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APPENDIX A

An Opinion from Dr. R.I.G. Morrison, Environment Canada

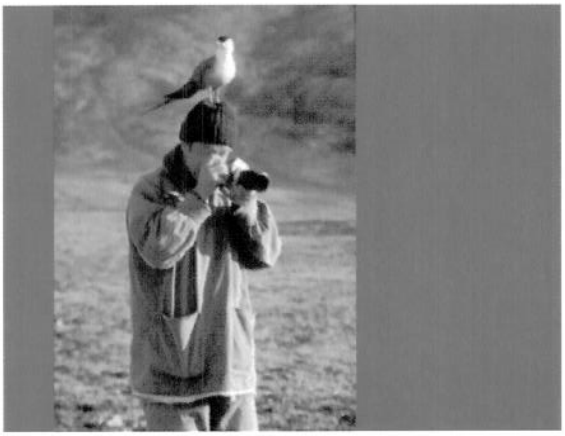
Birds at Alert: World Travellers

Dr. R.I.G. Morrison, Environment Canada, Science and Technology.

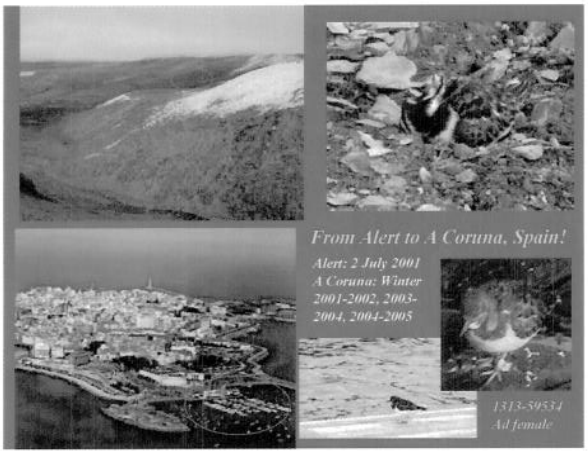
Birds breeding in the Alert area migrate to many parts of the world during the northern winter. Arctic Terns *Sterna paradisea* are thought to reach the Antarctic Ocean and are said to see more daylight than any other living creature as they experience 24-hour daylight at both ends of the world. Long-tailed Jaegers *Stercorarius longicauda* are thought to winter off west Africa. Several shorebird species at Alert, including Red Knots *Calidris canutus* and Ruddy Turnstones *Arenaria interpres*, migrate to European wintering grounds. Turnstones colour-marked at Alert have been found wintering as far north as the Faroe Islands and as far south as Nambia in Africa. The latter bird was seen on the same beach in Namibia for seven consecutive "winters" and was known as "Mr. Ellesmere"! Other sightings have been made throughout Europe, including the UK, Netherlands, Belgium, Germany, France, Spain (and Canary Islands), Portugal, and Mauritania. The same individuals of many species return to Alert each year to breed indicating that Alert is not simply an "overflow" area from "better" areas farther south. Examples include a Long-tailed Jaeger originally marked near Alert in 1996 and still breeding on the same territory in 2008, a Red Knot originally caught near Dean Hill ("Crystal Mountain") in 1992 and seen every year until 2003, and an Ivory Gull resighted at Alert 11 years after its initial capture. Several turnstones have been sighted in multiple years both at Alert and on their European wintering quarters.

Red Knot

Ivory Gull



Long-tailed Jaeger (and Fred Bruemmer)



One Ruddy Turnstone banded and photographed on its nest at Alert in 2001 has been seen and photographed where it winters regularly at a marina in NW Spain.

Body stores, migration, and survival. Red Knots reaching the Canadian High Arctic from European wintering quarters have a spectacular migration that either takes them to Iceland to refuel and then across the Greenland icecap, or in the case of birds at Alert, possibly via northern Norway and across the top of Greenland, as suggested by some recent sightings of Alert birds in Norway during spring migration. These birds not only accumulate large amounts of fat which they use for fuel during migration, but also undergo remarkable body transformations, which turn them into virtual "flying machines". In Iceland, for instance, the "flight machinery", including heart and flight muscles, increases in size before departure for the Arctic, whereas "baggage" such as stomach, intestines, leg muscles, etc., which is not needed during the flight, decreases in size. This leaves the bird exquisitely adapted for the long flight. The bird faces a different problem after arrival on the breeding grounds, since it then needs to become a "breeding machine". Our work at Alert has shown that the birds undergo another remarkable series of physical transformations before breeding. They arrive with

considerable extra stores of fat and protein in the form of body fat and flight muscle, and these extra stores are rapidly lost, providing nutrients for other body organs to be regrown, including the digestive apparatus (stomach and intestine), liver, gonads, and heart. The stores could also serve as an energy reserve to enable survival if weather conditions are severe after arrival. The consequences of not accumulating adequate stores during migration can be severe and may result in drastically reduced survival: this appears to have happened with the North American population of Red Knots which breeds in the central Canadian Arctic (well south of Alert!) and winters in Tierra del Fuego in South America. Failure of this population to reach adequate departure weights during northward migration in Delaware Bay owing to major reductions in their food supply (caused by overfishing of horseshoe crabs), led to a reduction in annual survival from about 85% to about 57% for several years, enough to account for the dramatic declines observed on the wintering grounds. This population is being proposed for Endangered Species status.

Work at Alert has also been instrumental in answering another biological question as to whether the stores brought to the breeding grounds are used for egg formation – whether the birds are "capital" breeders, using their body stores, or "income" breeders, relying on local food resources. These two possibilities can be distinguished since the stable isotope composition of the stores accumulated in marine habitats on migration will differ from that of food obtained from fresh-water, terrestrial habitats used by the birds after their arrival. Analysis of egg contents has shown that most eggs are formed almost entirely from local food resources, as might be expected if the main function of the stores is to enable body transformation into a state suitable for breeding.

	Fat	Flight muscles	Heart	Stomach	Proventriculus	Intestine	Liver	Gonads	Calcium
Pre-breeding	⇓	⇓	⇑	⇑	↑	⇑	⇑	↑	↑
Males	-69%	-13%	+46%	+26%	+20%	+8%	+45%	+3%	+6%
Females	-68%	-14%	+67%	+31%	+41%	+11%	+50%	+42%	+19%

Changes in body composition of Red Knots after arrival at Alert. The large stores of fat and protein accumulated during and remaining after migration are used for fuelling body changes to enable the bird to attain proper breeding condition.

Lemming cycles, climate-related issues. The well-known 3-4 year cycle in abundance of lemmings is well focused at Alert and plays a major role in the breeding success of many species, particularly Long-tailed Jaegers and shorebirds. Jaegers are only able to breed in high lemming years, and it has been estimated that this occurs on average about 1½ years out of every four years. Shorebirds are affected indirectly, in that in high lemming years predators such as foxes concentrate on lemmings and spend less time searching for shorebird nests and young so that shorebird breeding success is generally higher in such years. The weather is also very influential in how the relationship plays out in a given year, since a late spring may cause reduced breeding success even in years of high lemming abundance.

Mean June temperatures have been generally increasing at Alert since the 1970s. Studies of energy metabolism of shorebirds at Alert are helping understand shorebird distribution in the Canadian Arctic in relation to climate. Climate has been shown to be influential in the evolution of shorebird physiology, and turnstones have been shown to lay larger eggs in years with warmer temperatures. While warming temperatures might at first sight appear to benefit shorebirds, changes in phenology of food resources, changes in habitats, and changes in amount of snowfall make clear prediction of effects complicated to predict.

Science in the North. The support provided by the military and CFS Alert represents a highly important opportunity for Canadian scientists to be able to work at the most northern limits of our country. Work at Alert is also part of IPY studies planned for 2007-2009. On a broader front, it also makes a contribution to Canadian sovereignty (see picture below).

Dr. R.I.G. Morrison assisting Her Excellency the Governor General Adrienne Clarkson during construction of a cairn at Alert, 19 June 2005.

Wildlife/Shorebird Research at Alert

Studies on shorebird and other bird populations at Alert constitute one of the longest running bird research programs conducted by Environment Canada in the Arctic. Work started in the 1970s, running from 1974-1976, and has continued from 1986 to the present, with 2008 bring the 25th field season.

Research focuses mostly on shorebirds, principally Red Knots and Ruddy Turnstones, with additional studies on Long-tailed Jaegers and Ivory Gulls. Long-term studies include work on migration, survival, and return rates of individually marked birds; studies of energy metabolism using doubly-labelled water; ecophysiological studies of dynamics and functions of body stores using stable isotopes; relations between climate change and shorebird breeding and distribution; interactions of predators, lemming cycles, and weather with breeding success; orientation at high latitudes; relationships between blood metabolites and migratory/breeding states; stress responses in High Arctic birds; and various other topics.

Results from the work have made important contributions of both biological and conservational interest. For instance, it was discovered that body stores which the birds accumulate during migration and which are brought to the breeding grounds are not used for egg formation but are likely essential for physiological transformation from a state suitable for migration to one suitable for breeding. Work has also shown that when the birds are unable to accumulate suitable amounts of body stores, there is a severe penalty in reduced survival. This important finding has provided an understanding of the reasons for the drastic declines and lower survival rates of North American populations of Red Knots, which have recently been designated as Endangered.

Over the years, the military at CFS Alert has provided outstanding support for this research, as have staff at the Environment Canada Weather Station and GAW laboratory.

The facilities at Alert provide a unique and important opportunity for studying birds and wildlife at the most northerly limits of land in the world. There is no other site in the Arctic where it would be possible to catch, band, and carry out field and laboratory studies on shorebirds in the numbers required for scientific sampling. The unique nature of Alert is related at present to the sewage outfall stream, which attracts shorebirds and other birds early in the summer after their arrival when much of the landscape is still covered with snow, as well as later in the summer, when birds are preparing for their migration south.

The birds gather at the stream not to feed on the sewage, but to feed on the small food particles that result from left-over food being garburated in the kitchen and flushed down the stream.

It seems certain that if a sewage treatment facility were to be installed that resulted in kitchen waste food particles being removed from the water, so that no particles were discharged into the stream, that the birds would be highly unlikely to

gather in any numbers at the stream, and the opportunities for studies involving banding significant numbers of birds would be destroyed.

Since there is ongoing interest by Environment Canada and university scientists in continuing this work, and building on the results accumulated over the past quarter century, it would be a major loss if the installation of a sewage treatment facility resulted in the destruction of Alert as an area where the most northerly shorebird research in the world could be carried out.

Dr. R.I.G. Morrison, Environment Canada, Science and Technology, Wildlife Research

From: "Morrison,Guy [NCR]" <Guy.Morrison@ec.gc.ca>
To: "Ron Kent" <Ron@fsc.ca>
Date: 13/01/2009 8:38:49 pm
Subject: RE: CFS Alert Project

Dear Ron

The birds that use the sewage outfall at the moment would probably be affected to some extent - it would seem likely that the presence of food in the stream (kitchen waste, garburated and flushed down the sewage stream) might enhance their survival in some years when conditions were particularly difficult, but one sees many birds (including ones that come to the stream) feeding in natural habitats throughout the summer, and the stream would certainly not have a widespread impact on Arctic populations, given the size of the Arctic.

What it does do is provide a superb research opportunity - I think there is nowhere else in the Arctic that can provide the opportunity of catching significant samples of birds for banding and physiological studies. If the construction of a sewage treatment facility meant that no food particles came down the stream, it would probably effectively destroy our ability to continue the work we have built up over the past quarter century.

In the early days, most birds went to the garbage dump to feed on kitchen waste that was dumped there, but when this was stopped, the birds abandoned the dump and moved to the stream. They would probably abandon the stream if the food scraps were to be removed. Obviously, this is an artificial situation, but it provides a superb study opportunity, especially considering its location near the most northerly limits of land in the world.

Alert is something of an attraction for the wolves. They do visit the stream, though I have never seen them catch a bird (they would take an injured or exhausted one, no doubt, if the chance occurred). They sometimes lounge around the stream but I don't think they use it for any purpose.

I suppose some of us are wondering why the installation of a sewage treatment facility is being considered - the present treatment seems adequate, though I suppose it is not particularly hygenic. It would be nice if the waste food could continue to be discharged in the future - or would the construction of a treatment facility mean there would no longer be a stream at all?