How one of the most endangered migratory birds is shoring up against its imperilled global flyways

The Plight *of the* Red Knot

BY ALLAN J. BAKER

This page: The *rufa* subspecies that flies through Ontario has the smallest population of all the red knots.

Opposite: This adult in winter plumage demonstrates the powerful wing beats red knots use for sustained flight during their 30,000-km annual migrations.

Photo: Isidro Vila Verde

Photo: Alfred Yan

One of the most magnificent sights in the world takes place at the far ends of the earth, in places like Tierra del Fuego, northwest Australia, New Zealand, and South Africa: huge flocks of shorebirds circle high in the sky, calling excitedly as they begin their arduous journey to breeding grounds in the arctic tundras of the northern hemisphere. No matter how many times I witness it, the sight fills me with awe. And no wonder: some of these migrating birds travel 30,000 kilometres annually back and forth between their northern breeding sites and the southern feeding grounds where they spend the winter.

To fuel their remarkable journeys, the birds need suitable feeding sites along their flyway, or route. I like to use the analogy of a 747 aircraft taking onboard large amounts of fuel before departure for a world-wide flight, stopping at a few widely spaced refuelling sites. Unfortunately for these birds, only a few good refuelling sites—wetlands with abundant food supplies—exist around the world. Many of these critically important wetlands face destruction or degradation, threatening many shorebird species with huge population declines and eventual extinction. In 2003, global surveys of 207 shorebird populations showed that about half were declining in number, while only 16 percent were increasing. This ranks shorebirds as the most endangered group among all species of migratory birds in the world.

Left: Patricia Gonzalez from the Fundacion Inalafquen in San Antonio Oeste in Argentina examines a captured knot to score the progress of its body moult. She is co-organizer of all international expeditions in South America and works throughout the red knot's flyway.

Middle: Adult red knots in breeding plumage land at a beach in New Jersey to feast on the eggs of spawning horseshoe crabs. The birds must compete with dense flocks of gulls for the energy- rich eggs.

Right: A juvenile at its wintering site, after migrating from the Arctic. It's in new plumage—the black tips of its primary wing feathers are only slightly worn and won't be replaced until the following year.

Photos: Patricia Gonzalez, Allan Baker. Red knots and seagulls, © Bill Dalton

Photos: Juvenile knot, Peter Grube. Poster bird, Allan Baker

Rufa **red knots need about two weeks at Delaware Bay to recover from the long flight from South America and to store nutrients for the onward flight to their Arctic breeding grounds**

My own concern for migrant shorebirds began in 1995, when my great friend and colleague, Professor Theunis Piersma of the Netherlands, inspired me with his cutting-edge ecological research on red knots. This shorebird species, a bird slightly larger than an American robin, is the ultimate long-distance migrant. Six different subspecies of red knots migrate along global flyways from southern wintering sites to discrete breeding grounds in the high Arctic tundras. To my chagrin, I realized that the *rufa* subspecies of red knot that flies through Ontario—my own backyard—had one of the smallest populations of all.

Thankfully, Brian Harrington from the Manomet Bird Observatory in Massachusetts had been conducting pioneering work, laying the foundation for understanding the flyway of this subspecies. He had discovered that these birds, which winter in Tierra del Fuego, have the longest flyway of all the knot shorebirds. They migrate north and refuel in Argentina and Brazil at key wetlands, then make a huge flight into North America, where they refuel for the final leg to the Arctic.

That same year I decided it was high time to roll up my sleeves to better understand this amazing flyway—and to get involved in applied conservation work. Rather than pressing on with my usual taxonomic work in the office and lab, I needed to head out to the field and capture and band birds so we could estimate—and try to contribute to—their survival in different parts of the flyway.

When I challenged Theunis to come along, he agreed, and became part of an international team that joined me in February 1995 in a ROM-led expedition to Tierra del Fuego, the southern terminus of the red knot flyway. Our objective was to determine how many knots were present near the town of Rio Grande, where we know these birds live when it is winter in the northern hemisphere. We aimed to catch and band a good sample, so that we could begin the task of estimating the annual survival rate of adults by recapturing them in subsequent years. On that expedition local people from Argentina joined us, including Luis Benegas from the Museo De La Ciudad Virginia Choquintol in Rio Grande and Patricia Gonzalez from Fundacion Inalafquen in the northern Patagonia town of San Antonio Oeste, about 1,400 km north of Tierra del Fuego.

Little did I know then that San Antonio Oeste held the most important wetland in Argentina. Red knots depend heavily on it to refuel during the northward migration to the Arctic. It's an ideal spot for capturing birds in our cannon nets during their northward flights from February to April each year, allowing us to sample populations for survivors in the non-breeding season and to check their physical condition. On that first expedition, we captured and banded 350 *rufa* red knots with small numbered metal bands. In future years, we fitted the birds with coloured flags with laser-inscribed characters uniquely identifying each bird. Unlike the metal bands, these flags could be read through high-powered spotting scopes, enabling us to gather much more data on survival of individuals without recapturing them. From our annual studies throughout the flyway since 1995 we have discovered that there are three discrete populations of *rufa* red knots: the group we knew about spends the non-breeding season in Tierra del Fuego, but there is another in Maranhao in northern tropical Brazil, and a third in Florida. As of 2008, by far the largest population—14,800 birds—is the group that winters in Tierra del Fuego. Fewer than 5,000 birds winter in Maranhao and 5,000 in Florida. Only a decade ago these populations were much larger, but since 2000 their numbers have declined rapidly. In January 2000 we took an aerial count of the population in Tierra del Fuego, and at that time there were about 53,000 red knots.

So what caused this alarming decline? By analyzing our data on the annual survival of red knots before, during, and after the period of rapid decline, we identified two primary causes. First was the birds' late arrival at the northward migration refuelling site at Delaware Bay in the United States. Inclement weather en route or poor refuelling at stopover sites can delay migration. The timing of their arrival at Delaware Bay is critical because the birds need about two weeks there to recover from the long flight from South America and to store nutrients for the onward flight to their Arctic breeding grounds. The second cause was that food resources at Delaware Bay were depleted. Because food on the tundra is scarce when the birds arrive and because they need energy to switch from migration to breeding condition, they need to carry more nutrients than are required for the flight. During good seasons in the bay, the *rufa* red knots feed voraciously on a superabundant supply of horseshoe crab eggs and regularly reach departure weights of 180 grams or more, some of them doubling their arrival weights of 90 to 120 grams. But in bad seasons, when food is scarce, most of the birds do not reach this optimum weight, which leaves them vulnerable to starvation or freezing when they arrive in the Arctic.

From 1997 to 2002, spawning horseshoe crabs were heavily overharvested as bait for the conch and eel fisheries, and this had a disastrous impact on red knots, which were unable to refuel properly. Birds seen alive in future years were heavier when they arrived in the bay than birds that were never seen again. From May 2000 to May 2001, 37 percent fewer adults survived than in previous years, and the number of immature birds in wintering flocks declined by 47 percent. The result was that from 2000 to 2002, population size in Tierra del Fuego declined alarmingly from 53,000 to 27,000. Based on the low annual survival rate and the poor production of young in the Arctic, we built a demographic model and predicted that if this decline continued apace, the subspecies could approach extinction in as little as 10 years. Fortunately, this worst-case scenario has not transpired. Still, by 2008, the Tierra del Fuego population had declined to an all-time low of 14,800 birds—a significant enough drop that the subspecies has been recommended for endangered status in Canada.

A positive result of this applied research, which involves international teams, is that it mobilized conservation groups to pressure state and federal agencies in the US to ban or severely reduce harvesting horseshoe crabs in New Jersey and Delaware. This succeeded only partially since a strong lobby by the horseshoe crab industry diluted effective management plans. Only New Jersey has been able to maintain a ban on horseshoe crab harvesting, and only while the knots are refuelling each May, but these measures have helped to slow the rate of decline in the *rufa* populations.

Against this dismal backdrop, a team led by Larry Niles in New Jersey has formulated a plan for the red knot. In it, objectives are defined that need to be met if the population is to recover. Simply put, the supply of horseshoe crab eggs in Delaware Bay has to return to pre-1997 levels to enable at least 80 percent of the red

Poster Bird: An Amazing Journey

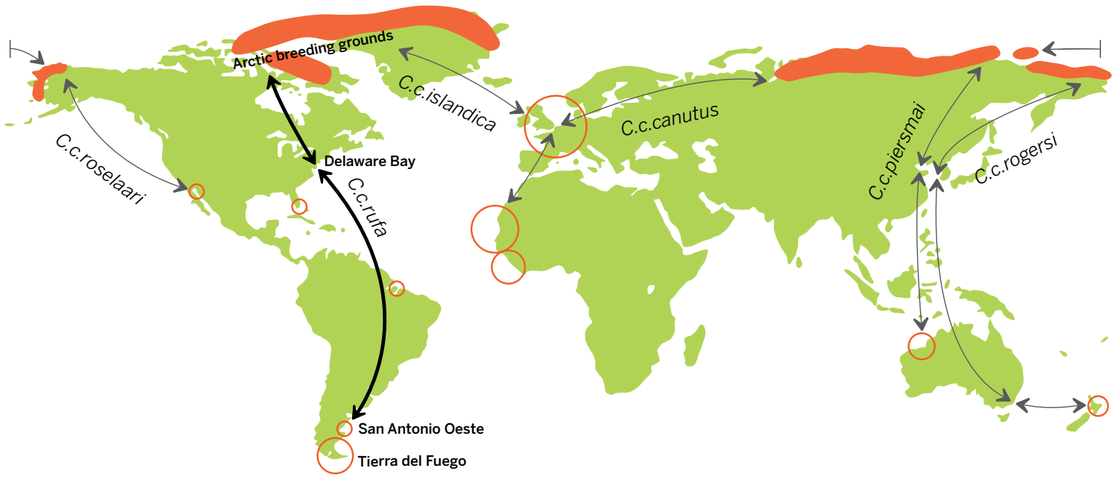
In 1995, the first year I began studying the endangered shorebirds called red knots, a ROM-led international team captured and banded a cohort of these birds. Most of them have long since died as, on average, the birds live only seven years. But this many years later, a lone survivor remains. In 1996 he was fitted with a coloured flag that has laser inscribed characters uniquely identifying him. Analogous to an engraved bangle or medical alert bracelet worn by humans, the band clearly identified him as bird B (95).

The elderly bird's fame has so attracted public imagination that some conservation agencies are using his story in their fundraising literature. We first caught him in February 1995 when he was an adult and thus at least three years old. So he is now at least 16 years of age. If we multiply 16 annual migrations by 30,000 km we get a total flight distance of 480,000 km. He has flown the average distance to the moon (385,000 km), and is on the way back to Earth! We know B (95) is male because when we recaptured him in Rio Grande in November 2007 and took a tiny blood sample, the extracted DNA showed two copies of the male-specific sex chromosome Z, whereas females have one copy each of the Z and W chromosomes. The astonishing B (95) was seen in August 2008 on the north shore of the Gulf of St. Lawrence in Quebec and we saw him again in December 2008 on our latest expedition to Rio Grande.

***Rufa* red knot stats**

	C.c. rufa
Total migration distance annually (km)	30,000
Max. single flight distance (km)	8,000
Breeding latitude	64.13°N
Population size	14,800

Below: The flight path, or flyway, for the *rufa* subspecies of red knot is marked in black. Its wintering grounds are circled.



knot population to reach departure weights of 180 grams, and this likely requires a total ban on harvesting of crabs for about five years, or at least a small harvest until the horseshoe crab population recovers to levels high enough to sustain the birds. Based on years when birds have been able to refuel adequately, we know the knots need about 50,000 horseshoe crab eggs per square metre laid in the top 5 cm of the beaches. This requires the number of horseshoe crabs spawning on the beaches to increase to 15 crabs per trawl from the current average catch of 1 to 5 in the annual Delaware Bay trawl survey. As well, adult survival among the red knots has to be increased to the normal level of about 85 percent or more, and production of young has to be at least 20 percent, as it was in the past, so that the breeding population can expand.

Even after 13 years of close study, for us, the biggest remaining unknown about the flyway was how successful the birds were in breeding each year. Partly because breeding pairs are spread widely across the Arctic and because the juveniles diffuse across the Americas, it is hard to assess numbers. But we've now found a way to address this problem. In 1996, Quebec ornithologist Yves Aubry of the Canadian Wildlife Service alerted us to the fact that during their homeward flight after the breeding season, red knots were refuelling on the beautiful small islands in the Mingan Archipelago National Park Reserve, just offshore from Havre St. Pierre on the north side of the Gulf of St. Lawrence. Mingan offers a perfect opportunity to count the number of juveniles coming out of the Arctic, and thus a way to gauge annual breeding productivity.

So, for the last two summers my ROM team has been working at Mingan jointly with a Quebec team led by Aubry. Although the stopover site seems like a long way east for the birds to fly to from their Arctic breeding sites on Southampton Island in Nunavat, it is on the great circle route, the shortest path to Tierra del Fuego from the Maritimes. Because of the favourable winds at this time of the year, the route is also used by other fall migrants. If the knots refuel adequately in Mingan, they can fly nonstop to South America.

In 2007 and 2008, we were able to re-sight more than 1,000 birds that had been previously flagged in Tierra del Fuego, San Antonio Oeste, Maranhao, Delaware Bay, and Florida. These data will be used to estimate annual survival on northward versus southward migration, and between Delaware Bay and Mingan. In August 2008, in five small catches spaced throughout the month, we caught 112 knots. Our earliest catch that month included mostly females, which leave the Arctic soon after their eggs hatch, and some males that probably failed to breed or raise chicks. Almost all birds caught after August 7 were males. These males had likely raised chicks, since fathers stay about three weeks longer in the Arctic to brood the chicks at night and protect them from predators.

Spawning horseshoe crabs were heavily overharvested as bait for the conch and eel fisheries, and this had a disastrous impact on red knots, which were unable to refuel properly

Juveniles also began appearing with the late males, and we counted many more young than in 2007. That year males, females, and juveniles had all arrived at the same time. We concluded that 2008 was a rare good breeding season. On October 3, Patricia Gonzalez telephoned me from the beach in San Antonio in Argentina to report an estimated 30 juveniles among some 400 red knots she was scanning with her team. The flock included one adult female seen in Mingan just 6 weeks previously. In the intervening weeks, the bird had migrated the 13,000 km to Patagonia.

This is the first time that a southbound knot observed departing from Canada has been detected in Argentina soon after arrival. Although San Antonio Oeste is a vital feeding ground for the birds to fuel up for their northbound flights to the Arctic, it also provides a brief stopover on the return flight to Rio Grande and Bahia Lomas in the Argentinian and Chilean parts of Tierra del Fuego, respectively. Thanks to financial support from Birdlife Netherlands through the Global Flyway Network, the Western Hemisphere Shorebird Reserve Network through the Manomet Bird Observatory in Massachusetts, and the stewardship provided by the Fundacion Inalafquen, this wetland has become extremely well monitored and was a centrepiece in international efforts to protect stopover sites. Since the San Antonio Oeste Interpretation Centre was constructed, it has transformed public education and awareness of just how critical wetlands are for conserving shorebirds like red knots. But sadly, the municipality of San Antonio Oeste, despite protests from local and international conservation groups, recently excavated a tidal swimming pool in the richest part of the knots' feeding habitat. Hopefully, our efforts will prevent further construction on the beaches and give the birds a chance to refuel there, as they have always done in the past.

When I met Patricia in 1995 I never imagined our shared dream of building a flyway-wide team together to advance red knot and wetland conservation across the countries would be so rewarding, connecting us all in this extraordinary way. o

Below: A thin red knot at Delaware Bay searches for eggs among upturned horseshoe crabs. Knots ingest the eggs at high rates, converting them into fat and muscle as energy stores for onward migration and survival in the Arctic.

Inset, top: A knot captured in Rio Grande, Tierra del Fuego, is examined to estimate what percentage of red breeding plumage has been moulted just after flying 15,000 km from the Arctic. Birds in good condition tend to moult earlier.

Inset, bottom: Luis Benegas of the Virginia Choquintel Museum in Rio Grande has co-organized all international expeditions to Argentinian Tierra del Fuego since 1995.

Photos: Luis Benegas and captured knot, Allan Baker; Knot and horseshoe crabs, © Bill Dalton