

IMPORTANT BIRD
AREAS OF CANADA



LES ZONES IMPORTANTES
POUR LA CONSERVATION
DES OISEAUX AU CANADA

COMMUNITY CONSERVATION PLAN for the Redberry Lake Important Bird Area



Photo by Gerard W. Beyersbergen



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for the

Redberry Lake Important Bird Area

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prepared by

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Vision

The residents of the Redberry Lake Important Bird Area seek to implement management strategies and infrastructures to advance the conservation of birds through maintaining an ecosystem that nurtures a quality of life for its people and its wildlife, together.

Executive Summary

This Community Conservation Plan for Redberry Lake was prepared as part of Saskatchewan's Important Bird Area (IBA) Program. In this program, special areas are awarded an Important Bird Area designation for conservation purposes if the areas are used by large concentrations of birds, if birds present are at risk, or if the sites represent intact biomes and their bird inhabitants.

The IBA Program was launched initially by BirdLife International in the UK. Today there are BirdLife Partners in over 100 countries. In Canada the national partners are the Canadian Nature Federation and Bird Studies Canada. In Saskatchewan, the conservation component of this program is being delivered by Nature Saskatchewan. Funding partners of the Community Conservation Plan for Redberry Lake include Canadian Adaptation and Rural Development Saskatchewan (CARDS), the University of Saskatchewan, and Saskatchewan Environment and Resource Management (SERM) and the Canadian Millennium Partnership Program.

The Redberry Lake IBA dedication ceremony was held on 12 June 1999, as part of the 10 year anniversary celebration of the Redberry Pelican Project (Canada) Foundation at Redberry Lake Provincial Park.

Redberry Lake lies in a 55 km² glacial depression that contains three islands and reached 18 m at its deepest point in 1974. This saline lake lies within a 1181 km² watershed of glacial moraine landscape in the aspen parkland ecozone of Saskatchewan. Redberry Lake and its shores constitute the IBA, but this conservation plan is focused on both the lake and its watershed. About 1000 people live in the watershed and half of these reside in the town of Hafford. Land use in the area is primarily for crop production with some grazing of livestock and tourism.

Redberry Lake satisfies the IBA 'congregatory' criterion through its use by over 500 pairs of American White Pelicans that nest on the lake's island. This makes the lake "globally significant." Redberry Lake furthermore satisfies the 'threat-

ened' criterion through the use of the lake's shore by globally vulnerable and nationally endangered Piping Plovers, making the site "nationally significant." In addition, hundreds of pairs of Double-crested Cormorants, White-winged Scoters, California and Ring-billed Gulls use the islands for nesting. Many shorebirds use the lake for short-stops on migration. Waterfowl use the site during migration also, and a diverse bird community of at least 187 species has been recorded in the area.

Encouraged by a forward looking human community of mainly Ukrainian extraction, many conservation measures are in place at Redberry Lake. Following the traditional wildlife management practiced by aboriginal peoples of the region, the first formal designation was a Federal Migratory Bird Sanctuary established in 1925. In 1970, the islands became a Provincial Wildlife Refuge and today there are at least 13 conventions that aim to protect the lake and its resources. Most recently, the lake and its watershed was nominated for UNESCO Biosphere Reserve status.

Education, research and/or conservation measures are carried out by the Canadian Wildlife Service, Ducks Unlimited Canada, the National Water Research Institute, The Redberry Pelican Project (Canada) Foundation, the Rural Municipality of Redberry, Saskatchewan Environment and Resource Management, SaskWater and many local residents. This exemplary effort represents an opportunity for effective and coordinated conservation of the birds and the ecosystem that supports birds and people. Challenges include major threats to migratory species that take their effect outside of the watershed. Locally, management efforts include curbing disturbance and maintaining habitat. In a fundamentally changed precipitation- evaporation- erosion- and surface runoff cycle, water levels in the lake have been receding and salinity has increased correspondingly. One island has been eliminated as a refuge because of an emergent land bridge.

Given the prevailing crop rotations in the watershed, agrochemicals including pesticides are used extensively. Judging from a series of studies in and outside of the Redberry Lake watershed,

atmospheric drift and chemical runoff into the lake, and into surface and ground water supplies can lead to herbicide accumulation by aquatic invertebrates and affect human health. The prevailing agricultural land use in and outside of the watershed is unlikely to be sustainable in the long-term, and human residents are at a loss as to how to influence current trends in prairie agriculture.

The objectives that are specified in this plan to facilitate the conservation of Redberry Lake, its bird resources and its ecosystem include research, monitoring, organization, education and planning. These are:

1. Develop a plan for the monitoring of bird numbers and all related ecosystem processes (e.g. salinity, predation) to be able to detect threats and to enable an adaptive response.
2. Create an entity whose role it is to unite food consumers and producers in sustainable and best possible production and consumption that is consistent with bird protection. This may be viewed as a pilot project at Redberry Lake, for refinement here, and possible adoption elsewhere.
3. Use or modify land use programs that are made available from various levels of government, to assist local residents in integrating sustainable production, ecosystem integrity and a quality of life.
4. Strengthen community/ stakeholder co-operation, and re-evaluate successes and failures of the proposed plan.
5. Encourage linkages between urban and rural Elementary and High School students to explore the connections between nature, human populations, food production and consumption, and sustainability.

The Redberry Pelican Project (Canada) Foundation is the "champion" of this IBA and thus will take the lead in its conservation. Assistance will be provided by IBA program participants; Nature Saskatchewan, the Canadian Nature Federation, and Bird Studies Canada. Finally, the 16 individuals listed in the appendix can also be counted on for advice.

1. Introduction

Bird conservation is not ‘just for the birds.’ In a widely acknowledged and visionary treatment of the causes, human uses and the state of decline of diverse life forms on Earth, E.O. Wilson (1992) suggests that certain species will and should receive special attention. Wilson points out that individual species which may be large and colourful or otherwise charismatic, often are conservation favorites even though they represent a small fraction of living things. Such species, Wilson claims, can motivate conservation at many levels, from individual to government. Since no species exists in isolation from other species or its environment, such conservation efforts already in the first instance serve to protect elements of a functioning life support system. If human economic, cultural and social values are adapted in addition to species and systems concerns, the conservation efforts will come ‘full circle’ and have gone well beyond the birds.

The purpose of this report is to provide an impetus for further conservation. Toward this end, this report tries to;

- i) explain why Redberry Lake had been chosen as an Important Bird Area,
- ii) describe the lake’s ecosystem of which the birds are a part,
- iii) outline opportunities and challenges for conservation,
- iv) list potential stakeholders and contact people,
- v) provide a conceptual backdrop (biological,

- social and economic) in which conservation efforts may operate,
- vi) briefly review appropriate literature and thus suggest other resources,
- vii) consider what is known but, for effective planning, also speculate as to the potential impact of the unknown, and
- viii) anticipate opportunities and concerns across as many sectors in society as possible.

1.1 Why protect birds

Surveys of human values and economic impacts have shown that birds have attracted the attention of many people in Saskatchewan and around the World. In a 1991 survey, 83.3% of Canadians reported that “maintaining abundant wildlife is very or fairly important” (Filion et al. 1993). Globally, 62% of people surveyed in 1990 in 42 countries reported “strong approval” for the ecology movement (Nevitte 1996). These human values are more than wishful thinking to many people. A survey in Saskatchewan in 1996, showed that 74% of the population was involved in indirect nature-related activities (through media, visiting zoos, purchasing art and the like), and 15% of the population participated in trips specifically to view wildlife (<http://www.ec.gc.ca/nature.html>). These data signal a change in values by which we rank the worth of humans vs. wildlife, an expansion of the ‘human-animal boundary’ (Cartmill 1993). These changing world views represent both a responsibility and an opportunity. It will be the conservation planner’s role to help formulate a scenario in which these new opportunities may be realized.

This conservation plan focuses on Redberry Lake, in the aspen parkland ecoregion of south-

central Saskatchewan (Fig. 1). Special bird resources that occur on the lake include American White Pelican (*Pelecanus erythrorhynchos*) and Piping Plover (*Charadrius melodus*). The aerial display is magnificent when groups from a population of over 1,000 pelicans (1-2% of world population) travel gracefully between the lake's islands where they nest, and feeding areas sometimes many kilometres away. The globally vulnerable and nationally endangered plovers hide their fewer than 10 nests on saline shores of the lake. The site is ranked as "Globally significant" and satisfies requirements for threatened and congregatory species.

1.2 Possible approaches to bird protection

Redberry Lake's special bird resources and the natural systems in which they are embedded clearly do not exist in isolation from aspects of human culture (how we view and do things) and production (how we make a living). Effective prescriptions for conservation should include all elements, and in particular the human elements. A participatory, community-based research and management system might be adopted. Kramer's (1986) model of community-based research and action, outlines several stages that cannot be skipped: need -> interest -> involvement -> ownership -> commitment -> collaboration. An important characteristic in this process is the sharing of power. Weeks and Packard (1997) have illustrated how several barriers arising from a top-down management style have hampered conservation success.

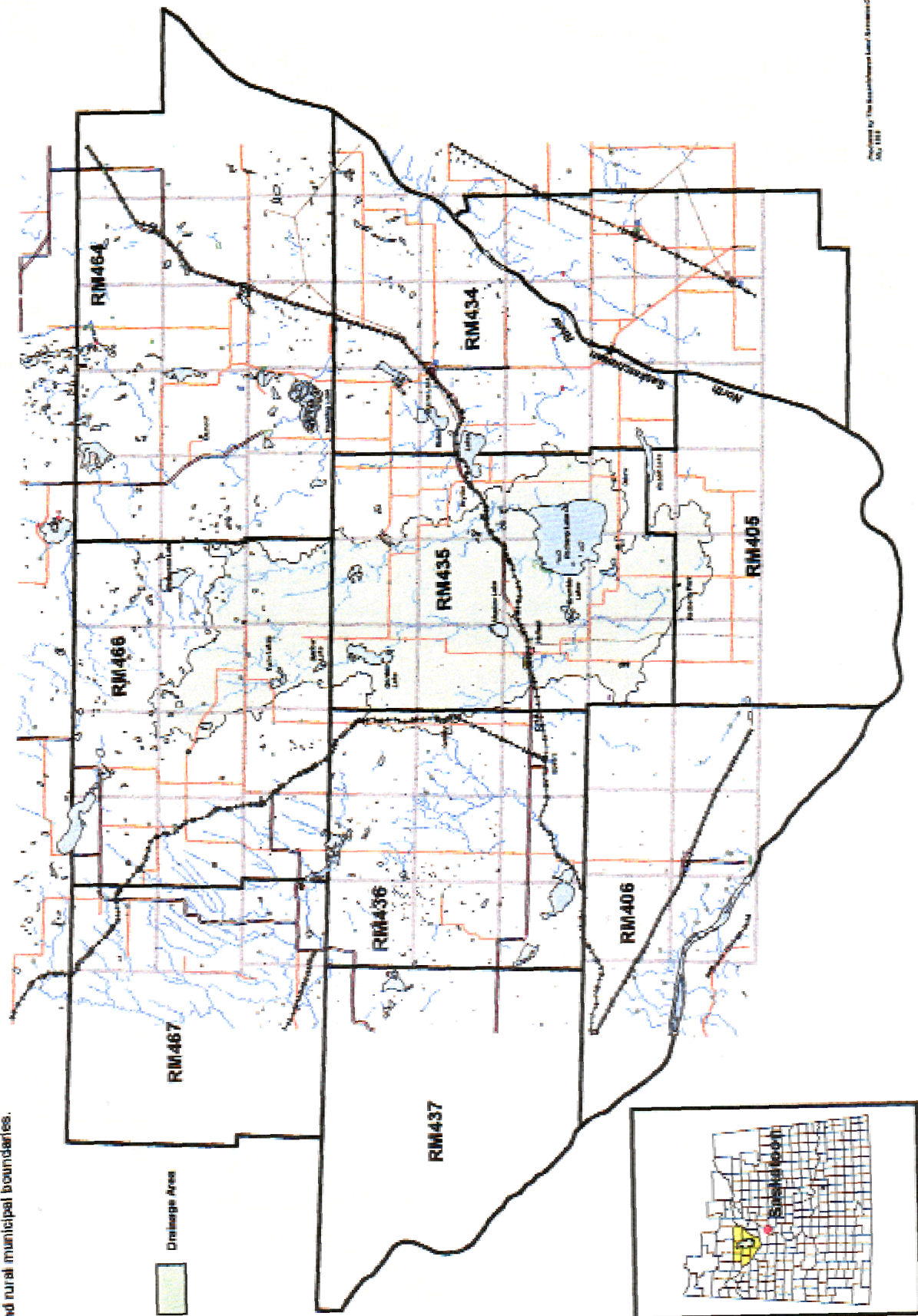
Every attempt will be made in this project to respond to local issues and to represent the aspirations of the local people, making this endeavor a community-based, and interactive process with wide stakeholder involvement. At least three local

institutions form a direct link between management at the lake and local residents. The rural municipality (RM) participates in land management around the lake. The management of a Regional Park is guided by a park board (Sect. 6.3). The Redberry Pelican Project (Canada) Foundation operates nature tours and an interpretive centre at the lake, the project is at least peripherally involved in much of the research, and it acts as a clearing house for resource matters for the local people. All of these organizations have local representation. The Redberry Pelican Project, in particular, is well situated to be the champion for this conservation plan and the plan's implementation.

While local involvement is critical for achieving the plan's goals, 'community' and 'stakeholder' should also be broadly defined. The stakeholders and the community for the Redberry Lake, for instance, involve the local community first. However, because natural systems are inextricably connected, these connections and therefore obligations extend eventually to all Canadians and in some small sense to all citizens on Earth. In many respects, Canada has a tradition of collective goals with both local and regional input in decision making (Raad and Kenworthy 1998). Furthermore, Canada as a nation participates in international agreements such as the Biodiversity Convention (Anonymous 1995).

By far the greatest wildlife attraction for people are the pelicans (Sect. 4.2.1) of Redberry Lake. These magnificent birds served as icons in promotion to visitors and residents interested in the wildlife and human communities. The pelicans and other bird resources are an important impetus for the zoning of the lake, for the protection of lake surroundings and for conservation action

Fig. 1. Location of Redberry Lake and its watershed in relation to the North Saskatchewan River and rural municipal boundaries.



throughout the watershed. Furthermore, this move to incorporate natural resources and natural beauty in a vision for the human community can serve as an example for others to follow. In some sense, this exemplary inclusion of nature in local planning may be rooted in a Ukrainian heritage that is widely shared in the RM. This common heritage likely facilitates consensus building.

Many of the currently employed farming practices demand increasing inputs which are costly to the farmer and to the environment. Farmers in the Redberry municipality are looking to expand their options for a quality of life on the farm. Farmers have joined with community decision-makers and the wider community to work toward an environmentally/socially sustainable future. Currently, this is a key objective of the Biosphere Reserve framework (Sect. 6.3). The IBA program is well suited to make important contributions in this setting.

2. The IBA Program

The IBA program is an international non-government initiative coordinated by BirdLife International, a partnership of over 100 countries seeking to identify and conserve sites important to all bird species worldwide. By encouraging the protection of birds and habitats, it also promotes the conservation of the world's biodiversity. There are currently IBA programs in Europe, Africa, the Middle East, Asia, and the Americas.

The Canadian BirdLife co-partners are the Canadian Nature Federation and Bird Studies

Canada (<http://www.ibacanada.com/html>). Bird Studies Canada is primarily responsible for site identification and designation under the IBA protocols. The Canadian Nature Federation facilitates conservation planning and implementation, working with its provincial partners. The Canadian IBA program is part of the Americas IBA program which includes the United States, Mexico, and 17 countries in Central and South America.

The goals of the Canadian IBA program are to:

- identify a network of sites that conserve the natural diversity of Canadian bird species and are critical to the long-term viability of naturally occurring bird populations;
- determine the type of protection or stewardship that exists or is required for each site, and ensure the conservation of sites through partnerships of local stakeholders who develop and implement appropriate on-the-ground conservation plans; and
- establish ongoing local involvement in site protection and monitoring.

IBAs are identified by the presence of birds falling under one or more of the following internationally agreed-upon IBA categories:

- Sites regularly holding significant numbers of an endangered, threatened, or vulnerable species.
- Sites regularly holding an endemic species, or species with restricted ranges.
- Sites regularly holding an assemblage of species largely restricted to a biome.
- Sites where birds concentrate in significant numbers when breeding, in winter, or during migration.

2.1 IBA Saskatchewan

Nature Saskatchewan is working with the Canadian Nature Federation and Bird Studies Canada to deliver the conservation planning component of this program in Saskatchewan. IBA Saskatchewan was launched on 1 Feb. 1999.

Nature Saskatchewan was founded in 1949 and is one of Saskatchewan's largest conservation organizations, providing a reasoned conservation voice under the vision "Humanity in harmony with nature." Nature Saskatchewan is active in the areas of education, conservation and research, and publishes scholarly books (22 to date), an international journal - the Blue Jay, and a quarterly newsletter. Nature Saskatchewan holds informative meetings, offers ecotours, operates a book shop, raises funds for worthy programs and campaigns, and has worked closely on several initiatives with Saskatchewan Environment and Resource Management and other conservation agencies.

Given the province's rich bird resources, 120 sites were originally nominated by knowledgeable Saskatchewan birders, biologists and conservationists. Of these, 50 have met the IBA criteria to date and others are under consideration. Our objective is to highlight the bird value in particular, and biodiversity value in general, of all final IBA sites in Saskatchewan's four ecozones. Our objective is also to select a subset of sites, based on need, for conservation planning. At these sites, the state of the ecosystem and bird conservation will be examined in light of the opportunities for sustainable human uses. In so doing, IBA Saskatchewan will work with and support the objectives of existing stakeholders, add some objectives of our own where needed, enlist a local champion for the plan as a conservation contact and for monitoring. The goal is to maintain each site's ecological integrity for

the distant future.

IBA Saskatchewan currently has two homes, one in Nature Saskatchewan's office in Regina and one in the Centre for Studies in Agriculture, Law and the Environment (CSALE), at the University of Saskatchewan in Saskatoon. CSALE is a newly formed strategic partnership integrating the disciplines of science, law and economics to conduct research into environmental issues related to agriculture. CSALE undertakes studies, provides education and develops policy options so as to enhance prairie and other agroecosystems.

3. IBA Site Information

The rural people living in the municipality of Redberry Lake (~500) and those in the town of Hafford (~550) have shown an exemplary vision for the natural treasure which the lake provides. The people have shown a remarkable commitment over decades and have persevered to protect this treasure.

Redberry Lake and its watershed represent a region just south of the boreal transition zone that has been much altered by crop production (Fig 2). Since bird conservation at Redberry Lake is intricately tied to water levels in the lake (Sect. 8.4), to agricultural pollutants entering the water sphere (Sect. 8.2), to soil and water renewal in intensive agricultural production, and to population processes such as dispersal and predation (Sect. 8.5), the conservation focus in this plan includes the lakes' entire watershed. This watershed is comprised of two subsystems, one for each creek tributary.

The primary industry in the watershed is agriculture on productive loamy black soils. Crop



production predominates but some livestock is raised also (Sect. 6.2.2). The lands that were used for cultivation initially were the south facing slopes where fescue grasslands existed. The clearing gradually included the aspen woods in the mosaic, and the draining of wetlands. Currently, approximately 75% of the land is used for annual crops.

Most of the development at Redberry Lake is located at the NW shore. A popular golf course is located at the north end of the Regional Park (Sect. 6.2.3). A smaller development (20 cottages), a bible camp and sailing club are located at the E and SW shore.

3.1 Redberry Lake's water cycle

As is typical of many prairie ponds and lakes, evaporation exceeds precipitation. For Redberry Lake, this has resulted in a lowering of maximum water levels by nearly 3 m during the last 33 years (Fig. 3). In view of declining water levels and its many potential influences on the ecosystem, it may be useful to consider aspects of the system's 'behaviour,' the water cycle.

In its simplest cyclical form, water evaporates and precipitates, over and over again. A great feature of this cycle is that as water evaporates it is purified each time, an ecological service which we derive from the ecosystem. Depending on where precipitation falls as rain or snow, it can be carried

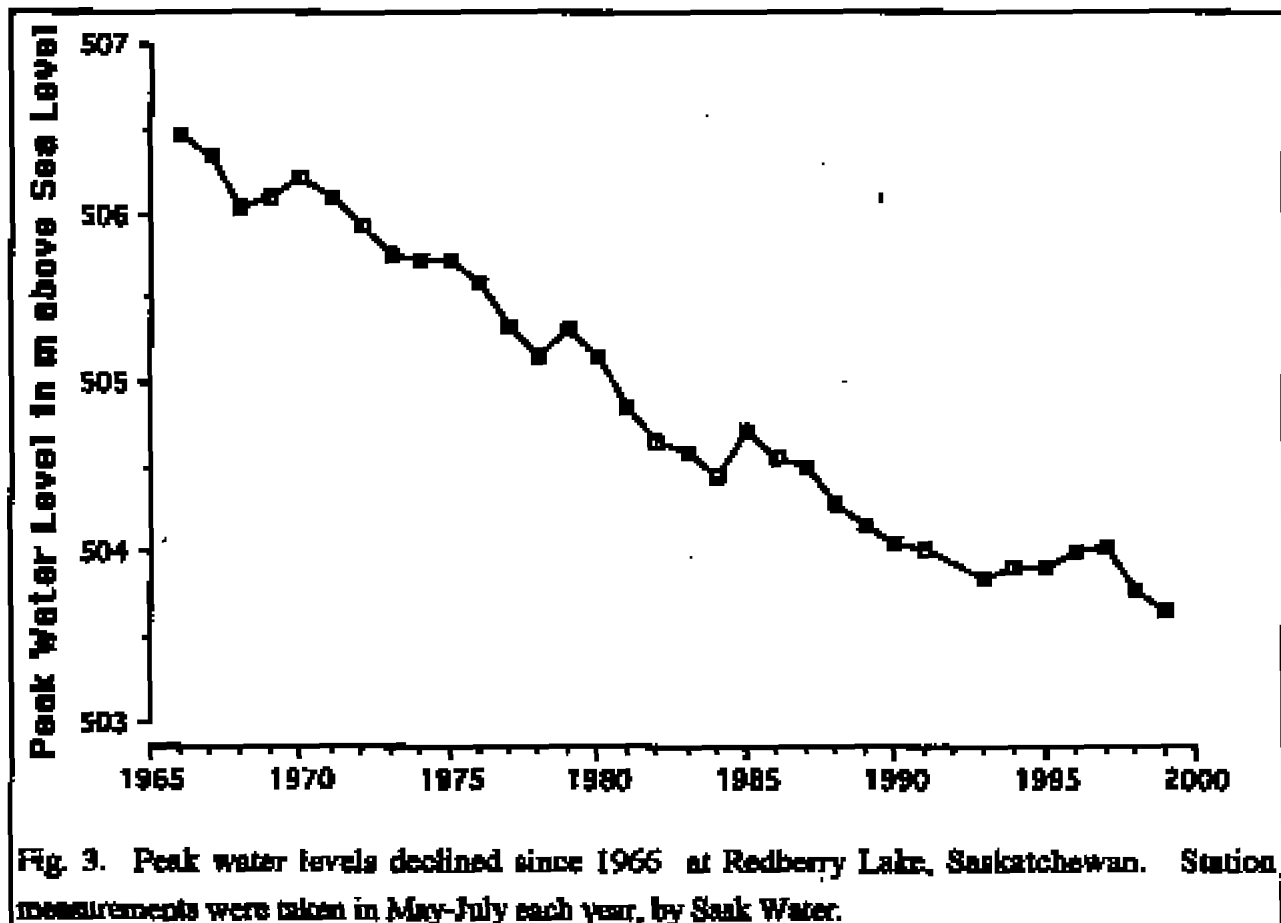
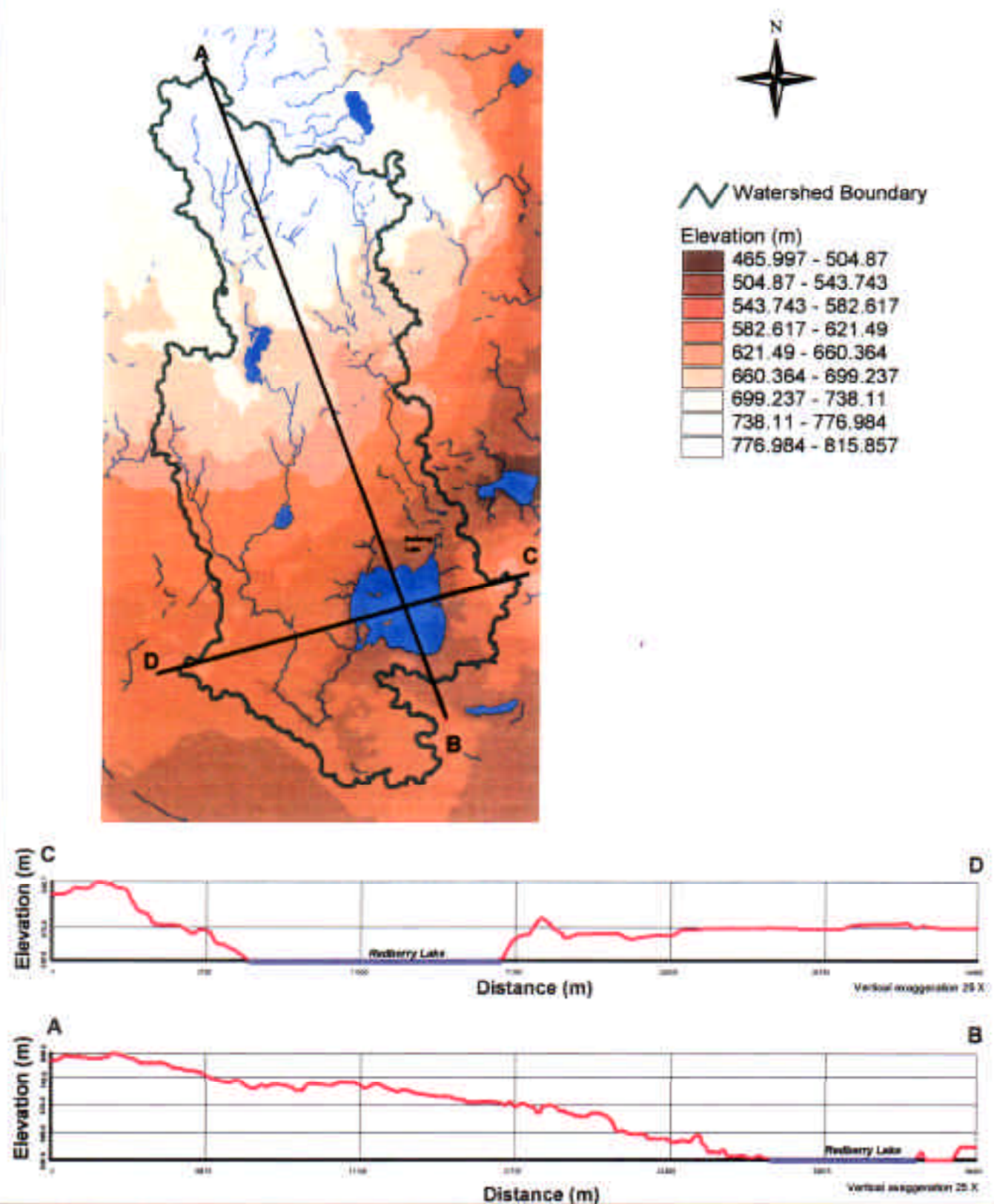


Fig. 4. Changes in elevation are shown along two axes across the watershed of Redberry Lake, Saskatchewan. Elevation is depicted at positions as reflected by axes A to B and C to D.



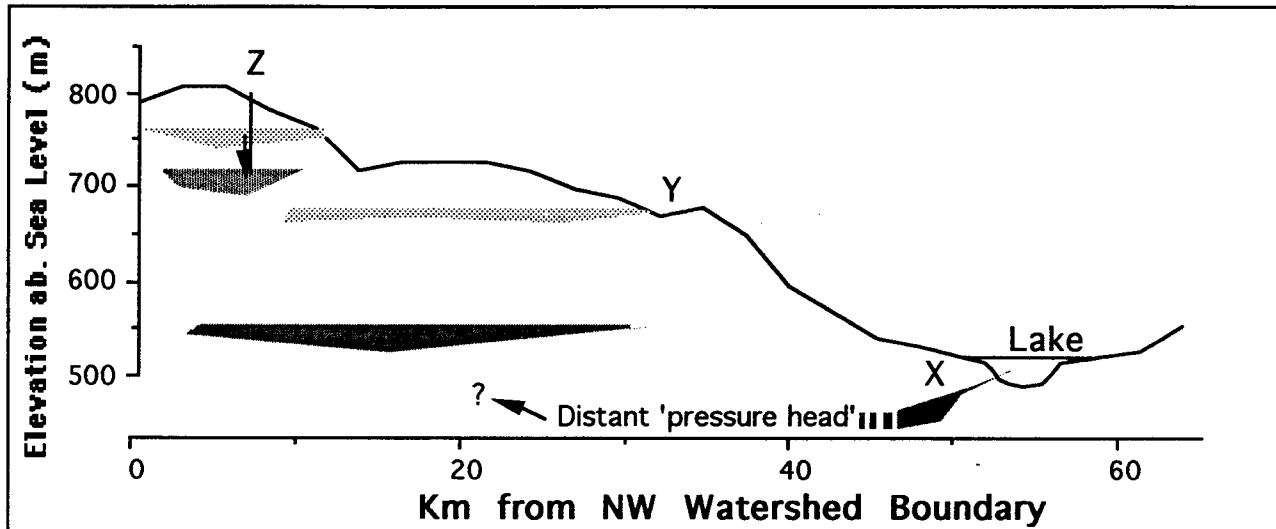


Fig. 5. A potential scenario for the connections and exchange between surface and ground water pertaining to surface water levels at Redberry Lake, Saskatchewan. Changes in elevation are a simplified representation of the A-B axis in Fig. 4. "X" attempts to depict an artesian connection to a deep aquifer. "Y" is a shallow aquifer connected to a creek. "Z" is a drilled well that connects, and if incompletely plugged, drains water from one aquifer to a lower one.

over soil surface to streams, rivers and eventually oceans, can be carried to lakes within a self contained and land-locked drainage basin, or stored temporarily or permanently in ground water reservoirs under ground.

Redberry Lake is one of 15 land-locked drainage basins in Saskatchewan (Fung et al. 1999). The lake derives its water from rain and snow, draining off of a 1181 km² watershed (Fig. 2) directly into the lake, or via Marshy and Oscar creeks. Marshy Creek enters the lake from the SE and has a much larger watershed subunit than Oscar Creek that enters the lake NW. Figure 4 shows a mix of slopes in the watershed. Some areas, especially in the Thickwood Hills to the NW (near "A"), show a fairly consistent slope that facilitates water run-off. Other areas, for instance W of Redberry Lake (near "D"), include poorly drained plain where more water may percolate through to ground water during

high precipitation events. The degree to which Redberry Lake derives ground water that may originate from outside the watershed, is unknown.

As water volume declines, salt is left behind and the salt concentration in the lake necessarily increases (Sect. 8.3). Salt-containing lakes occur on every continent, and the total volume of salt lakes compared to freshwater lakes is about equal (Hammer 1986). Salt water lakes can be very productive ecologically, but the presence of salt introduces an additional vulnerability.

For salt to be left behind in the evaporation process the salt had to come from somewhere, presumably from the land-locked sea that once covered the Great Plains. Beak (1989) reported that the waters of Redberry Lake are unusual in comparison to other lakes in the region. The water 'fingerprint' does not completely match a pattern to be expected if the lake were connected to nearby shallow ground

water reservoirs, nor does it match expectation from a deep ground water aquifer alone. The water analyses were approximations because few data are available. It may be that the lake is connected to both shallow and deep aquifers, and in addition receives some water from the surface.

Figure 5 is an attempt to offer a plausible scenario for water connections and lake water declines. First, it is widely recognized that human surface and subsurface activities since settlement may have influenced a widespread decline in surface water volume on the Canadian prairies (Sect. 8.4). This alone would influence water levels at Redberry Lake

There are four groups of large aquifers at depths of 100 to over 1000 m below ground underneath Saskatoon. All but the top aquifer have water too salty to be 'potable.' One branch of a group of aquifers, the Battleford Valley aquifer, is held within deposits of the Tertiary geological period (12-60 million years ago). This aquifer is located very close to Redberry Lake. It is conceivable that such a deep salt water channel may have an upward connection, and water under pressure can flow upward, as in an artesian well (Fig. 5 "X;" Beak 1989). The deeper the aquifer the longer it takes to recharge (or discharge) water from this aquifer. The long delays can make an interpretation of potential cause and effect very difficult.

Shallow aquifers or 'sheets' can cover a large region, or be small in extent. Thus, changes in water level can have local, but sometimes also distant effects. In Scenario "Y," a shallow aquifer to which surface water percolates from relatively flat land (recharge) can feed a creek (discharge) and thus contribute to lake water levels a considerable dis-

tance away. This water flow would be influenced by precipitation, but with a delay of months and perhaps years.

In "Z," a water well, or seismic exploration hole, is bored through one aquifer and into another. Water wells are meant to be sealed to prevent drainage, but the seal may break or the pipe eventually disintegrate, allowing water to flow from one reservoir to another¹.

4. IBA Species Information

4.1 IBA species

Of the many species of birds that frequent Redberry Lake, there are at least two of particular importance and these are recognized through the IBA process (Table 1). Redberry Lake is recommended as a globally significant IBA under the congregatory species category. Just over 1% of the world's American White Pelican population is present during the breeding season (about 2 % of the Canadian breeding population). The American White Pelican has increased in numbers recently (Fig. 6), and nested on islands in the lake at least as far back as 1936.

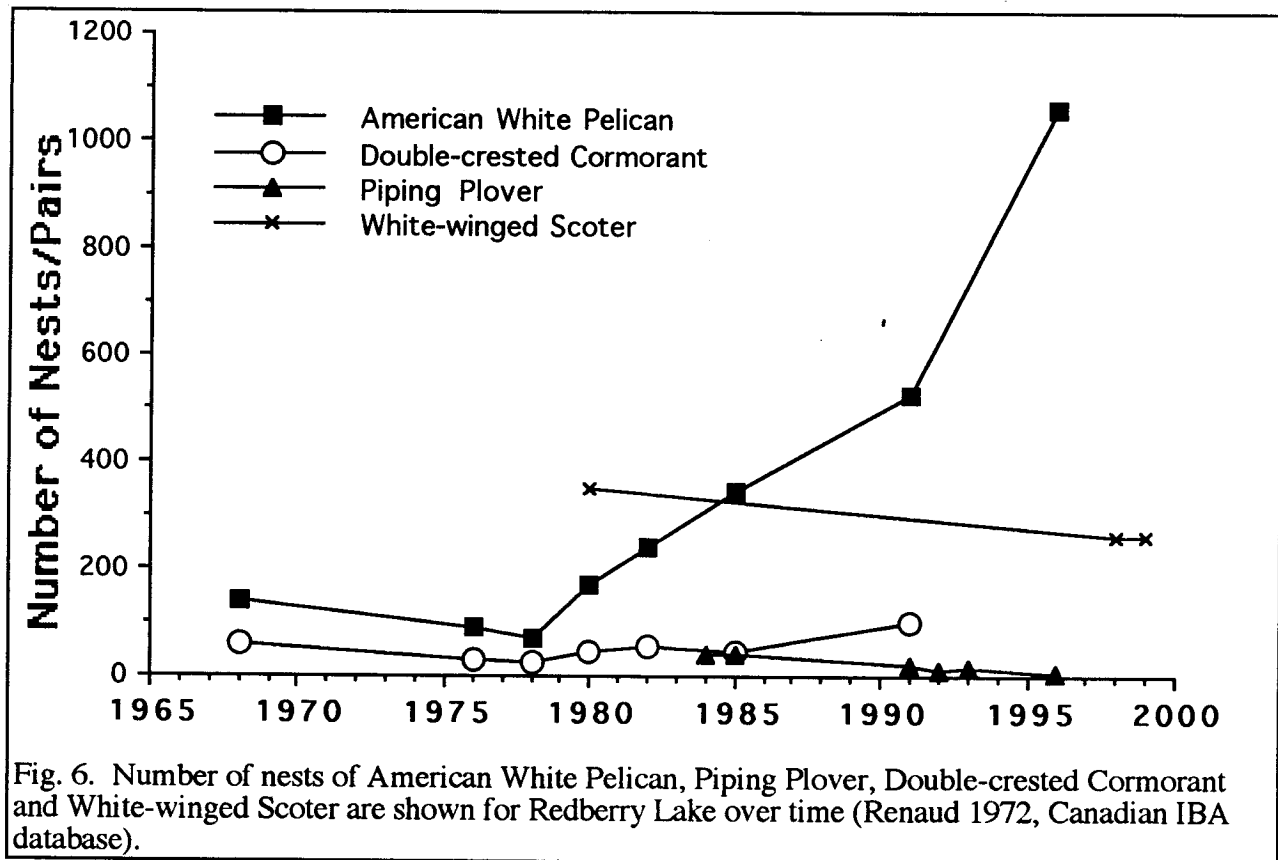
Redberry Lake is also important because its shores are home to Piping Plovers which are vulnerable globally and endangered in Canada. Although the number of plovers found at the lake is small, they have been regularly present here and the site is therefore considered important.

¹ A Maclean's article in the 1980s reported that a hole drilled for seismic exploration on the Continental Shelf off the East Coast, had drained sea water into the hole for more than a decade, and was still draining at the time.

Many rural residents who derive their drinking water from wells, have experienced declines in a well's productivity and water quality. Some residents report changes in their well that coincide with earthquakes or water-related, human activity. For instance, resident of the Coronach area in Saskatchewan felt that their wells lost capacity and/or water quality following draining of an aquifer at a nearby mine.

Table 1. Population status of two ‘important’ birds at Redberry Lake, Saskatchewan. Data are taken from the Canadian IBA Database.

	American White Pelican	Piping Plover
IBA category	Congregatory	Endangered
Max. numbers per day	1,060 pairs (1996)	21 plovers in 1991, 4 in 1996
Importance	Globally significant	Globally vulnerable
Proportion of:		
Global population	1-2%	<1%
National population	1-2%	<1%



Historically, Redberry Lake also supported nationally significant numbers of the globally vulnerable and nationally endangered Piping Plover. Forty-one plovers were observed in both 1984 and 1985, 21 plovers in 1991, and 4 in 1996.

4.2 Natural history of IBA species

In this report, aspects of the birds' natural history and ecology are summarized insofar as they pertain to the bird area, and to the area's sustained use and conservation. The main locations of nesting areas for pelicans, plovers and gulls are shown in Fig. 7 and Table 2. Unless otherwise indicated, the natural history information described here is taken from species summaries by Evans and Knopf (1993) for the American White Pelican, and Haig (1992) for Piping Plover.

Table 2. Results of a 1996 nest count on islands of Redberry Lake, Saskatchewan.

	Islands	
	New Tern	Pelican
Am. White Pelican	1178	
Double-c. Cormorants	352	
Great Blue Herons	6	
California Gulls	1442	2237
Ring-billed Gulls	9077	157

4.2.1 American White Pelican. This pelican weighs 5-9 kg and relies largely on fish for food. It has to contend with few predators once it reaches adulthood and can live to 26 years of age.

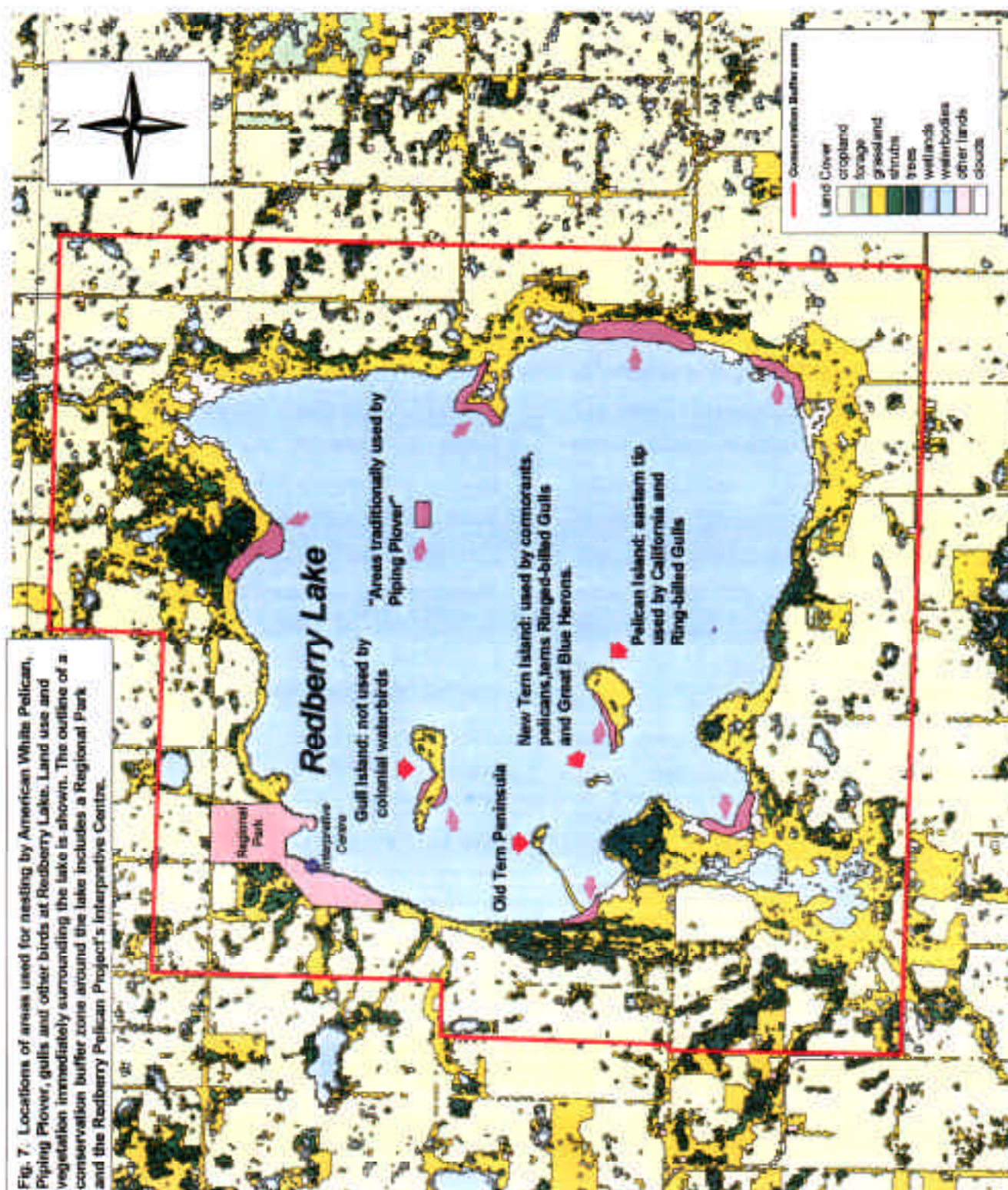
Redberry Lake lies within a large contiguous area where pelicans regularly breed in a band roughly bordering the northeastern fringe of the northern Great Plains, from NE South Dakota to NE Alberta. In addition to this band, there are eight other isolated pockets of breeding distribution in the western United States. and Canada. The birds

migrate in flocks as large as 180 birds mostly to eastern and western coastal areas in Mexico and the southern United States. Although, the American White Pelican flies over mountains and deserts on migration, it depends on water and only stops where water bodies are present.

The American White Pelican is vulnerable to small scale impacts (e.g. disturbance Sect. 8.6) because of their colonial habit. Birds in general can be 'colonial' for a wide spectrum of reasons, ranging from the simple coming together at a desirable habitat feature (e.g. an island), to complex social behaviour where one bird can help rear another bird's young. Coloniality in the American White Pelican nearly covers both extremes.

As island-nesting birds, the pelicans congregate naturally and in a landscape where islands are rare, numbers of pairs per island may be high. Even though such large aggregations by pelicans on islands may be partly 'coincidental,' there are added benefits from having pelican neighbours. The young huddle together in tight groups once they are 2-3 weeks old and save body heat, more often at night. When parents arrive the huddling young scatter to their nest sites and this is where they are recognized by their parents as the parents' own. Because individual recognition is poorly developed when young are small and immobile, it sometimes happens that the otherwise very protective parents do not assist their displaced young. Any factor that disrupts the normal home-nest-dynamics is serious for the birds. Sometimes a simple disturbance at the nest can cause abandonment. In contrast, when out feeding the pelicans can be quite tolerant of disturbance. The nest is the only site pelicans defend.

During feeding, pelicans are very gregarious



and have developed sophisticated cooperative feeding strategies. Feeding pelicans often spread out and with wing-flapping and bill-dipping drive prey into the shallow water near shore where prey is more easily caught. Such drives can be by two groups of pelicans swimming toward each other and can last up to 10 min.

Lakes that contain islands are not always also sufficiently productive for feeding. Pelicans cope with this two-pronged nesting-vs.-feeding demand by flying a maximum of 150 km to feed. Food is carried in the gullet and regurgitated for the young.

Pelicans eat mostly fish taken in shallow water at day or night. Because pelicans spend little time in feeding areas compared to nesting areas, it is easy to underestimate the importance of those feeding areas. Conservation measures for pelicans should look well beyond those sites where they spend a majority of time, to include feeding areas where they may stay only briefly. Conservation strategies should therefore include a regional view and not a mere site-based concern. This is most certainly true of the Redberry Lake pelican colony.

Pelicans are vulnerable to pollutants because the pelicans involve an almost entirely water-based food chain. Urban, agricultural and industrial pollutants enter the water sphere easily (Sect. 8.2). In the case of pollutants that take long to degrade, such as persistent organochlorines (e.g. DDT) it could be shown that pelicans accumulate these chemicals. Rather than passing chemicals through their bodies, the physiology is such that chemicals are stored, often in body fat. When fat stores are used later, as during egg laying, these chemicals

can be released in amounts sufficient to cause harm (e.g. eggshell thinning leading to egg breakage).

Pelicans appeal to people because of their size and their graceful and coordinated flight. Flight can be in a staggered line, 'V' or 'J,' in which the bird flying behind another takes advantage of the energy savings accrued from flying in the swirl of turbulent air. Flying birds sometimes rise and fall in succession, creating a wave-like effect. Pelicans characteristically alternate wing flapping with gliding (60-75% of low altitude flight), which is initiated by the leading bird and this "phase-shift" moves back through the line, again analogous to a wave.

Pelicans have a long history at Redberry Lake. In 1936-37 combined, 328 young pelicans were banded by bird banders Lyon and McArthur (in Renaud 1972). Between 1936 and 1972, a total of 2,468

pelicans were banded. Pelican numbers are increasing at Redberry Lake (Fig. 6). It is not clear whether this increase is due to increased recruitment of locally produced young, or a move toward larger lakes by the birds faced with declining nesting opportunities. American White Pelicans used Pelican and Gull Islands in 1972; by 1996 they had switched to New Tern, an island that has been exposed only since 1957 (Fig. 7). Also, Gull Island is now too densely covered with shrubs to attract pelicans.

Judging by local observations, the pelicans feed at Redberry Lake, in the many smaller water bodies in the watershed, and even outside the watershed perhaps as far away as the South (Fig. 1) and North Saskatchewan Rivers. The nearest persistent

nesting colony is at least 200 km from Redberry Lake. Pelicans frequent the South Saskatchewan River in Saskatoon, where they apparently take advantage of fish vulnerable in the eddies created at a weir. Here, they are a favored bird to watch, and notoriety goes to the first person to record pelicans in Spring.

4.2.2 Piping Plover. The Piping Plover took the ‘shorebird’ taxonomic family name very literally. It spends virtually its entire life on the beach, at ocean shores, in bays, on inland lakes and rivers, and temporary ponds. Even when on the beach, it uses primarily the water’s edge and a narrow upland strip. Bathing seems to be the only time when it gets deliberately wet.

Piping Plovers feed on aquatic and terrestrial invertebrates. At the water’s edge, they capture those invertebrates that are vulnerable after having been whipped up by wave action, or left behind in the film of receding water. On the Great Plains, aquatic invertebrates include mostly aquatic insects in the larval stage. The plovers also run down terrestrial insects on the beach and seem not to take them in flight.

To raise their brood, Piping Plovers make a depression in the sand for nesting. This depression that needs to be inconspicuous, is lined only with items nearby, pebbles and sometimes broken shells from snails or clams. The male and female appear ritualistic and ceremonial when they line their nest, tossing items with their bill, with an accuracy that would make a horseshoe thrower proud. During the 4-week incubation period the plovers are ‘tied’ to this

spot, but soon after the young hatch, the family is able to move to other areas on the beach. The young fledge at three weeks of age. In some areas, Piping Plovers apparently can raise a second brood, but this has not been observed in two Canadian populations (East Coasts: Sabine Dietz and Roland Chiasson, Important Bird Area Program, pers. comm.; Prairie: Margaret Skeel, Nature Sask., pers. comm.).

By all accounts, concealment and camouflage are essential features in the Piping Plover’s life, especially during nesting. Nests are sometimes near larger objects such as logs or boulders, presumably selecting rough areas which any large animal might avoid. Piping Plovers have many predators of eggs and young, including mammals and birds (Sects. 5.1.2, 5.1.3, 8.5). Their reliance on shores predisposes the plovers to predation, because these water bodies are visited by many animals in an arid landscape where water bodies can be rare. Human activity also is often concentrated at shores and this can result in conflicts. Rushing storm water sometimes washes away nests, and others are flooded when water levels are drastically altered in reservoirs.

Attempts to protect the declining Piping Plovers have been many. Still, plover numbers on the Great Plains continue to decline. Plovers along the Atlantic Coast are barely maintained through intensive protection measures including limiting human, vehicle or other recreational travel along shores. Plovers of the Great Lakes continue to decline despite protection measures.

At Redberry Lake, Piping Plovers use rocky and sparsely vegetated sections of the lake’s shores,

and the shores of Gull and Pelican islands (Fig. 7). In 1972, Renaud (1972) described the Piping Plovers as a “regular and fairly common breeder.” During Piping Plover surveys at Redberry lake, 41 individuals were counted in 1984 and 1985, 21 plovers in 1991 but only 4 in 1996. Judging from a regular occurrence of Piping Plover at nearby lakes (Skeel et al. 1996), this portion of the Aspen Parkland is a traditional home for this species. The two pairs found in 1996 frequented the NW shore of the lake. The observers noted that water was high and the habitat marginal (Skeel et al. 1996).

4.3 Species perception.

Some bird species cause crop damage or otherwise compete with human resource extraction. In the case of Piping Plovers, this is not a problem. Although the pelicans utilize fish, studies have shown that the fish are smaller in comparison to those sought by sport (or earlier commercial) fishers at Redberry Lake. The indirect impact by the birds on the food chain seems to be accepted by people. It appears that the birds are not blamed for the decline of a stocked fishery at Redberry Lake many decades ago. However, the cormorants were thought to be in competition with people when fish were released periodically at Redberry Lake.

Restrictions to boat travel near the nest islands seem to be considered necessary and are largely accepted by the local community (8.6). This restriction on people’s activities is likely outweighed by the positive aspects of having the birds nearby.

Concern has arisen among some landowners in Canada over the impact of the proposed federal endangered species legislation at the farm or ranch

level. While the fear may be much greater than warranted, a sensitivity to this issue may be called for. For instance, attempts to protect Piping Plover nesting areas from cattle through fencing has not always been well received. This conflict is quite minor, but it does illustrate the urgent need to approach people with sensitivity. Kramer’s model would suggest that the approach proceed from need -> interest -> involvement -> ownership -> commitment -> collaboration. If land owners/lessees can be convinced of the ‘need,’ they themselves will show an interest, become involved and so on. If any step is bypassed, conservation success is likely lowered. Despite the urgency advanced here to find a need relevant for the landowner or resource user, this need has several dimensions. Every resource user is also a member of a larger society with many individuals who have their needs in turn. When 83% of Canadians wish to see abundant wildlife maintained, this is a need. When Canada signed an international convention to protect biodiversity, this became a formalized societal need (Sect. 1.2).

5. Other Elements of High Conservation Value

In addition to pelicans and plovers there are many other species that use Redberry Lake and its surroundings. According to Kerbes et al. (1986), a total of 187 species of birds were recorded in the Redberry Lake area in 1985. This included 100 “uncommon” species, 71 “common,” 15 “rare” and 1 “accidental.” Redberry Lake birds are highly accessible for viewing. Because Redberry Lake is located less than one hour’s drive from Saskatoon this area is important from the tourism point of view.

5.1 Other birds

5.1.1 White-winged Scoter. The White-winged Scoters' natural history is given prominence here because i) its nesting density may be higher at Redberry Lake than elsewhere, ii) because it had been extensively studied at Redberry in the 1970-80s and iii) detailed studies may resume in future (Peter Kingsmill, Redberry Lake Pelican Project, pers. comm.).

The White-winged Scoter, one of three species of scoters in the World, is a 1,000-1,700 g diving duck with males larger than females. This mainly black (male) or brownish-black (female) duck nests on islands within or near lakes, from prairie Canada and interior British Columbia to interior Alaska. Of all North American studies, much has been learned about the biology of this species from studies at Redberry Lake (reviewed by Brown and Fredrickson 1997).

Historically, the distribution of the White-winged Scoter extended well into southern Manitoba and North Dakota. Judging from this duck's breeding habit which included nests at considerable distance from water, the cultivation of uplands in the pond rich parkland habitat may have led to the vacation of this portion of the range. Currently, the scoters still frequent lakes where they mostly nest on islands.

White-winged Scoters nest in large concentrations on islands in Redberry lake (0.06-0.60 scoter pairs/ha) although not as high there as in the centre of the species distribution in NW Canada's boreal forest. Nest concealment appears to be an important factor for this species. This is accomplished by nesting in dense, often thorny, vegetation on islands (on average 96 m from shore at Redberry

lake), or up to 800 m away on mainland. The aggregations of nesting females appear to be 'coincidental.' However, authors are divided on the question whether the aggregations between scoters and gulls are purely coincidental, or whether the scoters derive some nest protection by nesting near gulls. Ironically, the gulls are also their major nest predators and especially predators of young scoters (Sects. 5.1.2, 5.1.3).

The pair bond of scoters is short, lasting from shortly after arrival in spring to just past laying of about 9 eggs. Only the female incubates, for 25-30 days, while the males flock and depart to molt at locations that are unknown. The female spends 80-90% of her time on the nest, which leaves little time to feed. After incubation, her energy reserves are close to depletion.

In a study at Redberry Lake 76% of 99 nests hatched at least one young. Usually hatching success is high (82%) among eggs in nests that are not completely or partially depredated. However, duckling mortality is also high, largely due to gull predation, resulting in 0.22-0.45 ducklings produced per pair, as recorded over several years at Redberry Lake.

Females tend to remain with their young for only about two weeks before they abandon them to fend for themselves during the remaining 50-65 day pre-flight period. This parental behaviour, which is irresponsible by human standards, is attributed to the near depletion of energy in which the hen finds itself after incubation. Furthermore, the desirable feeding areas for adults and young are different, which would prevent the female from restoring her bodily reserves in time for migration were she forced to stay with her young throughout.

Nearly all food consumed by adults and young is obtained by diving. Even the newly hatched young can dive for 5-20 seconds and a depth of 1.5 m. At Redberry, judging from where the ducklings fed and what was available there, the primary food (97% by weight) was an amphipod of the genus *Hyalella*, a free-swimming freshwater shrimp. It is suspected that this amphipod also provides the main food which females rely on during egg formation (Sect. 8.2).

Outside of the breeding season adult scoters dive deeper and take large animals which include crustaceans and mollusks. In winter, large concentrations of scoters can be found along east and west shores of N. America. Here they feed in the food rich estuaries at the mouths of rivers. Interestingly, female scoters marked at Redberry Lake were equally likely to be found on the East or West Coasts in winter.

While the Piping Plover seldom swims, the White-winged Scoter seldom walks on land, except at nests during laying and incubation. Females defend no territory, only their nest scrape. The abandonment by females of their young does not involve a smooth transition. When two females meet with their broods less than 2 weeks old, females frequently fight. During this disturbance, ducklings are not protected by the hen and readily succumb to gull predation. Ducklings also mix in the scuffle and one female often retains all or most young of both broods combined. These aggregations of young accompanied by a few hens are known as crèches. Crèches can include up to 150 ducklings and 1-7 hens, more commonly 30-55 ducklings. Many ducklings are lost to predators in the first week of life when the family moves from the nest to a suitable feeding area. The next period of high

duckling loss occurs about midway in their growth. Since this is the time when the energy demand is highest, it is assumed that the main factor here is starvation, or other starvation-mediated forms of mortality.

After detailed studies had been conducted on scoters at Redberry and adjacent lakes in the 1970s and 1980s, there was a hiatus in research. Plans are underway by the Canadian Wildlife Service to resume this work (Peter Kingsmill, Redberry Lake Pelican Project, pers. comm.). Preliminary surveys in 1998 and 1999 suggest that scoter numbers may have declined somewhat (Fig. 6). Currently, scoters nest on Gull and Pelican islands (Fig. 7), and on the shores and headlands where there is adequate grass or shrub cover.

5.1.2 California Gull. The biology of the California Gull has been summarized by Winkler (1996). The California Gull is a medium-size, white-headed gull that breeds on the northern Great Plains including the boreal forest portion, and in the valleys of the Rocky Mountain interior. It nests on islands free of terrestrial predators. Colonies can include over 20,000 California Gulls, notably in California, Utah and Alberta. Smaller colonies of nearly any size are also common. In winter, the gulls frequent the West Coast, from southern British Columbia to central Mexico. of 1145 California Gulls banded at Redberry Lake, 19 had been sighted and their bands read at a garbage dump near Vancouver (Houston 1974). Especially the younger non-breeding gulls seem to display little fidelity to wintering areas but may be on the move throughout. Available records suggest that the range of this species has changed little since settlement.

This gull seems to have permanently ingra-

tiated itself with the Mormon community because of this gull's decimation of grasshoppers at a time when these threatened crops early in settlement and threatened the survival of a colony of Mormon settlers in Utah. As a result, a fondness for this gull seems so deeply rooted that the California Gull's depredation of cherry crops is tolerated. The gulls have been observed hovering over cherry trees, beating cherries from the tree and then eating these on the ground.

California Gulls, as are most other gulls, are food opportunists consuming virtually any small vertebrate or invertebrate they can find, catch and swallow whole. The gulls' feeding strategies are also resourceful and include following machinery to eat exposed food, scooping flies in flight or snapping at dense swarms, pursuing mobile prey on ground or on wing over water. California Gulls have been observed paddling in water to churn up food, waiting at burrows for mice trying to escape flood waters, and even catching swallows on the wing. The gulls can also dive to a depth of 0.5 m and catch fish. Although the gulls seem to prefer large and live prey that can be efficiently subdued and swallowed, garbage including vegetable matter and fruit can make up a large portion of the diet. In some situations, California Gulls have had a severe impact on other species, Snowy Plovers (*Charadrius alexandrinus*) in California, waterfowl in Utah and grebes in Manitoba (Sect. 8.5). The gulls can feed at highly saline lakes, but in this case they fly to fresh water to drink.

Male and female gulls defend only a small territory around the nest. There is little social interaction beyond roosting and flock formation.

Coloniality is of the 'coincidental type' (4.2.1). Two-three eggs are laid in a nest scrape on the ground, that is lined with vegetation, bones and feathers from previous years, and down. Both parents take their 3-4 hr turn in incubation, and both feed their chicks to fledging. Young leave the nesting area soon after fledging, 40-60 days after hatching, and before the parents do so. California Gulls usually do not breed until their third year, and these non-breeders make up the flocks that drift widely in search of food including cities and garbage dumps.²

Counts of gulls are difficult logistically, because the locations of colonies and especially roosting or loafing sites containing large numbers of California Gulls can change. The total North American (World) population is thought to be between 500,000 to 1 million birds. Making some assumptions about counts in the past, it is thought that California Gull numbers have more than doubled since 1930. This increase has been attributed to increased availability of islands through reservoir construction, decreased harvesting of feathers and eggs, and increased availability of food on wintering grounds especially through refuse dumps.²

At Redberry Lake, California Gulls nest on Pelican Island, along with Ring-billed Gulls (*Larus delawarensis*), as they do characteristically in other locations. Renaud (1972) summarized banding data for 1955-72, when from 11-876 California Gulls were banded in 16 of the 17 summers. The total number of young banded was 4,924.

² In 1986, 60 California Gulls were in convulsions or dead from an organophosphate (trade name Dasanit) consumed at a municipal landfill near Prince Albert, SK, and 45 California Gulls died near Moose Jaw from eating grasshoppers sprayed with Furadan (T. Leighton, 1988, Blue Jay 46:121-125)

5.1.3 Ring-billed Gull. The Ring-billed Gull is smaller but otherwise similar in appearance to the California Gull. The two species often nest on the same islands where the ranges overlap. Ring-billed Gulls have been well studied, with one review paper citing 333 references. The biology and ecology of this species has been summarized by Ryder (1993).

The Ring-billed Gull nests across southern Canada and the northern United States. It winters on the shores and also up to hundreds of kilometres inland. The West Coast portion of its winter range includes coast from southern British Columbia to central Mexico and here it overlaps with the California Gull. In addition, the Ring-billed Gull frequents coastline in the United States, along the Gulf of Mexico and the Atlantic, and winters inland on the southern Great Plains and the Atlantic shelf.

Ring-billed Gulls declined in number and range between the 1840s and 1920s. This was attributed to persecution for their feathers used to decorate women's headdress, to the collection of eggs for food, and to loss of nesting habitat due to settlers. Populations recovered following the introduction of the Migratory Birds Convention Act (Sect. 6.3). Populations continued to grow due to agricultural expansion which provided grain, to tilling exposing large soil insects in fields, to the creation of islands through reservoir construction, the stocking of reservoirs with fish, and the growth of garbage dumps and wasted food.

Ring-billed Gulls are food opportunists as are California Gulls and others, but Ring-billed Gulls seem to be inclined to concentrate more on fish and grain than California Gulls. Also similar to

California Gulls, Ring-billed Gulls are monogamous, 62% of 29 pairs retained the same mate in a subsequent year, and they share in incubation and brood rearing duties. In nesting, Ring-billed Gulls also prefer sparsely vegetated islands and when vegetation encroaches the gulls usually choose a new site.

Ring-billed Gulls were impacted by polychlorinated biphenyl pesticides as were many other birds. These PCB levels have declined by 80% since these pesticides were outlawed.

5.1.4 Other notable birds. Some additional bird species rely on Redberry Lake and its surroundings. The endangered Whooping Crane uses various sites in the region for stopping on migration. Whooping Cranes have been sighted at Redberry lake at least three times prior to 1984 (Beak Associates 1989), and Whooping Cranes continue to use the watershed as stopover sites on migration (Philip Taylor, Can. Wildl. Serv., pers. comm.). In 1941 a low of 16 Whooping Cranes was counted on the coastal wintering grounds in Texas. With captive breeding and other intensive management, the population increased to at least 133 individuals including 47 breeding pairs on their Canadian breeding ground in Wood Buffalo National Park in 1995 (Johns 1996). In 1997, the total population of Whooping Cranes in the wild and in captivity was 354 (Committee on the Status of End. Wildl. in Canada).

Redberry Lake is also an important area for birds 'simply hanging out' (staging), including grebes (Horned *Podiceps auritus*, Western *Aechmophorus occidentalis*, Eared *Podiceps nigricollis* and Red-necked Grebes *Podiceps grisegena*), gulls (Bonaparte's Gull *Larus philadelphia*) and

common loon (*Gavia immer*). Also, other colonial birds including several hundred pairs of Common Tern (*Sterna hirundo*) and 14 pairs of Great Blue Herons (*Ardea herodias*) used the lake in 1999 as they have before (Philip Taylor, Can. Wildl. Serv., pers. comm.).

Double-crested Cormorants now nest among the pelicans on the small and tree-less New Tern Island (Fig. 7). Judging from data compiled by Renaud (1972), the cormorants have a long history at Redberry Lake. In 1936-37, when local banding began, 153 young cormorants were banded in the two summers combined. By 1972, a total of 664 cormorants had been banded when the island had been visited during 19 summers in this 37 year period.

When comparing the use by migratory birds of various prairie habitat subregions, Poston et al. (1990) ranked the 'Redberry Lake Upland' nationally important for one species (Piping Plover), regionally for four, and locally important for six. In addition to many species of ducks (Lesser Scaup *Aythya affinis*), Mallard *Anas platyrhynchos*, and Northern Pintail *A. acuta*), Renaud (1972) also recorded some less common birds on or near Redberry Lake. These include: "a few pairs" of Common Loon, and Spotted Sandpiper (*Actitis macularia*) described as a "common breeder of shores and islands."

It may be advisable to undertake a thorough survey of the birds of Redberry Lake in the near future. Such a survey should take stock of the older bird records which are fragmented and not easily accessible. This survey might also describe any change in the bird community over time.

5.2 Rare plants

According to data from the Saskatchewan Conservation Data Centre and the W.P. Fraser Herbarium, University of Saskatchewan, there are species of rare plants known from the area (Fig. 8). Support for conservation can be enhanced by combining two or more features, which alone may not be seen of sufficient value to motivate action. In a landscape that has been so much altered as the Redberry Lake's watershed (Fig. 2), nearly all of the native vegetation that remains may be crucial as corridors for movement, for habitat *per se* and for the functioning of the ecosystem as a whole. In addition to features worthy of protection an analysis of vulnerability such as soil erosion potential by water (Saskatchewan Soil Survey 1995; Fig. 9) may add another perspective on conservation needs and solutions. The Native Plant Society (Sect. 6.4) has an interest in rare plants and can be counted on for advice.

6. Human Context Information

6.1 Land ownership

The lake itself, the islands within it and most land immediately adjacent to Redberry Lake is Crown land. Since the first surveys of the region were done in 1906-09 the shore has receded from 0-2 km and this land is leased by the Crown for grazing, hay production or recreational uses (Fig. 7). Most of the land in the watershed is privately owned.

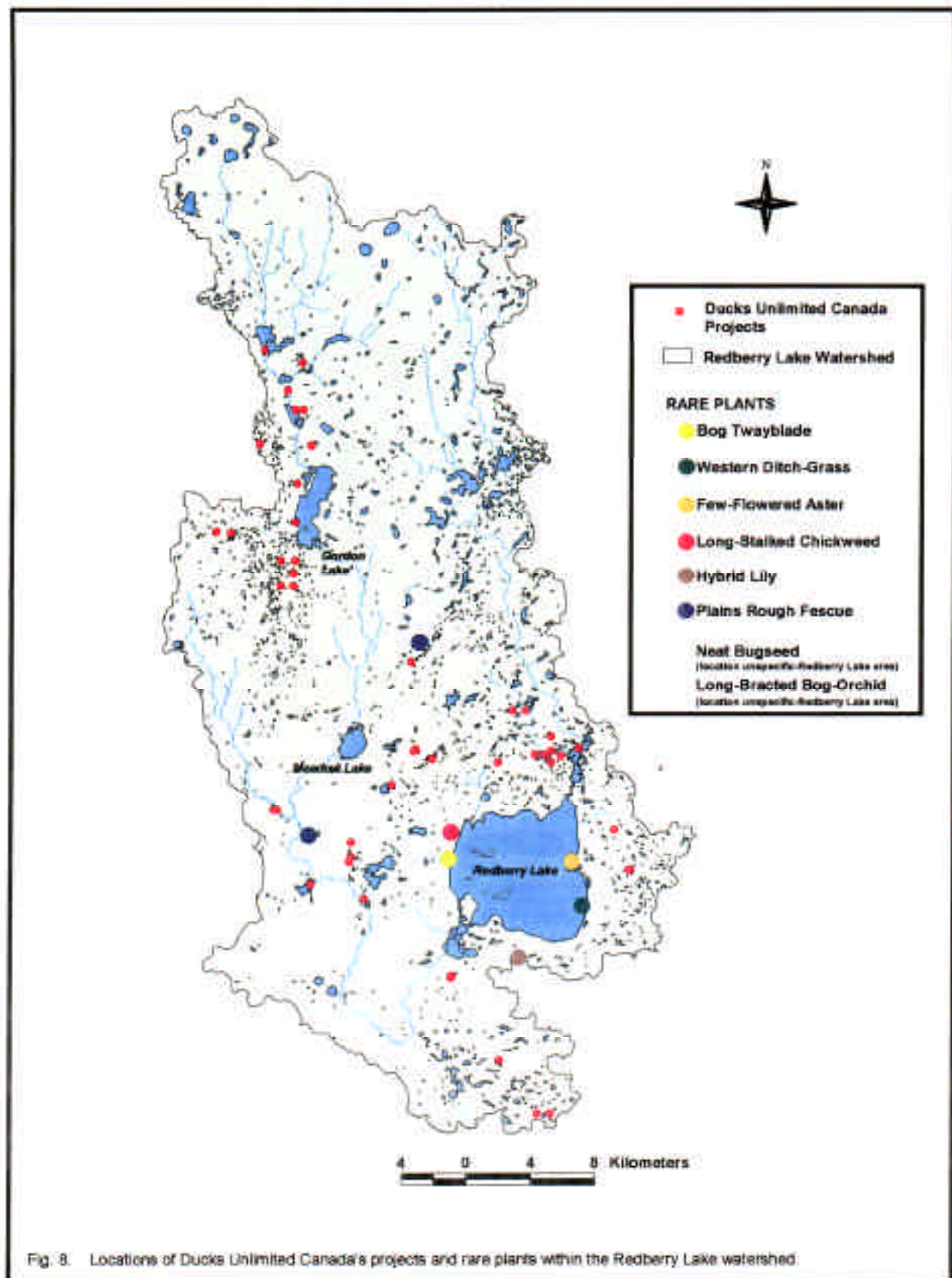
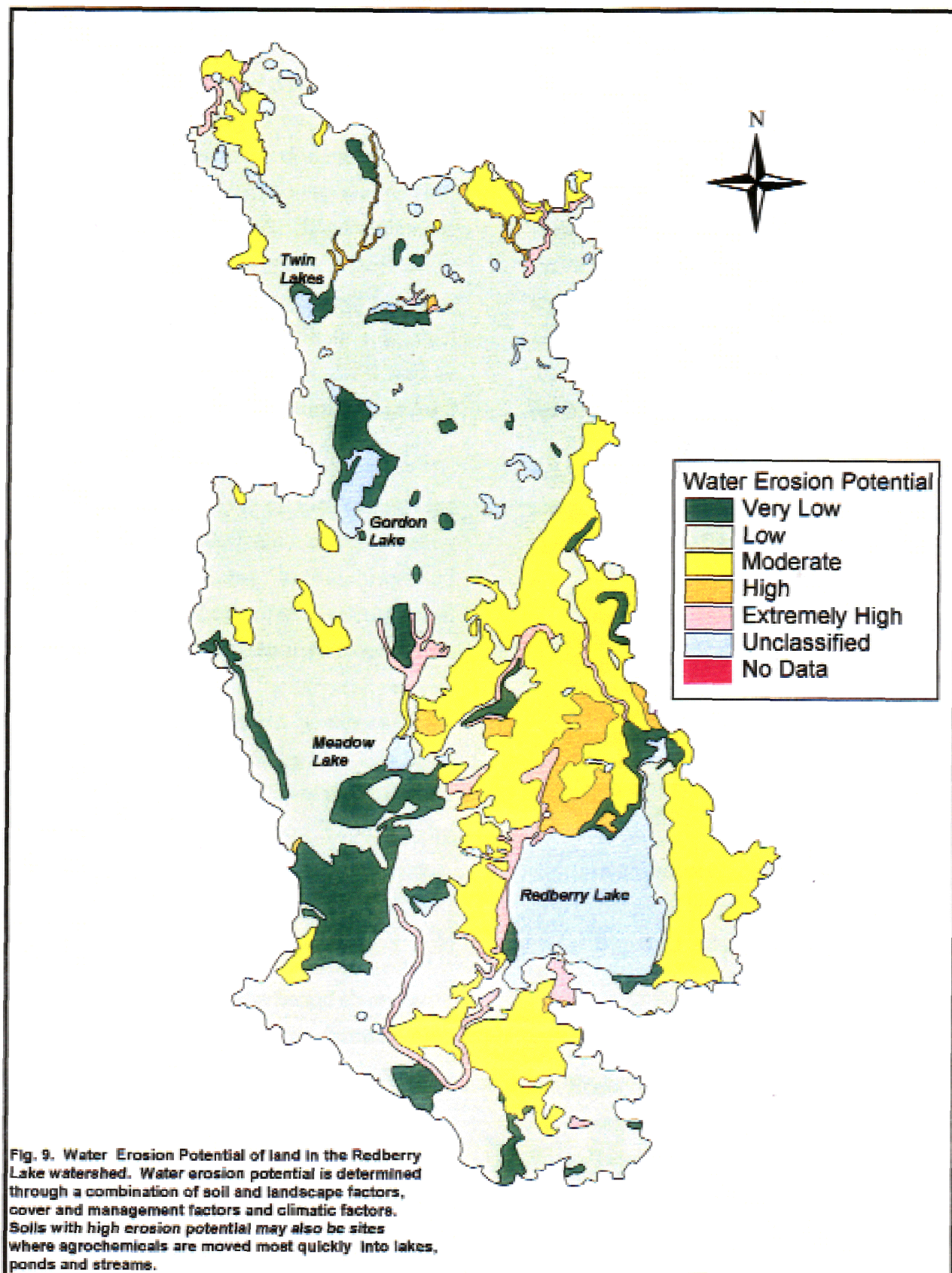


Fig. 8. Locations of Ducks Unlimited Canada's projects and rare plants within the Redberry Lake watershed.





6.2 Land use

6.2.1 Historical land use. While humans came to North America 30-40,000 years ago (Kupsch 1984) it is unlikely that even the earliest of Pleistocene hunters utilized the aspen parklands of Saskatchewan before ice started to recede 17,000 years ago (Linnaeae et al. 1988). Artifacts recovered 60 km SE of Redberry Lake suggest occupation at least 7-8000 years ago (Guide Book to Wanuskewin 1995). Climate change, both cooler and warmer at different times, caused glaciers to retreat eventually. Landscape changed from domination by ice and melt water, to spruce forests and recently to grassland (Eisele 1999). Since settlement, prairie fires have been fought and large native grazers have largely disappeared, favoring shrubs and trees. The result is a gradual southward expansion of woodland habitat and a decline in the woodland-grassland mosaic.

With the arrival of Europeans, land uses moved generally from a market hunting and trapping economy, to ranching and finally farming and other resource extraction. Ranching was the dominant economy from 1873-1910, declining for several reasons including a series of harsh winters and the farm settlement policies by the Canadian government in central Canada. Redberry Lake lies within the region explored by Macoun who, contrary to Palliser, recommended farming as a dominant land use.

During the 90-year period since the beginning of prairie agriculture, farming practices have undergone many changes. It was soon recognized that a practice that evolved under very different ecosystem conditions in Eurasia was not sustainable on the northern Great Plains. Some useful adjustments were made as the practice

moved from the mixed family farm to mechanized farming, then chemical farming, industrial farming in a global economy and most recently biotechnology in agriculture. Despite some successes, the farming economy and its people are experiencing serious stresses (e.g. Lind 1995). Given the prevailing agricultural land use up to the shores of Redberry Lake and throughout the lake's watershed (see Figs. 2 & 7), events in the farming sector cannot be separated from the health of Redberry Lake and its birds.

6.2.2 Current land use. Broadly categorized, the following land uses are in place at Redberry lake and in its watershed.

- Agriculture/cultivation
- Water management
- Fisheries/aqua culture
- Hunting
- Rangeland/pasture
- Recreation/tourism
- Transport
- Urban
- Utility power structures
- Wildlife conservation/research

Agricultural crop production has clearly been the single factor which has had by far the most impact on the watershed. Saskatchewan is divided into crop districts for which land use statistics are compiled. Each district contains many municipalities. The Redberry Municipality comprises about 5% of land in Saskatchewan crop district (9a). However, because of Redberry's southerly location in this crop district, the RM accounts perhaps for 10% of the agricultural products, including: 1,250,679 acres in grain, 648,179 acres in flax or canola, 267,900 cattle, 46,700 pigs and 1500 sheep (Sask. Ag. & Food 1998). These statistics do not include game farm animals, poultry, specialty live-

stock or other rare crops.

There is one factory-type pig barn (Heartland Pork #1), located immediately outside of the lake's watershed (Fig. 2; NE 36, Tp 43, Range 11, W3), and a second one under construction as of July 1999 (Horizon Pork Production Ltd. 3) in the Rural Municipality of Speers, west of the Redberry Lake watershed. Even though the provincial government does not require industrial zoning for pig barns, the scale of their operation and problems in waste management clearly make such an operation 'industrial.' In contrast to earlier methods of manure disposal, manure from Heartland Pork #1 will be injected a few cm into the soil as opposed to being broadcast on the surface. Because rural drinking water supplies rely on both surface and ground waters, the existing threat to water supplies from pesticides and fertilizers is augmented by the pig barn's water based manure. Many rural farm families in Saskatchewan already take up herbicides through their drinking water (Alan Cessna, National Hydrology Research Institute, pers. comm.; Sect. 8.2), and the waste from pig barns has the potential of becoming the next health risk in Saskatchewan (Jim Dosman, Ctr. for Agric. Medicine, Univ. of Sask., pers. comm.). The impact on natural communities in and around the lake is likely to be at least equally severe.

6.2.3 Recreation. The above crop district statistics do not mention a service industry based in the town of Hafford. There is likely to be some hunting, but, measured in person-days, bird watching and cottage vacationing is probably the most important recreational activity in the watershed. There are approximately 50 occupied cottages at the lake's border, a sailing club, a golf course and a youth camp. Regional tourism guides suggest the following uses

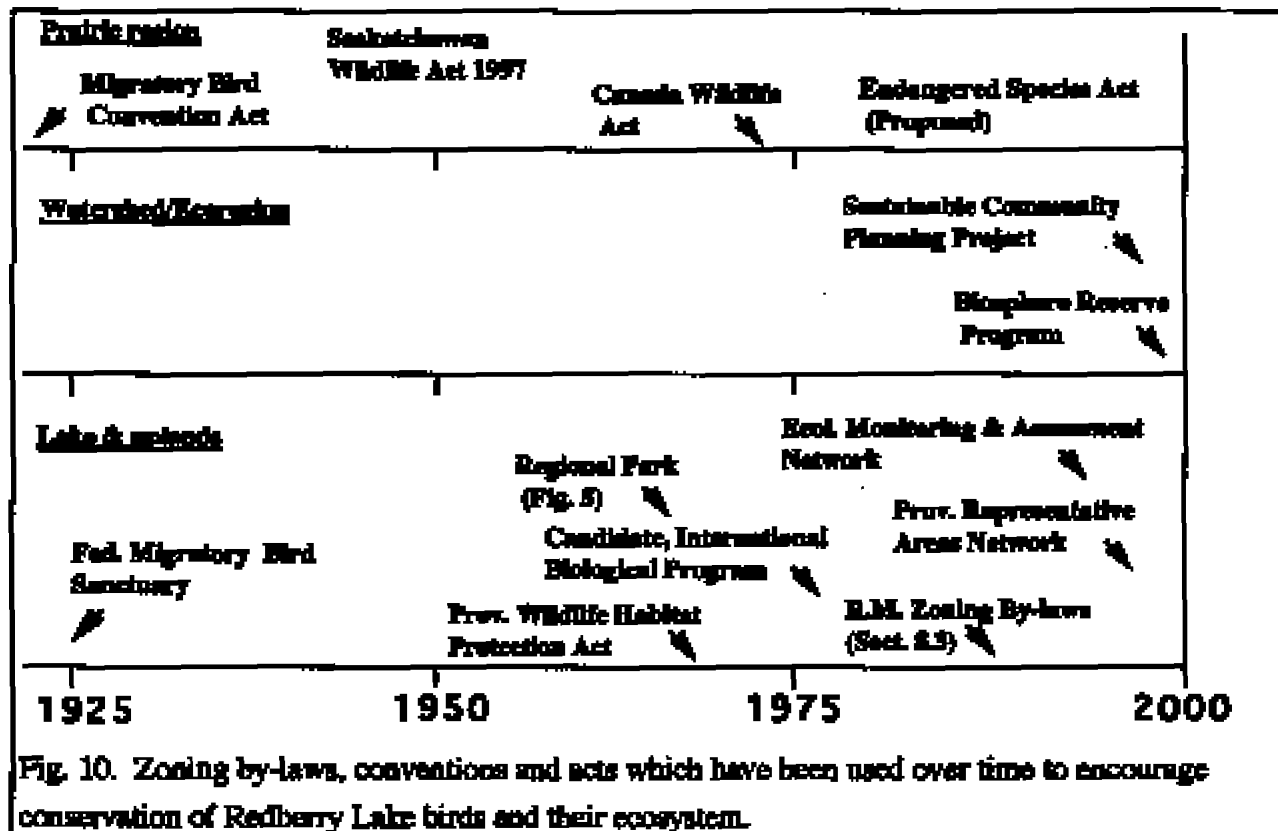
of Redberry Lake and its shores: swimming, camping, playground activities, golfing, sailing, fishing, and boating, with services provided. The salinity of the water gives concern to some pleasure boaters. Those who have a tradition of residence near the sea feel a sense of nostalgia at the lake.

Redberry Lake, with its Regional Park (Fig. 7), has seen a steadily increasing amount of tourism visitation over the past decade, due in part to the higher profile of the Migratory Bird Sanctuary and in part to the lake's growing reputation as a quiet place for families to visit and camp. The interpretive centre draws visitors, and provides information for bird-friendly use of the lake by recreational boaters. The Redberry Lake Pelican Project monitors visitor numbers and impacts; at this time (1999) there is no threat from the visitor-load currently being experienced. Economic benefit to the town and park could be enhanced through the provision by business people of a higher number and level of tourist services.

6.3 Conservation management achieved at the IBA site

The conservation management in place at Redberry Lake includes many stakeholders (Fig. 10; Sect. 6.3; Appendix 1). This list also includes private landowners who use the land according to a blend of scientific, local and traditional knowledge, and personal experience and conviction.

The Migratory Birds Convention Act was established in 1917 to offer protection to migratory birds that frequent one or more of the participating countries including Canada, the United States and later Mexico. This act and its regulations give



Environment Canada the authority to protect birds, and control seasons and bag limits for hunted species. The Canada Wildlife Act was instituted in 1973 to foster a partnership in conservation between the federal government, the provinces and territories. Canada is currently developing national legislation to facilitate the conservation and protection of species at risk and their habitat (<http://www.speciesatrisk.gc.ca/Species/English/Default.cfm>).

In 1925, Redberry Lake became one of Canada's Migratory Bird Sanctuaries, which was planned for already in 1915 by reserving land for it. Canada now has 101 Migratory Bird Sanctuaries (Anonymous 1994). The relevant regulations prevent disturbances while the birds are actually present

including hunting and egg collecting. This designation does not protect habitat.

Redberry Lake was nominated in the 1960s but not eventually included in a network of sites for study and conservation management under the Canadian Committee for the International Biological Programme, National Research Council of Canada. Other conservation measures include the Representative Areas Network.

The Ecological Monitoring and Assessment Network was established in April 1994 by Environment Canada, and is coordinated by the Ecological Monitoring and Coordination Office (Lumb 1997). This program relies on partners which have long-term monitoring programs in place with the goal to detect environmental stresses, to pro-

vide rationale for management strategies and to evaluate the response by the ecosystem to such management. At Redberry Lake, such monitoring involves biodiversity, lake biology and climate studies.

Saskatchewan Environment and Resource Management (<http://www.gov.sk.ca/serm/WWW/INDEX.HTM>) has responsibilities in the area of fish, wildlife and parks management. Recently, *The Wildlife Act 1997* was amended to include Species at Risk. The province has also created *The Conservation Easements Act* and introduced the Representative Areas Network program. The Representative Areas Network incorporates and protects unique features and landscapes, and includes places already managed as parks, reserves and wildlife lands. Wildlife lands are purchased from funds derived from hunting and fishing licenses. Network sites are identified according to predetermined criteria including geology, soils, climate, plants and animals. These sites can serve as benchmarks against which one can compare the impacts of management practices applied outside of the network. Redberry Lake is included in this network because past management of the lake and associated uplands has maintained considerable ecological integrity and biodiversity. In 1997, SERM entered into a Memorandum of Understanding with The Redberry Pelican Project (Canada) Foundation to promote conservation in the long term through the sustainable use of wetlands and native uplands in the area. In addition to these lands, at least eight quarter sections have been purchased by or donated to the Saskatchewan Wildlife Federation for conservation (Anonymous 1995).

Redberry Lake has been nominated as a Biosphere Reserve by the Canadian Biosphere

Reserve Association, and nominated by Canada to the United Nations Educational, Scientific and Cultural Organization (UNESCO), awaiting formal designation. Biosphere Reserves are an international network of sites which highlight the main global ecological systems and the human uses associated with these systems. They are designated by UNESCO under its Man and the Biosphere Program.

Biosphere Reserves do not have legal protection status, but can add to the international prominence of a given site, encourage protection at various levels, and promote tourism. This designation also acknowledges human resource use, in addition to conservation objectives, when dealing with resource management issues.

The Sustainable Community Planning Project is an effort by the Biosphere Reserve Community Committee and the Biosphere Reserve Technical Committee to develop strategies for sustainable community planning through communication between residents, farm and business operators, and the scientific community.

From the 1950's until the mid 1980's Ducks Unlimited Canada's activities within the Redberry Lake watershed were based on securing and enhancing permanent wetland habitat for breeding, moulting and staging waterfowl. From the mid 1980's to the present, strategies focused on encouraging land use practices which benefit waterfowl and other wildlife by improving habitat through the provision of upland nesting cover, securement of small wetlands and by encouraging sustainable land use practices that provide soil and water conservation benefits (Fig. 9). Extension program options include winter cereals promotion and development, forage production and management, grazing management,

and the provision of ‘flushing bars’ to protect nesting birds from injury during hay cutting. Modified agriculture options include the conversion of cropland to forages and managed grazing. Intensive programs are implemented in areas with the highest capabilities for waterfowl production and include purchase and lease of existing native habitat, hay land, pasture, and cultivated land which is then converted to nesting cover. Conservation easements and the restoration, enhancement and creation of wetlands are other options included as intensive programs. Policy initiatives that promote sustainable land use and provide wildlife benefits are also being pursued by Ducks Unlimited Canada.

6.4 Stakeholders

Many individuals have agreed to represent themselves or their organization in working toward long-term conservation of the Redberry Lake IBA

(see Appendix 1 for details).

Other relevant conservation or research programs, in addition to those mentioned in Sect. 6.3, have a stake in conservation. Partners in Flight Canada (http://www.ec.gc.ca/cwsscf/can-bird/pif/p_title.htm) is a nationally coordinated program with the goal to “ensure the long-term viability of populations of native Canadian land birds across their range of habitats.” Among other concerns, the particular conservation focus of Partners in Flight includes birds that migrate to and from the Neotropics, including the tropical forests of central Mexico to the Cape Horn of southern South America. This includes many forest birds that breed in aspen woodland in Redberry Lake’s watershed.

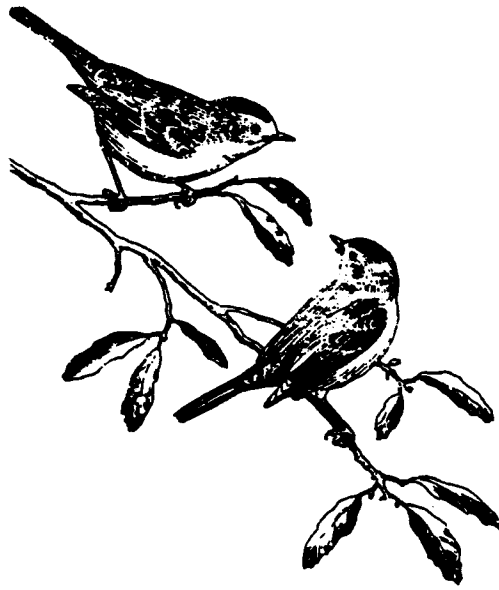
The Colonial Waterbird Society has met in Florida and Washington State to draft a Colonial Waterbird Conservation Plan

Government agencies with direct responsibilities for conservation in the Redberry Lake watershed include:

<u>Government agencies</u>	<u>Main responsibility</u>	<u>Contact</u>
Canadian Wildlife Service	Migratory birds, species at risk	Philip Taylor
Prairie Farm Rehab. Admin.	Pasture, soil and water	Glen Shaw
Rural Municipality of Redberry	Roads and land services	John Sawyshyn
Sask. Agriculture and Food	Extension & Crown land	Wayne Gosselin
Sask. Env. & Resource Manage.	Fish, wildlife & parks	Adam Schmidt
SaskWater Corporation	Water & shore*	Terry Chamaluk

**This responsibility is shared by Sask. Env. & Resource Manage., Economic & Co-operative Development*

<u>Other organizations</u>	<u>Contact</u>
Centre for Studies in Agric., Law and the Env.	Richard Gray
Ducks Unlimited Canada	Bill Chappell
Mixed farm	Larry Hawrysh
Redberry Lake Biosphere Reserve Comm.	Peter Kingsmill
Native Plant Society	Andy Hammermeister
Nature Saskatchewan	Garth Nelson
Sask. Soil Cons. Association	Ken Sapsford
Saskatoon Nature Society	Mary Gilliland



(<http://www.pwrc.usgs.gov/nacwcp/>). A plan is also being drafted by Garry Donaldson, Can. Wildl. Serv., to complement a North American initiative. The goal of the society is to “...maintain healthy populations, distributions, and habitats of colonial-nesting waterbirds in North America, throughout their breeding, migratory, and wintering ranges.”

The Native Plant Society is taking an active interest in plant conservation in Saskatchewan (E-mail: info@npss.sk.ca). Members of this society participate in surveys and monitoring, and the Society also formulates statements of policy.

7. Opportunities

The substantial list of conservation designations, zoning restrictions and other conservation actions that have been initiated or supported by the people who live near Redberry Lake, is impressive (Fig. 10). This illustrates the existence of a human community dynamic that has evolved already with a constructive cooperative spirit toward conservation for the future. Scientific observations, designations or even regulations rarely achieve meaningful change toward complex visions without a broad base of support from people. Thus, the existence of biological knowledge and conservation programs coupled with a willingness by people to work together represents perhaps the single greatest opportunity for the conservation of Redberry Lake birds and their ecosystem.

In and around the Town of Hafford, there are signs of stylized pelicans flying above waves of water. The sign reads “Hafford-by-the-lake” and “Where summer takes wing...” This sign illus-

trates the importance the lake represents for local residents. The lake and its Regional Park (Fig. 7) serve for ‘cottaging,’ boating, golfing and a meeting place (Sect. 6.2.3). There is a mood of optimism and pride which is a cornerstone for conservation.

7.1 Ecosystems and their natural, human and economic forces

Increasingly, the single-factor conservation strategies of the past are gradually being replaced by system-level solutions (e.g. Anonymous no date). In conservation at the ecosystem-level, human culture and production are an integral part, and, one could maintain, even a ‘natural’ force. People, their constraints and their aspirations play a crucial role in ecosystem conservation.

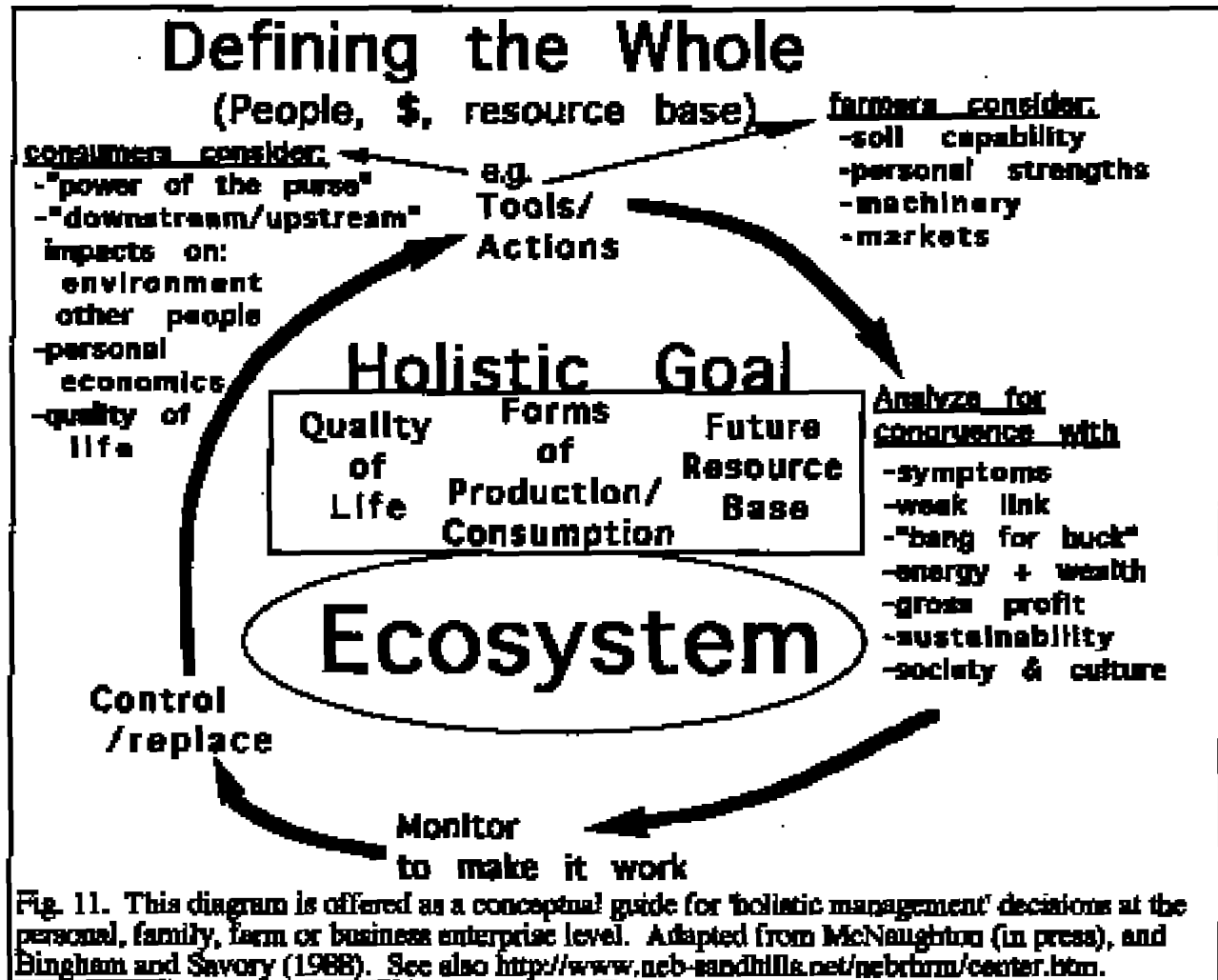
Agricultural producers make decisions on their land based on their personal/moral conviction with respect to how land is used, and based on economic signals they receive through the market (e.g. Goal III). These market signals are largely influenced by the policies that are in place. A ‘co-evolutionary view’ holds that not only is each policy within a subsystem related to all other policies, but that each is changing and affecting the evolution of the others (Norgaard 1988). Based on these principles the agricultural production system and the natural system in which it is imbedded have co-evolved into the present form, which is only a transition state between some previous and future system states. Costanza et al. (1993) reinforce this co-evolutionary principle by stating that, in order to make environmentally sound ecosystem management decisions, emphasis should be given to methods which answer many different questions: social, economic and ecological. The national or global markets are too large to influence perhaps

even by nations, not to mention the conservation actions outlined here (but see Goal III). A subset of smaller ‘community markets’ could be created and those could be sensitive to resource, environmental and social goals (Fig. 11, Appendix 2 & 3).

Redberry Lake’s watershed with its ecological processes and its human inhabitants perhaps represents the smallest level at which a functioning ecosystem can be identified and conserved. A fruitful approach for ecosystem conservation may be to continue to help adapt a mix of strategies, including regulation (e.g. zoning), economically attractive and socially acceptable incentives (e.g. easement legislation e.g. Anonymous 1997, land-use related incentives, grants), and personal values. Perhaps the solutions with most enduring promise are those which seek to reconcile environmental, biodiversity, human health and social costs squarely within the production system’s balance sheet (Fig. 11). For instance, when one sector in society maintains that meeting Canada’s Carbon emission standards will erode too much profit, this may reflect that this sector is not paying the full costs associated with climate change. In ‘total-systems’ conservation, earning a livelihood and seeking a quality of life does not only respect the so-called ‘bottom line,’ but also requires consideration of innumerable economic connections and esthetic values. As suggested by Hawken (1993):

“...we need to create an economy and way of relating to our material world that is not an either/or argument, but a means to create the best life for the greatest number of people precisely because we do not know the eventual outcome or impact of our current industrial practices.”

Several ‘real world’ examples or practical suggestions exist that integrate ecosystem conser-



vation and a quality of life for people, and these may provide useful ideas for consideration. According to Brunner and Clark (1997), ecosystem-based management can benefit from an appropriate juxtaposition of three fundamental approaches, 1) the clarification of goals, 2) a solid scientific foundation, and 3) a reliance primarily on practice and not merely further study.

Members of the Society for Holistic Management, for instance, attempt to provide practical advice in dealing with goals (e.g. <http://www.neb-sandhills.net/nebrhrm/center.htm>). McNaughton (1999) has presented insight which may represent simple common sense at an analyti-

cal level, but this insight is remarkably rarely appropriated because it is difficult to incorporate in every-day action (Fig. 11). Yet, if the ecology/sustainability movement is to come of age, there is good reason to think that this appropriation has to happen by all people, including consumers, and not merely farmers or fishers, loggers or miners. A holistic goal for the user of resources, including consumers, includes consideration of quality of life for self and others, of the forms of production required, and of the impact on future resource base (sustainability). The management style encourages an adaptive style, amended as required, to achieve as closely as possible a congruence with

goals and related outcomes.

Sound conservation also relies on objective knowledge. While it could be said that there is never enough known about the biology of ecosystems and their innumerable connections, the birds and the ecology of Redberry Lake have been well studied. This represents an opportunity in this conservation context. Basic and applied studies should continue.

Perhaps the least analyzed and most difficult portion of conservation action is Brunner and Clark's third approach - practice. A practice that adapts itself to changes and through reality checks is clearly important at least at two levels - policy level influencing forms of production and the personal level. Redberry Lake stakeholders should continue to be vigilant at a policy level and attempt to influence 'big policy' which seems harmless and distant on the surface, yet is remarkably pervasive in the long term (e.g. globalization, biotechnology in agriculture, legislation, human health, tourism). To increase effectiveness in this area, a group might be identified and receive assistance for serving as a 'clearinghouse for issues' and serve as a connection to other such groups.

In accordance with overused slogans such as 'walk the talk' or 'think globally - act locally,' successful conservation in the Redberry Lake watershed will likely originate here, rather than elsewhere, though not solely so. For this conservation to be successful, a facilitating infrastructure, and uncompromising support of it, will be required. For instance, Canada's outstanding reputation for ability among her people in hockey did not arise in isolation - it is based on considerable infrastructure in schools and in society at large. To facilitate

conservation at the watershed level, inter-dependent connections and rewards will need to be established with other sectors. The residents of the Redberry Lake watershed cannot be singled out and expected to practice conservation beyond their own farm, family or business level against their own best interests. If 83% of Canadians indeed care about nature, could some of these Canadians, and particularly the bird-watching public, lend a hand in the conservation of Redberry Lake (Goal II)?

Some remarkable community initiatives that integrate forms of production, sustainability and a human quality of life may provide ideas for Redberry Lake. i) According to Ferris and Behmann (1994): the "Twin Creeks Shared Farm at St. Adolphe, Manitoba, enables farming in a more ecological manner, reduces transport costs and serves as a means to preserve family farms and rebuild rural communities that have been decimated by export-oriented industrial agriculture." Transitions in farming practices are often associated with risks for the farm family and therefore quality information, assistance and support is needed. ii) Thierrin (1998) describes the planning by two brothers in an eight-year transition period from conventional to organic farming. iii) In an Oregon example, ranchers formed an alliance with consumers, facilitated by a marketing link. Ranchers signed an affidavit to guarantee that beef was reared as agreed-to with consumers, and rotated in shipping a year-round supply of 70 cows/week (Butterfield 1995). In this example, the consumer could influence human and ecosystem health through conservation and production concerns they felt were important (see also Schultz 1999). iv) Clive Gordon uses the term "food miles" to draw attention to the energy spent in transporting food inefficiently. He

also points to the Canadian Pacific Royal York Hotel as an example, where the hotel feeds 600 pigs every day through an adapted food waste disposal system where a farmer collects 6-10, 64-gallon bins to feed pigs (see Food - The World On Our Plate - Is it Sustainable? <http://www.sustainablebusiness.com/insider/sep99/airline.cfm>).

In Saskatoon, the Child Hunger and Education Program in cooperation with other community efforts, operates a 'Good Food Box' program. The goal is to improve access to nutritious food, support the local economy, encourage healthy eating habits and advocate an equitable food system. This program has an increasing number of subscribers who purchase two boxes per month for a distribution of 700 boxes per month.

Holmlund and Fulton (in Anonymous 1999) suggest reasons why linkages between consumers and producers may be important from an agricultural economics point of view. Finally, the use of sensible 'green technologies' in fields other than agriculture could represent an opportunity for sustainable practice within and outside of the Redberry Lake's watershed (Abelson 1991, Davidson 1998).

7.2 IBA community conservation planning

In addition to the considerable effort devoted to Redberry Lake and its surroundings by several conservation groups and individuals, the IBA program can make three important complementary contributions.

- i. This IBA conservation plan encourages the stakeholders to coordinate their ecological surveys, studies and management actions. These surveys tend to be carried out by each group (e.g. Redberry Pelican Project, Can.

Wildl. Serv., Ducks Unlimited Canada, National Water Res. Inst.) periodically for their own purposes. If such surveys are coordinated in time and focus, more can be gained per unit effort (see Conservation Goals and Objectives for details). There may be opportunities to encourage other surveys at the same time when the wildlife surveys are taken, for instance statistics collated by Sask. Agric. & Food, land use surveys, and questionnaires for area residents (Goal I).

- ii. This plan may represent an opportunity to help agricultural producers shift according to their own schedules and farm management plans to alternative production methods that are sustainable. This is also implicit in the Biosphere Reserve program now coined for Redberry Lake, where the site under protection is divided in a core area, a buffer zone and a transition area. The core area is the lake itself. The buffer zone was created in 1989 by the R.M. of Redberry under a zoning by-law covering lands around the lake itself, including the regional park (Fig. 7). The transition zone includes the remainder of the watershed. Here, sustainable resource management practices are promoted and facilitated. Some informal food contracts between farmers in the watershed and Saskatoon consumers have been struck. This approach needs to be expanded and plans are in place to seek funding for a pilot project to facilitate this (Goals II-IV).
- iii. An IBA contribution may also be to highlight the importance of Redberry Lake for the bird-caring public and other conservationists.

The protection afforded will serve recreation by ensuring that the natural quality of the lake and watershed remains intact. This IBA designation can also serve to attract visitors and help bolster existing ecotourism ventures.

8. Threats

Threats to land, waters and birds within the IBA include intensive and chemical agriculture, animal and plant invasions, disturbance and mortality. Equally or perhaps more significant are threats the migratory birds encounter on migration and in winter.

8.1 Habitat

Agricultural intensification is progressing at a rapid rate and in a watershed where agriculture is the prevailing industry, this impact is large. The impact is system based: it is likely to affect ecosystem processes such as decomposition and rejuvenation of soils, snow melt and water erosion dynamics, and the loss of remaining habitat patches in a mechanized, industrial-type production. As indicated earlier, these changes are not a matter of choice at the farm level, but are an outcome of an economic system in which direct, indirect and environmental costs are inadequately accounted for (literature on this topic is enormous, see also National Farmers

Union <http://www.nfu.ca>).³

With regard to industrialization, as it pertains to sewage, a Redberry Pelican Project representative has indicated concern vis-à-vis a factory-type hog barn that was constructed immediately outside of the Redberry Lake watershed. Similar to over-fertilization of waterways and ground water from agricultural fertilizers, hog barn sewage has the potential to influence the natural plant and animal community through the food chain.

8.2 Pesticides

This brief introduction is intended as an example of a pest control mechanism and of the behaviour of a herbicide in the prairie ecosystem, with some general interpretations about pesticides and environmental health. Triallate, marketed as “Avadex BW” and as “Fortress” when combined with trifluralin, can serve as an example. Unless otherwise indicated this summary relies on a review by Kent et al. 1992.

Triallate was introduced into Canada in the early 1960s by Monsanto to control certain monocots, especially wild oats, and broad-leafed weeds in crops of barley, durum and spring wheat, lentils and dry peas. Triallate is meant to be applied before plants emerge from the ground at 17 kg/ha, at a cost of \$23.80 per kg. Triallate is intended for prairie soils that are prone to erosion where a late fall application of the granular form in fall stubble can be left for subsequent incorporation into the soil the following spring, thus saving a tillage step in fall. The ‘active’ ingredient is an amber coloured oil-like toxin which inhibits the normal growth and division of cells.

³There is also literature on how environmental concerns arising from food production, transport and processing are overstated. I feel that I cannot do justice to these arguments (but see for instance Dennis T. Avery, 1995. *Saving the planet with pesticides and plastic: The environmental triumph of high-yield farming*. Hudson Institute, Indianapolis, Ind., USA). In their extreme, these arguments seem to assume that the human economy is separable from the natural economy, that environmental problems that are created can be solved somehow, that ‘for every calorie of food on the table - 9 are spent in the process’ does not present a problem worth addressing, and that inequality among people is due to the people’s own doing.

Once applied, a portion of the herbicide leaves the application site by air as vapor or attached to dust particles, and through water running off the field. In general, the eventual fate of agrochemical in the ecosystem is influenced by many factors including breakdown by living organisms and by sunlight, chemical dissolution by water, evaporation, adhesion and erosion. The persistence of triallate was measured in greenhouse and field studies and this showed that 50% of the herbicide had disappeared over a time period ranging from 3-88 days. This loss happens more quickly in moist soil. When runoff water was measured in Saskatchewan, the concentrations of triallate recorded ranged from 0.47-0.98 micro grams per liter. Triallate was detected in rapid-flow irrigation channels but this plant toxin is difficult to detect in natural water bodies. The suspicion is that triallate settles rapidly to the pond bottom and is incorporated in the sediments.

The triallate that is not incorporated in the intended target plant becomes a contaminant. Contaminants that do not dissolve readily in water tend to build in the tissues of living organisms and often in fatty tissue. Carbon-14 labeled triallate was shown to accumulate in amphipods in an experimental study at Redberry Lake (Arts et al. 1995). After a 5 hr exposure to labeled triallate in a 'microcosm' constructed in Redberry Lake, triallate was recorded in fat containing tissues of the amphipods, including the nervous system and the eggs of female amphipods (Sect. 5.1.1). In other studies, triallate had been documented in water plants and several species of fishes (Kent et al. 1992).

In a study in southern Saskatchewan, Donald et al. (1999) found that in early July the average number of types of pesticides detected in wetlands

ranged from 1.8 in areas with less than 21 mm of rain during the previous 15 days, to 3.2 in areas with more rainfall. In the high rainfall areas in this study where erosion was greater as a result, as many as 60% of the wetlands had at least one pesticide in amounts that exceeded Canadian guidelines for the protection of aquatic life. Lindane and triallate exceeded these guidelines most often (Donald et al. 1999).

In a study of pesticide exposure and potential human health impacts in southwestern Saskatchewan (Semchuk 1999), detectable levels of pesticides were found in human blood plasma. There was no evidence that this exposure to pesticides affected the incidence of Hodgkins disease or pulmonary function, but it was linked to some pathologies of the immune system. While there was no evidence of impaired neuropsychological function resulting from pesticide exposure, people in the high exposure group tended to report above average levels of stress. In a study of non-fatal injuries in the rural population, there was a link between injury and exposure to insecticide but not herbicide or fungicide. Other studies have shown that insecticides in particular cause neurological effects similar to certain medications or alcohol. In a companion study of farm drinking water supply, the results showed levels of lead and selenium that exceeded municipal guidelines.

The farming community in general was very cooperative in these groups of studies (Semchuk 1999). The farming community showed great anxiety about the health of farmers and farm families. Because of atmospheric transport of agrochemicals, all prairie residents, even those in towns and cities, experience some level of exposure year-round. The chemical-agriculture and human/ecosys-

tem-health dilemma clearly is not of the farmers own doing. In large measure, this dilemma is Canadian-consumer and export driven, through an encouragement of the industrial food production model and a focus on cheap food. Though the food items may be inexpensive on the grocery store shelf, coupled with the associated human and environmental health costs, this model is likely one of the most expensive food models ever in human history.

The sample of studies cited here and many others not reported, are examples of fairly strong associations, positive or negative, between pesticides and environmental and human health. These studies already are most compelling and represent cause for action. However, to be realistic, the logistical difficulties in determining the fate and impact of a pesticide once it is released into the environment are enormous. Pesticide impacts can involve whole ecosystem processes, cross disciplines (e.g. Hardell and Erikson 1999) and thus elude detection (cf. Woodwell⁴). Many more “sub-detectable” and periodic environmental effects go undetected and these may be of even greater concern. It is for this reason that Hawken (1993) calls for “a new economy” (Sect. 7.1). The transition zone con-

cept in the Biosphere Reserve process and in this plan represents an opportunity to experiment with new designs in rural infrastructure for Hawken’s “new economy” (Appendix 2, Goal II).

8.3 Salinity

Redberry Lake and its salt-water ecosystem is both special and vulnerable. In general, salt lakes can be very productive at low or moderate salt concentrations. Redberry Lake has a high salt content (total dissolved solids 20.9 g/L) and ranks low in its biological production for this reason, and also due to low nutrients (Robarts et al. 1992). Since the lake’s salt content affects plants and animals in the food chain, and since salt content is dependent on precipitation-evaporation and run-off events (Sect. 3.1, 8.4), the future of the lake and its inhabitants will depend on events at the level of the drainage basin. Furthermore, salt-water ecosystems tend to have fewer species and when one species of plant or animal disappears, those organisms feeding on them have fewer opportunities to shift to different food. One of the ‘chains of reactions’ induced by salt is ‘supercooling.’ Salty water requires lower temperatures than does freshwater for it to freeze. This translates into thinner ice and colder water below. Although the salt-influenced freezing point is lowered by less than a degree in January- February, the fluid in the body cells of freshwater-adapted aquatic plants and animals is maintained closer to ‘fresh’ water and thus freezes in the salt water they live in.

The salt-water threat to living things in Redberry Lake has become more urgent in recent decades. Judging from early lake studies (Rawson and Moore 1944) and fisheries records, northern pike was fished in the lake in the 1920s. This is signif-

⁴On the question how firmly one needs to establish elusive ‘cause and effect’ relationships before one demands conservation action, G.M Woodwell had this to say: “I’m always surprised to discover that we are willing to give away, through a wish to appear reasonable, large pieces of our common heritage and the subject of our life’s work. Yet indulgence in the hyperobjectivity now being pushed on science from within and without is precisely this act; far from reasonable, it is the epitome of unreasonableness, and its practice not only lends support to avarice and pollution, but destroys the credibility of science and scientists as a source of simple common sense.” (1989. On causes of biotic impoverishment. *Ecology* 70:14-15)

The allusions to science’s limited power that are made here are not a wholesale condemnation of the scientific enterprise in Canadian society. Science, as has Art, has enriched the lives of all of us, and science is in part what distinguishes humans from other life on earth. Especially in the area of health, some advances have been invaluable; in Science & Technology, omitting mention of some noteworthy exceptions, there have been some excellent enrichments also. The urgent need, however, is at least two-fold, i) for society to use a blend of different ways of knowing, and to know the limits of each (Rowe 1990, Bauer 1992) when charting our collective course; and ii) to ask critically, “If we can make a faster car, do we need a faster car?” (Alan Lightman, Seminar, Univ. of Sask., 18 Nov. 1994)

icant, because northern pike is characteristically intolerant of salt. For these fish to have done well, salt content had to have been low. A small lake whitefish (*Coregonus clupeaformis*) fishery persisted in the 1950s, but test-netting in the 1980s yielded no young whitefish (Michael Arts, National Hydrology Res. Inst., pers. comm.). Walleye (*Stizostedium vitreum*), rainbow trout (*Oncorhynchus mykiss*) and lake whitefish were stocked at various times between 1940-86, but these species failed to persist. Only those fish species which are highly tolerant of salt water - they also exist in the sea - still persist in Redberry Lake. Brook stickleback (*Culaea inconstance*) are common in the water near Redberry Lake's shore.

Recently, there is good evidence that salt concentration is threatening the fishes' food, the water fleas. According to Michael Arts (National Hydrology Res. Inst., pers. comm.), there are three main species of *Daphnia* in Redberry Lake, and one of these now functions at the limit of salt tolerance. With further increases in salt content, this species is likely to disappear which is apt to have consequences higher up the food chain. The colonial bird species at Redberry Lake rely heavily on fish for food. Adult White-winged Scoters apparently rely heavily on the amphipod *Hyallela* for their energy for egg production and for rearing their young (see 5.1.1).

8.4 Lake water levels

Water level, insofar as it creates islands for nesting, and salt concentration seem crucial in determining the future of bird populations at Redberry Lake. Water depth was about 26 m at its deepest point in Redberry Lake in the 1940s (Beak 1989, and 18 m in 1974 (Hammer 1978). Water levels have con-

tinued to fall since then (see Fig. 3). Old Tern Island has now become a narrow peninsula with land bridge to the mainland (Fig. 7). It would apparently require a further drop in water levels of 12 m before the next island nearest to shore, Gull Island, would cease to exist owing to a land bridge (Beak 1989). Since more of the roughly conical lake's water volume is in the top layer, an equal loss in water volume will translate into an accelerated lowering of water levels as water loss goes on.

When viewed over many years, precipitation has fluctuated in 10-20 year cycles. There is much less evidence that precipitation has declined when viewed over the long term and throughout the prairie region. How can this be reconciled with a decline in water levels, receding shores and increasing salt concentration at Redberry Lake?

Some proximate influences on water levels in the prairie region seem to be recognized in both disciplinary and local knowledge. The extent to which these apply at Redberry Lake is unclear. Given the complexity of weather patterns where regional effects can have different causes (e.g. Trenberth et al. 1988), where the area over which influences occur is large and where mechanisms act deep under ground, it is difficult study mechanisms (Sect. 3.1). Therefore, the assumptions underlying both resource extraction and conservation action should be critically examined. Are uncertainties a fact of life, and if so, would this recognition make some actions more defensible than others?

Notwithstanding the complexity of the system, some cross-disciplinary analyses have been instructive (e.g. Nemanishen 1998). Apart from those lakes with a high-volume connection to a ground water aquifer, the largest impact on water

levels is the amount of water derived from spring runoff. This process can be influenced by natural and human forces including:

- i) Cultivated soils warm up more rapidly than soils with permanent plant cover. This influence can be witnessed in Saskatchewan each spring when bare soils are exposed first. Insofar as this encourages more than the usual number of freeze-thaw cycles and associated evaporation, some moisture may be lost from the watershed.
- ii) Soil organic matter acts as a sponge that stores water and releases it slowly. On cultivated soils, organic matter is much reduced and this is likely to lead to more volume of water runoff, a factor which should add more water to the lake. However, water not held by the soil's organic matter may also percolate through to the water table and this may be lost from the surface water portion of the watershed.
- iii) Small reservoirs exist and these divert water away from the lake each year, ('dugouts,' water reservoirs and beaver dams). The decline in the fur industry has led to a reduction in trapping effort and a substantial increase in the beaver population. This includes the Thickwood Hills in the NW portion of the watershed where many beaver are active. The beavers' activity may help 'recharge' ground water reservoirs at the expense of surface waters.
- iv) According to local knowledge "It takes water to make water." Detailed studies apparently have not been able to confirm this link between

the number of water bodies in a given area and precipitation in this same area (Bill Koonz, Manitoba Dept. of Natural Resources, pers. comm.). This is not surprising, given the complexity of atmospheric circulation patterns.

- v) Thirty-five registered water wells existed in 1988 in 120 sections (2.54 km²) immediately surrounding the lake. Deep wells (>30 m more) can perforate and connect two or more aquifers. This could remove some water from the system. Beak (1989) counted 14 springs at the west side of Redberry Lake where ground water was discharged.

Knowledge about ground water systems in general lags behind surface water knowledge (Garth van der Kamp, Ecol. Monitoring and Assessment Conference, Saskatoon, 21-25 January 1997; Dirk Schmidt, Geol. Dept., Univ. of Sask., pers. comm.). For Redberry Lake in particular, little is understood or documented about the contribution of ground water to the lake, or of the impact of well casing failure on aquifer yields (Don Dill, SaskWater, pers. comm.).

8.5 Predation

Predation may be a factor that continues to threaten Piping Plovers at Redberry Lake. Although gulls have existed in considerable numbers for many decades and perhaps centuries, local observations would suggest that the gull populations are increasing (Peter Kingsmill, Redberry Lake Pelican Project, pers. comm.). Human social considerations, whether predator control is desir-

able/palatable to people, and ecosystem changes that favor predators should be considered in designing conservation action.⁵

Possible impact on Piping Plover by gulls at Redberry Lake will be difficult to influence. An initiative to intervene in the predator-prey or gull-Piping Plover relationship should come to grips with both the above social and ecosystem considerations. A suggestion, for instance, to shoot magpies for the benefit of songbirds in Saskatchewan (Jordheim 1999), though logically defensible, has been met with mixed review by the naturalist community. Equally importantly, predator controls that are direct and not ecosystem based are expensive short-term repairs of symptoms (e.g. Sargeant et al. 1995).

Redberry Lake's shores are subject to invasion by trees and shrubs, which can influence pre-

dation/predator avoidance (With 1994, Bayne and Hobson 1997). However, other investigators have found that declines in reproduction among birds can be affected by factors more complicated than simple predation (Beauchamp et al. 1996, Côté and Sutherland 1997), perhaps reflecting that local conditions can fundamentally influence a trend.

Management strategies should ensure that the habitat is maintained in such a way that the plovers' efforts at nest concealment can be effective. Grazing, particularly late season grazing might be used to keep vegetation low to make it unattractive for predators. Fencing has been used to avoid trampling of nests by cattle. However, it is not clear to what extent the different habitat patch thus created is an attraction for predators, to what extent the fence posts attract predators and whether the presence of cattle discourages large mammalian predators. Subtle ways to avoid cattle concentrations at plover nesting areas may be most effective. This could include scattering of stones to discourage walking, and using salt blocks, water supply and positioning of gates to lure cattle away from nesting areas.

8.6 Disturbance

Managing direct disturbance of IBA birds is probably well in hand at Redberry Lake. As a Provincial Wildlife Refuge, any approach closer than 100 m to the islands is prohibited during the nesting season (April to September). Zoning guidelines and recreational restrictions have been supported by the residents and these are effective. A protection zone around the islands has been established. This informal but well-publicized restriction to travel is monitored by Redberry Lake Pelican Project staff. To maintain water quality, cottage sites

⁵ The roles of predators as perceived by academic ecologists and non-academics have changed repeatedly over time. Perhaps first afforded a spiritual quality by aboriginal peoples, an early Euro-Canadian view seemed to be that the 'only good predator is a dead predator.' In the 1940s and 50s the classic work of Paul Errington of owl predation on muskrats convinced many that predators serve a stabilizing and health-enhancing function for prey. This was confirmed by the classic work of David Meech concluding that populations of moose and wolves coexisted in stable numbers on Isle Royal, and by the failed management attempt to enhance mule deer through controlling predators on the Kaibab Plateau in northern Arizona. This positive view of predators seems to prevail today among many conservationists, hunters and others - helping to push back the human-animal boundary

The simplified models of predator and prey interactions, that were in vogue in the 1970s among academic ecologists, appear to have been replaced first by a declining interest in predator-prey studies in general, and second by the recognized need to examine instead specific ecological situations and their context on a site-by-site basis. Perhaps most relevant to Piping Plovers today is the newly emerging literature on 'incidental predation' (Litvaitis and Villafuerte 1996). This describes a relationship where certain rare species (e.g. Burrowing Owls, Clayton and Schmutz 1999) are not sufficiently numerous to benefit a predator significantly, but the 'incidental' kill is nonetheless serious for the rare species.

The arid and cold northern Great Plains were traditionally an ecosystem in which a burst of summer production was used by native consumers. Many of these consumers were either migrants or hibernators. Since settlement this ecosystem and adaptation process has been fundamentally changed, such that many avian predators have benefited (gulls and corvids from human waste (Sect 5.1.2), road kills) to the detriment of rare species and apparently the Piping Plover. Another relevant predator-prey concept is the notion of 'meso-predator release' (Litvaitis and Villafuerte 1996), where the removal of large predators (as on the Great Plains) benefits smaller predators which in turn place an unusually high burden on their prey or their habitat.

leased from the regional park are required to have closed-system holding tanks for sewage disposal, which are pumped out and the sewage is spread on fallow or stubble fields outside of the buffer zone.

8.7 Accidents

Road kills and accidents as they arise from power transmission-lines and similar structures, are an ongoing threat to migratory birds (World Wildlife Fund 1996). This factor operates year-round and may be more serious for the IBA species when frequenting more densely occupied areas away from the Redberry Lake watershed.

Accidents can be a significant problem for rare species with low populations, such as the Whooping Crane for example. Accidents here include power line collisions, accidental poisoning and accidental shooting.

8.8 Exotic and invasive species

Redberry Lake and its shores are in a semi-'natural' state insofar as development has altered only small portions of it. The current shoreline (200-500 m wide) and adjacent grasslands are used under a grazing lease. Exotic grasses 'naturally' invade native grassland communities at Redberry Lake, as is the case throughout the agricultural belt of southern Saskatchewan. Economic losses arising from weedy invaders (e.g. http://www.news.cornell.edu/releases/Jan99/species_costs.html) and the impact on biodiversity of this 'subtle' community change is considered great (Paul James, Sask. Env. & Resource Manage., pers. comm.).

Animal and plant invasions in ecosystems is a pervasive influence on habitat quality (e.g. Catling

1997). The decline in biodiversity in the remaining prairie fragments in Saskatchewan has been considered one of the greatest current conservation challenges (Paul James, Sask. Env. & Resource Manage., pers. comm.). An invasion of weedy species can alter the plant community and thereby affect food and cover requirements of native species. For instance, Eurasian smooth brome grass (*Bromus* sp.), is a highly valuable forage grass where it is planted, but its spread is persistent especially in fragmented and moist habitats. An expansion of woody cover encourages wood-dependent species including several avian and mammalian predators.

9. Conservation Goals and Objectives

Redberry Lake is both mature and exemplary as a conservation area for several reasons. This area has been recognized for its bird value long ago (Sect. 6.3). Since then, many residents of Hafford, many farm families in the RM and throughout the watershed, and cottagers around the lake have been vigilant about the need for protection of bird resources, and have invited or tolerated conservation designations and restrictions. In many ways, the first stages of conservation actions are in place. What remains to be done are the most difficult actions that introduce the real alternatives to help alleviate stresses in the ecosystem where these exist. Some of these actions are so far-reaching and diffuse, that few communities might be willing to tackle these. The following goals and objectives will put residents of the Redberry Lake watershed and other stakeholders to the test.

The goals listed below are offered as con-

sidered suggestions whose details need refining (adaptive management) as actions are implemented. Many of the goals and actions listed here parallel the Canadian Biodiversity Strategy's Goals and Strategic Directions (Anonymous 1995).

9.1 Research goals

Goal I: Develop a plan for the long-term monitoring of bird numbers (Sects. 4.2.2, 5.1.4), land use practices and related ecosystem processes (Sect. 8) to detect changes and threats, and to enable an adaptive response to them.

Action 1: Arrange for a meeting to devise a monitoring plan and to secure funding for the coordination and reporting component of the plan.

Agency: Can. Wildl. Serv., Ducks Unlimited, Nat. Water Res. Inst., Nature Sask., Redberry Lake Pelican Proj., SaskWater, Sask. Agric. & Food, Sask. Env. & Res. Manage.

Progress: Monitoring already takes place, but coordination is needed.

Action 2: Continue basic research and other forms of exploration that expand our understanding of natural and human phenomena and trends. Highlight the value of research currently undertaken and encourage new research endeavors that could complement ongoing work.

Agency: Any (Sects. 6.3, 6.4.)

Progress: Water quality research and various monitoring projects are in place. There could be more linkage and exchange between studies of these 'natural' phenomena, practices and constraints in agriculture, and human health and well-being.

Action 3: Conduct a bird species inventory to document changes in biodiversity, if any.

Agency: Can. Wildl. Serv., Ducks Unlimited, Nature Sask., Redberry Lake Pelican Proj., Sask. Env. & Res. Manage.

Progress: The last International Piping Plover Breeding Census was held in 1996, and the next census is planned for 2001. The Wildlife Branch of Sask. Env. & Resource Manage. will take the leading role in organizing this census. This may be an opportune time to include a wider monitoring of biodiversity and ecosystem stresses and improvements at Redberry Lake.

Action 4: Study pelican food habits to fill knowledge gaps, and to evaluate potential threats in feeding ecology.

Agency: Can. Wildl. Serv., Redberry Lake Pelican Proj., Sask. Env. & Res. Manage.

9.2 Infrastructure goals

Goal II. Create an entity whose role it is to unite food consumers and producers in the best possible and sustainable production and consumption that is consistent with bird protection and Earth-friendly production. This may be viewed as a pilot project at Redberry Lake, for refinement here and possible adoption elsewhere (Sect. 7.1, Appendix 3).

Action 5: Secure funding for a pilot project to implement this 'community-shared agriculture' model.

Agency: Can. Adaptation & Rural Dev. Sask., Nature Saskatchewan, Prairie Farm Rehab. Assoc., Redberry Lake Pelican Proj., Sask. Agric. & Food, private individuals.

Progress: See Appendix 3.

Action 6: Strengthen the 'sustainable food production' infrastructure and plan for its permanent incorporation in a 'community-shared' food system.

Agency: Can. Adaptation & Rural Dev. Sask., Nature Saskatchewan, Prairie Farm Rehab. Assoc., Redberry Lake Pelican Proj., Sask. Agric. & Food.

Progress: See examples in Section 7.1

Goal III. Use or modify land use programs that are made available from various levels of government, to assist local residents in integrating sustainable production, ecosystem integrity and a quality of life. Regular meetings, as in Goal I-Action 1, could be the forum within which brainstorming for new opportunities can happen.

Action 7: Evaluate critically the agricultural innovations that are suggested from time to time, for their adherence to sustainable practice.

Agency: Nature Saskatchewan, Redberry Lake Pelican Proj., Ctr. Studies in Ag. Law & Env.

Action 8: Keep abreast and make appropriate use of ‘policy instruments’ such as carbon sequestration under the Kyoto Protocol (Bryce et al. 1999), permanent cover programs, and agroforestry.

Agency: All.

Progress: Discussions at the policy level are now at the stage where the mechanisms for such a carbon sequestration program are drafted (Kallio Edwards 1999) and utility companies are soon likely to buy ‘carbon credit.’

Goal IV. Strengthen community/ stakeholder co-operation, and re-evaluate successes & failures of the proposed plan.

Action 9: Plan one meeting or canvass of stakeholders per year to review successes, and address future challenges.

Agency: Canadian Nature Fed., Ctr. Studies Ag. Law & Env., Nature Saskatchewan, Redberry Lake Pelican Proj.

Progress: Expand or add to existing Redberry Lake Technical Committee meeting.

Goal V. Use strategic land or ecosystem management interventions that affect the “source” and not merely symptoms, where possible.

Action 10: Adapt a specific grazing strategy to manage encroaching vegetation in the buffer zone and maintain appropriate cover at the lake’s shore to facilitate predator avoidance (Sect. 8.5).

Agency: Prairie Farm Rehab. Assoc., Redberry Lake Pelican Proj., Sask. Agric. & Food, Sask. Env. & Res. Manage.

Action 11: Make organic production, low chemical production alternatives, or permanent cover most attractive to those landowners closest to the lake, or on lands with high erosion potential (Fig. 9).

Agency: Canadian Nature Fed., Nature Saskatchewan, Prairie Farm Rehab. Admin., Redberry Lake Pelican Proj., Sask. Agric. & Food, Sask. Env. & Res. Manage.

9.3 Educational goals

Goal 6. Encourage linkages between urban and rural Elementary and High School students to explore the connections between nature, human populations, food production and consumption, and sustainability (Sect. 7.1).

Action 12: Facilitate linkages and exchanges between rural and urban school teachers, and suggest resource material and field trips.

Agency: Nature Saskatchewan, Redberry Lake Pelican Project.

10. Evaluating Success

The Redberry Pelican Project is well situated to be the local guardian for this conservation plan. All stakeholders no doubt have an interest in seeing their ‘investment’ in conservation bear fruit and probably recognize that ‘the whole of this conservation effort is greater than the sum of its parts.’ The project should be adaptive and hence this plan

should be amended frequently.

As original proponents, the provincial and national IBA partners have a great interest in seeing this endeavor 'take flight.' Until 2002 and probably beyond, the people and organizations listed below will give a great deal of attention to this effort. Plans will be made to ensure continuation of this urgent effort. Conservation is not just for today, it is forever.

Individuals and organizations with a stake in this project:

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12. References

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Appendix 1. Names, affiliation, contact information and general interests of individuals in connection with Redberry Lake. By agreeing to have their name stand here, these individuals have made no commitment beyond agreeing to be contacted when their participation is requested.

Michael T. Arts, National Water Research Institute, 11 Innovation Blvd., Saskatoon, SK, S7N 3H5, 306-975-6012 michael.arts@ec.gc.ca

Interests: Michael has participated in several studies on nutrient flux, food chain dynamics and herbicide assimilation in aquatic invertebrates and the microbial community. His most recent research focuses on the penetration of UV radiation into aquatic systems and the effects of UVR on aquatic biota. He is the National Water Research Institute's scientific advisor to the Redberry Lake Watershed Technical Committee.

Gordon (Gord) Burrows, Manager, Sask. Environment & Resource Manage. - Saskatoon Region, 112 Research Drive, Saskatoon, SK, S7K 2H6, Tel. 306-933-7927, gord.burrows@innovationplace.com

Interests: Gord's responsibility is to facilitate integrated resource management with emphasis on the Saskatoon region. He has been a very helpful resource person for the Redberry Pelican Project.

Terry Chamulak, Sask Water, 111 Fairford St. E., Moose Jaw, SK; Tel. 306-694-3746; E-mail tcha@saskwater.com

Interests: Terry is familiar with Redberry Lake and has access to the data collected at the hydrometric station there.

William (Bill) Chappell, Ducks Unlimited Canada, Box 1180, North Battleford, SK, S9A 0J8; 306-445-2575 w_chappell@ducks.ca

Interests: Bill has been working for DU Canada for 14 years in west-central Saskatchewan including the Redberry Lake area.

Mary Gilliland, Saskatoon Nature Society, 902 University Dr., Saskatoon, Sask., S7N 0K1;

306-652-5970 birdwoman@home.com

Interests: Mary has spent a good deal of time birding and is very familiar with the Redberry Lake area. She has also provided an active voice for conservation in and outside the Redberry Lake watershed

Wayne Gosselin, Policy and Program Development Branch, Sask. Agriculture & Food, 3085 Albert St., Regina, SK, S4S 0B1; 306-787-6586 wgosselin@agr.gov.sk.ca

Interests: Wayne is a Policy Analyst for Sask. Ag. & Food and has a special interest in agriculture - environment interactions.

Larry and Diane Hawrysh, Hafford, SK, S0J 1A0, 306-549-4627 dhawrysh@sk.sympatico.ca

Interests: Larry and Diane operate a mixed farm in the watershed. Larry strongly supports conservation of the birds and their ecosystem. As a farmer he struggles to farm in a way that sustains the soil and a rural way of life. Diane Hawrysh teaches school in Hafford.

Jo-Anne Hochbaum, Sask. Environment & Resource Manage., 3211 Albert Street, Regina, SK S4S 5W6; Tel. 306-787-2796 FAX 306-787-9544 joanne.hochbaum.erm@gov-mail.gov.sk.ca

Interests: Jo-Anne is the Project Coordinator for SERM's Representative Areas Network.

Peter Kingsmill, The Redberry Pelican Project (Canada) Foundation, Box 221, Hafford, SK, S0J 1A0, Tel. 306-549-2258, FAX 306-549-2199, peter.kingsmill@ecocanada.com

Interests: Peter, formerly a journalist, rancher and (occasionally) a musician, moved to Hafford and worked with others to create the Redberry Pelican Project. Peter has been deeply involved with a number of tourism organizations at the local, provincial and national levels. His wife Valerie operates a Bed & Breakfast in Hafford. Peter's efforts have greatly facilitated research, education and monitoring activities at Redberry Lake.

Garth Nelson, Nature Saskatchewan, 529 Dalhousie

Crescent, Saskatoon, SK, S7H 3S5; 306-373-1745 E-mail gcnelson@sk.sympatico.ca

Interests: Garth is Conservation Director for Nature Saskatchewan. In this role, and out of personal conviction, he has provided input on many large and small conservation issues over the years.

Ken Sapsford, Sask. Soil Conservation Association, 3735 Thatcher Avenue, Saskatoon, SK S7K 2H6; Tel. 306-933-5287

Interests: As a member of the Sask. Soil Conservation Association, Ken is active in advocating soil conservation, education and awareness.

John Sawyshyn, The Redberry Pelican Project (Canada) Foundation, Hafford, SK,

Interests: He has been a very instrumental co-founder of the Redberry Pelican Project. John works as the society's comptroller and handles the international projects involved with CIDA sharing information with other similar projects in other parts of the world.

Glen Shaw, Prairie Farm Rehabilitation Administration, 1011-11 Innovation Blvd., Saskatoon, SK S7N 3H5; Tel. 306-975-4130, Fax 306-975-4594, E-mail shawga@em.agr.ca

Interests: Glen is the manager of the soil and lands program at PFRA. Glen has plenty of experience in the area of agriculture and rural development, and he will be a useful resource for ideas related to land use programs and policy instruments.

Adam Schmidt, Sask. Env. & Res. Manage., 117-3rd Ave. West, Melville, SK S0A 2P0; Tel. 306-728-7487, Fax 306-728-7447, E-mail Adam.Schmidt.erm@govmail.gov.sk.ca

Interests: Adam is the SERM, Parkland

Ecoregion Wildlife Biologist and White-tailed Deer specialist for the Department.

Philip S. Taylor, Canadian Wildlife Service, 115 Perimeter Road, Saskatoon, SK, S7N 0X4, 306-975-4106, FAX 306-975-4089 phil.taylor@ec.gc.ca

Interests: In his early years as a biologist, Phil has studied birds in the Canadian High Arctic. He's been in charge of habitat management for the Canadian Wildlife Service for over 20 years. Phil serves on the Redberry Pelican Project's advisory board and has a strong commitment to Redberry Lake.

Earl Wiltse, Sask. Environment & Resource Manage., 3211 Albert Street, Regina, SK, S4S 5W6, Tel. 306-787-2889 or 2464, FAX 306-787-9544, earl.wiltse.erm@gov-mail.gov.sk.ca

Interests: Earl has considerable background in plant ecology. He has recently been put in charge of SERMS's 'Species at Risk' section. Earl also serves on the IBA Advisory Board.

Appendix 2. Goals and actions for the Redberry Lake Biosphere Reserve (RLBR) in response to the United Nations Education, Science and Culture Organization's Man in the Biosphere (UNESCO-MAB) Seville strategy.

GOAL I: The Redberry Lake Biosphere Reserve will be a model for the conservation of natural and cultural diversity.

1. The RLBR will work assiduously to ensure that all agencies, land owners, and land managers work cooperatively to the benefit of natural habitats and species, with a focus on conserving species at risk.
2. The RLBR will celebrate cultural heritage and diversity as a key to understanding and implementing biodiversity.

GOAL II: The Redberry Lake Biosphere Reserve will be a model for environmentally sustainable land management practices and community cultural and economic sustainability.

1. The RLBR will involve all stakeholder groups in planning and decision making regarding the management and use of the region.
2. The RLBR will identify and address factors that lead to environmental degradation and unsustainable use of biological resources.
3. The RLBR will ensure that benefits derived from the use of natural resources are equitably shared among stakeholders, and will organize forums and demonstration sites to promote the sustainable utilization of biological resources characteristic of the region.

GOAL III: The Redberry Lake Biosphere Reserve will be a centre of excellence for research, monitoring, education, and training.

1. The RLBR will aggressively pursue basic and applied research projects, especially those

which focus on local issues and seek answers and solutions that may be applied to sustainable use and development in other regions. These projects could incorporate the natural and social sciences and those in particular involving the rehabilitation of degraded ecosystems, the conservation of soils and water, and the sustainable use of natural resources.

2. The RLBR will work to ensure that data collection and management systems are congruent with research standards and each other.
3. The RLBR will work to ensure that the region is used for making inventories of flora and fauna, collecting ecological and socio-economic data, making meteorological and hydrological observations, and studying the effects of pollution, both for scientific purposes and as a basis for making sound site management decisions.
4. The RLBR will undertake partnerships to use the region as an experimental area for the development and testing of methods and approaches for the evaluation and monitoring of biodiversity, sustainability, and the quality of life of its inhabitants.
5. The RLBR will work towards the development of indicators of sustainability (in ecological, economic, social, and institutional terms) for the different productive activities carried out with the Buffer Zone and the Transition Zone/Zone of Cooperation.
6. The RLBR will encourage the involvement of local communities, schoolchildren and other stakeholders in education and training programs and in research and monitoring activities within the region.
7. The RLBR will encourage the production of visitor information about the region and its importance for conservation, the sustain-

able use of biodiversity, its cultural aspects, its recreational opportunities, and its educational programs and resources.

8. The RLBR will promote the use of the ecology centre and other field stations as educational resources for schoolchildren and other groups.
9. The RLBR will promote the use of the region for on-site training and international, national, regional, and local seminars.
10. The RLBR will encourage appropriate training and employment of local people and the direct involvement of other stakeholders to allow their full participation in inventory, monitoring and research programs within the region.

UNESCO Biosphere Reserve network.

6. The RLBR will work aggressively to mobilize funds from business, NGOs and foundations for the benefit of the region.

GOAL IV: The Redberry Lake Biosphere Reserve will be a model to Canada and the world of the application of the biosphere reserve concept.

1. The RLBR will ensure the identification and mapping of the different zones of the region and define their prospective status.
2. The RLBR will oversee the preparation, implementation, and monitoring of an overall management plan that will include all zones of the region.
3. The RLBR will ensure that institutional mechanisms are in place to manage, coordinate and integrate programs and activities.
4. The RLBR will encourage private sector initiatives to establish and maintain environmentally and socially sustainable activities in the region and surrounding areas.
5. The RLBR will work assiduously to heighten awareness of biosphere reserve principles both locally and as a member of the

Appendix 3. “Redberry Granola”

During the ceremony dedicating Redberry Lake as an Important Bird Area, Joe Schmutz pointed toward the thorny buffalo berries abundant at the north shore of the lake as a desirable ingredient for granola. Joe pointed out that the granola he had eaten that very morning came from Peterborough, Ontario. Sea buckthorn, a close Eurasian relative of buffalo berry is hailed as a health food, a quality which the locally growing but largely ignored buffaloberry shares. He challenged that if anyone were to offer locally mixed granola with local products grown in an environmentally sensitive manner, he would sign a contract for a one-year personal supply with likelihood of renewal. Already, in fact, farmers from the Redberry Lake watershed had received tentative agreement from nine Saskatoon families to purchase locally grown meat in bulk. Examples of how such food “sub-systems” are practiced are referred to in Section 7.1.

As with any system, the connections in this utopian “Redberry Granola” food system need to be carefully considered. Practice reveals that even with the best intentions, systems are easily co-opted especially when connections and interests are not well balanced. The advantage in this case is that a system designed from the point of view of many diverse interests (e.g. economic viability, Redberry watershed conservation, sustainability, and consumer’s expectations) may have the greatest chance of survival.

The Canadian food system is in crisis. Hardly a week goes by without some major announcement about the plight of farmers; or the impact, or non-impact, of genetically modified foods. A reality seems to be that farming with high inputs is not advantageous to the birds, apparently not to farmers, and not to health and socially conscious consumers. There was never an outcry by farmers or by consumers for higher inputs in farming, or for genetically modified foods. It was driven by a market in which farmers were manipulated by policy and financial considerations and consumers became short-sighted bystanders. Politicians and senior administrators were seduced by the sim-

plistic market solutions and the enthusiasm provided by those few who had most to gain.

According to economist John Ikerd, Adam Smith’s market principles of 1716 no longer fit today. Smith, Ikerd said, did not advance his assumptions as universal principles in the first place, but merely as a description of what was happening then. “We are practicing greed and using economics as an excuse.” 80% of hungry children are living in countries that boast food surpluses.

The challenge is to find new markets and distribution systems that diversify supply and allow an element of choice in demand. Reigning in business interests and techno fixes will not be simple to achieve. Some cracks are showing in the armor; McCain Foods Ltd. has recently announced its rejection of genetically modified potatoes, not because the company feels they are unsafe, but because consumers prefer selective breeding to transgenics. In every turmoil lies an opportunity, which will likely be seized by someone. This opportunity could translate for a benefit to birds and producers alike. The Redberry watershed could participate in a new experiment in which Redberry producer’s forge new market alliances.

In follow-up discussions about the Redberry Granola model in principle, various people offered encouragement but also pointed to challenges. Glen Shaw of PFRA considered this model consistent with diverse attempts at different fronts to re-invigorate and diversify the rural economy in Saskatchewan. He also suggested that various agricultural/horticultural/agroforestry programs could be creatively added to the mix of strategies. Catherine Folkersen of the Sask. Ag. & Food - Industry Dev. Branch, encouraged this model, but also pointed out several stumbling blocks. She suggested that, most simply put, such ventures require an appropriate market, a committed and capable champion for the concept and dollars for financing. She felt that such an idea would not likely be adopted by the mainstream food retail sector but could rely to advantage on niche marketing strategies. Valerie Kingsmill of Hafford is currently exploring this idea further. Garth Nelson,

Conservation Director for Nature Saskatchewan, and Colin Clay, University of Saskatchewan Chaplain, both felt that the Nature Saskatchewan membership and members of various church groups

could be invited to act on their ecological and social conviction and use their purchasing power to support this model.

Black November

When I was a young turkey,
new to the coop,
My big brother Mike
took me out on the stoop,
Then he sat me down,
and he spoke real slow,
And he told me there was something
that I had to know;

His look and his tone
I will always remember,
When he told me of the horrors
of..... Black November;
“Come about August,
now listen to me,
Each day you’ll get six meals
instead of just three,
And soon you’ll be thick,
where once you were thin,
And you’ll grow a big rubbery thing
under your chin;”

“And then one morning,
when you’re warm in your bed,
In will burst the farmer’s wife,
and hack off your head;
Then she’ll pluck all your feathers

so you’re bald ‘n pink,
And scoop out all your insides
and leave ya lyin’ in the sink;
“And then comes the worst part”
he said not bluffing,
“She’ll spread your cheeks
and pack your rear with stuffing”.

Well, the rest of his words
were too grim to repeat,
I sat on the stoop
like a winged piece of meat,
And decided on the spot
that to avoid being cooked,
I’d have to lay low
and remain overlooked;

I began a new diet
of nuts and granola,
High-roughage salads,
juice and diet cola;
And as they ate pastries,
chocolates and crepes,

I stayed in my room
doing Jane Fonda tapes;
I maintained my weight
of two pounds and a half,
And tried not to notice
when the bigger birds laughed;

But ‘twas I who was laughing,
under my breath,
As they chomped and they chewed,
ever closer to death;

And sure enough
when Black November rolled around,
I was the last turkey
left in the entire compound;
So now I’m a pet
in the farmer’s wife’s lap;

I haven’t a worry,
so I eat and I nap;
She held me today,
while sewing and humming,
And smiled at me and said:
“Christmas is coming..

Anonymous 1999

