Birds, Bird Habitat and the Mackenzie Gas Project: Important Bird Areas and Migratory Birds as Valued Components

Nature Canada Intervener Report

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1. Introduction

Nature Canada is a non-profit and charitable organization, founded in 1939, with a supporter base of approximately 40,000 individuals across Canada. Its mission is to protect nature, its diversity and the processes that sustain it. Nature Canada has for more than a decade strategically promoted the permanent protection of more than 200,000 square kilometres of Canadian wildlands. More recently, Nature Canada has led in calling attention to Canada's national wildlife areas (NWAs) and migratory bird sanctuaries (MBSs) – their ecological importance, deficiencies in investment and management, and associated declines in site ecological integrity. We are one of two Canadian co-partners in BirdLife International, a global network of non-governmental organizations focused on bird conservation. Together with our Canadian BirdLife co-partner Bird Studies Canada, we have identified nearly 600 Important Bird Areas (IBAs) in Canada, and have provided funds in support of the stewardship of approximately 100 of these sites. Nature Canada's interest in the environmental assessment of the Mackenzie Gas Project stems from our work to promote protected areas as one important mechanism for conservation in Canada, and from our efforts to conserve Important Bird Areas, as several IBAs are located within the study area for the Mackenzie Gas Project.

2. Important Bird Areas

Important Bird Areas are sites of the highest global priority for biodiversity conservation. IBAs are internationally recognized sites providing essential habitat for one or more species of breeding or non-breeding birds. These sites may contain threatened species, endemic species, species representative of a biome, or highly exceptional concentrations of birds. They are often irreplaceable 'hotspots' and potentially vulnerable. Identified nationally, from data gathered locally and using scientific and internationally standardized criteria, IBAs form a worldwide network of sites for the conservation of nature. The goal of the IBA program is to identify, document and conserve a worldwide network of sites necessary to ensure the long-term viability of naturally occurring bird populations. As of March 2006 over 8,000 IBAs have been identified, mapped, and documented in 178 countries and at sea by BirdLife partners.

A detailed overview of the global and Canadian IBA programs, as well as the scientific criteria used to identify Canadian IBAs, has been provided to the Joint Review Panel in exhibit J-SCC-00009. A brief summary of key points on the topic is presented below:

- BirdLife International initiated the first IBA program in Europe in 1985 in response to the European Economic Community's request for a priority list of sites for protection in Europe. Currently, IBA programs are underway around the world with more than 7,500 sites identified.
- The Canadian IBA program was launched in 1996 by the Canadian Nature Federation (now Nature Canada) and Bird Studies Canada, the Canadian BirdLife partners, in conjunction with the launch of parallel programs in the United States and Mexico.

- Canadian IBAs were identified by applying criteria that are used with global consensus and that are scientifically defensible.
- IBA criteria are organized into four categories: 1) Threatened Species, 2) Restricted Range Species, 3) Biome-restricted/representative Species and 4) Congregatory Species. Each IBA is also identified as globally, continentally or nationally significant based on its documented bird populations measured against established population thresholds, with a site qualifying at the appropriate level if it holds one or more species that meet or exceed 1% of the global, continental or national population for that species.
- A total of 1,246 potential sites were evaluated, leading to the designation of 597 IBAs in Canada in 2001.

2.1. Important Bird Areas Within the Mackenzie Gas Project Study Areas

Five Important Bird Areas, together comprising almost 6,700 square kilometres, are entirely or partially within the Regional Study Area in the Northwest Territories. Four of these – the Mackenzie River Delta IBA, the Kugaluk River IBA, the Lower Mackenzie River Islands IBA and the Middle Mackenzie River Islands IBA – are globally significant and one – Brackett Lake IBA – is continentally significant. Two globally significant IBAs outside the Regional Study Area – Mills Lake (part of the Mackenzie River near Fort Providence) and Beaver Lake (in the western bay of Great Slave Lake where the Mackenzie begins) – are also addressed due to concerns that they could be affected by Project-related activities. A map of the Mackenzie Gas Project Study Areas showing the seven Important Bird Areas is given in Figure 1.

These IBAs are described in detail in exhibit J-SCC-00009 (including individual IBA maps, information on bird populations, and a description of conservation issues for each IBA). Summary information on six of these IBAs is presented below. (The seventh IBA, Mackenzie River Delta IBA, contains the Kendall Island Bird Sanctuary. Information on this IBA will be presented by Nature Canada to the Joint Review Panel at a later date.)

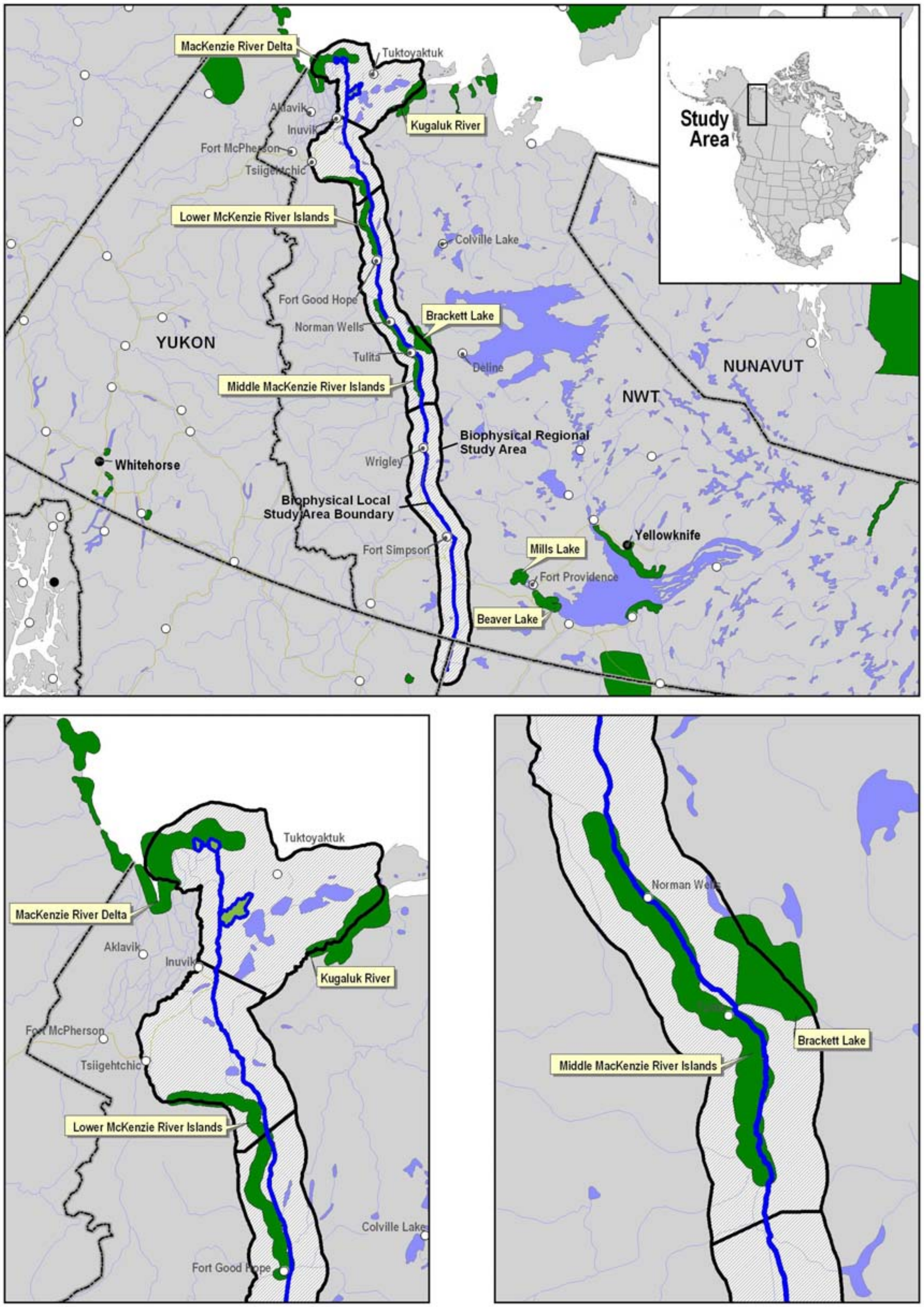

Figure 1 - Important Bird Areas (indicated by IBA name) in relation to the entire Mackenzie Gas Project's Regional and Local Study Areas

Kugaluk River IBA site (69.33^{o} N; 130.83^{o} W) covers about 40 km of the Kugaluk River, the lower 10 km of both the Moose and Smoke rivers and the upper reaches of Liverpool Bay. Two large islands in the bay are also included. The IBA has been identified as globally significant for congregatory species and waterfowl concentrations. Highlights of bird concentrations in the IBA include:

- Between 10,000 and 20,000 Canada geese of the subspecies *hutchinsii* and *parvipes* moulting in July and August (translating to a maximum of 2.6% of the current Canada goose *hutchinsii* and *parvipes* populations).
- As much as 2% of the mid-continent population of greater white-fronted geese during moulting.
- Between 900 and 1,400 tundra swans moulting here, which is more than 1% of the eastern Tundra Swan population.
- About 1% of the global population of glaucous gulls (between 3,00 – 4,000 birds) feeding at the Moose and Smoke River deltas.
- Considerable mid-summer numbers (moulting or feeding) of waterbirds.

Lower Mackenzie River Islands IBA (67^{o} N; 130.17^{o} W) site starts at Fort Good Hope and continues down the Mackenzie River for 270 kilometres to where the Tree River joins the Mackenzie. The IBA has been identified as globally significant for congregatory species and waterfowl concentrations. Highlights of bird concentrations in the IBA include:

- Most of the Western Central Flyway population of lesser snow geese migrating through the IBA in the spring.
- Large numbers of tundra swans and other waterfowl passing through the IBA in the spring, with numbers representing approximately 1.5% of the North American population of tundra swans.

Middle Mackenzie River Islands IBA site (64.88^{o} N; 125.58^{o} W) consists of a 250-kilometre stretch of the Mackenzie River and the associated shoreline between Redstone River and a spot 30 kilometres north of Oscar Creek This IBA is globally significant for congregatory species and waterfowl. Highlights of bird concentrations in the IBA include:

- Abundant Western Central Flyway population snow geese stopping over on spring migration, in numbers representing the majority of this population, and up to a total of 6% of the global population of snow geese.

Bracket Lake IBA encompasses Bracket Lake and parts of Bracket River (65.25^{o} N; 125.17^{o} W), while part of the Great Bear River forms the southern boundary. Brackett Lake IBA is continentally significant for congregatory species and nationally significant for congregatory species and waterfowl concentrations. Highlights of bird concentrations in the IBA include:

- High density of breeding ducks (with a large number of scaup) in the wetlands of the IBA.
- Thousands of staging ducks, geese, and swans using the area later in the season, including up to 2% of the Canadian population of greater white-fronted geese

staging in the IBA, and flocks of 1,500 tundra swans and 12,000 ducks recorded in the area in the fall.
- Numerous shorebirds using the IBA for staging, including long-billed dowitcher, pectoral sandpiper and lesser yellowlegs.

Mills Lake IBA (61.42^{o} N; 118.25^{o} W) is situated at a widening of the upper Mackenzie River at a point where the Horn River joins the Mackenzie River. It is a circular lake, about 20 km wide that lies downstream from Fort Providence. The IBA is designated as globally significant for waterfowl concentrations. Highlights of bird concentrations in the IBA include:
- Over 1% of the mid-continent greater white-fronted goose population.
- Over 1% of the North American population of tundra swans.
- 2% of the Western Central Flyway population of snow geese.
- Thousands of migrating ducks in the fall, primarily American wigeon, northern pintail, mallard and canvasback.

Beaver Lake IBA (61.12^{o} N; 117.13^{o} W) includes Beaver Lake, which is a wide part of the Mackenzie River where the river meets the western end of Great Slave Lake. Fort Providence is situated 20 kilometres downstream. The IBA is designated as globally significant for congregatory species and nationally significant for waterfowl concentrations. Highlights of bird concentrations in the IBA include:
- Fall numbers as high as 2% of the current North American tundra swan population
- Approximately 10,000 ducks using the area in the fall, and 5,000 in the spring, with the most common species being canvasback, American wigeon, mallard, and scaup

Nine areas of high conservation value were identified in the Mackenzie Gas Project EIS Additional Information Report (J-IORVL_00085, March, 2005). Areas of high conservation value considered did not specifically include the areas of concentration of migratory birds, such as breeding areas, colonies, spring and fall staging areas, and wintering areas or Important Bird Areas. Of the nine areas of high conservation value only one overlaps with an Important Bird Area – continentally significant Brackett Lake IBA.

2.2. Global Conservation Value and Recognition of IBAs

Important Bird Areas are widely recognized as priority sites for biodiversity conservation and are a substantive component of many countries' biodiversity conservation strategies and policies. The IBA concept is now actively used by civil society groups, governments, NGOs (including members of the BirdLife network), international agencies and scientists all over the world as a tool for setting priorities and achieving conservation action. IBAs are widely recognized around the world by local communities, national legislation and policy, international agreements and regulations, and multilateral instruments and organizations.

This wide-scale acceptance of the value of IBAs sites to focus conservation actions stems not only from the fact that birds are an excellent basis for looking at site networks, but also because IBAs do a good job of capturing other biodiversity for conservation. For example, there is a high overlap between IBAs and Key Biodiversity Areas globally. IBAs, though identified for birds, are disproportionately important for other animals and plants: IBA networks are good at capturing threatened, endemic and representative species for other terrestrial fauna and flora.

2.3. Recommendation

- Given the international recognition of Important Bird Areas and the global significance of the IBAs found within the Mackenzie Gas Project study area, the importance of these IBAs should be recognized by the project proponents and specifically taken into consideration by the Joint Review Panel when considering potential project impacts to birds and their habitat, as well as mitigation and monitoring activities.

3. Examination of the Bird Species Selected as Valued Components

3.1. Avian Valued Components and their Selection

The approach used in the EIS to assess the potential impacts of the MGP on avian species involved selecting ten bird species as valued components (VCs) and evaluating the extent to which these species may be impacted by the MGP. Species were selected as VCs based on their socio-economic value, regulatory status, ecological importance, or a combination of these considerations. Here, we examine only the latter two selection criteria.

The EIS identified species of ecological importance as those that had:

1. Distributions and habitat requirements that are well understood and representative of the requirements of other species. These species were termed ‘umbrella’ species.
2. A disproportionately large effect on other species in a community, such that the loss of these species would change the populations of other species or ecosystem processes. These influential species were termed keystone species.
3. Species that play a critical role in food webs.

The species selected, and the reasons for their selection, are:

1. Greater white-fronted goose (*Anser albifrons*)
   The greater white-fronted goose was selected as a VC for the tundra region because of its socio-economic importance and because it may be an umbrella

species for other goose species (e.g. Canada goose, brant) using habitats on the outer delta of the Mackenzie river.

2. Greater scaup (*Aythya marila)* Vol5 p10-24
   Greater scaup was selected as a VC for the tundra region because North American populations are in decline and designated as sensitive in the Northwest Territories. Greater scaup are sensitive to disturbance when they are flightless and congregate during brood rearing and moulting. Greater scaup were also considered a keystone species because they compose a large proportion of the duck population in the production area. Greater scaup were also considered an umbrella species for other duck species of concern, such as scoters and long-tailed duck.

3. Lesser scaup (*Aythya affinis)*
   Lesser scaup was selected as a VC for the boreal forest region for all of the same reasons as greater scaup. Lesser scaup was considered a keystone species because they compose a large proportion of the duck population along the pipeline corridor.

4. Peregrine Falcon (*Falco peregrinus*) Vol5 P10-24:
   Peregrine falcon was selected as a VC for the tundra and boreal forest regions because of its regulatory status and because it may be an umbrella species for other cliff nesting raptors. It is also a high-level predator at the top of the food chain.

5. Whimbrel (*Numenius phaeopus*) Vol5 P10-25:
   Whimbrel was selected as a VC for the tundra region because of its regulatory status and because it may be an umbrella species for other tundra-nesting shorebird species of concern, such as Hudsonian godwit and American golden-plover.

6. Lesser Yellowlegs (*Tringa flavipes*) Vol5 P10-25:
   Lesser yellowlegs was selected as a VC for the boreal forest region because of its regulatory status and because it may be an umbrella species for other boreal-nesting shorebirds in the pipeline corridor.

7. Arctic Tern (*Sterna paradisaea*) Vol5 P10-25:
   Arctic tern was selected as a VC for the tundra and boreal forest regions because it nests colonially, making it sensitive to disturbance. Arctic tern was also considered to be sensitive to effects on aquatic systems because it is a high-level predator. Arctic tern was considered an umbrella species for other colonially nesting waterbirds, such as glaucous gull.

8. Boreal Chickadee (*Poecile hudsonica*) vol5 p10-25:
   Boreal chickadee was selected as a VC for the boreal forest region because of its regulatory status and because it may serve as an umbrella for other boreal

passerine species, such as blackpoll warbler, American tree sparrow and rusty blackbird, which are species of concern in NWT. Boreal chickadees are also year-round residents in the Mackenzie Valley.

9. Tundra Swan (*Cygnus columbianus*)
   Tundra swan was selected as a VC for the tundra region because swans are abundant in the Mackenzie Delta, which is a primary breeding area in Canada. One third of the North American swan population breeds in the Mackenzie Delta (AMEC Americas Limited 2005). Tundra swans are of high socio-economic value and are sensitive during brood rearing and moult when they are flightless and congregate into large flocks.

10. Snow Goose (*Chen caerulescens*) vol5 part E page 10-23
    Snow goose was selected as a VC for the tundra and boreal region because one of the few nesting colonies of snow geese in the western Canadian arctic occurs near KIBS and the majority of the western Arctic population migrates through the Mackenzie Valley. Snow geese are also of high socio-economic value and are sensitive because they nest in colonies and occur in large congregations during the flightless moult period. Snow geese may serve as an umbrella species for other species of waterfowl that stage in large congregations during the spring along the Mackenzie River, including tundra swans.

3.2. Examination of the Surrogate Species Concept

3.2.1. Ecologically Important Species

Because constraints on time and money preclude the evaluation of potential impacts of development on all species in a region, it is common for environmental assessments to use a select set of 'surrogate' species to infer, indirectly, the potential for impacts on other species not explicitly considered in the assessment (Caro and O'Doherty 1999). There are several different kinds of surrogate species, two of which are used by the EIS: umbrella and keystone species. In this section we review the definitions of these terms, the evidence in the scientific literature on their efficacy, and the information needed to reliably identify keystone and umbrella species. We conclude by examining the evidence presented in the EIS to justify the selection of VCs based on ecological criteria.

Umbrella species are generally defined as species with the most stringent habitat requirements, such that the conditions necessary for the persistence of the umbrella species should be sufficient for the persistence of many other species with less demanding requirements (Lambeck 1997, Simberloff 1998, Caro and O'Doherty 1999, Carignan and Villard 2002). The term originally referred to species with low population densities and large home ranges that required large areas of habitat to maintain a viable population (Gittleman 1986). It was argued that these large areas of habitat would also protect viable populations of spatially co-occurring species with higher population densities and smaller area requirements (Landres et al. 1988, Simberloff 1998, Caro and O'Doherty 1999, Carignan and Villard 2002). The main application of umbrella species has been to estimate the size of habitat reserves necessary to maintain viable populations of many species (e.g. Berger 1997). More recently, the concept has been extended to incorporate any species that is more sensitive to a potential threat than one or more other species (Lambeck 1997).

Keystone species have critical ecological interactions with a number of other species that are disproportionately large relative to their abundance (Simberloff 1998, Caro and O'Doherty 1999, Carignan and Villard 2002). Interactions are critical if the presence of the keystone species is essential for the continued persistence of the species with which the keystone interacts.

The use of surrogate species has increased over the last 20 years (Verner et al. 1986, Wren 1986). However, the practice has come under particular criticism in the scientific literature (Niemi et al. 1997, van Jaarsveld et al. 1998, Anderson 1999, Lindenmayer 1999, Andelman and Fagan 2000, Lindenmayer et al. 2002, Niemi and McDonald 2004, Roberge and Angelstam 2004) and many recent studies have found surrogate species to be an ineffective environmental assessment tool (Taper et al. 1995, Gustafsson 2000, Caro 2001, Rubinoff 2001, Fleishman et al. 2002, Bifolchi and Lode 2005, Smith et al. 2005, Rowland et al. 2006). We are aware of only one study that has shown umbrella species to be effective (Caro 2003), while effectiveness of the keystone species concept remains largely untested (Simberloff 1998).

For example, a study by Taper et al. (1995) illustrates the potential problems with the umbrella species concept. They tested whether bird species responded similarly or individually to environmental change. The study examined population dynamics of the same bird species in different environments, and how the population dynamics of different birds species varied in the same environment. The study analyzed population trends for 59 insectivorous songbird species, some of which were closely related, occurring in multiple regions of the eastern and central United States. The results showed that 77% of the species increased in some regions while decreasing in others, and 91% of the areas studied had some species that increased while others decreased. The authors concluded that bird populations were individualistically driven by spatial and temporal variation in the environment and, therefore, poor predictors of other species' population trends and response to environmental change. Consequently, there was little evidence that any of the 59 species could reliably be considered umbrella species. In general, the literature shows that surrogate species have been largely ineffective at ensuring the conservation of co-occurring species given the generally large ecological variation that exists between taxa.

These results are not evidence that umbrella or keystone species do not exist (although this is possible), nor are they conclusive evidence that identifying a subset of such species will not be informative in environmental assessment. Species do not go extinct or become extirpated simultaneously, so they must differ in their susceptibility to threats at some level. These results do suggest that the identification of umbrella or keystone species is difficult, that it may require many such species to ensure all other species persist in the face of potential threats, and that the results of any impact assessment based on the assumed existence of umbrella or keystone species should be viewed cautiously.

The frequent failure of umbrella and keystone species as conservation tools may be due to poor selection criteria. Suitable species may be present, but the selection process may not be rigorous enough to reliably identify them. Often species are selected with little ecological justification and rarely with any direct validation that the species chosen is indeed an umbrella or keystone species (Simberloff 1998, Niemi and McDonald 2004). Ultimately, the potential impacts of a specific development will drive the selection of surrogate species (Lambeck 1997, Dixon et al. 1998, Niemi and McDonald 2004), but clearly defining the criteria for choosing surrogate species is stressed throughout the literature (Landres et al. 1988, Caro and O'Doherty 1999, Noss 1999, Niemi and McDonald 2004). In addition, validating the efficacy of proposed indicator species is valuable prior to initiating projects that will use such species (Caro and O'Doherty 1999). There are numerous examples in the literature where surrogate species were chosen based on their flagship or charisma value, historical precedent, or because they were easy to access, but such surrogate species have frequently failed in their ability to assay responses of other species to changes in environmental conditions (Caro and O'Doherty 1999).

3.3. Examination of the Criteria for Selecting Surrogate Species

In light of the poor past performance of surrogate species, we examined the avian VC species selected in the EIS to assess the confidence with which the VCs may serve as umbrella or keystone species. Our evaluation was based on two main considerations: the criteria used to select the avian surrogate species and the evidence provided to support their selection. We then identified groups of species that were not considered in the impact analysis either directly as VCs or through a proposed surrogate VC species. Finally, we comment on the number of species umbrella species are expected to protect.

3.3.1. Criteria Used to Select Surrogate Species

Although nine of the ten avian VCs were proposed to be umbrella species, the only criteria given in the EIS to identify umbrella species is that their distribution and habitat requirements are well understood and representative of other species. While the first two criteria are necessary to select umbrella species, the latter criteria is not, nor are these criteria sufficient. As defined in the above section, *Examination of the Surrogate Species Concept*, umbrella species must have ecological characteristics that make them *more* susceptible to impacts than other species. As such, the habitat requirements of umbrella species may not be representative (they should be in excess) of the species they are expected to protect.

For example:

- There is no indication in the EIS of why whimbrel, one of the tundra VCs, was selected as an umbrella species for Hudsonian godwit and American golden-plover. Why wasn't Hudsonian godwit, American golden-plover, or any of the other species of shorebirds that nest in the tundra region selected as the umbrella?

- Similarly, there is no indication in the EIS of why greater and lesser scaup are proposed to be umbrellas for other waterfowl species of concern such as scoters and long-tailed ducks. Scaup are diving ducks (Tribe: Aythyini) whereas scoters and long-tailed ducks are sea ducks (Tribe: Mergini), suggesting differences in life history strategies and ecology between them. Was there a particular aspect of the ecology of scaup that suggested they should be more sensitive than scoters or long-tailed ducks? If so, what was it and what threat are they more sensitive to?

There are no criteria given in the EIS to identify keystone species, nor any indication of what other species or ecological processes the keystone species are required to maintain. The only indication of a criteria is that associated with the description of the species themselves. Greater and lesser scaup, the only VCs proposed to be keystone species, were selected because they are abundant in the tundra and boreal regions, respectively. However, the definition in the above section, *Examination of the Surrogate Species Concept*, specifically states that keystone species should have ecological interactions with a number of other species that is *disproportionately large relative to its abundance*. Consequently, the regional abundance of a species can not be used to define keystone species.

The third class of species that were considered of ecological importance were those that play a critical role in food webs. However, there were no criteria provided upon which to determine whether a species played a critical role in a food web or not. Because all species are components of food webs, selecting species in a meaningful way is entirely dependent on the meaning of 'critical'. We also note that there is potential for this ecological criteria to overlap with the keystone species criteria.

3.3.2. Evidence Supporting Surrogate Species Selection

We were unable to identify any sources of evidence in the EIS used to support the selection of any of the species VCs as either umbrella species, keystone species or species that play a critical role in food webs. The lack of such information greatly reduces our confidence that the VCs are suitable surrogate species such that low impacts of the project on these species infers even lower impacts on other species.

3.3.3. Species Protected by Surrogates

In most cases the number of species expected to be protected by umbrella species was below 20. This number alone does not seem excessive, but the utility of the umbrella species to confer protection to these species still needs to be substantiated. However, the EIS proposed the boreal chickadee as an umbrella species for all other species of boreal passerines, estimated roughly to include over 80 species. A study by Environment Canada (Cooper et al. 2004) on the potential impacts of the Mackenzie Gas Project on birds from pipeline clearings in the Mackenzie Valley detected 75 species of birds in

2004, 49 of which were estimated to lose habitat and breeding pairs, including species listed as sensitive by the NWT. Seventeen of the 21 listed species are expected to lose habitat and breeding pairs to pipeline development in the boreal forest. It is highly unlikely that one species could reasonably act as an umbrella species for such a large, and ecologically variable, group of species (Taper et al. 1995).

3.3.4. Gaps in Surrogate Species Coverage

A number of species groups appear to have been omitted from the impact analysis. Most obviously, there are no bird species selected as VCs for the Beaufort marine region, in spite of the numerous species of aquatic birds that utilize coastal areas and are susceptible to disturbance, habitat alteration and accidental spills of hydrocarbons.

The 15 species of passerines that utilize the tundra region are also not covered in the impact analysis. The hoary redpoll (*Carduelis hornemanni*) is a species of particular interest in this group because it is a year-round resident in the tundra region. Consequently, it will be exposed to potential impacts during all phases of the project. Other groups omitted from the analysis of all three study regions include: gallinaceous birds such as grouse and ptarmigan, non-cliff nesting raptors such as hawks and owls, and woodpeckers, which are an ecologically important group for cavity-dependent birds and mammals.

3.4. Recommendations For Selecting Surrogate Species

There is a growing body of literature concerning multi-species approaches to biodiversity conservation and natural resource management (Lambeck 1997, Carignan and Villard 2002, Gregory et al. 2005). These approaches are recommended because they are more likely to result in effective conservation measures (Niemi and McDonald 2004, Roberge and Angelstam 2004). Our review indicates the approach used by the EIS to select surrogate species as VCs only marginally follows the recommended multi-species approaches as described in the primary literature. Our specific concerns are:

1. The concepts of umbrella species and keystone species are incorrectly defined while the definition of a ‘critical role in a food web’ is not operationally defined at all.

2. The criteria necessary to identify surrogate species are not given. These criteria should be tied explicitly to project activities that are expected to threaten bird species or their habitat.

3. No information is given to substantiate the efficacy of the proposed surrogate species. This is a particularly critical point for proposed umbrella species. In cases where this information is not available, or the information is weak, there should be little confidence that the proposed surrogate will provide an effective conservation umbrella for other species.

Criteria for selecting surrogate species in a multi-species or ecosystem approach are not clearly established in the literature, as the specific goal and context of the project will determine the criteria used. For example, the criteria for a project designed to maintain species in a human-dominated ecosystem will differ substantially from a project designed to minimize the impacts of limited human activity in a naturally-regulated ecosystem. However, general criteria are available for identifying surrogate species in an ecosystem context. Much emphasis has been placed on choosing a suite of species that represent different attributes important to the maintenance of ecosystem structure and function or are likely to be the most sensitive to impacts. We have compiled a list of criteria compiled from the primary literature (Noss 1990, Lambeck 1997, Noss 1999, Beazley and Cardinal 2004, Niemi and McDonald 2004). Such criteria should include, but not be limited to:

1. Vulnerable taxa or species of concern already identified by other institutions. Candidate species should not be limited to those at the highest level of vulnerability; avoiding impacts on less vulnerable species now will help to prevent their decline in the future.

2. Species having strong ecological interactions in a community through their role as predators or prey, competitors with other species, or by providing ecosystem processes (e.g. pollination or seed dispersal).

3. Species that require large areas of habitat to maintain viable populations (area-limited species).

4. Species that are limited in their ability to move to other areas of habitat (dispersal-limited species).

5. Species that require specific food or habitat resources which may be in short supply, such as forest snags for cavity nesting birds or fruit sources for frugivores (resource-limited species).

6. Species whose ecology is dependent on specific ecosystem processes, such as flooding or fire (process-limited species).

7. Species restricted to small geographic areas within the project area (local endemics).

8. Species with genetically distinct populations. Such species are also expected to be dispersal-limited species, but widely dispersing species may also exhibit genetically distinct populations.

9. Species with populations representing a significant percentage of provincial, territorial, national, continental or global populations.

10. Species that can be found in large congregations at certain times. These species are susceptible to even short-term impacts occurring over a small area and indicate the ecological importance of the habitat being used.

11. Species that are currently experiencing population declines due to identified or unidentified impacts occurring in the same region as the project or in other regions. Additional impacts of the project may accelerate population declines of these species.

These criteria are based on ecological characteristics that are generally associated with impact-sensitive species, though many other criteria could be developed to reflect specific threats of individual projects. Specific threats facing species of concern should also be included as criteria. Some of these criteria were considered in the EIS, while others were not (e.g. 5, 6, 7 and 9).

The next step is to go through the entire list of species that occur in an area and determine which of these criteria they meet and explicitly state why. For each group that meets each individual criteria, the species that is the most sensitive to the potential impact should be identified as the umbrella species. Ideally the identification of the umbrella will be based on data. The impact on this species can then be assessed, and any conditions necessary to mitigate impacts on the umbrella species or its habitat are also applied to all other species in its group.

We illustrate this process with an example from the MGP EIS. The EIS identified cliff-nesting raptors as a group of resource limited species. This group includes peregrine falcons and golden eagles and may also contain gyrfalcons and merlins. The EIS also identified disturbance from aircraft as a potential threat to species in this group. The next stage, which the EIS did not complete, is to identify which species is most sensitive to aircraft disturbance. If golden eagles are most easily disturbed, perhaps by aircraft approaching within 1km of their nest site, then aircraft should be restricted from flying within 1 km of any cliff habitat.

3.5. Application Problems with Surrogate Species

We noted a number of problems with the application of the umbrella species criteria in the impact assessment and mitigation sections of the EIS.

In spite of the EIS's stated criteria that the distribution and habitat requirements of umbrella species should be well understood, there were large and frequent gaps in either knowledge about the habitat requirements of many of the proposed umbrella species or the data available to identify and quantify their required habitats. The only habitat type quantified for any of the VCs was nesting habitat. The EIS did not quantify the foraging habitat, brood rearing habitat, moulting habitat, or staging habitat for any of the ten species of VCs. Even the wintering habitat for boreal chickadee, which was selected in part because they are year-round residents, could not be quantified because too little was known about their requirements. While the EIS suggests that other approaches can be used to assess impacts on these other required habitats, the results of these assessments are not available, suggesting the conclusion that the project impacts on these habitats will be insignificant is premature.

This gap in knowledge and data is particularly unfortunate because nesting habitat for ground nesting birds (which includes eight of the ten avian VCs) is likely the least limiting of their habitat requirements. For example, studies have shown that the vegetation characteristics surrounding the nests of waterfowl have no effect on nesting success or nest site selection (Shutler et al. 1998). In addition, extensive experimental and observational work conducted on waterfowl in the boreal forest region of Sweden and Finland has revealed that many wetlands which appear suitable for waterfowl nesting are never used, primarily because they do not provide sufficient food for ducklings (Pöysä et al. 2000, Sjöberg et al. 2000). Under these conditions an assessment of the amount of suitable nesting habitat based simply on the types of vegetation surrounding wetlands would grossly over-estimate the true amount of nesting habitat available. Unfortunately, the latter approach is used by the EIS to quantify the extent of nesting habitat for the species VCs. Given that the significance of the project impacts are evaluated by comparing the amount of habitat altered by the project to the amount of habitat estimated to be available in the regional and local study areas, such over-estimation of the amount of nesting habitat available may lead to a significant under-estimation of the net impact of the project on the species VCs.

We note that the habitat 'models' used to estimate the quantity and distribution of nesting habitat were not tested for any of the bird species VCs as they were for some of the mammalian species VCs. Consequently, it is unknown to what degree these models may over- or under-estimate the quantity and distribution of nesting habitat, not to mention the quantity or distribution of the more critical foraging, brood-rearing and moulting habitats.

The amount and distribution of required habitats were not estimated for peregrine falcons because 'nesting areas for these species are well known and can be delineated from other sources' (AMEC Americas Limited 2005 p. 1-8). These other sources provided specific information on the locations of known cliff nest sites of peregrine falcons. While such specific information is obviously of great value for mitigating potential impacts on peregrines, the detailed nature of the information tends to undermine the utility of the species as an umbrella. Peregrine falcons were proposed as umbrella species for other cliff-nesting raptors. How will the identification of known peregrine nest sites reduce impacts on unidentified nest sites of other cliff-nesting raptors?

The amount and distribution of required habitats were not estimated for snow geese either, because 'nesting areas for these species are well known and can be delineated from other sources' (AMEC Americas Limited 2005 p. 1-8). These other sources provided specific information on the location of nesting, brood rearing and moulting habitat for snow geese. However, snow geese were proposed as an umbrella for other species of waterfowl, including tundra swans, that stage in large congregations during the spring along the Mackenzie River. What information is available on the staging habitat requirements of snow geese?

The amount and distribution of required habitat was not estimated in any way for Arctic terns because its required habitat could not be delineated using available data (Mackenzie Gas Project - Environmental Impact Statement 2004 p. 10-7). In addition, ‘the proximity of nesting colonies and productive feeding areas to project features is not known’ (Mackenzie Gas Project - Environmental Impact Statement 2004 p. 10-7). In spite of this enormous gap in knowledge, the EIS concluded that there will not be significant impacts to Arctic terns.

3.5.1. Recommendations

- The distribution of critical habitats in addition to nesting habitat (i.e. foraging, brood-rearing and moulting habitat) for bird species VCs should be quantified with specific attention given to direct measurement of the foraging resources available.
- If the methods used to quantify these habitats involve assumptions, they should be tested with independent data.
- The predicted extent and distribution of the critical habitats should be verified with independent data.

3.6. Regulatory Status

The EIS Terms of Reference makes an explicit statement that the EIS must consider any change that the project may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species. Of the 62 bird species that occur in the MGP study area that are listed as sensitive by the Government of the Northwest Territories (GNWT) or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or are listed by Alberta Environment or the Species at Risk Act (SARA) (Mackenzie Gas Project - Environmental Impact Statement 2004 Table 10-1), the EIS assessed impacts for five of these species. In particular, species such as the Eskimo curlew and short-eared owl, which are species listed as endangered and of special concern, respectively, under SARA and by COSEWIC, were not addressed in the EIS. As mentioned above in the section on *Gaps in Surrogate Species Coverage*, owls were not addressed at all in the EIS. Whimbrel were proposed as an umbrella species for tundra-nesting shorebirds, such as Eskimo curlew, but it is impossible that whimbrel could act as an umbrella for all threats to the much more imperiled Eskimo curlew. Clearly there must be some threats that curlews are more susceptible to compared to whimbrels, otherwise both species would be at equal risk of extinction.

Many of the species listed as having regulatory status were not addressed by the EIS directly, or indirectly, through a proposed umbrella species. Bank swallow, gray-headed chickadee (Siberian tit), American pipit, American tree sparrow and Harris' sparrow are all passerines found primarily, or additionally, in the tundra region. Osprey, bald eagle, northern goshawk, Swainson's hawk and broad-winged hawk are all found in the boreal forest region, but were not addressed directly or via an umbrella species. Other species that were not addressed were either species of grebe, American bittern, sharp-tailed grouse or rock ptarmigan.

We do note that some of these species were excluded from the EIS because a limited proportion of their range was within the project area (gray-headed chickadee) or they were 'a priori considered unlikely to be affected at a biologically meaningful way'(AMEC Americas Limited 2005 p. 10-18) (American tree sparrow and glaucous gull). While this argument is reasonable for the gray-headed chickadee, it is not clear why American tree sparrow or glaucous gull would be excluded from the EIS a priori. We also note that Arctic tern was proposed as an umbrella species for glaucous gull. The justification for a priori exclusion of species from the EIS should be given and substantiated with evidence.

3.6.1. Recommendations

- All species with regulatory status should be considered directly by the EIS or be covered by an explicit umbrella species.

- Species excluded a priori from the EIS should be identified. Reasons for their exclusion should be given and substantiated.

3.7. Cumulative Effects

The EIS does not assess cumulative effects for bird species VCs. Birds were excluded from the cumulative effects analysis because (AMEC Americas Limited 2004 p. 12-59):

- 'all project effects on birds are predicted to be low in magnitude'.

Cumulative effects on migratory birds were not assessed because (AMEC Americas Limited 2004 p. 12-59):

- 'Effects from other land uses occur beyond the administrative jurisdiction of the regulatory review of this assessment'

- 'Characterization of those remote land uses regarding their contribution to cumulative effects is not possible.'

- 'An assessment of all projects and activities within the combined summer and winter migration ranges of the migratory VCs is beyond the scope of this assessment.'

We find these reasons to be either presumptuous, irrelevant, indicative of a lack of analytical creativity, or convenient. Although we agree that cumulative effects analyses will be more difficult for migratory birds compared to more sedentary terrestrial species, the very fact that migratory birds are exposed to many additional impacts makes a cumulative effects analysis critically important. We note that many species of migratory birds found in the MGP have undergone significant reductions in continental population sizes, indicating substantial cumulative effects. For example:

- Common eiders of the pacific race (*S. m. v-nigra*) nesting in western Alaska and Canadian breeding grounds have shown declines of 50-90% over the past 25 years. This population includes approximately 100,000 individuals and is therefore the rarest race of all common eiders (Sea Duck Joint Venture 2004a).

- King eiders of the western North American population have also declined, approximate 55% between 1976 and 1996 (Sea Duck Joint Venture 2004b).

- Population estimates of long-tailed ducks are lacking due to the species' broad distribution and low densities. Breeding population surveys in Alaska and northwestern Canada indicate this species has declined approximately 80% in this area. Despite the long-term decline in this population, the long-tailed duck is the most abundant arctic sea duck and is therefore not listed as a species of concern (Sea Duck Joint Venture 2003a).

- White-winged and surf scoters nest on lakes in the boreal forest. Accurate population indices for scoter species are lacking because census data combine the 3 species of scoters (white-winged, surf, and black), however, long-term breeding surveys indicate a decline of approximately 50% since the 1950's (Sea Duck Joint Venture 2003b, 2004c).

- Northern pintail have experienced a 75% decline in population size since 1955 (U.S. Fish and Wildlife Service 2005).

Data on population trends are widely available for many other species found in the project area.

3.7.1. Recommendation

- Cumulative effects analyses be completed for all avian VCs. We suggest the proponents consider methods of quantifying cumulative effects different from the more direct methods utilized for the mammalian VCs. The proponents may wish to consider using population trend data, as cited above, as an estimate of cumulative effects. Some might argue that population trend data is a more direct estimate of cumulative effects than estimating changes in habitat availability.

4. Literature Cited

AMEC Americas Limited. 2004. Mackenzie Gas Project - Environmental Impact Statement Volume 5: Biophysical Impact Assessment Part F - Climate Change, Cumulative Effects, Biodiversity and Environmental Effects on the Project Section 12.

AMEC Americas Limited. 2005. Mackenzie Gas Project - Wildlife Habitat Suitability Modelling: Birds.

Andelman, S. J., and W. F. Fagan. 2000. Umbrellas and flagships: Efficient conservation surrogates or expensive mistakes? Proceedings of the National Academy of Sciences of the United States of America **97**:5954-5959.

Anderson, A. N. 1999. My bioindicator or yours? Making the selection. Journal of Insect Conservation **3**:61-64.

Beazley, K., and N. Cardinal. 2004. A systematic approach for selecting focal species for conservation in the forests of Nova Scotia and Maine. Environmental Conservation **31**:91-101.

Berger, J. 1997. Population constraints associated with the use of Black Rhinos as an umbrella species for desert herbivores. Conservation Biology **11**:69-78.

Bifolchi, A., and T. Lode. 2005. Efficiency of conservation shortcuts: An investigation with otters as umbrella species. Biological Conservation **126**:523-527.

Carignan, V., and M. A. Villard. 2002. Selecting indicator species to monitor ecological integrity: A review. Environmental Monitoring and Assessment **78**:45-61.

Caro, T. M. 2001. Species richness and abundance of small mammals inside and outside an African national park. Biological Conservation **98**:251-257.

Caro, T. M. 2003. Umbrella species: critique and lessons from East Africa. Animal Conservation **6**:171-181.

Caro, T. M., and G. O'Doherty. 1999. On the use of surrogate species in conservation biology. Conservation Biology **13**:805-814.

Cooper, J. M., M. Wheatly, C. P. A., A. Deans, C. Holschuh, and S. Beaushesne, M. 2004. Potential impacts on birds in the Mackenzie Valley from Pipeline Clearings for the Mackenzie Gas Project. Technical Report Series No 442. Canadian Wildlife Service, Prairie and Northern Region, Yellowknife.

Dixon, P. M., A. R. Olsen, and B. M. Kahn. 1998. Measuring trends in ecological resources. Ecological Applications **8**:225-227.

Fleishman, E., C. J. Betrus, R. B. Blair, R. Mac Nally, and D. D. Murphy. 2002. Nestedness analysis and conservation planning: the importance of place, environment, and life history across taxonomic groups. Oecologia **133**:78-89.

Gittleman, J. L. 1986. Carnivore Life-History Patterns - Allometric, Phylogenetic, and Ecological Associations. American Naturalist **127**:744-771.

Gregory, R. D., A. van Strien, P. Vorisek, A. W. G. Meyling, D. G. Noble, R. P. B. Foppen, and D. W. Gibbons. 2005. Developing indicators for European birds. Philosophical Transactions of the Royal Society B-Biological Sciences **360**:269-288.

Gustafsson, L. 2000. Red-listed species and indicators: vascular plants in woodland key habitats and surrounding production forests in Sweden. Biological Conservation **92**:35-43.

Lambeck, R. J. 1997. Focal species: A multi-species umbrella for nature conservation. Conservation Biology **11**:849-856.

Landres, P. B., J. Verner, and J. W. Thomas. 1988. Ecological Uses of Vertebrate Indicator Species - a Critique. Conservation Biology **2**:316-328.

Lindenmayer, D. B. 1999. Future directions for biodiversity conservation in managed forests: indicator species, impact studies and monitoring programs. Forest Ecology and Management. **115**:277-287.

Lindenmayer, D. B., A. D. Manning, P. L. Smith, H. P. Possingham, J. Fischer, I. Oliver, and M. A. McCarthy. 2002. The focal-species approach and landscape restoration: a critique. Conservation Biology **16**:338-345.

Mackenzie Gas Project - Environmental Impact Statement. 2004. Volume 5: Biophysical Impact Assessment. Part E – Terrestrial Resources: Wildlife.

Niemi, G. J., J. M. Hanowski, A. R. Lima, T. Nicholls, and N. Weiland. 1997. A critical analysis on the use of indicator species in management. Journal of Wildlife Management **61**:1240-1252.

Niemi, G. J., and M. E. McDonald. 2004. Application of ecological indicators. Annual Review of Ecology Evolution and Systematics **35**:89-111.

Noss, R. F. 1990. Indicators for Monitoring Biodiversity - a Hierarchical Approach. Conservation Biology **4**:355-364.

Noss, R. F. 1999. Assessing and monitoring forest biodiversity: A suggested framework and indicators. Forest Ecology and Management **115**:135-146.

Pöysä, H., J. Elmberg, K. Sjöberg, and P. Nummi. 2000. Nesting mallards (Anas platyrhynchos) forecast brood-stage food limitation when selecting habitat: experimental evidence. Oecologia **122**:582-586.

Roberge, J. M., and P. Angelstam. 2004. Usefulness of the umbrella species concept as a conservation tool. Conservation Biology **18**:76-85.

Rowland, M. M., M. J. Wisdom, L. H. Suring, and C. W. Meinke. 2006. Greater sage-grouse as an umbrella species for sagebrush-associated vertebrates. Biological Conservation **129**:323-335.

Rubinoff, D. 2001. Evaluating the California gnatcatcher as an umbrella species for conservation of southern California coastal sage scrub. Conservation Biology **15**:1374-1383.

Sea Duck Joint Venture. 2003a. Sea Duck Information Series: Long-tailed Duck (Clangula hyemalis). Sea Duck Joint Venture **10**.

Sea Duck Joint Venture. 2003b. Sea Duck Information Series: White-winged Scoter (Melanitta fusca). Sea Duck Joint Venture **15**.

Sea Duck Joint Venture. 2004a. Sea Duck Information Series: Common Eider (Somateria mollissima). Sea Duck Joint Venture **4**.

Sea Duck Joint Venture. 2004b. Sea Duck Information Series: King Eider (Somateria spectabilis). Sea Duck Joint Venture **9**.

Sea Duck Joint Venture. 2004c. Sea Duck Information Series: Surf Scoter (Melanitta perspicillata). Sea Duck Joint Venture **14**.

Shutler, D., M. L. Gloutney, and R. G. Clark. 1998. Body mass, energetic constraints, and duck nesting ecology. Canadian Journal of Zoology **76**:1805-1814.

Simberloff, D. 1998. Flagships, umbrellas, and keystones: Is single-species management passe in the landscape era? Biological Conservation **83**:247-257.

Sjöberg, K., H. Pöysä, J. Elmberg, and P. Nummi. 2000. Response of mallard ducklings to variation in habitat quality: an experiment of food limitation. Ecology **81**:329-335.

Smith, W. P., S. M. Gende, and J. V. Nichols. 2005. The northern flying squirrel as an indicator species of temperate rain forest: Test of an hypothesis. Ecological Applications **15**:689-700.

Taper, M. L., K. Bohninggaese, and J. H. Brown. 1995. Individualistic Responses of Bird Species to Environmental-Change. Oecologia **101**:478-486.

U.S. Fish and Wildlife Service. 2005. Waterfowl population status, 2005. U.S. Department of the Interior, Washington, D.C.

van Jaarsveld, A. S., S. Freitag, S. L. Chown, C. Muller, S. Koch, H. Hull, C. Bellamy, M. Kruger, S. Endrody-Younga, M. W. Mansell, and C. H. Scholtz. 1998. Biodiversity assessment and conservation strategies. Science **279**:2106-2108.

Verner, J., M. L. Morrison, and C. J. Ralph, editors. 1986. Wildlife 2000: Modeling Habitat Relationships of Terrestrial Vertebrates. University of Wisconsin Press, Madison, Wisconsin.

Wren, C. D. 1986. Mammals as Biological Monitors of Environmental Metal Levels. Environmental Monitoring and Assessment **6**:127-144.