ᑐᓂᓴᐅᔪᖅ ᓄᓇᕗᑦ ᐆᒪᔪᓕᕆᔨᖅᔪᐊᒃᑯᑦ ᑲᑎᒻᒪᔨᖏᓐᓄᑦ
ᒪᑐᒧᖓ

ᖃᐅᔨᒃᑲᐃᒍᑎ: X

ᐃᓱᒪᓕᐊᕐᓴᖅ:

ᐱᔾᔪᑎᖓ: ᐊᑐᓕᖅᑎᑕᐅᒍᒪᓂᖓ ᐅᑎᖅᑭᒥᑎᒃᓯᒐᓱᐊᓐᓂᖕᒥᒃ ᐊᐅᓚᕝᓯᓂᖕᒧᑦᑐ ᐸᖓᐅᑎᒥᒃ ᓯᒡᔭᓇᐊᓄᑦ ᑲᓇᑕᒥᐅᓄᑦ.

<u>ᓯᒡᔭᓇᐊᖅ</u>

ᖃᓄᐃᑦᑑᓂᖏᑦ:

ᓯᒡᔭᓇᐊᖅ ᐊᖏᒧᐊᖏᑦᑐᖅ ᓯᒡᔭᕿᒥᓲᖅ. ᓄᓕᐅᖅᑎᓪᓗᒋᑦ ᑕᖅᓴᖏᑦ ᑲᔫᓯᑦ ᓈᖏᑦ ᐊᐅᐸᕈᔪᑦᑎᓪᓗᒋᑦ. ᐱᖓᓲᓕᖃᖓᔪᐃᑦ ᓯᒡᔭᓇᐊᖑᔪᐃᑦ ᖃᐅᔨᒪᔭᐅᔪᑦ <u>ᑲᓇᑕᒥ:</u> ᕿᑭᖅᑖᓗᐸᑉᓯᖕᒦᓲᑦ *(rufa)* ᓯᒡᔭᓇᐊᑦ ᑲᓇᑕᐅᑉ ᐃᓗᐊᓂ ᑭᓯᐊᓂ ᓄᓕᐅᓲᑦ, *(Islandica)* ᓯᒡᔭᓇᐊᑦ ᖁᑦᓯᑦᑐᒦᓲᑦ ᓄᓕᐅᓲᑦ ᑲᓇᑕᒥ..ᐊᑯᑭᑦᑐᓂᓪᓗ, ᐊᒻᒪᓗ (*roselaari)* ᓯᒡᔭᓇᐊᑦ ᐅᐊᓕᓂᖅᐸᓯᖕᒦᓲᑦ ᑲᓇᑕᒨᓲᑦ ᑲᑦᓲᓐᓇᕈᓗᐃᑦ

ᑐᓵᑎᑦᑐᒋᑦ. ᑖᒃᑯᐊ ᐱᖓᓱᓕᖅᑲᖓᔪᐃᑦ ᑎᑎᕋᖅᓯᒪᔪᑦ ᑎᑎᕋᖅᓯᒪᔪᖅᑯᑎᓂ 1ᒥᒃ ᐆᒪᔪᐃᑦ ᐃᓄᐃᓵᓕᕐᑐᐊᖅᑯᓇᒋᑦ ᐱᖅᑯᔾᖏᓐᓂ *(SARA)* *(rufa)* ᖅᑭᖅᑳᕐᑐᑉᐸᓱᖕᒦᓲᑦ ᓱᖕᔾᓇᐊᑦ ᑎᑎᕋᖅᓯᒪᔪᑦ ᐱᑕᖅᑲᕈᓐᓃᓕᖅᑑᑦᑐᑎᒃ, (*roselaari*) ᐅᐊᓕᓂᖕᒦᓲᑦ ᓱᖕᔾᓇᐊᑦ ᑎᑎᕋᖅᓯᒪᔪᑦ ᐊᑦᑕᖅᑯᓲᑕᐅᓕᖅᑐᑦ, (*islandica*) ᖅᑯᕐᓯᑐᒦᓲᑦ ᓱᖕᔾᓇᐊᖕᒋᑦ ᑎᑎᕋᖅᓯᒪᔪᑦ ᐃᓱᒫᑐᒋᔾᐅᓕᖅᑐᑦ. (*roselaari*) ᐅᐊᓕᓂᖕᒦᓲᑦ ᓱᖕᔾᓇᐊᑦ ᑐᓵᓲᑦ ᑲᓇᑕᐅᑉ ᐅᐊᓕᓂᖕᖓᒍᑦ ᑕᒫᓂᑐ ᓄᓕᐅᖅᑲᑦᑕᖕᒋᓐᓂᖕᒋᓐᓂᒃ ᐅᑉᐱᓇᔾᐅᔪᑦ. ᓄᓇᕗᒻᒥᖅᑲᑦᑕᖕᒋᑦᑐᑦ. 100% ᓄᓇᖅᔪᐊᑉ ᓱᖕᔾᓇᐊᖕᒋᑦ ᖅᑭᖅᑳᕐᑐᑉᐸᓱᖕᒦᓲᑦ *(rufa)* ᐊᒻᒪᑐ 18% ᖕᒋᑦ ᓄᓇᖅᔪᐊᑉ ᓱᖕᔾᓇᐊᖕᒋᑦ (*islandica*) ᖅᑯᕐᓯᑐᒦᓲᑦ ᖅᑲᐅᔨᒪᔾᐅᔪᑦ ᓄᓕᐅᓲᖖᒪᑕ ᑲᓇᑕᒥ. ᓱᖕᔾᓇᐊᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᑦ ᐆᒪᔪᐃᑦ ᐃᓄᐃᓵᓕᕐᑐᐊᖅᑯᓇᒋᑦ ᐱᖅᑯᔾᖏᓐᓄᑦ *(SARA)* ᐱᔾᔪᑎᒋᑦᑐᒍ ᐊᑯᓂᐅᓕᖅᑐᖅ ᐊᑉᐸᖅᐸᕐᓕᐊᓯᒪᓂᖕᒋᓐᓄᑦ ᖅᑲᑦᓯᐅᓂᖕᒋᑦ.

(rufa) ᖅᑭᖅᑳᕐᑐᑉᐸᓱᖕᒦᓲᑦ ᓱᖕᔾᓇᐊᑦ ᑎᑎᕋᖅᑕᐅᓚᐅᖅᓯᒪᔪᑦ ᐱᑕᖅᑲᕈᓐᓃᓕᖅᑐᒧᑦ ᐃᓕᔾᐅᕐᑐᑎᒃ ᐱᔾᔪᑎᒋᑦᑐᒍ 70%ᒥᒃ ᐊᑉᐸᓚᐅᖕᓂᖕᒋᓐᓄᑦ ᐊᒥᓲᓂᖕᒋᑦ ᑕᑯᓕᒋᑦ ᐅᑭᐅᑦ 15. ᑭᖑᓂᑦᑎᓐᓂ. ᑖᒃᑯᐊ ᓱᖕᔾᓇᐊᑦ ᓄᓕᐅᓲᑦ ᑭᓯᐊᓂ ᑲᓇᑕᐅᑉ ᐅᑭᐅᑦᑕᖅᑐᖓᓂ ᐊᒻᒪᑐ ᐅᑭᐅᖅᑎᑦᑐᒍ ᒥᐊᓕᖓᐃᑦ ᓄᓇᖓᑕ ᓂᒋᐊᓃᑦᑐᒧᑦ ᖅᑭᖅᑳᕐᑐᖕᒧᑦ. ᐊᐅᓵᓱᖑᑦᑐᑎᒃ. ᐊᑦᑕᖅᑯᓲᑕᐅᔪᑦ ᐱᔾᔪᑎᒋᑦᑐᒍ ᖅᑲᑦᓱᕐᓇᕈᖅᐸᑦᓕᐊᓂᖕᒋᓐᓄᑦ horseshoe ᐳᔾᔫᑏᑦ ᒪᓐᓂᖕᒋᑦ, ᓂᖅᑭᒋᑦᓚᓇᑦᑐᓂᒋᑦ ᑐᓵᒋᐊᖅᑐᓕᖅᑎᑦᑐᒋᑦ ᐅᑭᐅᑦᑕᖅᑐᒧᑦ.

(*roselaari*) ᐅᐊᓕᓂᖕᒦᓲᑦ ᓱᖕᔾᓇᐊᑦ ᑎᑎᕋᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᑦᑕᖅᑯᓲᑕᐅᓕᖅᑐᒧᑦ ᐱᔾᔪᑎᒋᑦᑐᒍ 47%ᒥᒃ ᐊᑉᐸᖅᑐᒥᓂᐅᓚᐅᖅᑎᑦᑐᒋᑦ ᐅᑭᐅᑦ 15 ᑕᑯᑐᒋᑦ. ᐊᑦᑕᖅᑯᓲᑕᐅᔪᑦ ᓇᔪᖓᖕᒋᑕ ᐊᑲᐅᖕᒋᓕᐅᖕᓂᖕᒋᓐᓄᑦ ᐊᒻᒪᑐ ᐅᑭᐅᖅᒥ ᓇᔪᖅᑲᑦᑕᖅᑕᖕᒋᑦ ᓱᕋᖅᑎᑕᐅᕝᑦᓕᐊᓂᖕᒋᓐᓄᑦ ᐊᒻᒪᑐ ᖅᑲᑦᓱᕐᓇᐅᓂᖅᓴᐅᓕᖕᓂᖕᒋᓐᓄᑦ horseshoe ᐳᔾᔫᑏᑦ ᒪᓐᓂᖕᒋᑦ ᐊᖅᑯᓵᖅᑕᖅᕙᖕᒋᑎᑰᖅᑎᑦᑐᒋᑦ . ᑖᓐᓇ ᓱᖕᔾᓇᐊᖅ ᐅᖅᑲᐅᓯᐅᒃᑲᓂᒃᓵᒍᓐᓃᖅᑐᖅ ᑖᒃᕚᓇ ᓇᓂᔭᐅᕙᖕᒋᒻᒪᑕ ᓄᓇᕗᒥ.

(*islandica*) ᖅᑯᕐᓯᑐᒦᓲᑦ ᓱᖕᔾᓇᐊᖕᒋᑦ ᐅᑭᐅᒃᑯᑦ ᔪᐊᕋᑉᒧᑦ ᐊᐅᓪᓵᓲᑦ. 15 ᐅᑭᐅᑦ ᑭᖑᓂᑦᑎᓐᓂ, ᓱᖕᔾᓇᐊᖖᖅᑲᑎᑏᑦ ᐊᑉᐸᓚᐅᖅᑐᑦ 17%ᒥᒃ. ᐊᑦᑕᖕᓇᕈᑕᐅᔪᓂᒃ ᖅᑲᐅᔨᔪᖅᑲᖅᓯᒪᖕᒋᑦᑐᖅ ᓱᖕᔾᓇᐊᓄᑦ ᑲᓇᑕᒦᑦᑐᓄᑦ. ᓇᔪᖓᖕᒋᑦ ᑲᓇᑕᒥ ᓄᓕᐅᖅᕕᒋᕙᒃᑕᖕᒋᑦ ᖅᑲᓄᐃᖕᒋᑦᑐᐃᑦ, ᑭᓯᐊᓂ ᓂᖅᑭᖕᒋᑦ ᐳᔾᔫᑎᕈᔪᐃᑦ ᐊᒃᑕᖕᓇᖅᑐᒦᑦᑐᑦ ᐅᑭᐅᒃᑯ ᓇᔪᖅᑲᑦᑕᖅᑕᖕᒋᓐᓂᒃ ᔪᐊᕋᑉᒥ ᓲᓕ ᐊᑦᑕᖕᓇᖅᑑᔪᖅ.

ᑎᑎᕋᕐᑕᐅᔪᑦ 1. ᑖᓐᓇ ᐊᔾᔨᖑᐊᖅ ᐱᓯᒪᔪᖅ ᐅᑎᖅᑎᒃᓯᓇᓱᐊᓐᓂᐅᑉ ᑎᑎᕐᑲᖏᓐᓂᒃ. ᑕᑯᔅᓴᐅᑎᒃᓯᔪᖅ ᓄᓇᖅᔪᐊᕐᒥᒃ ᑎᕐᒥᕕᒋᕐᑲᑦᑕᖅᑕᕐᒋᑦ (*rufa*) ᕿᕿᖅᑖᓗᑉᐸᓯᖕᒥᓲᑦ ᓯᒡᔭᕆᐊᑦ, (*roselaari*) ᐅᐊᓕᓂᖕᒥᓲᑦ ᓯᒡᔭᕆᐊᑦ ᐊᒻᒪᓗ (*islandica*) ᖁᑦᓯᑐᒥᓲᑦ ᓯᒡᔭᕆᐊᖏᑦ. ᓇᓗᓇᐃᔭᖅᓯᒪᕗᑦ ᓇᐅᑰᓲᖑᒻᒪᖕᒫᑕ ᓯᒡᔭᕆᐊᑦ

(rufa) ᕿᑭᖅᑖᓗᐸᐸᓯᖕᒥᓃᑦ ᓯᒡᔭᕆᐊᖏᑦ ᑕᖅᓴᓕᒃ ᑲᔪᖅᒥᒃ, (*roselaari*) ᐅᐊᓕᓂᖕᒦᓃᑦ ᓯᒡᔭᕆᐊᖏᑦ ,ᑕᖅᓴᓕᒃ ᐊᐅᐸᖅᑐᒥᒃ (*islandica*) ᖁᑦᓯᑐᒦᓃᑦ ᓯᒡᔭᕆᐊᖏᑦ ᑕᖅᓴᖓ ᐊᐅᐸᔺᖓᔪᖅ).

ᐅᑎᖅᔫᒥᑎᒃᓯᓇᓱᐊᖅᓅᑦ ᐊᒻᒪᓗ ᐊᐅᓚᑦᓯᓂᖅᒨᑦ ᐸᖕᓇᐅᑏᑦ:

ᓯᒡᔭᕆᐊᓂᒃ ᐅᑎᖅᔫᒥᑎᒃᓯᓇᓱᐊᖕᓂᖅ ᐊᒻᒪᓗ ᐊᐅᓚᑦᓯᓂᕐᒨᑦ ᐸᖕᓇᐅᑎ ᓱᓕ ᐱᔭᕇᖅᓯᒪᖏᒻᒪᑦ ᕿᒥᕈᔭᐅᒃᑲᓐᓂᖅᑕᑎᐊᖅᑲᖕᓂᑯᖏᓐᓄᑦ ᐱᔭᕇᖅᑕᐅᓚᐅᖏᓐᓂᖓᓂ. ᓇᐃᓈᖅᓯᒪᔪᖅ ᐅᓂᒃᑳᓕᐊᕆᓯᒪᔪᖅ ᖃᓄᐃᑦᑐᓂᒃ ᓂᕆᐅᒋᔭᒃᓴᖃᒐᔭᖕᓂᖏᓐᓂᒃ ᐱᔭᕇᖅᑕᐅᓚᐅᖏᓐᓂᖓᓂ ᐅᖃᐅᓯᐅᕗᖅ ᓇᐃᓈᕐᓯᒪᔪᒥᒃ:

<u>ᑎᖕᒥᐊᖑᖃᑎᒌᑦ ᐊᒻᒪᓗ ᓱᑯᑦᓯᐊᓅᖃᑦᑕᖕᓂᖏᑦ ᑎᑭᑕᐅᓇᓱᐊᖅᑐᑦ *(rufa)* ᕿᑭᖅᑖᓗᐸᐸᓯᖕᒥᓃᑦ ᓯᒡᔭᕆᐊᓄᑦ/ᐊᐅᓚᑦᓯᓂᕐᒨᑦ ᑎᑭᑕᐅᓇᓱᐊᖅᑐᑦ (*islandica*) ᖁᑦᓯᑐᒦᓃᑦ ᓯᒡᔭᕆᐊᖏᓄᑦ.</u>

ᓇᐃᓈᕐᑐᒥᒃ ᐱᓕᕆᐊᖑᒧᒪᔪᖅ *(rufa)* ᕿᑭᖅᑖᓗᐸᐸᓯᖕᒥᓃᑦ ᓯᒡᔭᕆᐊᖏᓐᓄᑦ ᐊᒻᒪᓗ (*islandica*) ᖁᑦᓯᑐᒥ ᓯᒡᔭᕆᐊᖏᓐᓄᑦ ᑲᓇᑕᒦᑦᑐᓄ ᓄᖅᑲᖓᑎᑕᐅᒧᒪᖓᓗᐊᖕᒪᑕ ᓄᓇᖅᔪᐊᓕᒫᒥ ᖃᑦᓯᐅᓂᖏᑦ ᐊᐸᐸᓪᓕᐊᓂᖔ ᑎᑭᓚᐅᖏᓐᓂᖓᓂ 2020 ᐊᕐᕌᒍᖓ. ᐊᑯᓂᐅᔪᒃᑯᑦ ᐱᓕᕆᐊᖑᒧᒪᔪᖅ ᐃᒪᐃᑦᑑᕗᖅ ᐃᓚᒋᐊᒃᑲᓐᓂᕐᑯᓪᓗᒋᑦ ᐊᒻᒪᓗ ᖃᓄᐃᖏᑦᑐᒥᒃ ᓯᒡᔭᕆᐊᖑᖃᑎᒋᓪᓗᑎᒃ ᑕᑯᔭᐅᖅᑲᑦᑕᓚᐅᕐᓯᒪᑎᓪᓗᒋᑦ ᐊᒦᓲᑎᓪᓗᒋᑦ ᑕᐃᑲᓂ 1986–1990.

<u>ᓯᕙᑐᔪᒃᑯᑦ ᐱᓕᕆᐊᖑᒧᒪᔪᑦ:</u>

ᑎᓴᒪᐅᓕᖅᑲᖓᔪᐃᑦ ᓯᕙᑐᔪᒃᑯᑦ ᐱᓕᕆᐊᖑᒧᒪᔪᑦ ᐃᓕᑕᕆᔭᐅᓯᒪᔪᑦ ᐱᔭᕇᖅᓯᒪᖏᑦᑐᒥᒃ ᐅᑎᖅᔫᒥᑎᒃᓯᓇᓱᐊᖕᓂᐅᕚᔭᖅᑐᓂᒃ ᖃᐅᔾᔭᐅᕐᑯᓪᓗᒋᑦ ᐊᑦᑕᖕᓇᕐᑐᐃᑦ ᐆᒪᕚᓱᐊᕐᑯᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐅᑎᖅᔫᒥᕐᑯᓪᓗᒋᑦ ᓯᒡᔭᕆᐊᑦ. ᑎᓴᒪᐃᑦ ᐅᑎᖅᔫᒥᑎᒃᓯᓇᓱᐊᖕᓂᐅᕚᔭᖅᑐᑦ ᓇᓗᓇᐃᕐᓯᒪᕗᑦ ᐊᑖᓂ ᖃᐅᔾᔭᐅᓯᒪᔪᐃᑦ ᓇᓗᓇᐃᖅᓯᒪᓪᓗᑎᒃ ᐊᑐᓂ:

- ᖃᐅᔨᓴᖅᐸᓪᓕᐊᔪᒥᒃ ᖃᐅᔨᓴᕐᓂᖅ ᐊᒻᒪᓗ ᖃᐅᔨᒪᓇᓱᖕᓂᖅ
    - ᓇᓗᓇᐃᕐᓗᒋᑦ ᐃᓘᓐᓇᑎᒃ ᐱᒻᒪᕆᐅᔪᑦ ᓄᓚᐅᕐᕕᒋᓲᖏᑦ ᑲᓇᑕᒥ
    - ᐋᕿᒋᓗᓂ ᐊᑐᕐᓗᒋᓪᓗ ᓄᐊᑦᓯᓂᐅᔫᓇᖅᑐᓂᒃ ᖃᓄᐃᓐᓂᖕᒋᓐᓂᒃ ᖃᐊᔨᒪᓇᓱᐊᖕᓂᐅᔪᓂᓪᓗ ᓯᒡᔭᕆᐊᓂᒃ
    - ᖃᐅᔨᓗᒋᑦ ᑭᓱᒧᑦ ᐊᐸᖃᑦᑕᖕᒪᖕᒫᑕ ᓯᒡᔭᕆᐊᖑᖃᑎᒌᑦ
- ᓇᔪᖓᖏᑦ ᓯᒡᔭᕆᐊᓪᓗ ᓴᐳᔾᔭᐅᓯᒪᓂᖏᑦ ᐊᐅᓚᑕᐅᓂᖏᓪᓗ
    - ᐊᓚᒃᑲᐃᓗᓂ ᐊᑯᓂᐅᔪᒃᑯᑦ ᐊᑐᕋᒃᓴᒥᒃ ᓴᐳᔾᔭᐅᓯᒪᓂᕆᓚᔭᖅᑕᖏᓐᓂᒃ ᓄᓕᐅᓲᑦ ᓇᔪᖓᖏᑕ
    - ᓴᐳᑎᓗᒋᑦ ᓇᔪᖓᖏᑦ ᑖᒃᑯᓄᖓ ᑎᖕᒥᐊᓄᑦ ᓄᓕᐅᖅᑐᓄᑦ ᓄᓕᐅᖏᑦᑐᓄᓪᓗ
    - ᐊᐅᓚᓂᖃᑦᓯᐊᕐᓗᓂ ᓇᔪᖓᕆᔭᖏᓐᓂᒃ ᓄᓕᐅᕐᑐᓄᑦ ᓄᓕᐅᖏᑦᑐᓄᓪᓗ ᓯᒡᔭᕆᐊᑦ ᐊᑐᕆᐊᓕᖏᓐᓂᒃ ᐊᑐᕐᑯᓪᓗᒋᑦ.
- ᐃᓕᓐᓂᐊᖅᑎᒃᓯᓂᖅ ᖃᐅᔨᒪᑎᒃᓯᓂᕐᓗ ᐊᕙᑎᒥᒃ ᒥᐊᓂᖅᓯᓂᖕᒥᒃ ᐱᓕᕆᖃᑎᖃᖕᖑᔪᐃᓪᓗ

- ᐱᕙᖅᑲᖅᑎᒃᓯᓗᓂ ᑲᓇᑕᒥᐅᓕᒫᓂᒃ ᓄᓇᖅᔪᐊᓕᒫᓄᑦ ᐃᑲᔪᖅᑎᒌᖕᓂᖕᒥᒃ ᐱᓕᕆᖅᑎᒌᖕᓂᒥᑦ ᖃᐅᔨᒪᔭᐅᔪᑦ ᐃᓕᓗᒋᑦ ᐊᓪᓚᑕᐅᓗᑎᒃ ᐊᒻᒪᓗ ᐊᐅᓚᑦᓯᓗᑎᒃ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓂᒃ
- ᐱᕙᖅᑲᖅᑎᒃᓯᓗᓂ ᐊᑭᓕᖅᓱᑕᐅᕐᒋᑦᑐᑎᒃ ᐃᓚᒋᔭᐅᓂᕐᒥᒃ ᓄᐊᑦᓯᑎᑦᑐᒋᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓴᖅᐸᑦᓕᐊᔭᒥᒃ ᖃᐅᔨᓴᖅᑎᑦᑐᒋᑦ
- ᐱᕙᖅᑲᖅᑎᒃᓯᓗᓂ ᒪᓕᑦᑕᐅᒐᓗᐊᕐᒪᖔᑕ ᒐᕙᒪᑐᖅᑳᒃᑯᑦ, ᐊᕕᑦᑐᖅᓯᒪᔪᐃᑦ ᓄᓇᓕᖅᔪᐊᑦ, ᐊᕕᑦᑐᖅᓯᒪᔪᐃᑦ ᓄᓇᐃᑦ ᐊᒻᒪᓗ ᓄᓇᓕᖕᒋᑕ ᒪᓕᒐᖕᒋᓐᓂᒃ ᐊᑐᐊᒐᖕᒋᓐᓂᓪᓗ

• ᐱᖁᔭᐃᑦ ᐊᑐᐊᒐᐃᓪᓗ
- ᐊᑐᐃᓐᓇᐅᑎᑕᐅᕐᒋᓐᓇᖅᐳᑎᒃ ᓴᕐᒌᖅᓯᒪᓗᑎᒃ ᐅᓪᓗᒥᒨᕐᒐᖅᓯᐊᖅᐳᑎᓪᓗ ᒪᓕᒐᐃᑦ ᐊᐅᓚᖅᑎᔾᔪᑏᑦ ᐃᓕᖕᒐᖅᓯᐊᖅᐳᑎᒃ ᓴᐳᔾᔭᐅᓯᒪᓂᖅᑯᑦ
- ᓴᖅᐰᓗᓂ ᐊᐅᓚᖅᓯᔾᔪᑎᒃᓯᐊᕙᐅᔪᓂᒃ ᑎᕐᒥᐊᓄᑦ, ᓂᖅᑭᑭᕙᒃᑕᕐᒋᓐᓄᓪᓗ ᓇᔪᒐᕐᒋᓐᓂᓪᓗ
- ᐊᑐᓕᖅᑎᒃᓯᓗᓂ ᐊᑐᐃᓐᓇᐅᖏᖅᑐᓂᒃ ᐊᑐᐊᒐᐅᔪᓂᒃ ᐊᒻᒪᓗ ᒥᑭᓪᓕᕚᓪᓕᑎᒃᓯᓇᓱᐊᕐᓂᐅᔪᓂᒃ ᑲᒪᔪᐃᑦ ᐊᒃᑐᐊᓗᐊᑦᑕᐃᓕᑎᒃᓯᓗᑎᓪᓘᓐᓃᑦ ᐊᒃᑕᓇᕐᓂᕐᒐᑕ ᓴᐳᓐᓇᖅᑐᐃᑦ ᐋᖅᑮᓗᓂᓗ ᓄᑖᓂᒃ ᐊᑐᐊᒐᕐᓂᒃ ᐱᓕᕆᐊᖑᔪᓂᓪᓗ ᑲᒪᒋᔭᖅᑲᒋᐊᖅᑲᕈᑎᒃ.

ᐱᒻᒪᕆᐅᔪᑦ ᓇᔪᒐᑦ:

ᐆᒪᔪᐃᑦ ᐃᓱᒫᓗᒋᔭᐅᓕᖅᑐᑦ ᐱᖁᔭᕐᒐᒍᑦ ᐱᒻᒪᕆᐅᔪᓂᒃ ᓇᔪᒐᕐᓂᒃ ᓇᓗᓇᐃᖅᑕᐅᔪᖅᑲᕆᐊᓕᒃ ᓴᐳᔾᔭᐅᓗᑎᓪᓗ ᑕᒪᓐᓇ ᐊᑐᖅᑐᖅ ᑭᓯᐊᓂ ᐆᒪᔪᖅ ᑎᑎᕋᖅᑕᐅᓯᒪᒍᓂ ᐱᑕᖅᑲᕐᓃᓕᖅᑐᒥᒃ ᐊᒻᒪᓗ ᐊᑦᑕᖅᑯᓲᑕᐅᓕᖅᑐᒥᒃ. ᐱᒻᒪᕆᐅᔪᑦ ᓇᔪᒐᐃᑦ ᐊᑐᐃᓐᓇᐅᕆᐊᖃᖅᑐᑦ ᐆᒪᖅᑯᑦᑐᒋᑦ ᐅᑎᖅᑰᒥᓂᐊᕈᑎᑦᑑᓐᓃᑦ *(rufa)* ᕿᑭᖅᑖᓗᑉᐸᓯᖕᒦᓰᑦ ᓯᓪᔭᓇᐊᑦ ᐃᓚᖕᒐᒍᑦ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᔪᑦ ᐱᔭᕇᖅᓯᒪᖕᒋᑦᑐᒥᒃ ᓱᓕ ᐅᑎᖅᑰᒥᒍᑎᒃᓴᐅᒐᔭᖅᑐᓂᒃ ᑎᑎᕋᖅᓯᒪᔪᖅᑯᑎᖕᒋᓐᓂᒃ ᐊᒻᒪᓗ ᐱᔭᕇᖅᓯᒪᔪᖅ ᐱᒻᒪᕆᐅᔪᑦ ᓇᔪᒐᐃᑦ ᓇᓗᓇᐃᖅᑕᐅᓂᐊᖅᑐᑦ ᐸᖓᐅᑎᒃᓴᐅᔪᓄᑦ.

ᐱᒻᒪᕆᐅᔪᑦ ᓇᔪᒐᒃᓴᐃᑦ ᐊᑑᑎᖃᖕᒋᑦᑐᐃᑦ ᐆᒪᔪᓐᓄᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᓄᑦ ᐃᓱᒫᓗᒋᔭᐅᓕᖅᓯᒪᔪᓄᑦ ᑕᐃᒪᐃᒻᒪᑦ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᖕᒋᑦᑐᑦ (*islandica*) ᖁᑦᓯᑐᒦᓰᑦ ᓯᓪᔭᓇᐊᕐᒋᑦ. ᑕᒃᑯᓂ ᐅᑎᖅᑰᒥᒍᑕᐅᔪᓐᓇᖅᑐᓄᑦ ᑎᑎᖅᑲᖕᒋᓐᓄᑦ. ᖃᐅᔨᓴᕈᑎᒃᓴᐅᔪᓂᒃ ᐋᖅᑮᓯᒪᓕᖅᑐᑦ ᐱᔪᓐᓇᖅᑯᓪᓗᒋᑦ ᖃᐅᔨᒪᔾᔪᑎᒃᓴᐅᒐᔭᖅᑐᓂᒃ ᖃᐅᔨᔭᐅᑦᓯᐊᖅᑯᓪᓗᒋᑦ ᐱᒻᒪᕆᐅᔪᑦ ᓇᔪᒐᒃᓴᑦ ᑎᑭᐅᒪᖅᑯᓪᓗᒋᑦ ᑎᕐᒥᐊᕐᔪᖅᑲᑎᖏᓐᓂᕐᒋᑦ ᐊᒻᒪᓗ ᓱᑯᑦᓯᐊᓅᖅᑲᑦᑕᕐᓂᕐᒋᑕ ᓇᓗᓇᐃᓗᒋᑦ ᑎᑭᑕᐅᓇᓱᑦᑐᑦ ᑳᒃᑯᓄᕐᒐ *(rufa)* ᕿᑭᖅᑖᓗᑉᐸᓯᖕᒦᓰᑦ ᓯᓪᔭᓇᐊᕐᒋᓄᑦ. ᑕᑦᓕᒪᐃᑦ ᐅᑭᐅᑦ ᑎᑎᖅᑲᑕᐅᓚᐅᖅᑎᑦᑐᒋᑦ ᑳᒃᑯᐊ ᐅᑎᖅᑰᒥᑎᒃᓯᓇᓱᐊᕐᓂᕐᒧᑦ ᑎᑎᖅᓯᒪᔪᑦ ᐆᒪᔪᐃᑦ ᖃᓄᐃᓕᕐᒐᑎᑕᐅᓕᕐᓂᕐᒋᓐᓄᑦ ᑐᑭᓯᒋᐊᖅᕙᕐᒥᒃ ᖃᓂᑕᐅᔭᒃᑯᑦ, ᐊᑕᐅᓯᕐᒥᒃ ᐊᒥᓲᓂᖅᓴᓂᑦᑑᓐᓃᑦ ᐸᖓᐅᑎᒃᓴᕐᒋᓐᓂᒃ ᐃᓕᓯᔪᖅᑳᓕᖅᑐᖅ ᑳᒃᑯᓄᕐᒐ *(rufa)* ᕿᑭᖅᑖᓗᑉᐸᓯᖕᒦᓰᑦ ᓯᓪᔭᓇᐊᕐᒋᓐᓄᑦ

ᐆᒪᔪᐃᑦ ᐃᓄᐃᓴᓪᓕᓗᐊᖁᓇᒋᑦ ᐱᖁᔭᖓᓂ, ᐱᑦᑕᐃᓕᒋᐊᖃᖏᓂᖏᒃ ᑎᑎᕋᖅᓯᒪᔪᖃᖏᑦᑐᖅ ᐆᒪᔫᖅᑕᐅᒋᐊᖃᖏᓐᓂᖏᓐᓂᒃ ᐅᒃᑯᓗ ᒪᓕᒋᐊᓕᖏᒃ ᓇᔪᒐᐃᑦ ᐱᓪᓗᒋᑦ ᐆᒪᔪᖕᓄᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᓄᑦ ᐃᓱᒪᓗᒋᔭᐅᓕᕐᓯᒪᔪᓄᑦ.

ᐊᑐᓇᐊᓕᑦᑕᖃᕐᑐᖅ ᐋᕿᐅᓗᓂ ᐊᐅᓚᕐᓯᓂᖑᑦ ᐸᖕᓇᐅᑎᒥᒃ ᐅᑭᐅᑦ ᐱᖓᓱᑦ ᑎᑎᕋᖅᑕᐅᓚᐅᕐᑎᓪᓗᒋᑦ ᐆᒪᔪᐃᑦ. ᐊᐅᓚᕐᓯᓂᖑᑦ ᐸᖕᓇᐅᑎ ᑖᑦᓱᒧᖓ (*islandica*) ᖁᑦᓯᑐᒦᓱᑦ ᓱᕙᓇᐊᖏᓐᓄᑦ. ᑲᑎᑕᐅᑐᐃᓐᓇᖅᑐᑦ ᐅᑎᖅᑮᒥᑎᒃᓯᒐᓱᐊᖑᓂᖑᑦ (*rufa*) ᕿᑭᖅᑖᓗᐸᐸᓱᖕᒥᓱᑦ ᓱᕙᓇᐊᖏᓐᓄᑦ ᐊᒻᒪᓗ (*roselaari*) ᐅᐊᓕᓂᖕᒦᓱᑦ ᓱᕙᓇᐊᓄᑦ.

ᐊᑐᓇᐊᖅ ᓯᕗᓪᓕᑦ:

ᐱᔭᕇᖅᓯᒪᖏᑦᑐᖅ ᓱᕙᓇᐊᓗᑦ ᐅᑎᖅᑮᒥᑎᒃᓯᓇᓱᐊᖑᓂᐅᔪᖅ ᐊᒻᒪᓗ ᐊᐅᓚᕐᓯᓂᖑᑦ ᐸᖕᓇᐅᑎ ᓄᓇᓕᖕᓄᑦ ᐊᕕᑦᑐᖅᓯᒪᔪᓄᑦ ᐊᐅᓪᓚᖅᑎᑕᐅᕖᕐᑐᑦ ᐊᒻᒪᓗ ᐆᒪᔪᓕᓇᕐᖅᔪᐊᒃᑯᑦ ᑲᑎᒻᒪᕐᖏᓐᓄᑦ ᕿᒥᕐᕈᔭᐅᓗᓂ ᔫᓂᐅᑉ ᐱᒋᐊᖕᓂᖓᓂᒃ.

ᐊᕙᑎᓕᓇᕐᖅᔪᐊᒃᑯᑦ ᑲᓇᑕᒥ ᐊᐅᓪᓚᑎᒃᓯᒐᔭᖅᑐᑦ ᑲᑎᕐᓱᖅᓯᒪᔪᓂᒃ ᐅᓂᒃᑳᓕᐊᓇᓯᒪᔪᓂᒃ (ᑎᑎᕐᑲᓂᐊᕐᕕᑎᒍᑦ ᖃᓇᑕᐅᔭᒃᑯᓪᓗ) ᐊᑐᓕᖁᔭᐅᔪᒥᒃ ᐅᑎᖅᑮᒥᑎᒃᓯᒐᓱᐊᖑᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐊᐅᓚᕐᓯᓂᕐᒧᑦ ᐸᖕᓇᐅᑎᒃᓴᒥᒃ ᓱᕙᓇᐊᓗᑦ ᐊᐅᔭᐅᑉ ᓄᖑᐊᓂ. ᑲᑎᕐᓱᖅᓯᒪᔪᐃᑦ ᐅᓂᒃᑳᑦ ᐊᐅᓪᓚᕐᑎᑕᐅᒐᔭᖅᑐᑦ ᓄᓇᕗᑦ ᓄᓇᓕᖏᓐᓄᑦ 15ᓄᑦ (*rufa*) ᕿᑭᖅᑖᓗᐸᐸᓱᖕᒥᓱᑦ ᓱᕙᓇᐊᖏᓐᓄᑦ ᐊᒻᒪᓗ ᑎᓴᒪᓄᑦ ᓄᓇᓕᓐᓄᑦ (*islandica*) ᖁᑦᓯᑐᒦᓱᑦ ᓱᕙᓇᐊᖏᓐᓄᑦ. ᐅᖃᐅᓯᐅᓯᒪᕗᖅ ᑎᑎᕋᖅᓯᒪᔪᒥᒃ 1–ᒥᒃ ᐊᑖᓃᑦᑐᒥᒃ. ᑲᑎᕐᓱᖅᑕᐅᓯᒪᔪᑦ ᐊᑐᐃᓐᓇᐅᑎᑕᐅᔪᑦ ᓇᓗᓇᐃᖅᓯᓯᒪᔪᑦ ᖃᐅᔨᒪᔭᐅᔪᓂᒃ ᐊᑐᓕᖁᔭᐅᔪᒥᒃ ᐅᑎᕐᑮᒥᑎᒃᓯᒐᓱᐊᖑᓂᐅᔪᓂᒃ ᐊᒻᒪᓗ ᓄᓇᓕᓐᓂᒃ ᐱᕕᖃᖅᑎᒃᓯᓪᓗᑎᒃ ᑐᓂᓯᒍᒪᒍᕐᓯ ᖃᐅᔨᒪᔭᒃᓯᓐᓂᒃ ᐊᐱᖁᑎᒃᓴᖅᑭᕐᓯᔫᓐᓃᑦ ᐊᒻᒪᓗ ᑲᑎᖃᑎᕌᑦᑐᓴᐅᒻᒪᖔᑕ ᑲᑎᒻᒪᑐᑎᒃ ᐱᔭᐅᒋᐊᖃᕐᓴᔭᖕᒪᑕ. ᖃᐅᔨᒪᔾᔪᑎᒃᓴᐃᑦ ᑲᑎᕐᓱᖅᓯᒪᔪᑦ ᐃᓚᖃᖅᑐᑦ ᐅᑯᓂᖓ:

- ᐃᓄᑦᑎᑑᖓᔪᑦ ᖃᓪᓗᓈᑎᑐᓪᓗ ᑎᑎᖃᖅ ᐊᖑᓇᓱᑦᑐᓕᓇᕐᒃᑯᓐᓄᑦ
- ᐃᓄᑦᑎᑑᖓᔪᑦ ᖃᓪᓗᓈᑎᑐᓪᓗ ᓇᐃᓈᖅᓯᒪᔪᖅ ᐅᑎᖅᑮᒥᑎᒃᓯᒐᓱᐊᖑᓂᐅᔪᑦ
- ᖃᓪᓗᓈᑎᑑᖓᔪᖅ ᐱᔭᕇᖅᓯᒪᔪᖅ ᐊᑐᓕᖁᔭᐅᓯᒪᔪᖅ ᐅᑎᖅᑮᒥᑎᒃᓯᓂᖑᖠᖓᔪᖅ
- ᐃᓄᑦᑎᑑᖓᔪᖅ ᖃᓪᓗᓈᑎᑐᓪᓗ ᑕᑯᓐᓇᕋᒃᓴᖅ ᐅᓂᒃᑳᓕᐊᓇᓯᒪᔪᖅ ᓇᐃᓈᖅᓯᒪᔪᒥᒃ ᐅᓂᒃᑳᖅ ᐅᑎᖅᑮᒥᖁᓪᓗᒋ ᐊᑐᓕᖁᔭᐅᓯᒪᔪᑦ.
- ᖃᓪᓗᓈᑎᑑᖓᔪᖅ ᐃᓄᑦᑎᑐᓪᓗ ᐊᐱᖁᑏᑦ ᑭᐅᒐᒃᓴᖅ ᐸᐃᑉᐹᖅ ᐊᖑᓇᓱᑦᑐᓕᓇᕐᒃᑯᑦ ᐃᑲᔪᖅᑐᐃᒻᒪᖔᑕ ᐃᑲᔪᖅᑐᐃᖏᒻᒪᖔᑕᓗᐊᓐᓂᑦ ᓇᓪᓕᐊᒍᑐᐃᓐᓈᖁᔨᔪᓪᓗᐊᓐᓂᑦ ᐊᑐᓕᖁᔭᐅᔪᒥᒃ ᓱᕙᓇᐊᑦ ᐅᑎᖅᑮᒥᒍᑎᒃᓴᓇᒐᔭᖅᑕᖏᓐᓂᒃ ᐊᒻᒪᓗ ᐊᐅᓚᕐᓯᓂᖑᑦ ᐸᖕᓇᐅᑎᒃᓴᖓᑦ

ᖃᐅᔨᒋᐊᖕᓂᑦ ᐱᔭᕇᖅᐸᑕ, ᑎᑎᕋᖅᓯᒪᔪᖅ ᓄᑖᖑᖅᑎᑕᐅᒋᐊᖕᓂᐊᖅᑐᖅ ᐃᓕᔭᐅᓗᓂᓗ ᓄᓇᖅᔪᐊᓕᒫᖕᒥ ᐆᒪᔪᐃᑦ ᖃᓄᐃᓕᖓᑎᑕᐅᓂᖏᓐᓄᑦ ᑐᑭᓯᒋᐊᕐᕕᐅᔪᒧᑦ ᖃᓇᑕᐅᔭᒥ ᐅᓪᓗᓄ 60ᓄᑦ ᐅᖃᐅᓯᖅᖅᕕᐅᔪᓐᓇᖁᓪᓗᒍ ᐊᒻᒪᓗ ᕿᓐᒍᓪᓕᖅᐹᒥ ᐱᕕᖃᒍᓐᓇᓂᐊᕐᑐᑦ ᐅᖃᐅᓯᒃᓴᖃᕐᕕᒋᓗᒍ ᑎᑎᕋᕐᓯᒪᔪᖅ. ᐱᔭᕇᕈᑎᒃ ᑖᒃᑯᐊ ᐅᓪᓗᐃᑦ, ᐱᔭᕇᖅᑕᐅᕐᓯᐊᒐᔭᕐᑐᖅ ᑎᑎᕋᕐᓯᒪᓂᖓ. ᑕᐃᑲᓂ ᑐᓂᓯᓂᐊᕐᑐᒍᑦ ᐱᔭᕇᕐᓯᒪᓕᕐᑎᓪᓗᒍ ᑎᑎᕋᑦᑕᐅᓯᒪᓂᖓ ᖃᐅᔨᒋᐊᖓᓂᐅᓚᐅᕐᑐᐃᓪᓗ ᑐᓂᔭᐅᓗᑎᒃ ᓄᓇᕗᒥ

ᐆᒪᔪᓕᕆᔨᕐᔪᐊᒃᑯᖏᑕ ᑲᑎᒪᔨᖏᓐᓄᑦ ᑎᓴᒪᖓᓐᓂ ᑲᑎᒪᓕᖅᒥᑉᐸᑕ ᐊᐱᕆᓂᐊᕐᓗᑎᒍᓪᓗ ᐃᓱᒪᓕᐅᓕᕐᑯᓪᓗᒋᑦ ᐊᖏᖅᑕᐅᓗᓂ ᑎᑎᕋᕐᓯᒪᔪᖅ.

ᑎᑎᕋᖅᑕᐅᔪᑦ 1. ᓄᓇᓕᐅᔪᑦ ᖃᐅᔨᒪᔭᐅᔪᑦ ᐱᑕᖃᓲᖑᓂᖏᓐᓂᒃ ᓯᒡᔭᕆᐊᓂᒃ ᖃᐅᔨᒋᐊᖅᑕᐅᖖᕐᑐᑦ ᓯᒡᔭᕆᐊᑦ ᐅᑎᖅᑫᒥᑎᒃᓯᓇᓯᐊᖕᓂᐅᔪᓂᒃ ᐊᒻᒪᓗ ᐊᐅᓚᖕᓯᓂᖕᒍᑦ ᐸᖕᓇᐅᑎᒥᒃ. ᓇᓗᓇᐃᖅᓯᒪᔪᑦ ᐃᒪᐃᑦᑐᒥᒃ ‘X’ ᓇᓪᓚᐊᓂᒃ ᓯᒡᔭᕆᐊᖅᑲᖕᓂᖏᓐᓂᒃ ᓄᓇᓖᑦ ᖃᐅᔨᒋᐊᕿᐅᓂᐊᕐᑐᑦ.

ᓄᓇᓕᒃ	*(rufa)* ᖏᑭᖅᑖᓗᑉᐸᓯᖕᒦᓲᑦ ᓯᒡᔭᕆᐊᑦ	(*islandica*) ᖁᑦᓯᑐᒦᓲᑦ ᓯᒡᔭᕆᐊᑦ
ᐃᑉᐱᐊᖅᔪᒃ		X
ᐃᖃᓗᑦᑑᑦᑎᐊᖅ	X	
ᑭᓐᖓᐃᑦ	X	
ᑲᖏᖅᑐᒑᐱᒃ	X	
ᓴᓪᓁᑦ	X	
ᐅᖅᓱᖅᑑᖅ	X	
ᐊᐅᓱᐃᑦᑐᖅ		X
ᓴᓂᕿᔭᖅ	X	
ᐃᒡᓗᓕᒃ	X	
ᐃᖃᓗᐃᑦ	X	
ᑭᒻᒥᕈᑦ	X	
ᑰᒑᖅᔫᒃ	X	
ᐸᓐᓂᖅᑑᖅ	X	
ᒥᑦᑎᒪᑕᓕᒃ	X	X
ᖏᑭᖅᑕᖅᔪᐊᖅ	X	
ᓇᐅᔾᔫᑦ	X	
ᖃᐅᓱᐃᑦᑐᖅ		X
ᑕᓗᖅᔪᐊᖅ	X	

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ᑲᓇᑕᒥ ᐆᒪᔪᓕᕆᔨᖅᔪᐊᒃᑯᑦ, ᐃᖃᓗᐃᑦ, ᓄᓇᕗᑦ
ᐅᖄᓚᐅᑖ: 867-975-4638
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Draft

Species at Risk Act
Recovery Strategy Series

Recovery Strategy and Management Plan for the Red Knot (*Calidris canutus*) in Canada

Recovery Strategy
Calidris canutus rufa
Calidris canutus roselaari

Management Plan
Calidris canutus islandica

Red Knot

2016

Canada

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For copies of the recovery strategy and management plan, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the SAR Public Registry[1].

Cover illustration: Red Knot by © Jan van de Kam

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[1] www.registrelep.gc.ca/default_e.cfm

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Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and management plans for species of special concern. They are also required to report on progress five years after the publication of the final document on the SAR public registry.

The Minister of the Environment and the Minister responsible for the Parks Canada Agency are the competent ministers under SARA for Red Knot and have prepared this document, as per sections 37 and 65 of SARA. To the extent possible, it has been prepared in cooperation with the Provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador as well as the territories of Yukon, Nunavut and Northwest Territories and others as per sections 39(1) and 66(1) of SARA.

Success in the recovery and/or conservation of Red Knot depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this document and will not be achieved by Environment Canada and the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this document for the benefit of Red Knot and Canadian society as a whole.

This document will be followed by one or more action plans for the *rufa* and *roselaari* subspecies of Red Knot that will provide information on recovery measures to be taken by Environment Canada and the Parks Canada Agency and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this document is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions, wildlife management boards, and organizations.

Acknowledgments

Executive Summary

Red Knot is a chunky medium-sized shorebird with a straight bill that tapers to a thin tip, small head, long legs, and long tapered wings. In breeding plumage, knots are highly distinctive, with face, neck, breast and much of the underparts coloured a rufous chestnut red. Three subspecies of Red Knot are known to occur in Canada: *rufa* breeds solely in Canada, *islandica* breeds in Canada and Greenland, and *roselaari* breed in Alaska and Russia and occur in Canada, in small numbers, during migration. *Rufa* is listed as Endangered, *roselaari* as Threatened, and *islandica* as a species of Special Concern on Schedule 1 of the federal *Species at Risk Act* (SARA) because of long-term declines. New information has arisen for *roselaari* since its assessment by the Committee on the Status of Wildlife in Canada (COSEWIC) in 2007 which suggests that the subspecies does not breed in Canada (*roselaari* thought to be breeding in Canada were shown to be *rufa*) and only a few minor stopover sites have been identified in Canada). 100% of the global population of *rufa,* estimated to be 42,000 individuals, is known to breed in Canada, less than one percent of the global population of *roselaari,* estimated to be 17,000 individuals, is estimated to frequent Canada during migration, and approximately 18% of the global population of *islandica*, estimated to be 450,000 individuals, is known to breed in Canada.

Red Knots nest on the ground on dry and slightly elevated tundra within 500 m of a freshwater wetland or other water body (e.g., lake, stream, river, or pond) generally at elevations less than 150m above sea level. During migration and winter, Red Knots require habitat (generally coastal marine and estuarine habitats for foraging and roosting) relatively free of human disturbance: the species uses sandy beaches, sandspits, sandbanks, tidal mudflats, restinga/inter-tidal rocky flats, and salt marshes at stopover sites (Niles et al. 2007). Stopover sites must provide access to abundant, easily-digested, food. During spring migration in Delaware Bay (Delaware and New Jersey, United States), *rufa* requires spawning Horseshoe Crabs. Crab eggs provide a vital food source. Red Knots winter along sandy beaches but also use rocky shorelines, restinga/inter-tidal rocky flats, peat banks, salt marshes, rice fields, brackish lagoons, and tidal mudflats.

The threats to the species are found within the following categories: residential & commercial development, agriculture & aquaculture, energy production & mining, biological resource use, human intrusions & disturbance, natural system modifications (i.e., dams and water management, shoreline stabilization), invasive & other problematic species & genes, pollution, and climate change & severe weather.

The recovery of the Red Knot in Canada is considered feasible for *rufa*. There are several unknown factors associated with the feasibility of recovering *roselaari* which are addressed in this document. Despite these unknowns, and in keeping with the precautionary principle, this document has been prepared as per section 41(1) of SARA. Recovery feasibility does not apply to species of Special Concern and is therefore not established for *islandica* in this document.

The short-term objective for *rufa* and *islandica* in Canada is to halt the national decline before 2020. The long-term population objective for *rufa* thereafter is to increase and then maintain the population at or above 1986-1990 levels (100,000-150,000 individuals). The long-term population objective for *islandica* is to maintain the population at current levels (2016). Given new information for *roselaari* since its COSEWIC assessment, the objective is to conserve *roselaari* and any Canadian stopover sites identified with greater than, or equal to, one percent of the population which would enable its persistence as a migrant in Canada.

Broad strategies to be taken to address the threats to the survival and recovery of Red Knot are presented in section 6.2: Strategic Direction for Recovery.

Under SARA, critical habitat identification and protection only applies to Endangered and Threatened species. Critical Habitat necessary for the survival or recovery of *rufa* and *roselaari* is partially identified in section 7.1. Critical habitat does not apply to species of Special Concern and is therefore not identified for *islandica* in this document. A schedule of studies has been developed to provide the information necessary to completely identify the critical habitat sufficient to meet the population and distribution objectives.

One or more action plans for *rufa* and *roselaari* will be posted on the Species at Risk Public Registry within the five years following the posting of this document.

Recovery Feasibility Summary

Based on the following four criteria that Environment Canada uses to establish recovery feasibility, the recovery of *C.c. rufa* is considered technically and biologically feasible. This document has been prepared as per section 41(1) of SARA.

Based on the following four criteria outlined by the Government of Canada (2009), there are several unknown factors associated with the feasibility of recovering *C.c. roselaari*. In keeping with the precautionary principle, this document has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible. This document addresses the unknowns surrounding the feasibility of recovery.

Recovery feasibility does not apply to species of Special Concern and is therefore not established for *C.c. islandica* in this document.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

C.c. rufa

Yes. *Rufa* is found throughout much of its breeding range and breeding individuals are currently distributed throughout the Canadian range. The population in 2012 was estimated to be approximately 42,000 individuals (Andres *et al.* 2012). It is believed that there are currently adequate numbers of individuals available to sustain the subspecies in Canada or improve its abundance.

C.c. roselaari

Yes. The population in 2012 was estimated to be approximately 17,000 individuals (Carmona *et al.* 2013, Andres *et al.* 2012) which breed in northwest and northern Alaska, USA, and Wrangel Island, Russia (Andres *et al.* 2012; Buchanan *et al.* 2010, 2011, Carmona *et al.* 2013). Given new information detailed in Andres *et al.* (2012) and Carmona *et al.* (2013), *roselaari* is not suspected to breed in Canada and small numbers (less than one percent of the population) are known to use stopover habitat in British Columbia (Carmona *et al.* 2013) during northward migration.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

C.c. rufa

Yes. Sufficient suitable breeding habitat (e.g., nesting and roosting substrate) is available and sufficient suitable stopover and winter habitat could be available through habitat management and/or restoration.

C.c. roselaari
Yes. Suitable breeding habitat is thought to be available in northwest and northern Alaska, USA, and Wrangel Island, Russia. Breeding does not occur in Canada and the subspecies does not use stopover habitat in Canada in appreciable numbers (i.e., sites used contain less than one percent of the population) (Carmona *et al.* 2013) and so is insufficient to sustain even a minimum population in Canada. The subspecies primarily bypasses British Columbia during migration (US Fish and Wildlife Service 2011).

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

C.c. rufa
Unknown. The primary threat to the subspecies lies with the management of the Horseshoe Crab (*Limulus Polyphemus*) fishery along the Atlantic seaboard of the United States. Overharvesting of crabs has deprived migrating knots of an essential food resource required for birds to recover from long flights and to prepare for further migration to the Arctic. Limited harvesting of crabs should allow their recovery which may concurrently support the recovery of Red Knot numbers.

Disturbance at, and degradation of, non-breeding habitats outside Canadian borders are presumably mitigatable threats, especially given the international conservation interest and projects/initiatives already underway. Climate change and resulting habitat changes may be immitigable.

C.c. roselaari
Unknown. Disturbance at, and degradation of, non-breeding habitats outside Canadian borders such as San Francisco Bay and Grays Harbor, Washington are probable threats to *roselaari* (COSEWIC 2007). These, presumably, can be mitigated.

Red Knots and other shorebirds are still threatened by legal and illegal human hunting in the Caribbean and parts of South America. It is unclear if Red Knot populations ever recovered from intense hunting pressure which significantly reduced populations in the 1800s (Cohen *et al*. 2008, Harrington 2001, Karpanty *et al*. 2014). Efforts to regulate and/or ban hunting are underway in some areas (e.g., Barbados, Guadeloupe, French Guiana) and expectations in U.S. Fish and Wildlife Service threat assessment (2014) are that the threat of hunting for this subspecies will continue to decrease.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

C.c. rufa
Unknown. Achieving sustainable Horseshoe Crab fisheries management and ensuring critical stopover sites are managed to support shorebirds will ensure ongoing recovery. It is unclear whether potential threats outside Canadian borders could be avoided, should they be verified by research.

C.c. roselaari

Unknown. The small Canadian population occurs only during migration and the vast majority of its distribution and population occurs on its breeding grounds (northwest and northern Alaska, Wrangel Island in Russia) and its wintering grounds (northwestern Mexico). It is unclear whether potential threats outside Canadian borders could be avoided, should they be verified by research.

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1. COSEWIC* Species Assessment Information

Date of Assessment:	April 2007		
Common Name (population):	Red Knot *rufa* subspecies	Red Knot *roselaari* type[1]	Red Knot *islandica* subspecies
Scientific Name:	*Calidris canutus rufa*	*Calidris canutus roselaari* type	*Calidris canutus islandica*
COSEWIC Status:	Endangered	Threatened	Special Concern
Canadian Occurence:	NT, NU, BC, AB, SK, MB, ON, QC, NB, PE, NS, NL	YT, NT, BC	NT, NU
COSEWIC Staus History:	Designated in April 2007		

Reason for Designation (*rufa* subspecies): This subspecies is a medium-sized shorebird that breeds only in Arctic Canada and migrates thousands of kilometres between its Arctic breeding grounds and wintering areas at the tip of South America. The subspecies has shown a 70% decline in abundance over the past three generations (15 years). It is threatened by a depletion of horseshoe crab eggs, a critical food source used during northern migration. There is no potential for rescue from other populations.

Reason for Designation (*roselaari* type)[1]: This designatable unit includes the subspecies *roselaari* and two other populations that winter in Florida and northern Brazil and that seem to share characteristics of *roselaari*. The subspecies *roselaari* migrates through BC and breeds in Alaska. The migration routes and breeding areas of the other two populations are unknown. This group has declined by 47% overall during the last three generations (15 years). Ongoing threats include habitat loss and degradation on wintering sites and, for the Florida/SE US and Maranhão groups, depleted levels of horseshoe crab eggs, a critical food source needed during northward migration. Rescue from other populations is not anticipated.

Reason for Designation (*islandica* subspecies): This subspecies is a medium-sized Arctic breeding shorebird that migrates to wintering grounds in Europe. Forty percent of the breeding population of this subspecies occurs in Canada. This subspecies has declined by 17% over the last three generations (15 years). There are no identified threats to individuals in Canada. Habitat on the Canadian breeding grounds is likely stable, but shellfish harvesting on the wintering grounds in Europe presents an ongoing threat.

*COSEWIC (Committee on the Status of Endangered Wildlife in Canada)
[1]see section 2 for a summary of information that has arisen for this subspecies since the COSEWIC assessment.

2. Species Status Information

New information on the distribution and population size of *Calidris canutus roselaari* (hereafter *roselaari*) has arisen since the assessment of Red Knot (*Calidris canutus*) by COSEWIC in 2007. Banding and geolocator results along with previous stable isotope work (Atkinson *et al.* 2005) indicate that non-breeding Red Knots, once thought to be *roselaari* along the west coast of Florida, southeastern United States, and northern Brazil, are likely *Calidris canutus rufa (*hereafter *rufa)* (Andres *et al.* 2012, Niles *et al.* 2008) and that nearly all, if not all, non-breeding Red Knots in the northwest Gulf of Mexico are also *rufa* (U.S. Fish and Wildlife Service 2014). This recent information indicates that *roselaari* is principally confined to the Pacific coast of North and South America. The subspecies does not breed in the western Canadian Arctic as previously believed (those birds were determined to be *rufa*) and the subspecies is considered accidental in Yukon (Environment Yukon 2014). The U.S. Fish and Wildlife Service 90-day finding (2011) on *roselaari* states that the subspecies predominantly bypasses British Columbia during migration. Given this new information, less than one percent of the global population of *roselaari* is now thought to frequent Canada (i.e., migrate through British Columbia).

Throughout this document, the terms ‘winter’, ‘winters’, and ‘wintering’ are used to refer to the non-breeding period (as early as September and as late as May but generally December to February) when the birds are not in the process of migrating (as per U.S. Fish and Wildlife Service 2014).

Ontario, Nova Scotia, and Newfoundland and Labrador have listed *rufa* under their endangered species acts and the subspecies is a candidate for listing in the province of Quebec. *Calidris canutus islandica* (hereafter *islandica*) and *roselaari* are not listed under provincial or territorial endangered species legislation.

In the United States, *rufa* was listed as Threatened under the *U.S. Endangered Species Act* in 2014. At the state level, the subspecies is listed as Threatened in New Jersey and as a species of Special Concern in Georgia (Niles *et al.* 2005). In 2005, *rufa* was added to Appendix 1 of the Convention on Migratory Species (CMS or Bonn Convention, CMS 2005) containing migratory species threatened with extinction. Red Knot was listed as Critically Endangered on the Brazilian Ministry of the Environment red list in 2014. The International Union for the Conservation of Nature (IUCN) indicates Red Knot as a species of Least Concern however it does not report on the potentially different status of the six subspecies (BirdLife International 2012). Table 1 provides conservation status ranks for Red Knot.

Table 1. Conservation status ranks for *rufa, roselaari, and islandica* (NatureServe 2015).

Subspecies	Global (G) Rank	National (N) Rank	Sub-national (S) Rank[1]
rufa	G4T2 (species: Apparently Secure, subspecies: Imperiled)	Canada: N1B, N3N4N, N3M United States: N1B	Northwest Territories (S1B) Nunavut (SNRB) British Columbia (SNR) Alberta (SU) Saskatchewan (S2M) Manitoba (SNA) Ontario (S1N) Quebec (S1M) New Brunswick (S3M) Prince Edward Island (S2N) Nova Scotia (S2S3M) Newfoundland (S3N), and Labrador (S3N)
roselaari	G4TNR (species: Apparently Secure, subspecies: Unranked)	Canada: NNR	Yukon (SNA) Northwest Territories (SNR) British Columbia (SNR)
Islandica	G4TNR (species: Apparently Secure, subspecies: Unranked)	Canada: N3B	Northwest Territories (S2B) Nunavut (SNRB)

[1]Sub-national (S) Rank: S1: Critically Imperiled; S2: Imperiled; S3: Vulnerable; S4: Apparently Secure; S5: Secure; U: Unrankable; NR: Unranked; NA: Not Applicable; B: Breeding; N: Non-breeding; and M: Migrant

3. Species Information

3.1 Species Description

Red Knot is a medium-sized shorebird with a typical sandpiper profile: long bill and smallish head, long tapered wings giving the body an elongated streamlined profile, and longish legs. In breeding plumage, knots are highly distinctive, with face, neck, breast and much of the underparts coloured a rufous chestnut red. Feathers on the upper parts are dark brown or black with rufous and grey, giving the back a spangled appearance. In winter plumage, knots are much plainer, with white underparts and pale grey back. Six subspecies are currently recognized worldwide, all of which form distinct biogeographical populations differing in distribution and scheduling of the annual cycle. Subspecies breeding in Canada include *rufa* and *islandica*. In Canada, r*oselaari* only occurs in small numbers during migration.

3.2 Population and Distribution

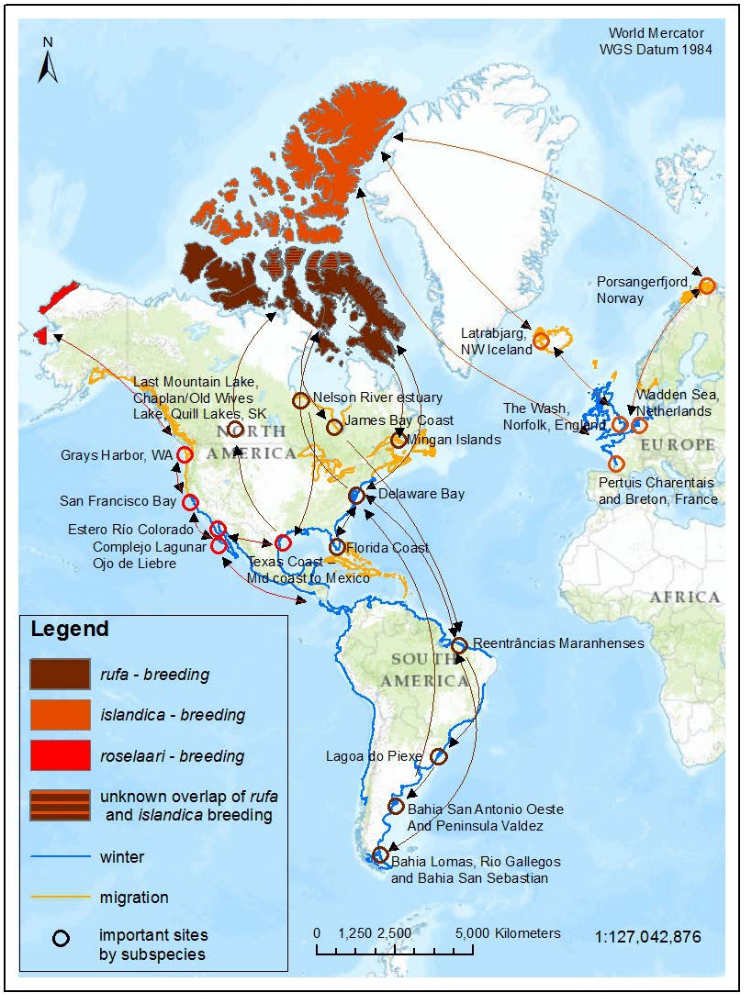

Figure 1: Global breeding (red shaded areas), migration (yellow shaded areas) and winter/non-breeding (blue shaded areas) ranges, flyways (arrows), and major non-breeding sites (open circles) for *rufa*, *roselaari*, and *islandica* (map adapted from graphic by Riccardo Pravettoni, UNEP/GRID-Arendal 2011).

rufa

The *rufa* population in 2012 was estimated to be 42,000 individuals based on comprehensive surveys of the Atlantic Coast in spring and work in the northwest Gulf of Mexico (Andres *et al.* 2012). Analyses of best available data from wintering and stopover sites suggest a steady decline of *rufa* during the 2000s (U.S. Fish and Wildlife Service 2014) followed by potential stability (at much lower levels than in the 1980s and 1990s) of the population from 2009 to 2014 (Andres *et al.* 2012, Dey *et al*. 2011, U.S. Fish and Wildlife Service 2014).

The breeding range of *rufa* falls entirely within the central parts of the Canadian Arctic (i.e., 100% of the global population breeds in Canada). Within this area, suitable habitat is not continuous across *rufa*'s range and it appears that not all suitable potential habitat is occupied. In Nunavut, r*ufa* breeds on Coats and Mansel islands in northern Hudson Bay, on Southampton Island, on the east coast (Godfrey 1986) as well as the islands of the Foxe Basin (e.g., Prince Charles Island, Rowley Island, and the west coast of Baffin Island (Niles *et al.* 2005, RIGM pers. observation), probably through the west side of the Boothia Peninsula area, on King William Island (Niles *et al*. 2005), and on the southern parts of Victoria Island (Parmelee *et al.* 1967). Suitable habitat does not appear to occur on land between northern Hudson Bay and the Rasmussen Basin (Niles *et al.* 2005), and the subspecies was not recorded in this area (Godfrey 1986, 1992) or in the Rasmussen Lowlands (Johnston *et al.* 2000). Although there appears to be suitable habitat on Banks Island, NWT at the western edge of the Arctic Islands, knots have not been recorded breeding in this area (Manning *et al.* 1956, V. Johnston pers. comm. 2005).

During northward migration, large flights of knots have been observed passing through southern James Bay at the end of May or start of June (RIGM unpubl. data), having probably flown directly from Delaware Bay (Delaware and New Jersey, United States) (Morrison and Harrington 1992). Data from *rufa* tagged with geolocators in Texas suggested a stopover site near the Nelson River on the west coast of Hudson Bay in northern Manitoba, Canada. Follow up surveys confirmed large concentrations of Red Knot (one-day ground count maximum of 1,900 individuals) about 25 km east of the Hayes River, Manitoba and birds were also confirmed in the area North and East of the mouth of the Nelson River (A. McKeller, unpubl. data). In addition, birds radio-tagged in Delaware Bay were detected during these surveys (A. McKeller, unpubl. data). Large concentrations are occasionally found around Lake Ontario, though these probably represent weather-related dropouts from the main migration (McRae 1982, Morrison and Harrington 1992, Weir 1989). The sighting of a bird colour-banded at Lagoa do Peixe in southern Brazil at Presqu'ile Provincial Park, Ontario, indicates the birds include migrants from the southern *rufa* population. Numerous flagged Red Knots (from Chile, Argentina, Brazil and Delaware Bay) were observed together on the same day on Lake St. Pierre (near Yamachiche, Quebec) in 2007 (Y. Aubry pers. comm. 2015).

During southward migration, large numbers of knots pass through the southwest coast of Hudson Bay (Manitoba and Ontario) and west and southern coasts of James Bay (Ontario) during July and August (Hope and Short 1944, Manning 1952, Ross *et al.* 2003). The southeast corner of Akimiski Island, Nunavut, also appears to be important for knots. In addition, knots have been recorded along Rupert Bay (Southern James Bay) and Boatswain Bay (Northeastern end of Rupert Bay in Quebec) (Benoit 2004). Sightings in the Mingan Islands archipelago National Park Reserve from 2006-2014 of numerous color-marked birds captured in Chile, Argentina and Brazil confirm the identity of birds as belonging to the *rufa* population wintering in southern South America (Y. Aubry pers. comm. 2015). Ouellet (1969) identified four knots collected from a flock of 200 on Anticosti Island as belonging to the *rufa* subspecies.

Important areas for *rufa* on migration outside Canada include: Bahia Lomas, Río Gallegos, Bahia San Sebastian, Península Valdés, and San Antonio Oeste (Patagonia, Argentina); Lagoa do Peixe (southeastern Brazil, State of Rio Grande do Sul); Maranhão (northern Brazil); Suriname and French Guyana, the Southeast United States (e.g., from Florida to North Carolina, United States); the Virginia barrier islands through to Massachusetts (United States); and Delaware Bay (Cohen *et al.* 2009, González 2005, Niles *et al.* 2008, U.S. Fish and Wildlife Service 2014).

The major wintering areas used by *rufa* are now thought to include the central Gulf coast of Florida, southeastern United States (i.e., Georgia and South Carolina), the northwest Gulf of Mexico (from the State of Tamaulipas in Mexico through Laguna Madre in Texas to Louisiana), the north coast of Brazil (i.e., in the State of Maranhão), the Atlantic coasts of Argentina and Chile (principally Tierra del Fuego which spans both countries) (Andres *et al.* 2012, Niles *et al.* 2008, U.S. Fish and Wildlife 2014). Red Knots also winter in the Caribbean in unknown numbers but evidence from geolocator-tagged birds suggests the Caribbean may be an important wintering location (U.S. Fish and Wildlife Service 2014).

roselaari

The *roselaari* population in 2012 was estimated to be approximately 17,000 individuals (95% range = 14,000-20,000) based on banding and mark recapture results (Andres *et al.* 2012, Carmona *et al.* 2013).

Clear links between *roselaari* wintering in northwestern Mexico, stopover sites in Washington, USA, and breeding grounds in northwest and northern Alaska and on Wrangel Island, Russia have been made (Andres *et al.* 2012, Buchanan *et al.* 2010, 2011, Carmona *et al.* 2013, U.S. Fish and Wildlife Service 2011). Small numbers of *roselaari* are also recorded from California and the northwest Gulf of Mexico (Andres *et al.* 2012). Geolocator and band resighting data to date suggest that nearly all, if not all, Red Knots wintering in the northwest Gulf of Mexico are *rufa* (U.S. Fish and Wildlife Service 2014). Given this new information, the global population of *roselaari* frequenting Canada (along the Pacific coast of British Columbia) is thought to be less than one percent of the population.

islandica

The *islandica* population in Canada was estimated at 80,000 (Andres *et al.* 2012, Morrison *et al.* 2006, 2007) representing approximately 18% of the global population (450,000 *islandica* individuals in 2009) (*Delany et al. 2009*, Wetlands International 2015).

The subspecies winters on the European seaboard in the United Kingdom and the Netherlands and breeds in the northeastern Canadian High Arctic, likely as far west as Prince Patrick, NWT Island and south to Prince of Wales Island, NU, and along the north coast of Greenland (COSEWIC 2007, Godfrey 1992, Manning and Macpherson 1961). Research is required to understand if there is overlap between the breeding ranges of *rufa* and *islandica* (Morrison and Harrington 1992). Northward migration for *islandica* is through Iceland and northern Norway.

3.3 Needs of Red Knot

Breeding

Red Knots require dry, slightly elevated, tundra for nesting that is free from snow cover. Nests are simple scrapes in the ground, often in small patches of vegetation and are typically spaced 0.75-1km apart (COSEWIC 2007). Males remove vegetation at the nest site and create scrapes in the ground which are then lined with lichens and dead leaves. Nests are generally located at elevations less than150 m above sea level within 50 m of the coast (New Jersey ENSP and Rutgers University landscape modelling exercise in Niles *et al.* 2007). Nests are isolated on the landscape, often 0.75-1km apart (COSEWIC 2007). After hatch, Red Knots require access to freshwater habitats with available terrestrial invertebrates for food including insects (e.g., mosquito larvae) and other arthropods (e.g., spiders) (Harrington 2001, Niles *et al*. 2008, U.S. Fish and Wildlife Service 2014). Broods may wander over a vast area (several kilometres).

Stopover habitat

Red Knots require quality[2] habitat (generally coastal marine and estuarine habitats but also inland saline lakes) for foraging and roosting at a small number of important sites. The species requires these non-breeding areas to be relatively free of human disturbance: in Canada and the United States, the species uses sandy beaches, sandspits, sandbanks, sandy/muddy tidal mudflats, restinga/inter-tidal rocky flats, rice fields, and salt marshes at stopover sites (Niles *et al.* 2007). During spring migration in Delaware Bay, *rufa* requires spawning Horseshoe Crabs which prefer beaches dominated by coarse sandy sediments (Niles *et al.* 2007). Red Knots must meet their energy demands during a short window of time and this requires the availability of stopover sites with abundant easily-digested food (i.e., with thin or no shells e.g., juvenile clams and mussels, horseshoe crab eggs, and marine worms) (Cohen *et al.* 2011; Niles *et al.* 2008; Piersma *et al*. 1999; van Gils *et al.* 2005a, 2005b).

Wintering habitat

Coastal marine and estuarine habitats used by Red Knots are similar to habitats used during migration (i.e., stopover habitat). Red Knots winter along sandy beaches but also use peat banks, salt marshes, brackish lagoons, tidal mudflats, and restinga/inter-tidal rocky flats. Red Knots require access to food (primarily mussel spat and clams) and for foraging and roosting habitats to be relatively free of human disturbance.

Immature pre-breeding habitat

It is thought that all immature Red Knots remain in non-breeding areas during their second summer of life at southern latitudes in habitat possibly similar to the stopover and post-breeding habitats (U.S. Fish and Wildlife 2014). Some second year *rufa* individuals have been captured in Argentina, which suggest that some immatures may follow adults toward more southerly post-breeding stopover sites before completing their first pre-breeding flight along with those adults (Y. Aubry pers. comm. 2015). Substantial numbers of non-breeding birds (suspected to be *roselaari*) have been recorded in June through August in the north-east of the Gulf of California, Mexico (Soto-Montoya *et al*. 2009).

Limiting factors

As with many ground-nesting Arctic birds, Red Knots are limited by generally low productivity which can be virtually zero in some years (COSEWIC 2007, Meltofte *et al*. 2007, Niles *et al.* 2008). Productivity is limited by weather (i.e., late snowmelt can lead to a reduction in invertebrate prey and poor weather can impact a chick's thermoregulatory ability leading to high mortality) and predator abundance (generally associated with asymmetrical lemming (*Dicrostonyx torquatus and Lemmus sibericus*) cycles occurring in 3-4 year intervals) (Fraser *et al*., 2013). Access to key stopover sites during spring migration may be a limiting factor for Red Knots. Red Knots require adequate food resources to sustain their long flights, undergo adaptive physiological changes, and to buffer against periods of food shortages on Arctic breeding grounds

[2] Quality roosting habitats are adjacent to foraging areas, with shelter from predators, and with sufficient space during high tides; and quality foraging habitats provide adequate and species-appropriate, easily-digested, food)

(Clark *et al*. 1993, Niles *et al.* 2008, Tsipoura and Burger 1999). Shifts in habitat use, feeding rates, and migration strategies can be influenced by the presence of raptors (Niles *et al*. 2008, Pomeroy *et al*. 2006).

4. Threats

4.1 Threat Assessment

Table 2. Threats Calculator Assessment

This threats classification is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system and was modified in 2011 based on experience in using it for COSEWIC and recovery teams. This threat calculator introduces international standards for identifying and assessing threats developed by the IUCN Species Survival Commission, the Conservation Measures Partnership (CMP – Salafsky et al. 2008) and The Nature Conservancy. These standards are used by COSEWIC, the CWS Migratory Bird Conservation and Management Program, the Province of British Columbia, and NatureServe. These international standards are in the process of being adopted for use in recovery planning under SARA in anticipation of improved data sharing and coordination among species at risk both within the federal government and across federal, provincial, and territorial governments where the latter also adopt the system.

Threat		Sub- species	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development					
1.1	Housing & urban areas	*rufa*	Low	Restricted	Slight	High
		roselaari	Low	Restricted	Slight	High
		islandica	Low	Restricted	Slight	High
1.2	Commercial & industrial areas	*rufa*	Low	Restricted-Small	Slight	High
		roselaari	Low	Restricted	Slight	High
		islandica	Low	Restricted	Slight	Moderate
1.3	Tourism & recreation areas	*rufa*	Unknown	Unknown	Unknown	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
2	Agriculture & aquaculture					
2.1	Annual & perennial non-timber crops	*rufa*	Unknown	Unknown	Unknown	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
2.3	Livestock Farming & Ranching	*rufa*	Unknown	Unknown	Unknown	High

Threat		Sub- species	Impact[a]	Scope[b]	Severity[c]	Timing[d]
		roselaari	-	-	-	-
		islandica	-	-	-	-
2.4	Marine & freshwater aquaculture	*rufa*	Unknown	Restricted	Unknown	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
3	Energy production & mining					
3.1	Oil & gas drilling	*rufa*	-	-	-	-
		roselaari	Low	Large	Slight	High
		islandica	-	-	-	-
3.2	Mining & quarrying	*rufa*	Low	Small	Slight	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
3.3	Renewable energy	rufa	Low	Small	Slight	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
4	Transportation & service corridors					
4.3	Shipping lanes	*rufa*	Negligible	Negligible	Slight	Moderate
		roselaari	-	-	-	-
		islandica	Negligible	Negligible	Negligible	Low
5	Biological resource use					
5.1	Hunting & collecting terrestrial animals	*rufa*	Unknown	Restricted	Unknown	Unknown
		roselaari	-	-	-	-
		islandica	Low	Small	Slight	High
5.4	Fishing & harvesting aquatic resources	*rufa*	Medium	Pervasive	Moderate	High
		roselaari	-	-	-	-
		islandica	Low	Small	Slight	Moderate
6	Human intrusions & disturbance					
6.1	Recreational activities	*rufa*	Low	Pervasive	Slight	High

Threat		Sub- species	Impact[a]	Scope[b]	Severity[c]	Timing[d]
		roselaari	Low	Large	Slight	High
		islandica	-	-	-	-
6.3	Work & other activities	*rufa*	Negligible	Pervasive	Negligible	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
7	Natural system modifications					
7.2	Dams & water management/use	*rufa*	Unknown	Restricted	Unknown	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
7.3	Other ecosystem modifications	*rufa*	Unknown	Large	Unknown	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
8	Invasive & other problematic species & genes					
8.1	Invasive non-native/alien species	*rufa*	Low	Small	Slight	High
		roselaari	Low	Large	Slight	High
		islandica	-	-	-	-
8.2	Problematic native species/diseases	*rufa*	Low	Pervasive	Slight	High
		roselaari	Unknown	Pervasive	Unknown	High
		islandica	-	-	-	-
9	Pollution					
9.1	Household sewage & urban waste water	*rufa*	Unknown	Unknown	Unknown	High
		roselaari	Low	Large	Slight	Moderate
		islandica	-	-	-	-
9.2	Industrial & military effluents	*rufa*	High-Medium	Large	Serious-Moderate	Moderate
		roselaari	-	-	-	-
		islandica	Negligible	Restricted	Negligible	Moderate
9.3	Agricultural & forestry effluents	*rufa*	Negligible	Small	Negligible	High
		roselaari	Low	Large	Slight	Moderate

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Threat		Sub- species	Impact[a]	Scope[b]	Severity[c]	Timing[d]
		islandica	-	-	-	-
9.4	Garbage & solid waste	*rufa*	Unknown	Unknown	Slight	High
		roselaari	-	-	-	-
		islandica	-	-	-	-
11	Climate change & severe weather					
11.1	Habitat shifting & alteration	*rufa*	Not Calculated[e]	Pervasive	Unknown	Low
		roselaari	Not Calculated[e]	Large	Unknown	Low
		islandica	Not Calculated[e]	Pervasive	Unknown	Low
11.4	Storms & flooding	*rufa*	Unknown	Pervasive	Unknown	Moderate
		roselaari	Unknown	Large	Unknown	Moderate
		islandica	-	-	-	-

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

[e] = outside assessment timeframe

4.2 Description of Threats

Threats with low to high impact are listed as above in the threat calculator assessment table and are described in more detail below.

1. Residential & commercial development

1.1 Housing & urban areas & 1.2 Commercial & industrial areas [*rufa*, *roselaari,* and *islandica*]: The human population continues to grow and this, coupled with our desire to live in coastal environments, creates conflict as humans develop in, or adjacent to, habitats preferred by shorebird habitats. Along the Atlantic coast of the United States, approximately one-third of the ocean coast remains available for development The ownership of some locations affords habitat protection through ownership (i.e., Federal, State, private land conservation organization, or under permanent conservation easement) (U.S. Fish and Wildlife Service 2014). In South America, urban, commercial, and industrial development may pose a risk for *rufa* along the northeast coast of Brazil and in Argentina (e.g., Río Gallegos and parts of Argentinean Tierra del Fuego) (U.S. Fish and Wildlife Service 2014, WHSRN 2015). Reclamation of tidal flats and salt marshes for urban, commercial, and industrial development is a concern for shorebirds as the city of Río Gallegos, Argentina, grows towards the coast (Ferrari *et al.* 2002). Nearly 10% of the *islandica* population winters along the French coastline where suitable roosting habitat may be limited because of pressure from urban, commercial, and industrial development (Bocher *et al.* 2012).

1.3 Tourism and recreation areas [*rufa*]: Tourist facilities and access points continue to be constructed along the beach at the stopover site of San Antonio Bay, Argentina. This unplanned expansion is resulting in degradation of shorebird habitat (WHSRN 2015). Recreation areas likely pose a localized threat to Red Knot within its migration and wintering ranges but the extent and impact of this threat is unknown.

2. Agriculture & perennial non-timber crops

2.1 Annual & perennial non-timber crops [rufa]: Stopover sites in Brazil may be negatively impacted by adjacent farming practices that alter hydrology and increase siltation of important lagoon habitats (Niles *et al*. 2008, U.S. Fish and Wildlife Service 2014). Neighboring upland coastal habitats near Lagoa de Peixe in Brazil, and Río Gallegos in Argentina are showing signs of degradation from food farming (e.g., onions, rice, corn) (U.S. Fish and Wildlife Service 2014, WHSRN 2015).

2.3 Livestock farming & ranching [*rufa*]: In South America, cattle ranching occurs on lands adjacent to reserves at Río Gallegos, Argentina (Niles *et al*. 2008) and extensive cattle grazing is impacting coastal habitats near Lagoa do Peixe on the east coast of Brazil (WHSRN 2015). Grazing by sheep in the intertidal zone is occurring at Bahía Lomas in Chilean Tierra del Fuego which potentially degrades both foraging and roosting habitat and also displaces the birds (U.S. Fish and Wildlife Service 2014).

2.4 Marine & freshwater aquaculture [*rufa*]: In Canada, clam farming (i.e., young clams collected through sand filtering are transplanted to nearby 'nursery' sandflats) is impacting the quality of habitat for foraging *rufa* in Quebec (Y. Aubry pers. comm. 2015). Shrimp farming and resultant habitat loss and degradation, has likely impacted Red Knot in northeastern Brazil over the past 20-25 years (Carlos *et al.* 2010). Seaweed farming and aquaculture are potentially degrading the quality of Red Knot habitat on Argentina and on Chiloé Island, Chile (U.S. Fish and Wildlife Service 2014).

3. Energy production & mining

3.1 Oil & gas drilling [*roselaari*]: Development, including infrastructure, associated with the oil and gas industry could have significant impacts on habitat in northern Alaska (Alaska Shorebird Group 2008). An increase in oil production is projected for Alaska for 2015-2017 and new discoveries are expected onshore in the Arctic (Resource Development Council 2015).

3.2 Mining & quarrying [*rufa*]: Increased mining activities (e.g., for diamonds, iron ore, coal, aggregate extraction) and associated infrastructure in Arctic breeding grounds may pose a threat to nesting Red Knot. A surge in the price of gold has led to an increase in small-scale gold mining in South America. Mining may directly damage river beds and banks, cause siltation downstream, and releases mercury in to the environment which may reach the coast via rivers (Alvarez-Berríos and Aide 2015).

3.3 Renewable energy [*rufa*]: Wind development is proposed within the U.S. migration range of Red Knot and onshore wind farms are already established. Growth in the wind energy industry is projected to occur in an effort to cut carbon pollution (Executive Office of the President 2013). Since 2009, wind power has rapidly increased as a source of power generation in Brazil (Brazil Wind Power 2015) and the interest, specifically in offshore wind, is growing (RECHARGE 2015). Wind farms are operating adjacent to the coast in northern Brazil (R.I.G Morrison pers. comm. 2015) and the impact of these and future wind developments on Red Knot are unknown. Certainly, environmental impacts of a coastal wind farm in the nearby northeastern state of Ceará (adjacent to Xavier Community) were serious (e.g., removal of large quantities of sand which was replaced by quarry sand and clay, effects on sediment transport, burial of interdunal lakes, compaction of soil and sand) (De Andrade Meireles *et al*. 2013). The impact of this coastal wind farm on wildlife is not clear.

5. Biological resource use

5.1 Hunting & collecting terrestrial animals [*rufa* and *islandica*]: Human hunting of shorebirds, including knots, may occur in some areas, including Caribbean islands, and north-central Brazil (Harrington 2001), though this practice is thought to have decreased greatly in the latter area over the past decade (Serrano pers. comm. in Niles *et al.* 2005) and Red Knot was recently added to the no-hunt list for the Guadeloupe (2012) and Martinique (2013) (Sorenson and Douglas 2013). Subsistence and sport hunting (both legal and illegal) is still common in the Guianas and in the Caribbean, along the northern coast of South America, and potentially other areas as well. Southern wintering birds that might frequent these locations during migration and/or during weather events are potentially at risk and an assessment of this threat is needed. As of 2012, *islandica* were still hunted in France (Bocher *et al.* 2012) but the government was considering removing the Red Knot from the list of hunted species (Sorenson and Douglas 2013).

5.4 Fishing & harvesting aquatic resources [*rufa* and *islandica]*: The principal known causal factor in the *rufa* decline was the commercial harvest of Horseshoe Crabs at their final northward stopover in Delaware Bay. Several studies have confirmed Horseshoe Crab eggs as the primary component of the diet of knots and other shorebirds during northward migration in Delaware Bay (Botton *et al.* 1994; Castro and Myers 1993; Clark *et al.* 2009; Haramis *et al.* 2002, 2007; Harrington 1996, 2001; Morrison and Harrington 1992; Tsipoura and Burger 1999). This once superabundant food supply was decimated as a result of over-fishing of horseshoe crabs (Morrison *et al.* 2004) and a correlation between *rufa*'s decline and Horseshoe Crab harvest was evident (U.S. Fish and Wildlife Service 2014). As the number of breeding crabs decreased, egg densities in the upper five centimeters of sand on beaches in New Jersey decreased and studies by Hernandez (2005) and Stillman *et al.* (2003) showed that egg densities were too low for efficient foraging by knots to meet energetic requirements during their stopover. Birds were unable to attain adequate departure masses before the flight to Arctic breeding grounds, at least in some years (Baker *et al.* 2004). Horseshoe Crab harvest is now adaptively managed in Delaware Bay and the restricted harvest has resulted in apparent population stability for the crab (Atlantic States Marine Fisheries Commission 2015). The commercial harvest itself is no longer considered a threat to *rufa* (U.S. Fish and Wildlife Service 2014). At fall stopover sites in Cacouna, Quebec, seaweed harvesting is occurring with uncertain implications for *rufa* stopover habitat (Y. Auby pers. comm. 2015). In France, some *islandica* may be impacted by professional clam or cockle harvesters at estuarine bays during winter (Bocher *et al*. 2012).

6. Human intrusions & disturbance

6.1 Recreational activities [*rufa* and *roselaari*]: Numerous studies have shown that repeated disturbance can negatively affect shorebirds, disrupting behaviour patterns and affecting energy balances (e.g., Davidson and Rothwell 1993, West *et al.* 2002). Although disturbance was initially a significant problem for shorebirds in Delaware Bay during spring migration (Burger *et al.* 1995, Sitters 2001), closure of major sections of the New Jersey shore since 2003 to human use during peak migration has successfully reduced disturbance (Burger *et al.* 2004, Niles *et al.* 2005). In other parts of the range, disturbance can be a significant factor causing shorebirds to abandon prime foraging or roosting habitats (U.S. Fish and Wildlife Service 2014). Disturbance of roosting and foraging flocks by humans and dogs has been reported from Florida, Georgia, North Carolina, South Carolina, Virginia, and Massachusetts (Niles *et al.* 2005). On the wintering grounds in Tierra del Fuego, roosting flocks at Rio Grande are frequently disturbed by walkers, runners, fishers, dogs, all-terrain vehicles, and motor cycles (Niles *et al.* 2005, RIGM pers. obs.). In

Argentina, similar types of disturbance to knots on migration have been reported from Rio Gallegos, Peninsula Valdes, San Antonio Oeste, and Bahia Samborombon (Niles *et al.* 2005). Little is known about the threat of human disturbance to *roselaari*. Stopover sites are near urban areas where human disturbance from recreational users is presumed to occur (G. Donaldson pers. comm.).

7. Natural system modifications

7.2 Dams & water management/use [r*ufa*]:

Many important wetlands used by migrating shorebirds are under water management scenarios in the Canadian prairies (C.L. Gratto-Trevor pers. comm.) and such management can have a negative effect on food supplies and suitable roosting habitat for migrating shorebirds. Water management (i.e., drawdown or reflooding within a wetland complex) in some locations can benefit shorebirds if the timing and duration of management is appropriate (Skagen 2013). Unregulated and unlicensed drainage of wetlands has been identified as a current threat to shorebird habitat at Quill Lakes, SK (WHSRN 2015) and infilling is also documented as a threat to ephemeral and temporary inland wetlands important for shorebirds (Skagen 2013).

7.3 Other ecosystem modifications [*rufa*]: Much of the already developed coastline of the U.S. within *rufa* range has undergone some form of shoreline stabilization (i.e., hard structures such as groins, seawalls, and breakwaters; soft structures such as geotubes, coir matting, sand bags, and beach nourishment which is the addition of sand to an eroding shoreline to widen an existing beach) (U.S. Fish and Wildlife Service 2014). Shoreline stabilization may also be a threat to *roselaari* throughout its range (U.S. Fish and Wildlife Service 2011). Loss of beach and intertidal habitats required by Red Knot are accelerated when shoreline stabilization projects are implemented that block natural shoreline landward migration, alter beach morphology, sediment quality, and water dynamics (e.g., Najjar *et al*. 2000). Shoreline stabilization with hard structures (Botton *et al*. 1988, Jackson et al. 2010, Myers 1986) and severe storms (Lathrop *et al.* 2013) are also known to degrade habitat required for spawning Horseshoe Crabs. It is expected that, as coastal areas become more developed and as sea level continues to rise, there will be a reactive increase in attempts to stabilize the shore with potentially negative impacts on migrating and wintering shorebirds. Beach nourishment must be repeated to maintain beaches and can lead to disturbance of shorebirds if work is completed while birds are present. Nourishment can cause temporary and/or permanent alteration of shorebird's invertebrate prey base (Peterson *et al.* 2014, Schlacher *et al*. 2012, U.S. Fish and Wildlife Service 2014), especially if added sediments are too different from natural sediments. Recovery of invertebrates post-nourishment is affected by many factors and there is still uncertainty around the effects of nourishment on the invertebrate community and, in turn, on Red Knots (U.S. Fish and Wildlife Service 2014). Beach nourishment may be important for enhancing, restoring and creating suitable habitat for spawning Horseshoe Crabs at degraded sites. Such restoration efforts are underway in key areas of Delaware Bay to maintain habitat for both Horseshoe Crabs and the shorebirds that depend on their eggs to fuel northward migration (Niles *et al*. 2013a, 2013b; Siok and Wilson 2011; U.S. Fish and Wildlife Service 2014).

8. Invasive & other problematic species & genes

8.1 Invasive non-native/alien species [*rufa* and *roselaari*]: In non-breeding habitats, Red Knots prefer sparse vegetation and require open habitats, free from tall perches, to avoid predation. Invasive plants that are woody or that form dense bunches or mats may alter vegetative communities and negatively impact shorebird habitat (Niles *et al.* 2008, USFWS 2014).

8.2 Problematic native species/diseases [*rufa* and *roselaari*]: Shorebirds have enjoyed what Butler *et al.* (2003) termed something of a “predator vacuum” over the past 30 years, arising from greatly depleted raptor populations caused by persecution and pesticide poisoning. Whether increasing predation from raptors has affected knots specifically is unclear, but raptor predation can be, in general, an important source of mortality for shorebirds at key sites (Piersma *et al*. 1993). Direct mortality risk at non-breeding sites is thought to be low but predation risk may negatively affect knots indirectly by causing disturbance, reducing foraging bouts, restricting access to prime foraging locations, and modifying migration behavior (e.g., Niles *et al*. 2008, Pomeroy *et al*. 2006, Stillman et al. 2005). A large direct mortality event suspected to be linked with toxic algal blooms (inconsistently coined ‘red tides’) was documented for *rufa* in Uruguay. Clams and other preferred prey may accumulate algal toxins if exposed (U.S. Fish and Wildlife Service 2014); toxins have been documented in prey within the Red Knot non-breeding range (Bricelj *et al*. 2012) but links to mortality have not been substantiated. Toxic algal blooms may therefore contribute to Red Knot mortality in warm non-breeding areas.

9. Pollution

9.1 Household sewage & urban waste water [*rufa* and *roselaari*]: Until recently (i.e., after 2012), untreated sewage was discharged in Red Knot habitat in Río Gallegos (U.S. Fish and Wildlife Service 2014, WHSRN 2015). The short- and long-term impacts of previously dumped sewage are unknown. Due to *roselaari*’s proximity to urban areas during migration and winter, it is suspected that they are exposed to areas which may be impacted by sewage and waste water (G. Donaldson pers. comm. 2015).

9.2 Industrial & military effluents [*rufa*]: In North America, important estuarine areas such as Delaware Bay and the Gulf of St. Lawrence are at risk from pollution and shipping incidents. The Mingan Islands, in the St. Lawrence, are particularly at risk because large ships carrying titanium and iron navigate through the archipelago to the Havre-St-Pierre harbour throughout the year (Y. Aubry pers. comm. 2007). Developments in California (e.g., San Francisco Bay) and Mexico and along the migration route of the Pacific coast population of *roselaari* could potentially affect wintering and migrating birds. Oil and natural gas exploration has intensified along the northeastern and northern coasts of Brazil (Paschoa 2014), and oil exploration is ongoing in Suriname and Guiana (Morrison *et al.* 2012). Extensive oil developments, with onshore and offshore wells, occur near major wintering areas of *rufa* in both the Chilean and Argentinean sectors of Tierra del Fuego, and represent a considerable potential for disaster (R.I.G. Morrison and R.K. Ross unpub. data). Two oil spills from shipping have been recorded near the Strait of Magellan First Narrows (Niles *et al.* 2005) and small amounts of oil have been noted on knots captured during banding operations in Bahia Lomas (A. Dey and L.J. Niles unpubl. data). Petroleum exploration and iron ore and gold mining, which can result in oil and mercury pollution and habitat loss, are important threats on the north-central coast of Brazil and could affect the Maranhão/Brazil population (Niles *et al.* 2005). The important migration stopover area at San Antonio Oeste, Argentina, also faces potential pollution from a soda ash factory (which could release up to 250,000 tons or more of calcium chloride per year, affecting intertidal invertebrate food supplies) and from port activities (e.g., pollution from shipping).

<u>9.3 Agricultural & forestry effluents [*rufa* and *roselaari*]:</u> Red Knot may be exposed to toxic agricultural effluent associated with the management of rice fields in Trinidad, Uruguay, Argentina, and French Guiana (Blanco *et al*. 2006, Niles 2012b, USFWS 2014) while foraging in these habitats, or nearby. Red Knot overwintering at the mouth of the Colorado River may be particularly negatively affected by agricultural effluent from the US and Mexico (G. Donaldson pers. comm. 2015).

<u>9.4 Garbage & solid waste [*rufa*]:</u> A garbage dump associated with the growing city of Río Gallegos, Argentina, is located adjacent to important *rufa* foraging and roosting locations (Ferrari *et al.* 2002). Strong winds deposit garbage over large parts of the estuary and diminishes the quality of the habitat for Red Knot (Ferrari *et al.* 2002). Unmanaged solid waste disposal in the city of Río Grande, Argentina, threatens wintering *rufa* habitat at Costa Atlantica (Rare 2010).

11. Climate change & severe weather

<u>11.1 Habitat Shifting & alteration [*rufa, roselaari,* and *islandica*]:</u> The Arctic has warmed more than any other region over the past 30 years (NSID 2015) and is therefore most likely to be affected by climate change (ACIA 2004). Meltofte *et al.* (2007) provided a detailed review of potential effects of climate change in the Arctic on shorebirds; major concerns include: changes in habitat, especially long-term reductions in High Arctic habitats, and uncoupling of phenology of food resources and breeding events (i.e., the availability of food resources does not coincide with migration timing). As the High Arctic zone is expected to shift northwards, Red Knots, as High Arctic breeders, are likely to be among the species most affected. This would be particularly the case for populations breeding towards the southern part of the High Arctic zone, such as *rufa* breeding in the central Canadian Arctic.

Disruptions in predator-rodent cycles, attributed to Climate Change, are occurring that may lead to prolonged periods of increased predation on breeding Red Knots (Fraser *et al*. 2013, Meltofte *et al.* 2007, Niles *et al.* 2008).

Potential losses of intertidal habitats owing to sea level rise were projected to range between 20% and 70% during the next century at five major sites in the USA, including Delaware Bay (60%; Galbraith *et al.* 2002). Habitat loss is projected in Tierra del Fuego due to sea level rise (U.S. Fish and Wildlife Service 2014) and other key sites will likely be affected as well. While detailed effects are difficult to predict (IPCC 2001, U.S. CCSP 2009, U.S. Fish and Wildlife Service 2014), significant changes to shorelines are expected over the next 100 years which casts serious doubt on the ability of sites to continue supporting current numbers of shorebirds, indicating increased future stress on knot populations.

11.4 Storms & flooding [*rufa, roselaari,* and *islandica*]: There has been a significant increase in the number and strength of hurricanes globally (1970–2004), including those occurring in the North Atlantic region (Webster *et al.* 2005) during times and in areas used by knots (RIGM unpubl. data). Whether knots have actually been affected (directly through mortality or indirectly through reduced invertebrates at foraging locations) is not known, but the increasing severity of weather events certainly represents an increased risk, which is likely to increase with predictions of climate change and increasing ocean temperatures.

5. Population and Distribution Objectives (*rufa* and *roselaari*) / Management Objectives (*islandica*)

The short-term population objective for *rufa* and *islandica* in Canada is to halt the national decline before 2025. The long-term population objective for *rufa* thereafter is to increase and then maintain the population at (or above) 1986-1990 levels (100,000-150,000 individuals (B.A. Harrington unpubl. results in Morrison and Harrington 1992)). The long-term population objective for *islandica* is to maintain the population at current levels (2016).

Given new information for *roselaari* since its assessment by COSEWIC in 2007 (i.e., *roselaari* thought to be breeding in Canada were shown to be *rufa* and only a few minor stopover sites identified in Canada), the objective is to conserve *roselaari* and any Canadian stopover sites identified with greater than, or equal to, one percent of the population which would enable its persistence as a migrant in Canada.

The distribution objective for breeding *rufa* and *islandica* is to maintain the extent of occurrence (i.e., the area that encompasses the geographic distribution of all known breeding populations) in Canada at the time of assessment. The extent of occurrence (breeding) was estimated to be 205,534 km^2 for *rufa* and 455,669 km^2 for *islandica* (COSEWIC 2007). The distribution objective for migrating *rufa* is to maintain all Canadian stopover sites identified with greater than, or equal to, one percent of the population.

The population objectives address the subspecies' long-term decline, which was the reason for its designation (COSEWIC 2007).

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Strategic Direction for Recovery

The strategic direction for the recovery of *rufa* and *roselaari* is set out in Table 3 as is required for Endangered and Threatened species in a Recovery Strategy. Further details and an implementation schedule will follow in one or more action plans. The conservation measures for *islandica* are detailed in Table 4 as is required for a species of Special Concern and includes an implementation schedule representing the entire conservation effort for the subspecies.

Table 3. Recovery Planning Table (*rufa* and *roselaari)*

Threat or Limitation	Broad Strategy to Recovery	Priority[1]	General Description of Research and Management Approaches
Knowledge gaps to recovery	Monitoring and research	High	• Identify all important breeding locations in Canada; • Develop and implement standardized protocols and survey designs (data collection and analysis) for the population and their habitat characteristics; • Determine causes of population decline and reduced adult survival; • Determine relative importance of known and suspected threats to the species and their habitats; • Investigate threat of harvest and determine mitigation activities; • Determine key demographic parameter estimates throughout the annual cycle; • Determine migratory connectivity and identify migratory routes; • Determine distribution and movements of subadult birds before first breeding, and the threats experienced during the pre-breeding period; • Determine First Nations, Métis, and Inuit traditional and local knowledge and its importance to species conservation and recovery; • Refer to Appendix B for a comprehensive list of research needs;
	Habitat and species conservation and management		• Develop a long-term protected areas strategy for breeding habitat • Conserve habitat for the species in breeding and non-breeding areas; • Effectively manage habitat in breeding and non-breeding areas to meet Red Knot's needs; • Enhance and restore non-breeding habitat in key sites, if deemed necessary; • Encourage the regulation of the Horseshoe Crab harvest in Delaware Bay and

Threat or Limitation	Broad Strategy to Recovery	Priority[1]	General Description of Research and Management Approaches
			elsewhere such that a sufficient supply of eggs is available for the species; • Mitigate disturbance in key breeding and non-breeding areas; • Reduce/eliminate Red Knot harvest in species' non-breeding range; • Encourage adherence to the principles of Integrated Pest Management and encourage use of environmentally benign pesticides at small scales; • Control problematic species where feasible and deemed necessary; • Maintain emergency intervention programs for oil;
All threats and knowledge gaps to recovery	Education and awareness, stewardship, and partnerships		• Promote the establishment of a functional flyway-based network and develop a concerted strategy to engage partners and stakeholders; • Foster cooperative relationships with government, landowners, industry, pet owners, and others to mitigate threats facing the species; • Promote national and international cooperation and collaboration to fill knowledge gaps, to coordinate activities, and to ensure that resources are distributed where they are most required across the species' range; • Promote volunteer participation in surveys and monitoring; • Build capacity for partners and volunteers; • Promote compliance with Federal (e.g., SARA, *Migratory Birds Convention Act* (1994)), Provincial, Territorial, and Municipal Acts and Policies as well as beneficial management practices that protect the species and their habitats; • Create opportunities for public involvement in habitat and species conservation and other conservation initiatives;
All anthropogenic threats	Law and policy		• Engage and influence existing regulatory structures to ensure that strong and up-to-date regulations are in place for protecting shorebirds and their habitats at local, regional, and flyway scales; • Develop beneficial management practices for the species, its prey, and their habitats; • Implement existing policies and reduction programs to reduce and/or mitigate the threat of pollution and develop new policies and programs where gaps exist

[1] "Priority" reflects the degree to which the approach contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.

Table 4. Conservation Measures and Implementation Schedule (*islandica*)

The conservation measures for *islandica* focus on the non-breeding aspects of the species' lifecycle because threats outside the breeding season are linked to population declines.

Conservation Measure	Priority[2]	Threats or Concerns Addressed	Timeline
Broad Strategy: Monitoring and Research			
Facilitate research to understand threats and requirements for recovery;	Low	Knowledge gaps to recovery	ongoing
Broad Strategy: Habitat and species conservation and management			
Encourage the development of flyway frameworks and bilateral/multilateral agreements that promote cooperative action to manage and protect key sites;	High	All	ongoing
Support the continued ban on mechanical fisheries in the Dutch Wadden Sea;	Low	Fishing & harvesting aquatic resources	ongoing
Encourage jurisdictions to ban unsustainable fisheries that impact the species;	High	Fishing & harvesting aquatic resources	ongoing
Encourage jurisdictions to mitigate threat of oil and gas extraction;	Medium	Oil & gas drilling	ongoing
Broad Strategy: Education and awareness, stewardship, and partnerships			
Promote public awareness of the species and its threats, especially the impacts of disturbance at foraging and roosting sites;	Medium	All anthropogenic threats	ongoing
Broad Strategy: Law and policy			
Promote cooperative action to legally protect the species and to promote compliance and/or enforcement of legislation	Medium	Hunting & collecting terrestrial animals	ongoing

[2] "Priority" reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the management objective for species. Medium priority measures may have a less immediate or less direct influence on reaching the management objective, but are still important for management of the population. Low priority recovery measures will likely have an indirect or gradual influence on reaching the management objective, but are considered important contributions to the knowledge base and/or public involvement and acceptance of species.

6.2 Narrative to Support the Recovery Planning Table (*rufa* and *roselaari*) and the Conservation Measures and Implementation Schedule (*islandica)*

Recovery of a species with an extensive range such as the Red Knot will require national and international commitment, collaboration, and cooperation among federal, provincial, and territorial jurisdictions, wildlife management boards, Aboriginal peoples, local communities, landowners, industry, and other interested parties. Due to Red Knot's reliance on a few key non-breeding sites, it will be important to monitor habitat conditions, population trend, and distribution of the species so the effectiveness of recovery efforts can be evaluated and adjusted as necessary. Established monitoring programs (e.g., Tierra del Fuego aerial surveys) should be maintained to track status of particular populations and effectiveness of conservation measures.

Intensive monitoring and research have been conducted for *rufa* throughout the subspecies' range since the mid1990s (Niles *et al*. 2007). Despite these efforts, the reasons for the population decline and reduced adult survival are not well understood. Work has largely been uncoordinated and there is a need for standardized protocols and survey designs for the population and their habitat characteristics. Research is required to fill numerous knowledge gaps before recovery can be attained.

7. Critical Habitat

Under SARA, critical habitat identification and protection only applies to Endangered and Threatened species. Critical habitat is addressed for *rufa* and *roselaari* in this document. Critical habitat does not apply to species of Special Concern and is therefore not identified for *islandica* in this document.

Critical habitat is the habitat that is necessary for the survival or recovery of the species. Identification is considered to be partial at this time because additional information is required to determine whether the critical habitat identified below is sufficient to meet the population and distribution objectives.

Section 41(1)(c) of SARA requires that the recovery strategy include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. Critical habitat is identified in this document to the extent possible given the best available information.

7.1 Identification of the Species' Critical Habitat

An examination of the geographic range of the species, its habitat specificity, its population size, and threats indicates that breeding critical habitat for Red Knot should be identified at a landscape scale[3].

Breeding critical habitat for *rufa* cannot be identified at this time. Habitat use and the breeding distribution of *rufa* in Arctic Canada are poorly defined because *rufa* nests are cryptic and difficult to locate and breeding *rufa* are thinly distributed across a vast and remote area (U.S. Fish and Wildlife Service 2014). Very few nests of the subspecies have been found to date (J. Rausch and P. Smith pers. comm. 2015) and extensive surveys are impractical at present. For these reasons, there is a high degree of uncertainty in the identification of breeding habitat necessary for the survival or recovery of *rufa*. Although some habitat preference analyses have been completed (Smith and Rausch 2014), the available information (specifically, the paucity of nest records and no ground truthing to test habitat preference assumptions), is not adequate to enable the identification of breeding critical habitat at a landscape scale. Critical breeding habitat does not apply to *roselaari* because there is no evidence that the subspecies breeds in Canada.

An examination of the geographic range of the species, its habitat specificity, its population size, and threats indicates stopover critical habitat for Red Knot should be identified at a site scale[2]

The known stopover biophysical attributes of critical habitat required by *rufa* are: muddy, sandy, or rocky coastal marine and estuarine habitats with large intertidal flats (e.g., mouths of bays and estuaries, salt marshes, sand spits, islets, shoals, sandbars, rocky (limestone) tidal flats covered with seaweed (e.g., Fucus species), and features often associated with natural inlets). The subspecies also uses inland saline lake habitat during migration. The subspecies requires access to adequate bivalves and other benthic invertebrates (i.e., organisms living in sediment and/or sub-surface layers) at stopover sites. Roosting habitat which is sparsely-vegetated and close to feeding areas, with adequate space available during the highest tides, and free from excessive human disturbance, is also required.

The areas containing stopover critical habitat for *rufa,* with the foraging and roosting habitat characteristics noted above used by greater than, or equal to, one percent of the population of *rufa* are identified in Figures 2-X. There are currently no sites meeting

[3] Environment Canada recognizes three broad approaches in identifying critical habitat: site-level (small/localized geographic range, narrow habitat specificity), area-level (intermediate geographic range, wide or narrow habitat specificity), and landscape-level (large geographic range, wide habitat specificity). These three conceptual scales are used to help provide context for the critical habitat identification, its presentation, and description of activities likely to destroy critical habitat (Environment Canada 2013).

critical stopover criteria for *roselaari*. Should sites be identified for *roselaari* that meet the stopover criteria, Figures 2-X will be amended.

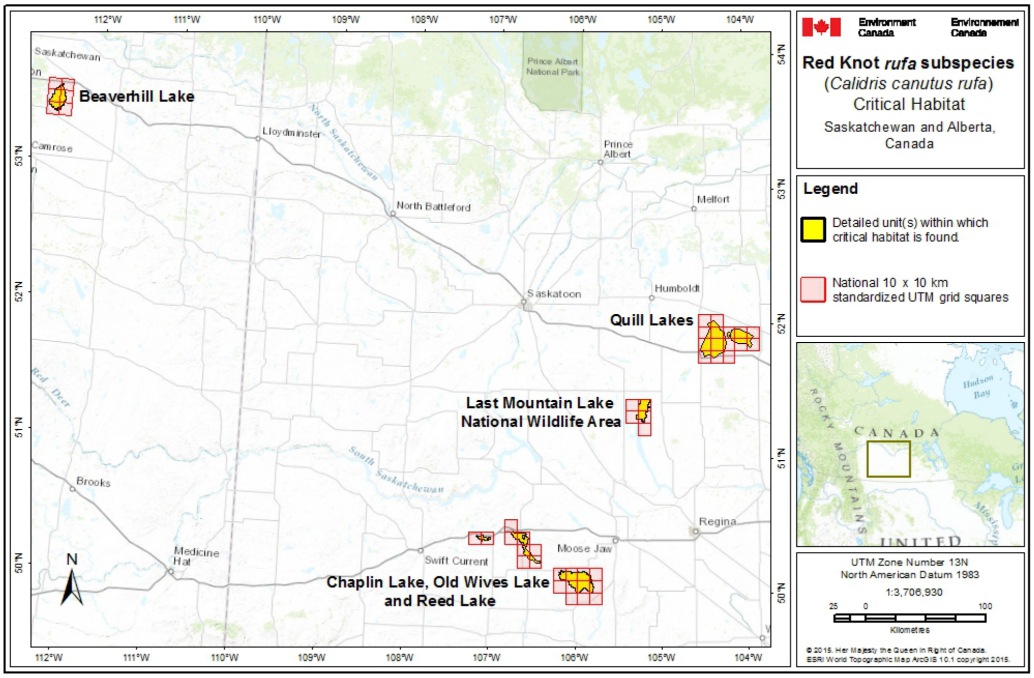

Figure 2. Stopover critical habitat for *rufa* in Alberta and Saskatchewan.
Stopover critical habitat for *rufa* in Canada (March 2015) occurs within habitat patches at sites represented by the yellow shaded polygons where the criteria and methodology set out in section 7.1 are met. The 10 km x 10 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

Figures 3-X:
Sites yet to be mapped:
Nelson River, MB
Churchill, MB
James Bay (West coast), ON
Pen Islands (Hudson Bay), ON
Battures aux Allouettes ,
Banc de Portneuf, QC
Îles-de-la-Madeleine, QC
Archipel de Mingan, QC
Baie de Rupert, QC
Boatswain Bay, QC

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A schedule of studies has been developed to provide the information necessary to complete the identification of critical habitat that will be sufficient to meet the population and distribution objectives. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan.

7.2 Schedule of Studies to Identify Critical Habitat

Table 5. Schedule of Studies to Identify Critical Habitat

Description of Activity	Rationale	Timeline
1. Breeding habitat: Improve modelling of habitat use by *rufa*, using existing sightings	Current knowledge of critical habitat is based on a coarse habitat classification. Habitat data with improved spatial resolution are available, as are more advanced techniques for defining Resource Selection Functions. Application of this improved data and methods is ongoing.	2017
2. Breeding habitat: Enhance knowledge of habitat use by *rufa* through targeted surveys	Red Knots often occur in areas used by few other shorebirds, and consequently, few nests have been found. Dedicated surveys have the potential to greatly enhance knowledge of habitat use.	2025

3. Breeding Habitat: Determine the northern range limit of *rufa*	*Islandica* replaces *rufa* to the north and determining the northern limit for *rufa* is required in order to determine breeding critical habitat for the subspecies.	ongoing
4. Stopover habitat: Determine the full extent of stopover habitat and its relative importance to Red Knot (i.e., proportion of each sub-population) in Canada.	Current knowledge of stopover habitat in Canada is limited by access to remote areas. Moreover, autumn migration stopover has been the focus of current understanding. Additional inventories and surveys during key migratory periods (spring and fall) may lead to identification of additional critical stopover habitat.	2025
5. Stopover habitat: Determine importance of inland freshwater habitats for *rufa* in Canada during migration	It is currently unknown if such habitat is critical for Red Knots during migration. Inventories and surveys may lead to identification of additional critical stopover habitat.	2018

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Any anthropogenic activity which alters or disturbs the key habitat attributes described in section 7.1 above is considered an activity likely to result in the destruction of critical habitat. Also, any activity that reduces access to habitat by Red Knots or reduces the functionality of habitat for knots is considered a destruction of critical habitat. Examples of activities which are likely to result in the destruction of critical habitat include:

Stopover habitat

Description of Activity	Description of effect
Off-road, all-terrain, or motorized vehicle use;	May result in permanent or temporary direct destruction of habitat or indirect effects (drainage patterns, sediment compaction which could impact food resources).
Coastal development occurring in roosting or foraging habitat or in other habitats closely associated with these habitats;	May result in permanent or temporary direct destruction of habitat (construction of ports and wharves, construction of cottages, homes, or tourist accommodations, boardwalks, and trails) and/or indirect effects (changes to drainage patterns, sediment compaction which could impact food resources).
Other industrial developments;	May result in permanent or temporary direct destruction of habitat (construction of wind farms, hydro, wave power generators) and/or indirect effects (changes to drainage patterns, sediment compaction which could impact food resources).
Beach nourishment (i.e., the addition of sand to an	May result in permanent or temporary indirect effects (changes to drainage patterns, sediment compaction which could impact food

eroding shoreline to widen an existing beach);	resources).
Beach stabilization (hard structures);	May result in permanent or temporary direct destruction of foraging and/or roosting habitat and/or indirect effects (changes to drainage patterns, sediment compaction which could impact food resources).
Sand mining and extraction;	May result in permanent direct destruction of foraging and/or roosting habitat.
Beach cleaning or raking activities that remove elements of natural habitat;	May result in permanent or temporary direct destruction of foraging and/or roosting habitat and/or indirect effects (damage and/or removal of food source, sediment compaction which could impact availability of food resources).
Deliberate or accidental discharge of oil, pesticides, and toxic chemicals	May result in permanent or temporary destruction of foraging and/or roosting habitat and/or indirect effects (damage to food source).

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

- In the short term (i.e., before 2025), declining population trends have been halted or reversed;
- In the long term (i.e., 2025), *rufa* populations are increased and maintained at (or above) 1986-1990 levels and *islandica* populations are maintained (i.e., at 2016 levels).
- The breeding extent of occurrence for *rufa* and *islandica* are maintained (at 2016 levels) in Canada and *rufa* are maintained at all Canadian stopover sites identified with greater than, or equal to, one percent of the population.

9. Statement on Action Plans

One or more action plans for *rufa* and *roselaari* will be posted on the Species at Risk Public Registry within the five years following the posting of this document.

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[4] goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that recovery planning documents may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the document itself, but are also summarized below.

All shorebirds (e.g., Ruddy Turnstone (*Arenaria interpres*), Sanderling (*Calidris alba*), Semipalmated Sandpiper (*Calidris pusilla*), Dunlin (*Calidris alpina*), Short-billed Dowitcher (*Limnodromus griseus*) that depend on coastal marine and estuarine habitats for foraging and roosting may benefit from some of the recommended approaches and/or conservation measures for Red Knot. Efforts to enhance and/or restore habitat with sensitive coastal features may especially benefit migrating shorebirds if such approaches were deemed necessary and feasible. Recovery actions for the species must be integrated with beneficial management practices for other listed species, especially where such practices may conflict.

The possibility that this document inadvertently generates negative effects on the environment and on other species was considered. Some raptor and gull species may be negatively affected as a result of predator management, should management be deemed feasible and warranted. It was concluded that this document will not result in any significant adverse effects.

[4] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

Appendix B: Research Needs

- Enhance knowledge of habitat use through targeted surveys on the breeding grounds [Schedule of Studies to Identify Critical Habitat #2];
- Enhance knowledge of habitat use through targeted surveys at foraging areas and roosts used by staging knots, and determine numbers staging at different sites in Canada [Schedule of Studies to Identify Critical Habitat #4];
- Enhance knowledge of habitat use and staging locations of juveniles through targeted surveys for post-fledging concentrations in the Arctic and at other northern latitudes, as well as in meridional (i.e., southern) and tropical latitudes for first and second year birds (potential 'over-summering');
- Use genetics, stable isotopes, or other techniques to determine subspecies of individuals in overlap *islandica*/*rufa* breeding zone in Arctic Canada, and more accurately delineate breeding habitat of each subspecies;
- Assess ongoing status of populations and effectiveness of conservation actions by consistent annual population counts at major non-breeding areas (e.g., Tierra del Fuego, Maranhao/ Ceara Brazil, French Guiana, southeast U.S.) and stopover sites (e.g., Peninsula Valdez, San Antonio Oeste, Lagoa do Peixe, Northern South America coast, Delaware Bay, Virginia coastal barrier islands, Mingan Islands, western and eastern James Bay coastline);
- Examine the possibility of improving Red Knot migration monitoring in Canada to supplement data obtained from ongoing 'winter' monitoring, by identifying all available staging locations in each region, addressing design considerations (e.g., site selection, optimization of sampling protocols, annual variability in stopover site quality), periodically determining length of stay and associated causal factors at specific staging sites, and assessing detection rates in order to reduce sampling bias;
- Continue mark/recapture (resighting) work to determine changes in annual survival, where in the life cycle most mortality is occurring (and why), effectiveness of management actions, and to understand the connections between breeding, staging, and non-breeding habitats;
- Determine reasons for declines for specific populations and at specific sites by evaluating effects of environmental and other parameters (e.g., climate change via Arctic temperatures/storms, timing of hatch of insects and chicks, frequency/timing of hurricanes during migration, droughts/floods, etc.), and evaluate effects of predators, human-related disturbance, hunting pressure, problematic species (e.g. overabundant snow geese during migration), contaminants and habitat modification as sources of observed declines;
- Examine different types of food availability and foraging methods at key stopover sites along the Atlantic Coast and elsewhere to clarify the importance of Delaware Bay (and its horseshoe crab prey) relative to other sites, and provide insights into the potential flexibility in foraging modes, or lack thereof, of *rufa*;
- Examine the breeding ecology, behavior, and nest survival of knots on their Arctic breeding grounds to determine whether conditions during the breeding season (e.g., weather and microtine rodent abundance) might limit populations, and how, or whether population change is most responsive to changes in adult survival;

- Use genetics, stable isotopes, or other techniques to determine breeding origin of nonbreeding individuals.