions with ropes and wires on fishing boats at night caused significant mortality of Ancient Murrelets around Langara Island (Bertram 1995).

Other issues include fishery discards and damage to the ocean floor by bottom trawlers ("draggers"). Discards from fish boats may change the feeding habits, population numbers and distribution of scavenging birds (Burger *et al.* 1997). Draggers may disrupt the ocean floor habitat of important prey species such as Pacific sandlance.

Habitat Loss and Degradation

Habitat loss and degradation is considered a serious threat facing Marbled Murrelets (Kaiser *et al.* 1994), sea ducks (SJDV Management Board 1999), Brant (BWG 1992 a) and shorebirds (CWS 2002) in British Columbia.

Logging and associated activities are an important conservation issue for marine birds in Haida Gwaii. Loss and fragmentation of old-growth forest nesting habitat has been identified as the most significant threat to Marbled Murrelets in British Columbia and the species is listed as threatened by COSEWIC largely as a result of logging practices (Rodway 1990; Hull 2000). Logging may also reduce nest site availability for those species of sea duck that nest in tree cavities. Logging and related road-building increase runoff and sedimentation, affecting the quality of inshore foraging areas (CWS 2002). Log-handling operations in estuaries may also degrade foraging habitats (Remington 1993 b).

Alteration of coastlines for recreation, mariculture or other development decreases habitat availability for marine birds and may degrade the quality of remaining habitat. Species that congregate

along coastlines, including inshore seabirds, marine waterfowl and shorebirds, are vulnerable. The Pacific Coast Brant Management Plan listed degradation of bays and lagoons with eelgrass, primary Brant habitat, as one of three major impediments to the species' recovery (BWG 1992 a). This was a major issue during the construction of Sandspit harbour (BWG 1992 b; Goudie and Hearne 1993). The building of a sports fishing lodge and wharf in an area of Naden Harbour set aside as a waterfowl reserve because of its high quality waterfowl habitat decreased habitat quantity and lodge activities may also have affected the quality of the surrounding area for marine waterfowl and shorebirds. Damming of rivers or streams by hydroelectric projects may affect habitat quality for nesting Harlequin Duck and Spotted Sandpiper which breed along moving water. Domestic livestock in estuarine wetlands degrade shorebird habitat and nests. For example, cattle have crushed Least Sandpiper nests in the Delkatla area (Cooper and Miller 1997).

Tourism and Recreation

The main impacts of tourism and recreational activities on marine birds in Haida Gwaii relate to disturbance of nesting, feeding and moulting birds. The majority of regional tourism is coastal and overlaps the breeding, migration and moulting seasons for most species. Gwaii Haanas had ~1870 visitors comprising 9,773 visitor-days in 2000, all of which occurred during April through September (A. Gajda, Gwaii Haanas, *personal communication)*. When guides, Gwaii Haanas staff, researchers and Watchmen are included, the total increases to 13, 731 user-days. Backcountry (wilderness) visitations in Gwaii Haanas are among the highest nation-wide for Parks Canada. Virtually all tourism in Gwaii Haanas involves small boats and occurs along the shore. Boaters traveling close to islands can cause surface-nesting seabirds as well as Peregrine Falcons to flush from their nests, leaving eggs and chicks exposed to predation (Verbeek 1982). The British Columbia Ministry of Water, Land and Air Protection guidelines for backcountry recreation recommend that motorized watercraft observe a buffer of 500 m around surface-nesting seabird sites (B.C. MoWLAP 2002). Disturbance of species such as Marbled Murrelets that forage in the same sheltered waters preferred by small boat operators is also a potential problem (Burger 2002). Sea ducks are vulnerable to disturbance from recreational boaters during moult when they are concentrated in protected bays (and are flightless) and during winter. Recreational boaters can also introduce oil into the marine waters, and lights associated with moored boats are a problem for nocturnal seabirds which become disoriented and occasionally injure themselves or die by colliding with ropes and wires near lights at night (Bertram 1995).

Approximately half of the visitors to Gwaii Haanas in 2000 camped overnight (A. Gajda, Gwaii Haanas, *personal communication)*. Campers who wander off the beaches may crush nesting burrows and campfires can injure or kill disoriented nocturnal seabirds. To protect nesting seabirds, camping is prohibited at SGaang Gwaii, East Copper, Rankine, House and Kerouard Islands year-round and until June 30 near the Ancient Murrelet colony on Ramsay Island. Many other colony sites are protected by their inaccessibility. Mandatory orientations undergone by guides and visitors emphasize the prohibition against disturbing nesting colonies. Boaters disembarking along beaches and people walking along shorelines also flush feeding shorebirds and may have significant localized impacts (CWS 2002).

The issues raised above are also applicable to areas of Haida Gwaii outside of Gwaii Haanas. Additional disturbance to feeding shorebirds comes from people running dogs or traveling by all-terrain vehicles

along shorelines (CWS 2002), two activities prohibited in Gwaii Haanas. Cooper and Miller (1997) reported that Semipalmated Sandpipers have abandoned nesting attempts on North Beach because of human disturbance. Low-flying aircraft may also disturb feeding shorebirds (CWS 2002). Recreational marine activities in winter, probably largely restricted to sheltered waters such as Skidegate and Masset Inlets, overlap significant wintering areas of marine waterfowl and Bald Eagles. Human disturbance was the leading cause of mortality of Bald Eagles in North America and disturbance by people boating and fishing in winter feeding areas was considered a significant contributor (Stalmaster and Newman 1978; Newton 1979).

The effects of recreational activities on marine birds in Haida Gwaii are poorly studied and unquantified. The field of "recreation ecology" (Liddle 1991) began with monitoring trampling effects of visitors to terrestrial parks. Marine studies have expanded to include trampling effects on intertidal rocky shores and coral reef flats. The full range of visitor effects on marine conservation areas includes trampling, fishing, diving, boating, disturbance and off-road vehicles, as reviewed by McCrone (2001). There is relatively little science on visitor effects on marine birds, but Walls (1999) provides a guide to impact issues using freshwater avifauna. Concerns include the paradox of increasing marine tourist and recreation impacts after conservation areas are declared (Jones 1994) and the need for zoning to decrease multiple use conflicts along coasts (Agardy 1993). The situation for Haida Gwaii is different, as its remoteness and attendant high costs for visitation currently limit tourism pressures.

Hunting

There is no recreational hunting in Gwaii Haanas or in Ecological Reserves. Elsewhere in Haida Gwaii including Naikoon Provincial Park, hunting is regulated under the *British Columbia Wildlife Act* and the *Migratory Birds Convention Act*. Hunted marine bird species are Harlequin Duck, Common Goldeneye, Barrow's Goldeneye and Common Snipe. Regulations include an October to January season (according to the *Migratory Birds Convention Act*), bag-possession limits and use of non-toxic shot.

For Haida food, social and ceremonial purposes, hunting marine birds and gathering their eggs is essentially unrestricted in the Haida Gwaii region including Gwaii Haanas. Species that have special conservation concern (e.g., CDC- or COSEWIC-listed species such as Marbled Murrelet) may also be taken. If the proposed federal *Species at Risk Act* is enacted, restrictions on aboriginal hunting may apply to federally-listed species under some circumstances. Public health and safety restrictions related to hunting, such as a ban on nighttime hunting, apply to all citizens.

Climate Change

A discussion of the effects of global climate change on marine birds can only be considered preliminary at present. Ocean warming has been indirectly linked to declines in seabird populations via declines in the abundances, and changes in species composition and timing, of the birds' prey (Ainley *et al*. 1996; Veit *et al.* 1996; Anderson and Piatt 1999; Bertram *et al.* 2001). Although similar population-level effects have not been documented on Haida Gwaii, declines in the breeding population of Cassin's Auklets on nearby Triangle Island have been related to changes in the zooplankton community associated with climate change (Bertram *et al.* 2000, 2001). Potential impacts tend to be extrapolated from observed effects during warm weather years or eras or depend on predictions of changes in weather, sea level, ocean

temperature, etc. El Niño events are characterised by warm oceanic waters and have been related to a decrease in the breeding success of Ancient Murrelets on Haida Gwaii (Gaston and Smith 2001). The murrelets produced fewer than one chick per pair during the 1997 to 1998 El Niño compared with more than 1.4 chicks per pair during non- El Niño years. Reduced survival of adult Cassin's Auklets was observed at Frederick Island during the same El Niño (Harfenist and Smith 2001). In a review of the potential effects of global warming on arctic-breeding birds (such as most of the shorebird species that migrate through Haida Gwaii), Boyd and Madsen (1997) stated that the most obvious concern was the loss or degradation of coastal staging areas critical during migration due to rising sea level. Changes in wind, cloud cover and precipitation may also affect migration through some regions. Butler *et al.* (1997) modeled the effect on shorebird migration in British Columbia from predicted changes in wind patterns due to global warming, and concluded that effects would likely be small.

Proposed "Nai Kun" Wind Farm Turbine Towers

A proposal was announced in 2002 to build up to 350 80 m-high towers each with three 35 m-long blades in an area nearby Naikoon Provincial Park. The proposed site, on Dogfish Bank in northwestern Hecate Strait, is one of only three major wintering sites of scoters in northern British Columbia found by Savard (1979). A description of the project can be found at http://www.uniterre.ca. Bird mortalities resulting from collisions with wind turbines are reviewed by Erickson *et al.* (2001) and updated information is available from the Avian Working Group of the National Wind Coordinating Committee [http://www.nationalwind.org]. Marine bird issues to be addressed in the Nai Kun environmental effects study include: collision with towers and/or blades, disturbance to birds, nighttime disorientation from tower aircraft-safety lighting, backup generator refueling and habitat loss.

Lights at Shore Installations

As noted in the section above on fisheries, collisions with ropes and wires is a cause of injury and mortality for nocturnal seabirds that are attracted to lights. Historically, between three and 15 birds were killed nightly at the lighthouse on St. James Island (Munro 1924). In contrast, on Langara Island only three birds were killed in three years. The difference in mortality rates between the two sites likely relates to the proximity of seabird colonies to the lightstations.

The Role of Monitoring in Marine Area Conservation

"*Before any new industry is initiated in a specific marine ecosystem such as the Queen Charlotte Basin, it is critical to establish a complete set of pre-perturbation baseline data on the biota, including life-cycle history, and their habitats, …*"

(Conclusions of Chapter 3 - Marine Ecology: Report of the Scientific Review Panel - Final Report of the Offshore Oil and Gas Task Force, January 2002)

Monitoring is fundamental to Parks Canada Agency's mandate for ecological integrity in terrestrial national parks (Woodley 1993; Parks Canada Agency 2000) and for facilitating sustainable use without compromising ecosystem structure and function in national marine conservation areas. A great benefit of protected spaces is their role as long-term regional reference sites. A key challenge is integrating monitoring costs into long-term operational funding rather than under short-term project funding. If oil and gas exploration and development proceeds, this could

further increase the importance of Gwaii Haanas as a regional baseline reference site. Industry cooperation is not a given, for example, platform operators in the northwest Atlantic have resisted having independent seabird monitors aboard despite strong recommendations (Wiese *et al.* 2001).

Although we are in the earliest stages of understanding Gwaii Haanas' marine ecosystems, we know enough to assess our monitoring needs. In the long-term, monitoring will be a foundation of Gwaii Haanas' marine management. An overall monitoring program should be achieved through interagency (PCA, CWS, DFO) and public consultation because the data would be a shared regional marine asset. Ideally, appropriate monitoring would both assist Gwaii Haanas management and feature Gwaii Haanas as a marine environmental reference site for Pacific Canada.

Monitoring should be treated as part of **adaptive management**. This is, a structured process of "learning-by-doing" that treats management as an experiment in which hypotheses are formulated and findings are used to test these hypotheses. Included in an adaptive management regime are target variables, pre-set values and decision points (management options) established in advance depending on whether explicit performance criteria are met. Monitoring facilitates the feed-back necessary to guide adjustments as the experiment unfolds and instructs managers. Monitoring should, therefore, be experimental and begin with a conceptual model of the ecosystem and be focused on the population dynamics of selected species relative to key ecosystem components and physio-chemical environmental variables (Davis 1993).

In a major marine area conservation review of science (NRC 2001), the following three tasks were considered central to monitoring:

- assessing management effectiveness;
- measuring long-term trends in ecosystem properties; and
- evaluating economic impacts, community attitudes, involvement and compliance.

To these we would add maintaining scientific accuracy and repeatability.

Parks Canada's marine policy (Parks Canada 1994; Mercier and Mondor 1995) alludes to goals for a monitoring program as follows:

- ensuring long-term viability of marine ecosystems;
- understanding natural spatial and temporal variability in structure (e.g., biodiversity) and function (e.g., production);
- learning how human impacts such as harvest are embedded within the background of natural variability; and
- relating present-day ecosystem conditions to past ecosystem conditions.

There is rapid expansion both in marine monitoring science (Schmitt and Osenberg 1996) and governments' commitments to marine monitoring. In Canada, monitoring marine environmental quality is an initiative for both EC and DFO. It is one of three components of DFO's Ocean Management Strategy under the *Oceans Act*. Both EC and DFO have collaborated through the National Marine Indicators Working Group to develop categories of marine indicators - parameters tracked over time to reveal trends in processes of interest such as resource use or ecosystem health (Smiley *et al.* 1998; Vandermeulen 1998). Fisheries and Oceans Canada has launched a national initiative to facilitate use of indicators towards marine environmental quality (DFO 2000). As well, the United States has issued its first nation-wide strategy for coastal marine monitoring (CRMSW 2000 [http://www.cleanwater.gov]). These

developments highlight the advances in marine monitoring relevant to interagency cooperation.

Parks Canada has not been part of the interagency marine monitoring cooperation, but this will change in the context of Gwaii Haanas. The above quote from the Final Report of the Offshore Oil and Gas Task Force (January 2002) is noteworthy. A $2M grant was awarded in April, 2002 to the Northern Land Use Institute of the University of Northern British Columbia, Prince George [http://www.unbc.ca/nlui] to develop a northern Coastal Ecosystem Research Program predicated on follow-up of the recommendations of the scientific review panel. Clearly there is an opportunity in the process of developing a marine baseline for an important role for marine bird knowledge.

There also is monitoring in aid of ecosystem restoration or rehabilitation within a conservation area. Monitoring could help identify, locate and estimate the spatial scale of threats to marine ecosystems. For site management, we must know which threats can be locally managed. Climate change, some species introductions and external (non-point source) pollution cannot, although they are worthy of monitoring. On the other hand, habitat destruction, other species introductions and overfishing are manageable within a conservation area. Those threats for which the spatial scales match those of conservation areas should be the prime management focus. However, Parks Canada marine policy is clear that in order to support our regional representation mandate, and in keeping with the openness and dynamism of marine environments, we must be concerned "*well beyond*" marine conservation area boundaries (Parks Canada 1994). An example would be monitoring migratory marine birds that temporarily occupy Gwaii Haanas.

Marine Birds in Marine Monitoring

"*Colonial seabirds can be useful indicators of changes in marine ecosystems.*" (Gaston and Smith 2001)

Marine birds are good indicators of changes in marine ecosystems (Furness and Greenwood 1993; Furness and Camphuysen 1997). As predators relatively high in marine food webs, they are sensitive to changes in food supply and good bio-accumulators of contaminants. Seabirds, for example, are useful because their life-histories are often relatively well known and their colonial breeding habits facilitate sampling (Vermeer *et al.* 1997 c).

Protected areas are good reference sites for marine bird monitoring and there is precedent for their use along in the northeast Pacific. Channel Islands National Park in southern California has been the U.S. National Park Service's national development location for marine monitoring (Davis 1993). As part of their overall program, seabirds have been continuously monitored there since 1985 (Lewis *et al.* 1988). Their protocol, focusing on detecting population changes over time rather than on causes of changes, includes the following:

- numbers of breeding birds as indicators of population trends;
- numbers of fledged young as indicators of reproductive success;
- timing (phenology) of egg-laying, hatching and fledging; and
- proportions of non-breeding juveniles to breeding adults.

Marine Birds in Contaminant Monitoring

Gilbertson *et al.* (1987) reviewed in detail the utility of seabirds in monitoring contaminant levels and their criteria are relevant to all marine bird species. In general, as long-lived, wide-ranging species near the top of the food chain, marine birds

effectively reflect changes in contaminant levels (Furness and Camphuysen 1997). Five species of seabirds have been used as indicators of chlorinated hydrocarbon and heavy metal contamination of the marine ecosystem around Haida Gwaii (Elliott *et al.* 1989, 1997). The species were selected to represent the following feeding guilds:

- Leach's and Fork-tailed Storm-Petrels (offshore surface-feeder);
- Rhinoceros Auklet (continental shelf, sub-surface piscivore); and
- Cassin's Auklet and Ancient Murrelet (continental shelf, sub-surface planktivore).

Bald Eagles have been used as indicators of nearshore pulp mill contamination (Elliott and Norstrom 1998).

Marine Birds in Ecosystem and Population Monitoring

The relationships between prey abundance and/or composition and various aspects of marine bird breeding biology have been studied in many species (Monaghan *et al.* 1994; Golet *et al.* 2000). Seabirds have also been used to assess the effects of ocean warming (Ainley *et al.* 1996; Veit *et al.* 1996). In Haida Gwaii, studies on Rhinoceros Auklets (on SGaang Gwaii), Ancient Murrelets (on East Limestone Island) and Cassin's Auklets (on Frederick Island) contributed to a monitoring program on the effects of the 1997/1998 El Niño event from California through Alaska (Bertram *et al.* 1999; Gaston and Smith 2001; Harfenist and Smith 2001; Bertram *et al. in press*).

Population monitoring programs are an integral component of existing regional, national and international marine bird conservation and management plans. Monitoring species and identifying population trends is the first step in an integrated population approach to bird conservation promoted by CWS (Hipfner *et al.* 2002). If declines are noted, the next steps are as follows:

- understand the demographic reasons for the decline;
- reveal the environmental and/or anthropogenic reasons for the decline;
- take management action; and
- assess the efficacy of management action.

The CWS has developed regional (Pacific and Yukon) conservation plans for seabirds (Hipfner *et al.* 2002), waterbirds including loons, grebes, gulls, skuas and jaegers (Morgan 2002), sea ducks (Breault 2002) and shorebirds (CWS 2002). Each plan refers to national and international management plans such as the North American Waterbird Conservation Plan (NAWCP 2000) and the Sea Duck Joint Venture (SDJV Continental Technical Team 2001) in acknowledgement of the international nature of managing species that migrate across provincial and national borders. Conservation plans in North America are coordinated through The North American Bird Conservation Initiative.

Of the CWS conservation plans outlined above, only the seabird plan includes a detailed monitoring plan for marine birds that has been underway for several decades. The seabird monitoring program involves population surveys at representative breeding colonies of Ancient Murrelets, Cassin's Auklets and Rhinoceros Auklets every five years (Hipfner *et al.* 2002). Colony surveys are used because population trends of seabirds are most effectively detected at breeding colonies (Anker-Nilssen *et al.* 1996). The focal species were chosen because British Columbia supports at least one half of the world's population of each. Additional colonies and species are surveyed on an opportunistic basis or to track the recovery of populations following the eradication of introduced predators.

No targeted monitoring programs have been implemented to date for species covered by the CWS waterbird conservation plan (Morgan 2002). These species have been largely ignored in the past in part because they do not fall neatly into freshwater or saltwater habitat categories. The draft priority species for monitoring identified in the plan include Red-throated Loon, Pied-billed Grebe, Horned Grebe, Western Grebe, Bonaparte's Gull, Ring-billed Gull and Caspian Tern.

Sea and freshwater ducks are addressed under the CWS waterfowl conservation plan (Breault 2002). Freshwater ducks have been extensively monitored in British Columbia and elsewhere in North America for decades, but monitoring of sea ducks is relatively new. The plan notes the need to delineate important marine areas used by sea ducks during migration, moult and winter, and to develop and implement a monitoring program at selected sites.

The monitoring component of the CWS shorebird conservation plan (CWS 2002) has not been implemented outside the Strait of Georgia. Appropriate monitoring protocols have not yet been developed for many shorebird species and surveys conducted in British Columbia have indicated habitat preferences, but rarely have been adequate to track population trends (CWS 2002). Suggested umbrella species (used as an indicator for other species using the same habitat) include Black Oystercatchers, Western Sandpipers and Red-necked Phalaropes to represent rocky shoreline, coastal lowland and open ocean habitats, respectively. To date, the work done by the Laskeek Bay Conservation Society in conjunction with the British Columbia Coastal Waterbird Study is the only long-term monitoring program for Black Oystercatchers coast-wide (S. Hazlitt, Bird Studies Canada, *personal communication*).

The British Columbia Ministry of Water, Land and Air Protection has conducted a monitoring program for Peregrine Falcons since 1971 (Edie and Munro 1990). Parks Canada Agency collaborates on the archipelago-wide surveys. Numbers of active eyries are counted at approximately 5-year intervals (Edie 1995). The monitoring of annual productivity of peregrines at Langara Island is conducted through the personal efforts of Wayne Nelson and is not part of an agency program (R.W. Nelson, *personal comunication*).

In cooperation with the U.S. Geological Survey, CWS also monitors trends in North American bird populations through the Breeding Bird Survey (BBS). The BBS provides indices of relative abundance derived from counts along roadside survey routes and, thus, is not an appropriate monitoring tool for many species of marine birds. For example, BBS data indicate a serious annual rate of decline in many species of sea ducks, but survey routes miss most of the sea duck breeding grounds. BBS results and a summary of factors influencing the utility of those results can be found on the BBS website [http://www.mbr-pwrc.usgs.gov/bbs/] or the CWS bird trends web site [http://www.cws-scf.ec.gc.ca/birds/trends].

The monitoring plans outlined above were developed to meet the mandates and priorities of agencies other than Parks Canada and at scales other than the Haida Gwaii region. The priority species, sensitivities of the protocols to changes in populations and the time frames involved may not be appropriate for Haida Gwaii or Parks Canada. However, they represent the best starting point from which Parks Canada can develop cooperative monitoring. The CWS plans refer to being able to detect 10% changes in populations with at least an 80% certainty. Sufficient data are available for nesting seabird populations to determine whether the methods employed are adequate to meet

the monitoring plan goals, but this has not yet been done. The North American Waterbird Conservation Plan (NAWCP) outlines census techniques for burrow-nesting seabirds with a goal of detecting ≤ 20% change in numbers of birds at a breeding site with a power of 90% at 0.1 level of significance (NAWCP 2000).

Non-government organizations also support bird monitoring programs in Haida Gwaii. The National Audubon Society sponsors annual CBCs which are counts by volunteers of all birds seen in an area on one day in mid-December to early January. Locally, CBCs are organized and compiled by the Delkatla Sanctuary Society. The objective is to monitor trends and distributions of bird populations in the Western Hemisphere. CBCs are conducted each year at Masset, Port Clements, Rose Spit and Skidegate Inlet (Queen Charlotte City, Sandspit and Skidegate). The protocol is described at the CBC website [http://www.mbr-pwrc.usgs.gov/bbs/cbc.html] and results are widely available [http://birdsource.tc.cornell.edu/cbcdata/]. CBC results have been used to describe population and distribution trends in some species that winter in British Columbia (Campbell *et al.* 1990 a, b). However, Burger (2002) concluded that the decline in Marbled Murrelet populations indicated by CBC data is misleading as count sites do not overlap wintering concentrations of the birds. The British Columbia Coastal Waterbird Survey, coordinated by Bird Studies Canada, is a recently-initiated land-based monitoring program that will provide baseline data on relative abundance and distribution patterns for multiple species. Of the ~250 sites monitored monthly by volunteers, two are in Haida Gwaii (Rose Spit and Sandspit).

Information Gaps

Any monitoring program for marine birds in Haida Gwaii must be founded on adequate baseline information. However, the knowledge base for marine birds in Haida Gwaii is very incomplete. Gaps in that baseline are identified below. As it will not be possible to develop a complete inventory of regional marine birds, we prioritize which gaps are the most important to fill in the Recommendations section that follows.

Breeding population estimates are available for many species of seabirds and shorebirds as well as for Bald Eagles and Peregrine Falcons throughout the archipelago. In contrast, estimates for all but one species of marine waterfowl are highly speculative.

The CWS seabird colony inventories provide a baseline for some species and nesting sites. However, many of the estimates have either no or very large confidence limits which may render them inadequate for monitoring purposes (Huettmann 2002). The estimates for Fork-tailed and Leach's Storm-petrels at many colonies were calculated using an average ratio of Fork-tailed to Leach's determined at other sites, as well as the average British Columbia occupancy rate. The estimates for Tufted and Horned Puffins are based on the number of birds flying by or standing near burrow sites and neither method has been shown to be a reliable measure of breeding population. However, the burrows of both species tend to be in fairly inaccessible areas and it may not be feasible to improve the reliability of the estimates. Pigeon Guillemot estimates are based on counts of birds on the water near islands because it is difficult to locate nests. A more accurate methodology for counting this species has not yet been developed. Marbled Murrelets are not colonial nesters and were, thus, not covered by the CWS colony inventories. Only recently have methodologies been developed to accurately count these birds.

Inventories are inadequate for marine waterfowl nesting throughout the archipelago with the exception of the Red-

throated Loon. Although nest sites were recorded during lake and stream inventories in Gwaii Haanas and Naikoon, those observations were incidental to the main work. The timing and duration of surveys was not optimal for assessing use by nesting birds (Reimchen *et al.* 1994). Lake surveys specifically designed to census marine waterfowl are required to fill this gap. Haida Gwaii probably does not support large nesting populations of most marine waterfowl species.

Nesting by several species of shorebird is confined to the Delkatla/Masset area and has been monitored to assess the success of the restoration of tidal flow to Delkatla Slough. Four species are more widespread throughout the archipelago. The CWS seabird colony inventories provide baseline population estimates for Black Oystercatchers nesting on colony islands. Oystercatchers nesting on the shorelines of Graham and Moresby have not been counted, but the colony island counts probably provide an adequate baseline against which to assess regional trends. Semipalmated Plovers have only been counted over a small portion of their nesting range. This species is the only shorebird known to nest extensively along the sand/cobble beaches along the eastern coastline of Graham Island and are subject to human disturbance. The breeding population of Spotted Sandpipers and Killdeer are unknown, but would be difficult to assess given the nesting habitats used by these birds.

Bald Eagle nests have been well inventoried along much of the coastline of the archipelago; inventories are incomplete along the shores and in the interiors of Graham and Moresby Islands. Peregrine Falcon eyrie surveys have covered all of the coastline of Haida Gwaii with the exception of north and east Graham Island where the topography is largely unsuitable for nesting by this species.

As was noted in the Methods section of this report, British Columbia Nest Record Scheme data were not available for inclusion. More precise mapping of known nest sites of several marine bird species will be possible when those data are obtained.

Although there are many observations of marine birds at sea and along the shorelines, the available data are insufficient to provide a baseline for monitoring population trends of moulting, migrating or wintering birds at a local or regional scale. The British Columbia Coastal Waterbird Survey may eventually address this lack at two sites in Haida Gwaii. Observations from the Delkatla area following the causeway breaching are presently being compiled (P. Hamel, Delkatla Sanctuary Society, *personal communication)* and may provide good baseline information at a third site. Key marine habitats are also poorly described. Seabird conservation efforts have focused on colony sites leaving foraging areas relatively unknown. The importance of the large estuaries and inlets to marine waterfowl and shorebirds throughout much of the year has been studied, but use of most of the smaller estuaries and inlets has not been well documented.

As Huettmann (2002) pointed out, total population size is unknown for any species of marine bird in British Columbia. Total population includes non-breeding adults and immature birds found away from the nesting areas as well as breeding birds.

RECOMMENDATIONS

We conclude that marine birds are key components of the structure and function of local marine ecosystems, culturally important to the Haida, potent symbols of ecosystem well-being for the general public, and valuable indicators of ecosystem status. There are, however, large gaps in our knowledge, rendering the baseline inventory of marine birds in Haida Gwaii

incomplete. This incomplete mosaic of information underscores the importance of employing the precautionary approach in an adaptive management regime – we have much learning to do as we evolve towards long-term, ecosystem-based marine bird conservation. There are strong roles for Gwaii Haanas (rocky shoreline and small estuary habitats) and Naikoon (sand to cobble-boulder shoreline and freshwater habitats) as long-term-protected reference sites in this critical learning process that involves our entire society. As well, migratory species elevate conservation into a global responsibility. Finally, marine birds will rightly play an important ecosystem status role given the prospect of oil and gas exploration and development in the Hecate Strait-Queen Charlotte Sound area.

Adequate breeding population estimates are available for most species of seabirds, shorebirds and marine raptors that nest on Haida Gwaii. The CWS seabird colony inventories provide a good starting point. In contrast, estimates for most species of nesting marine waterfowl are speculative. There are no population estimates for Haida Gwaii that combine the number of breeding birds of a species with the number of non-breeding adults and immature birds found in regional marine waters to give an estimate of total population size (Huettmann 2002). The available data on moulting, migrating and wintering marine birds are insufficient to provide a baseline for monitoring population trends.

Based on the knowledge recounted herein, where should we go from here with marine bird protection in Haida Gwaii? To address these concerns, and fill key information gaps, we recommend the following:

- **improve baseline population estimates for selected seabirds breeding on Haida Gwaii**

"If one lesson rings loud and clear from the Exxon Valdez experience, it is that pre-perturbation baseline data are absolutely critical for understanding what resources are at risk from development, as well as evaluating the population and community level consequences following development." (Esler 2002)

Fork-tailed and Leach's Storm-petrels - estimates for both species are inadequate. At many colonies, estimates were calculated using an average ratio of Fork-tailed to Leach's determined at other sites and the average British Columbia occupancy rate. Storm-petrels constitute a significant portion of Gwaii Haanas' marine birds, warranting better population baselines.

Marbled Murrelet - are not colonial nesters and have not been covered by the CWS colony inventories. Radar surveys are needed in selected inlets in conjunction with habitat suitability mapping to develop population estimates for this threatened species.

- **delineate important foraging, moulting, staging and wintering sites of selected seabird, sea duck and shorebird species populations**

"The large number of sea duck species, the vastness of their geographic range, and the complexity of issues affecting their conservation make sea duck management a task beyond the capability of one government agency, or even a single country. However, indicated population declines in 10 of the 15 species dictate that action must be taken now." (Sea Duck Joint Venture[SDJV] Management Board 1999)

More than 60% of Canadian sea duck and shorebird species populations are considered in decline. The delineation of important marine and coastal areas for sea ducks and shorebirds is a principal recommendation in the SDJV Strategic Plan (SDJV Continental Technical Team 2001) and the Canadian Shorebird Conservation

Plan (Donaldson *et al.* 2000). Although there are many observations of marine birds at sea and along the shorelines in Haida Gwaii, spatial coverage is poor and variability on daily, seasonal and annual time-scales is unknown. Key foraging, moulting and staging habitats are poorly described with the exception of the large inlets and estuaries; uses within smaller inlets and estuaries need to be better documented. Surveys should be conducted over eight months from late summer through winter to identify key areas for marine birds. A priority within Gwaii Haanas is to delineate important marine and coastal areas during late summer when the main threats from human disturbance overlap the moulting season of sea ducks and fall migration of many shorebirds. Because systematic pelagic surveys are costly, Burger *et al.* (1997) suggested a 3-step process to identify and map critical marine habitats as follows:

(1) analyze bird densities and species compositions in relation to ocean features;

(2) apply predictive relationships derived from the data to the study areas; and

(3) test and improve maps using systematic boat surveys in selected areas.

This process could be particularly useful in Haida Gwaii where ocean features are better studied than are bird distributions. A GIS-based database of pelagic and inshore bird distributional data developed by CWS will soon be available to facilitate analyses of at-sea data (K. Morgan, CWS, *personal communication)*.

- **develop an overall marine bird monitoring plan for Gwaii Haanas**

"For seabird colony data and population trends, most of the information is either old … or carry no or huge confidence intervals; they cannot always be used reliably for management and science …" (Huettmann 2002)

Existing marine bird monitoring plans are not adequate for assessing the well-being of breeding and non-breeding populations in Haida Gwaii. We acknowledge that we cannot monitor all marine bird species at every site. Priority species should include:

- indicator species chosen to represent major ecological niches and a diversity of foraging zones;
- species for which land managers of Haida Gwaii have a regional monitoring responsibility;
- species listed as of special conservation concern by an objective, scientifically-based process if significant portions of their populations are found in Haida Gwaii;
- species with established time-series data;
- species for which we have linkages with other oceanographic data sets;
- species of cultural significance to the Haida community; and
- species for which accurate and precise survey methodologies have been developed and are economically feasible.

At present, a monitoring plan for Gwaii Haanas should focus on breeding populations of Leach's or Fork-tailed Storm-petrel, Black Oystercatcher, Marbled Murrelet, Ancient Murrelet, Cassin's Auklet, Rhinoceros Auklet and Peregrine Falcon. A deeper analysis of historical data from CWS seabird monitoring program will likely indicate that the methods in use cannot detect trends of desired magnitude and with the desired level of confidence. In collaboration with the CWS and the North American Waterbird Conservation Plan (NAWCP 2000), current methodologies should be enhanced. Indices of productivity should be incorporated into the monitoring plan (Esler 2002) and threshold values that would trigger further

management action should be determined for all monitored species. Collaboration with CWS and MoWLAP will be critical to development of a archipelago-wide monitoring plan for Marbled Murrelets and collaboration with MoWLAP will be integral for continued surveys of Peregrine Falcons. Falcon productivity should be monitored in cooperation with Wayne Nelson's work on Langara Island.

Gwaii Haanas should partner with CWS and local NGOs to monitor trends in numbers and distributions of birds at sea once detailed regional (British Columbia and Yukon) monitoring plans are developed by CWS. Agreements on the utility and feasibility of targeting selected species regionally will have to be reached.

Beached-bird surveys should be included in a marine bird monitoring plan. Given the possibility of future offshore oil and gas development, baseline data for representative coastal areas should be determined. Monitoring of contaminant levels in marine birds in Haida Gwaii is conducted outside the borders of Gwaii Haanas. There is no reason to expand the present program to include more sites.

- **continue recording and analyses of traditional Haida knowledge on marine birds**

Marine birds are significant symbols of the natural world for Haida people and their culture. For this reason and marine birds' historical subsistence value, it is important that all traditional marine bird knowledge be brought to light. This applies to bird use in the archaeological record, songs, stories and geo-referenced traditional ecological knowledge. An important use of this knowledge is for formulating hypotheses to test in adaptive management regimes (Sloan 2002). This helps give respect to this knowledge source and utility in contemporary management.

- **deepen scientific cooperation with other government agencies, the Council of the Haida Nation and NGOs on regional marine bird issues**

" … effective application of ecological integrity principles will require collaboration and partnerships among federal science-based departments and agencies, and between the government and its non-federal partners." (Industry Canada - IC 2000)

Industry Canada, the highest federal science policy forum, strongly recommends collaboration to offset the complexity and scope of contemporary science-based conservation issues. This is particularly relevant to marine bird conservation because the highly migratory species use a wide range of habitat types and, thus, overlap jurisdictions and agency mandates. All regional, national and international marine bird conservation plans emphasize the critical nature of interagency cooperation. In Haida Gwaii, cooperation with Naikoon Provincial Park will be required to ensure that marine bird species representing a full suite of ecological niches are adequately monitored and managed. Breeding Semipalmated Plover and Red-throated Loon as well as migrating coastal lowland shorebird species are best monitored outside the boundaries of Gwaii Haanas. Naikoon supports significant portions of the archipelago populations of all three and conservation of species and critical habitats are objectives outlined in the Naikoon Management Plan (B.C. Parks 1999).

Cooperation will be required to ensure that regional databases of marine bird observations and survey results are maintained. Parks Canada Agency should develop a data sharing policy and encourage its partners in marine bird conservation to do likewise.

- **continue counteracting introduced predator effects on seabird colony islands**

An introduced predator program must counteract existing exotic species problems and prevent future invasions. Gwaii Haanas should continue to participate in efforts to monitor and control raccoons on seabird colony islands. Rat eradication should be conducted where feasible and the recovery of populations following an eradication program should be monitored. A contingency plan to prevent rat invasions of additional islands should be prepared. A program developed by the U.S. Fish and Wildlife Service in Alaska can be used as a model. Vigilance must be maintained to ensure that all vessels and supplies are rat-free.

Parks Canada Agency should also remain current on control methodologies. Although it is presently not feasible to address impacts of introduced predators on shorebirds and marine waterfowl nesting on the beaches, lakes and streams of Moresby, Graham and other large islands, new methodologies may be developed that allow action in these areas.

- **minimize human impacts to breeding sites and key marine areas**

Minimizing human disturbance of breeding birds will involve managing visitor activities nearby known nesting sites. It may include additional restrictions on activities, such as a ban on non-emergency campfires at night and in season at some well-known camping sites. Managing mooring sites to limit light-induced mortality or injury as was suggested for SGaang Gwaii should be enforced. As well, limiting recreational access to important moulting sites should be considered.

Detrimental interactions between marine birds and marine fisheries activities should also be managed. Designating locations where the use of fishing gear designed to reduce bird bycatch (seabirds and marine waterfowl) is mandatory would significantly decrease marine bird mortalities. Methods for reducing bycatch have been tested for both longline and gillnet fisheries and some jurisdictions have programs involving modification of gear in place.

- **develop an oil spill response plan for Gwaii Haanas**

The plan should include strategies to monitor and address long-term, low-level pollution as well as acute effects of spills. Gwaii Haanas staff should have basic oil spill response preparedness and know how to work with other agencies to best deal with oiled birds and threats to colony beaches. For example, audio-repelling devices have been used with great success in Quebec to enhance birds' spill avoidance.

- **incorporate marine bird use of fish species into fishery management plans and regulations**

Herring, rockfish and salmon are important fish prey for marine birds in Haida Gwaii, yet the birds' requirements are not explicitly incorporated into DFO's Integrated Fisheries Management Plans – not an ecosystem approach. For example, the reliance of marine birds on herring spawn should be understood when establishing quotas. Herring spawning represents a dramatic annual pulse of energy into nearshore Haida Gwaii food webs. And yet, the overall benefits derived by marine species feeding on this abundance are not known. Although Schweigert and Haegele (2000) concluded, from a fisheries point of view, that effects of marine bird predation were not detectable in herring spawn assessments in southern British Columbia, similar analyses have not been done for the Haida Gwaii region. Further, why not look at the herring spawn from a different (bird-based) view point?

What are the effects of the dramatic pulse of energy-rich herring spawn on marine bird seasonal dynamics such as preparation for breeding?

- **improve regional biological oceanographic knowledge**

Conservation efforts for marine birds must include conservation of their prey. Yet, our knowledge of the abundance and distribution of important prey species of marine birds is poor. Of particular note are the large euphausiids and copepods comprising a major portion of planktivores' diets and sandlance which are critical for many piscivores.

- **assess impacts of cadmium enrichment on Leach's Storm-petrel**

Exceptionally high levels of cadmium have been found in Leach's Storm-petrels nesting in Haida Gwaii, presumably from their food. The effects of high body burdens of cadmium are unknown. Although no causal relationship has been established, cadmium has been associated with scoter mortalities in Alaska.

- **build capacity in the Parks Canada Agency staff**

As the individuals most frequently in Gwaii Haanas, park wardens should be integral to implement monitoring of a selection of the area's marine bird species. The monitoring function, funded by A-base (routine operations) dollars, should be supported by staff (e.g., wardens and ships' crews) training developed in cooperation with CWS partners who have the technical background to share and the specific marine bird protection mandate.

- **ensure that maps demarcate protected terrestrial and marine areas**

Available topographical, marine and recreation maps of Haida Gwaii do not provide complete information on protected areas. Residents and visitors need to know the protected status of lands and waters and the restrictions that apply. Zones established within the proposed Gwaii Haanas National Marine Conservation Area will also need to be noted on maps.

- **maintain a good Haida Gwaii marine bird reference library**

During the writing of this review, it was clear that reference libraries in government agencies have deteriorated. Unpublished reports were commonly unavailable from sponsoring agencies. In some cases, even authors no longer had copies. Further, some data were stored in outdated, inaccessible electronic formats. As an aspiring regional biodiversity knowledge centre, Gwaii Haanas should maintain hard copies of these unpublished or grey literature documents.

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Appendix A.

The common and scientific names of marine bird species recorded from the Haida Gwaii region (data from Morgan *et al.* 1991; Morgan 1997; Hamel and Hearne 2001; K. Morgan, CWS, *personal communication*) and species' special conservation status. The species are listed in the conventional order of the 42nd supplement to the American Ornithologists Union's *Check-list of North American Birds*, 7th edition (AOU 2000). The species' special conservation status designations are from provincial (Conservation Data Centre, Victoria - CDC), national (Committee on the Status of Endangered Wildlife in Canada, Ottawa - COSEWIC) and international (World Conservation Union, Gland, Switzerland - IUCN) organizations.

Common Name	Scientific Name	CDC Rank[1]	COSEWIC Rank	IUCN Rank
Red-throated Loon	*Gavia stellata*			
Pacific Loon	*Gavia pacifica*			
Common Loon	*Gavia immer*		examined; not listed	
Yellow-billed Loon	*Gavia adamsii*		examined; not listed	
Pied-billed Grebe	*Podilymbus podiceps*			
Horned Grebe	*Podiceps auritus*			
Red-necked Grebe	*Podiceps grisegena*		examined; not listed	
Eared Grebe	*Podiceps nigricollis*			
Western Grebe	*Aechmophorus occidentalis*	Red		
Laysan Albatross	*Phoebastria immutabilis*	Blue		
Black-footed Albatross	*Phoebastria nigripes*			Vulnerable
Short-tailed Albatross	*Phoebastria albatrus*	Red		Vulnerable
Northern Fulmar	*Fulmarus glacialis*			
Murphy's Petrel	*Pterodroma ultima*			Near threatened
Mottled Petrel	*Pterodroma inexpectata*			
Pink-footed Shearwater	*Puffinus creatopus*	Red		Vulnerable
Flesh-footed Shearwater	*Puffinus carneipes*	Blue		
Buller's Shearwater	*Puffinus bulleri*	Blue		Near threatened
Sooty Shearwater	*Puffinus griseus*			
Short-tailed Shearwater	*Puffinus tenuirostris*			
Manx Shearwater	*Puffinus puffinus*			
Black-vented Shearwater	*Puffinus opisthomelas*			Vulnerable
Fork-tailed Storm-Petrel	*Oceanodroma furcata*			
Leach's Storm-Petrel	*Oceanodroma leucorhoa*			
Brandt's Cormorant	*Phalacrocorax penicillatus*	Red	candidate list[2]	
Double-crested Cormorant	*Phalacrocorax auritus albociliatus*	Red	candidate list	
Red-faced Cormorant	*Phalacrocorax urile*			
Pelagic Cormorant	*Phalacrocorax pelagicus*	Red		
Magnificent Frigatebird	*Fregata magnificens*			
Brant	*Branta bernicla*			
Steller's Eider	*Polysticta stelleri*			Vulnerable
King Eider	*Somateria spectabilis*			
Common Eider	*Somateria mollissima*			
Harlequin Duck	*Histrionicus histrionicus*		Special concern (eastern population)	
Surf Scoter	*Melanitta perspicillata*	Blue		
White-winged Scoter	*Melanitta fusca*			
Black Scoter	*Melanitta nigra*			
Long-tailed Duck[3]	*Clangula hyemalis*	Blue		
Bufflehead	*Bucephala albeola*			
Common Goldeneye	*Bucephala clangula*			

Common Name	Scientific Name	CDC Rank[1]	COSEWIC Rank	IUCN Rank
Barrow's Goldeneye	*Bucephala islandica*		Special concern (eastern population)	
Hooded Merganser	*Lophodytes cucullatus*			
Common Merganser	*Mergus merganser*			
Red-breasted Merganser	*Mergus serrator*			
Bald Eagle	*Haliaeetus leucocephalus*		examined; not listed	
Peale's Peregrine Falcon[4]	*Falco peregrinus pealei*	Blue	Special concern	
Black-bellied Plover	*Pluvialis squatarola*			
American Golden Plover	*Pluvialis dominica*	Blue		
Pacific Golden Plover	*Pluvialis fulva*			
Mongolian Plover	*Charadrius mongolus*			
Snowy Plover	*Charadrius alexandrinus*			
Semipalmated Plover	*Charadrius semipalmatus*			
Killdeer	*Charadrius vociferous*			
Black Oystercatcher	*Haematopus bachmani*			
Greater Yellowlegs	*Tringa melanoleuca*			
Lesser Yellowlegs	*Tringa flavipes*			
Wood Sandpiper	*Tringa glareola*			
Solitary Sandpiper	*Tringa solitaria*			
Wandering Tattler	*Heteroscelus incanus*	Blue		
Spotted Sandpiper	*Actitis macularia*			
Upland Sandpiper	*Bartramia longicauda*	Red		
Whimbrel	*Numenius phaeopus*			
Hudsonian Godwit	*Limosa haemastica*	Red		Near threatened
Bar-tailed Godwit	*Limosa lapponica*			
Marbled Godwit	*Limosa fedoa*			
Ruddy Turnstone	*Arenaria interpres*			
Black Turnstone	*Arenaria melanocephala*			
Surfbird	*Aphriza virgata*			
Red Knot	*Calidris canutus*			
Sanderling	*Calidris alba*			
Semipalmated Sandpiper	*Calidris pusilla*			
Western Sandpiper	*Calidris mauri*			
Red-necked Stint	*Calidris ruficollis*			
Least Sandpiper	*Calidris minutilla*			
White-rumped Sandpiper	*Calidris fuscicollis*			
Baird's Sandpiper	*Calidris bairdii*	Red		
Pectoral Sandpiper	*Calidris melanotos*			
Sharp-tailed Sandpiper	*Calidris acuminata*			
Rock Sandpiper	*Calidris ptilocnemis*			
Dunlin	*Calidris alpina*			
Curlew Sandpiper	*Calidris ferruginea*			
Stilt Sandpiper	*Calidris himantopus*			
Buff-breasted Sandpiper	*Tryngites subruficollis*			
Ruff	*Philomachus pugnax*			
Short-billed Dowitcher	*Limnodromus griseus*	Blue		
Long-billed Dowitcher	*Limnodromus scolopaceus*			
Common Snipe	*Gallinago Gallinago*			
Wilson's Phalarope	*Phalaropus tricolor*			
Red-necked Phalarope	*Phalaropus lobatus*	Blue		
Red Phalarope	*Phalaropus fulicaria*			
South Polar Skua	*Stercorarius maccormicki*			
Pomarine Jaeger	*Stercorarius pomarinus*			

Common Name	Scientific Name	CDC Rank[1]	COSEWIC Rank	IUCN Rank
Parasitic Jaeger	*Stercorarius parasiticus*			
Long-tailed Jaeger	*Stercorarius longicaudus*			
Franklin's Gull	*Larus pipixcan*			
Bonaparte's Gull	*Larus philadelphia*			
Heermann's Gull	*Larus heermanni*			Near threatened
Mew Gull	*Larus canus*			
Ring-billed Gull	*Larus delawarensis*			
California Gull	*Larus californicus*	Blue		
Herring Gull	*Larus argentatus*			
Thayer's Gull	*Larus thayeri*			
Slaty-backed Gull	*Larus schistisagus*			
Western Gull	*Larus occidentalis*			
Glaucous-winged Gull	*Larus glaucescens*			
Glaucous Gull	*Larus hyperboreus*			
Sabine's Gull	*Xema sabini*			
Black-legged Kittiwake	*Rissa tridactyla*			
Red-legged Kittiwake	*Rissa brevirostris*			Vulnerable
Caspian Tern	*Sterna caspia*	Blue	Delisted	
Arctic Tern	*Sterna paradisaea*			
Aleutian Tern	*Sterna aleutica*			
Common Murre	*Uria aalge inornata*	Red	candidate list	
Thick-billed Murre	*Uria lomvia*	Red	candidate list	
Pigeon Guillemot	*Cepphus columba*			
Marbled Murrelet	*Brachyramphus marmoratus*	Red	Threatened	Vulnerable
Kittlitz's Murrelet	*Brachyramphus brevirostris*			
Xantus' Murrelet	*Synthliboramphus hypoleucus*			Near threatened
Ancient Murrelet	*Synthliboramphus antiquus*	Blue	Special Concern	
Cassin's Auklet	*Ptychoramphus aleuticus*	Blue		
Parakeet Auklet	*Aethia psittacula*			
Rhinoceros Auklet	*Cerorhinca monocerata*			
Horned Puffin	*Fratercula corniculata*	Red		
Tufted Puffin	*Fratercula cirrhata*	Blue		

1 Red = endangered/threatened; Blue = vulnerable.

2 COSEWIC candidate list species are those that are suspected of being in some COSEWIC category of risk of extinction or extirpation at the national level, ***before*** being examined through the status assessment process. These species are considered priority species for assessment by COSEWIC.

3 Long-tailed Duck was previously known as Oldsquaw.

4 another subspecies, *Falco peregrinus anatum*, is not found on Haida Gwaii and is listed by COSEWIC as "threatened".

Appendix B.

Museums Contacted in the Preparation of this Report [not all records obtained were used in this report]

Collections in Canada

Royal British Columbia Museum (RBCM)
Mike McNall, Ornithology Collections Manager, Natural History Section
675 Belleville Street, Victoria, BC, V8W 9W2
65 records were obtained in response to a request.

Canadian Museum of Nature (CMN)
Peter Frank, Chief Registrar
PO Box 3443 Station D, Ottawa, ON, K1P 6P4
Phone: 613-364-4089; email: pfrank@mus-nature.ca
270 records were obtained in response to a request.

Royal Ontario Museum (ROM)
Brad Millen, Ornithology
Centre for Biodiversity and Conservation Biology
100 Queens Park, Don Street, Toronto, ON, M5S 2C6
Phone: 416-586-5768; email: bradm@rom.on.ca
351 records were obtained in response to a request.

University of British Columbia Bird Collection
G. Kaiser, Collection Manager
27 records were obtained in response to a request.

Collections Outside Canada

Slater Museum of Natural History
University of Puget Sound, Tacoma, WA
http://www.ups.edu/biology/museum/museum.html
32 records were obtained from an internet search

US National Museum of Natural History (NMNH), Smithsonian Institution,
Craig Ludwig, Scientific Data Manager
National Museum of Natural History, Smithsonian Institution
Washington DC, 20560-0108
phone 202-357-2172; http://www.nmnh.si.edu/vert/birds/
35 records were obtained in response to our inquiry.

Museum of Vertebrate Zoology, University of California at Berkeley (MVZ)
1101 VLSB, Berkeley, CA, 94720
Internet database: http://www.ucmp.berkeley.edu/collections/invert.html
799 records were obtained from an internet search

Peabody Museum of Natural History (YPM)
Vertebrate Zoology Division, Peabody Museum of Natural History ”P. O. Box 208118, Yale University”New Haven, CT 06520-8118 USA
Internet database: http://george.peabody.yale.edu/orn/
9 records were obtained from an internet search.

Field Museum of Natural History (FMNH)
1400 S. Lake Shore Drive, Chicago, IL, 60605-2496
Internet database http://www.fmnh.org/research_collections/zoology/default.htm
310 records were obtained from an internet search.

LA County Museum of Natural History (LACM)
900 Exposition Boulevard, Los Angeles, CA 90006, USA
http://www.nhm.org/research/ornithology/index.html
4 records were obtained from an internet search

University of Michigan Museum of Zoology (UMMZ)
Bird Division, Museum of Zoology”The University of Michigan”1109 Geddes Ave., Ann Arbor, MI 48109-1079 USA.”Phone 734-764-0457, Fax 734-763-4080
http://www.ummz.lsa.umich.edu/birds/
526 records were obtained from an internet search

Cornell University Museum of Vertebrates (CUMV)
Cornell Laboratory of Birds
E151 Corson Hall”Ithaca, NY 14553-2701 USA
http://cumv.bio.cornell.edu/cumv_tsa_search.html
8 records were obtained from an internet search

Western foundation for Vertebrate Zoology
René Corado, Collections Manager
439 Calle San Pablo, Camarillo, CA 93012
18 records were obtained in response to a request.

Natural History Museum, London, England
Akeman St., Tring
Herts, UK, HP23 6AP
No records were obtained in response to a request; data are not in a searchable format.

Manchester Museum, University of Manchester
Oxford Road, Manchester M13 9PL
Henry McGhie, Curator of Zoology e-mail: henry.mcghie@man.ac.uk
Tel: (+44) 0161 275 2666
No records were found in response to a request.

Appendix C

Haida (north and south) names of marine birds.

Common Name[1]	Northern Haida: Cumming (1931)[2]	Northern Haida: Blackman (1979)[3]	Southern Haida: Ellis (1991)	Southern Haida: SHIP[4] (2002)
Red-throated Loon/ Pacific Loon	t'en	tətla	xaasdlagaay	xaasdlagaay, xaasdlgaay
Common Loon			tadla	taadl
Horned Grebe		st'ə kaja		
Western Grebe			hixu dadaa	hiixuudada
Grebes species	saail			
Black-footed Albatross			sk'aay	sk'aay
Sooty Shearwater	saunk		saanga	saang.a
Fork-tailed Storm-Petrel/ Leach's Storm-Petrel	st' quana		jik'iiga, sdaagwaana	jiik'iiga, sdaagwaana, jiik'iida
Double-crested Cormorant			sgidgunda	sgidgunda
Pelagic Cormorant	kelow	k'aelu	k'yaaluu	k'yaaluu
Brant	shaesis cowaa		st'a k'ats'idgaa, tlajang xaaydagaay	st'.aak'aats'idga, tl' jing xaaydaagaay
Harlequin Duck			k'idaa k'uxaaw	k'aaydaa, k'uuxaawuu
Surf Scoter				sgil
Black Scoter/ White-winged Scoter	seil	səl	sgil	sgil-kuunang.aa, sgaagii sgil
Common Goldeneye/ Barrow's Goldeneye	quasit qumsha	jus dánga	taatl'aad gadalaa	taatl'aad gadalaa

	Northern Haida		Southern Haida	
Common Name[1]	**Cumming (1931)**[2]	**Blackman (1979)**[3]	**Ellis (1991)**	**SHIP**[4] **(2002)**
Long-tailed Duck	unganga	əng áng-a	ungaangii	ang.aang.ii
Bufflehead	quashit		kaysk'ud	k'aaysk'ud
Hooded Merganser		s-ai		
Common Merganser/ Red-breasted Merganser			tl'elky'aa (♀), k'aaxu gadaga (♂)	tl'hlk'yaa (♀), k'aaxugadaga (♂)
Bald Eagle	ɔoat	ɔtʼ	guud	gud
young Bald Eagle				gud ts'una
Peale's Peregrine Falcon	geget	jejat	hlk'yaah	hlk'yah
Black Oystercatcher	skidum	skáduwe	sgadanga	sgaadang.a
Semipalmated Sandpiper	culuskatina			
Red-necked Phalarope			gaayuu k'al kud, kak'aa	
any small shorebird seen in flocks			ts'ik'alt'axung	
any large gull			sk'in	
any small gull			tanggwaan sk'iinaay, sk'in gatl'adaang	
Young sea gull				gaalaay
Bonaparte's Gull	shena			
Glaucous-winged Gull	skun			
Murre species	waaw	ºwá		
Common Murre			gwaah	gwaah
Pigeon Guillemot	skadwa	qEdá kəjao	sgagadawaa, jaadxaws	sgaaxudaawa, jaadxaws, sgaaxadawaa

Common Name[1]	Northern Haida: Cumming (1931)[2]	Northern Haida: Blackman (1979)[3]	Southern Haida: Ellis (1991)	Southern Haida: SHIP[4] (2002)
Marbled Murrelet	tilum		ts'alangah	ts'alang.ah
Ancient Murrelet	saduna	sədána	sginxaana	sgin xaana, skin xaana
Cassin's Auklet	hutso	hadjá	hajaa	hajaa
Rhinoceros Auklet			hlagwaats'i, 7uhuu	hlagwaats'ii
Tufted Puffin	quana		kuxaana	kuxana
Puffin		kwan-á		

1 Listed in order according to the American Ornithological Union (AOU 2000).

2 Cumming worked only in the northern Graham Island area and his words are based on his "strictly phonetic" interpretation of the "Masset Haida dialect."

3 In the absences of a standard orthography for Masset Haida dialect, Blackman (1979) used a modified version of the international phonetic alphabet in her spellings. A glossary of symbols was appended to her paper.

4 SHIP is the Skidegate Haida Immersion Program of the Skidegate Haida Language Authority that deliberates on the spelling and pronunciation of southern Haida words

Parcs Canada, région de l'Atlantique, produira trois séries de rapports en sciences des écosystèmes afin de communiquer de nouvelles données scientifiques, de consigner des données scientifiques, et de résumer les connaissances existantes ou de formuler des recommandations d'ordre technique. La fonction principale et le public visé détermineront la série dans laquelle un rapport sera publié. Chaque série contiendra des informations scientifiques et techniques qui viendront enrichir les connaissances existantes, mais ne pourraient être publiées dans les revues professionnelles en raison de leur présentation.

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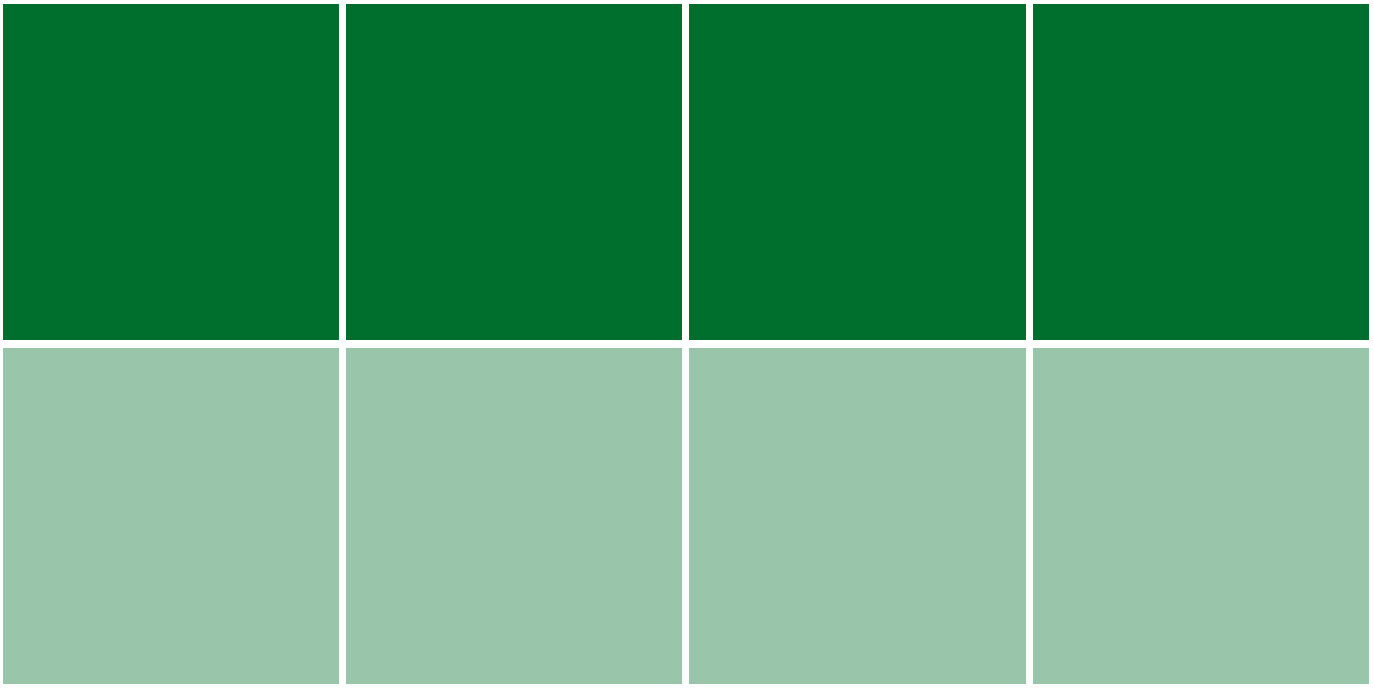

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