ESTIMATING THE ABUNDANCE OF THE GULF OF BOOTHIA POLAR BEAR SUB-POPULATION BY GENETIC MARK-RECAPTURE
2016 FIELD REPORT

MORGAN ANDERSON[1]

MARKUS DYCK[1]

And

MITCHELL TAYLOR[2]

[1] Department of Environment, Box 209 Igloolik, NU X0A 0L0
[2]Northern Associates, 66 Cottage Drive Rd, Neebing, ON P7L 0A9

15 September 2016

Submitted to meet requirements of:

Wildlife Research Permit WL 2015-005
Northwest Territories Animal Care Committee Approval NWTWCC 2016-004
Kitikmeot Inuit Association Land Use Permit KTX116X001
Qikiqtani Inuit Association Land Use Permit Q16X002
Nunavut Wildlife Research Trust Project 2-16-02

STATUS REPORT 2016-04
NUNAVUT DEPARTMENT OF ENVIRONMENT
WILDLIFE RESEARCH SECTION
IGLOOLIK, NU

M. Anderson, M. Dyck, and M. Taylor. 2016. Estimating the abundance of the Gulf of Boothia polar bear sub-population by genetic mark-recapture: 2016 field report. Nunavut Department of Environment, Wildlife Research Section, Status Report 2016-04, Igloolik, NU. 28 pp.

Summary

The Gulf of Boothia (GB) polar bear subpopulation is one of the largest in Canada and is managed entirely by Nunavut. The most recent demographic study on the GB subpopulation estimated the mean total number for the 1998-2000 study period to be 1,592 (SE=361) bears. A new 3-year research project was initiated in 2015 to provide updated information on the abundance of bears in GB. This mark-recapture study differs from the previous studies that relied on chemical immobilization of all bears for capture and marking. This study does not involve capture of bears but instead utilizes DNA extracted from tissue samples obtained using biopsy darts to uniquely identify individuals. The sub-population abundance estimate and status will be assessed by means of genetic mark-recapture.

Between 20 April and 14 May 2016, we spent 99.25 hours of helicopter flight time searching for polar bears. Most of the GB subpopulation range was surveyed but poor weather and logistical constraints limited the intensity of the coverage in a small portion of Committee Bay. We flew a total distance of approximately 12,867 km searching for polar bears. A total of 161 bears (in 98 groups) of various age classes and both sexes were encountered, of which 121 were successfully biopsied. The rate of sampling averaged 1.6 bears per hour of search time. The number of bears encountered during the spring of 2016 was equivalent to approximately 7.6% of the previous 1998-2000 mark-recapture population estimate currently used for harvest management. However, until genetic results are available it is impossible to discern how many different individual bears were encountered, or how many recaptures occurred.

General impressions from the first 2 years of sampling suggested that polar bears remain abundant and in good condition in GB. Preliminary habitat use analysis showed that polar bear densities in 2016 did not exhibit a significant preference or avoidance for any habitat types. In contrast, seal observations suggested a significant preference for active pack ice and brash ice, and significant avoidance of shore fast ice and inactive pack ice. Seal kill densities based on sea ice mapping were lower than expected in inactive pack ice. However, seal kill densities occurred at frequencies proportional to area for all sea ice habitats when assessed as microhabitats at the kill site. Preparations are under-way for the third and final field season which will begin in April 2017. The consistently good condition of polar bears observed in all habitats suggest that although seals may be more concentrated in some habitats, they remain sufficiently abundant in all habitats to sustain condition in all sex, age, and family status groups of polar bears. Polar bears appear to hunt based on microhabitats, but these data are insufficient to identify what microhabitats are preferred or if these vary by season and general habitat type.

(Summary, Inuktitut)

ᓇᐃᓪᓕᑎᖅᓯᒪᔪᖅ

ᑖᔾᓱᒪ ᐃᑭᕋᓴᐅᑉ ᐃᒪᖓᓂ (GB)–ᒥ ᓇᓄᐃᑦ ᐊᒥᓱᓂᖏᑦ ᓈᓴᖅᑕᐅᓯᒪᓂᒃᑯᑦ ᐊᓯᓲᓛᖑᕚᑦ ᑲᓇᑕᓕᒦᒥ ᑲᒪᒋᔭᐅᓪᓗᓂᓗ ᓄᓇᕗᒥᐅᑐᐊᕐᓄᑦ. ᑖᓐᓇ ᓄᑖᖑᓛᖑᔪᖅ ᖃᐅᔨᓴᕐᓂᐅᓚᐅᖅᑐᖅ (GB)–ᒥ ᑕᐃᑲᓂᑐᐊᖅ ᖃᔅᓯᐅᖕᒪᖔᑕ ᓇᓚᐅᑦᑖᖅᑕᐅᓯᒪᓂᖏᑦ ᓴᖅᑭᑎᑕᐅᔪᖅ ᑲᑎᓪᓗᒋᑦ ᐊᒥᓱᓂᖏᑦ 1998–ᒥᑦ 2000–ᒧᒐᓚᒃ ᑎᑭᓪᓗᒍ ᐃᒪᐃᓐᓂᕋᖅᑕᐅᓚᐅᖅᐳᑦ 1,592 (SE=361) ᓇᓄᐃᑦ. ᑖᓐᓇ ᓄᑖᖅ 3-ᓄᑦ ᐊᕐᕚᒍᓄᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ ᓇᒧᓇᐃᖅᓯᓪᓗᓂ 2015–ᒥ ᓇᒧᓇᕈᓐᓃᖅᑎᑦᑎᓇᓱᒃᓗᑎᒃ ᐅᓄᖅᑑᓂᖏᓐᓂᒃ ᓇᓄᐃᑦ ᐃᑭᕋᓴᐅᑉ ᐃᒪᖓᓂ (GB)–ᒥ. ᑖᓐᓇ ᑕᖅᑰᓪᓗᑎᑦ–ᐱᔭᐅᒃᑲᓐᓂᖅᓱᐃᓪᓗᑎᒃ ᖃᐅᔨᓴᕐᓂᖅ ᐊᔾᔨᒋᔭᐅᖏᒻᒪᑦ ᖃᐅᔨᓴᖅᓯᓂᐅᕙᓚᐅᖅᑐᓂᑦ ᑕᐃᒃᑯᓇᙱᑦᑯ ᐊᑐᕆᐊᖅᑲᖅᐸᓚᐅᖅᑐᓂᑦ ᓯᓂᖕᓇᖅᑐᓂᒃ ᑕᒪᐃᓐᓄᑦ ᓇᓄᕐᓄᑦ ᐱᔭᐅᕙᓪᓕᐊᔪᓄᑦ. ᑖᓐᓇ ᖃᐅᔨᓴᕐᓂᖅ ᐱᑕᖃᖏᑦᑎᐊᖅᐳᖅ ᑎᒍᓯᑲᑕᖃᑦᑕᕐᓂᕐᒥᒃ ᓇᓄᕐᓂᑦ ᑭᓯᐊᓂᓕ ᐲᖅᓯᕙᒋᓪᓗᓂᔾᔪᒃ ᑎᒥᖓᓂᑦ ᐅᑭᑦᑎᔾᔪᑎᒧᑦ ᖁᑭᖅᑐᒍ ᒡᑯᐊᓗ ᐊᑐᓂᑦ ᖃᐅᔾᔪᓐᓇᖅᑐᒥᑦ ᓇᓕᐊᖑᖕᒪᖔᑕ. ᒡᑯᐊ ᑕᕝᕙᓂᑐᐊᖅ ᖃᔅᓯᐅᓂᖏᑦ ᓈᓴᖅᑕᐅᓂᒃᑯᑦ ᒥᒃᓴᐅᓴᒃᑕᐅᓂᖏᑦ ᖃᓄᐃᓕᖓᓂᖏᓪᓗ ᖃᐅᔨᔭᐅᓇᓱᖕᓂᐊᖅᑐᑦ ᑎᒥᖏᑎᒍᑦ ᓇᒧᓇᐃᖅᑕᑦ – ᐱᔭᐅᒃᑲᓂᖅᑐᓪᓗ.

ᑕᕝᕙᓂ ᐊᑯᓐᓂᖓᓂ ᐊᐃᕐᓇᓕ 20 ᐊᒻᒪᓗ ᒪᐃ 14, 2016–ᒥ, ᖁᓕᒥᒨᓕᒃᑯᑦ ᐃᑲᕋᓂᒃ 99.25–ᓂᒃ ᓇᓄᕐᓂᒃ ᕿᓂᖅᓱᑕ. ᑕᒪᕐᒥᑲᓴᒃ ᑕᕝᕙᓂ ᐃᑭᕋᓴᐅᑉ ᐃᒪᖓᓂ (GB)–ᒥ ᓈᓴᐃᓂᐅᓚᐅᖅᐳᖅ ᑭᓯᐊᓂ ᓯᓚᑦᑎᐊᕙᐅᑲᑦᕐᒥᓐᓂᖓᓄᑦ ᐊᒻᒪᓗ ᓇᐅᒃᑰᕐᓂᕆᑲᑦᑕᕐᒥᑦ ᐊᔪᕐᓇᕈᔪᑲᑦᓂᕐᒥᓐᓄᑦ ᐱᕕᖃᑦᑎᐊᙱᑲᑕᓚᐅᕐᒪᑕ ᑕᒪᒃᑭᕋᓱᕆᐊᒃᓴᖓ ᒥᑭᑦᑑᑕᐅᑦᑕᕐᓗᒍ ᐃᓚᖓᓂ ᐊᑯᓪᓕᐅᑉ ᑕᕆᐅᖓᓂ. ᖃᖓᑕᓚᐅᖅᐳᒍᑦ ᑲᑎᓪᓗᒋᑦ (12,867 km)–ᓗᐊᒥᒃ ᐅᖓᓯᖕᓂᓕᖑᒧᑦ ᓇᓄᕐᓂᒃ ᕿᓂᖅᓱᑕ. ᑲᑎᓪᓗᒋᑦ ᑕᑯᔭᕗᑦ 161 ᓇᓄᐃᑦ (ᑲᑎᙵᔪᕕᓃᑦ 98–ᖑᓪᓗᑎᒃ) ᐊᕐᕋᒍᖏᑦ ᐊᔾᔨᒌᖏᑦᑐᑦ ᑕᒪᕐᒥᓪᓗ ᐊᖑᑕᐅᖕᒪᖔᑕ ᐊᓐᓇᐅᖕᒪᖔᑕᓘᓐᓃᑦ ᖃᐅᔨᔭᐅᕐᑲᑦᑕᓚᐅᖅᑐᑦ, ᑖᒃᑯᓇᙵᑦ 121–ᖑᔪᑦ ᖃᐅᔨᓴᖅᑕᐅᑦᑎᐊᕈᓐᓇᓚᐅᖅᑐᑦ. ᑕᐃᒃᑯᐊ ᐊᒥᓱᓂᖓ ᓇᓄᐃᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᑦ 1.6–ᓇᓄᐃᑦ ᐃᑲᕋᒧᑦ ᐊᑕᐅᓯᕐᒧᑦ ᕿᓂᖅᑕᐅᔪᓂ. ᑕᐃᒃᑯᐊ ᖃᔅᓯᐅᓂᖏᑦ ᓇᓄᐃᑦ ᑕᑯᔭᐅᔪᕕᓃᑦ ᐅᐱᕐᖖᒋᒃᑯᑦ 2016–ᒥ ᐊᒥᓱᓂᖃᓚᐅᖅᐳᑦ 7.6%–ᐳᓴᓐᑎᖓᓂᒃ 1998–ᒥᑦ 2000–ᒧᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᕕᓂᕐᓂ ᓱᓕ ᒫᓐᓇᒧᑦ ᐊᑐᖅᑕᐅᒪᑦ ᐊᖑᓇᓱᒃᑕᐅᔪᓐᓇᕐᓂᕐᒧᑦ ᓇᓄᐃᑦ ᐊᐅᓚᑦᑎᓂᐅᔪᒧᑦ. ᑭᓯᐊᓂᓕ, ᑕᐃᒃᑯᐊ ᐅᑭᑕᐅᔪᕕᓃᑦ ᖃᐅᔨᓴᕋᓱᖕᓂᕐᒧᑦ ᑐᑭᓯᔭᐅᓚᐅᖏᓐᓂᖏᓐᓂ ᐊᔪᕐᓇᑲᓚᐅᖅᓱᓂ ᐊᔾᔨᒌᖏᑦᑐᑦ ᖃᔅᓯᐅᓂᖏᑦ ᖃᐅᔨᔭᕆᐊᒃᓴᖅ ᓇᓄᐃᑦ ᑕᐃᒃᑯᐊ ᑕᑯᔭᐅᓯᒪᔪᑦ.

ᑖᒃᑯᐊ ᒪᓕᒃᓱᒋᑦ ᓇᒧᓇᕈᓐᓃᖅᑐᖅ ᐊᕐᕚᒎᖕᓄᑦ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᓕᖅᑎᓪᓗᒋᑦ ᓇᓄᐃᑦ ᓱᓕ ᐊᒥᓱᕚᑦ ᖃᓄᐃᖏᑎᑦᑎᐊᖅᓱᑎᒡᓗ ᑕᐃᑲᓂ ᐃᑭᕋᓴᐅᑉ ᐃᒪᖓᓂ (GB)–ᒥ. ᒫᓐᓇ ᐊᑐᖅᑕᐅᕙᓕᖅᑐᑦ ᓂᕈᐊᑎᓂᒃ ᖃᐅᔨᓴᕈᑎᑦ ᓇᒧᓇᐃᖅᓯᓯᒪᓕᖅᑐᑦ ᓇᓄᐃᑦ ᐊᒥᓱᓂᖏᓐᓂᒃ 2016–ᒥ ᐱᐅᒋᓛᖅᑲᕐᓂᕐᒨᖏᒻᒪᑦ ᐱᑦᑕᐃᓕᔭᖅᑲᕐᓂᕐᒧᑦᓘᓐᓃᑦ ᐊᓯᖏᓐᓂᒃ ᓂᕈᐊᑎᓂᒃ. ᐊᔾᔨᒋᔭᐅᖏᑉᐸᓪᓗᑎᒃ, ᓇᑦᑎᕐᓂᒃ ᖃᐅᔨᓴᕐᓃᑦ ᓇᒧᓇᐃᖅᓯᓯᒪᖕᒪᑕ ᐃᓂᒋᔪᒪᔾᔪᓪᓗᐊᑕᕙᒃᑕᖏᑦ ᐃᓂᑦᔭᐅᒪᔪᒃᑐᑦ ᓯᑯᐃᑦ ᑲᑎᙵᔪᑦ ᒪᓃᑦᑐᑦ ᓯᑯᐃᑦ, ᑕᒪᒃᑯᐊ ᐃᓂᒋᓗᐊᖅᑕᐅᓇᑎᒃ ᑭᓯᖃᙱᓗᐊᖅᑐᑦ ᓯᒃᔭᖅᐸᓱᒃᑐᑦ ᐃᖏᕋᓃᑦ ᓯᑯᐃᑦ ᐊᒻᒪᑦᑕᐅᖅ ᑭᓯᖃᙱᓗᐊᖅᑐᑦ ᑲᑎᙵᕈᓘᔭᓗᐊᖅᑐᑎᒡᓗ ᓯᑯᐃᑦ. ᓇᑦᑎᖅᑕᐅᖃᑦᑕᖅᑐᑦ ᐊᒥᓱᓂᖏᑦ ᒪᓕᒃᑐᑎᒃ ᐃᒦᓂ ᓯᑯᐃᑦ ᓇᒧᓇᐃᖅᑕᐅᓯᒪᓂᖏᓐᓂᒃ ᐊᒥᕐᒋᓐᓂᖅᓴᐅᓚᐅᖅᐳᑦ ᓇᓚᐅᑦᑖᖅᑕᒥᒍᑦ ᑭᓯᖃᙱᓐᓂᐅᔪᖅ ᓯᑯ. ᑭᓯᐊᓂᓕ, ᓇᑦᑎᖅᑲᑦᑕᕐᓂᕕᓂᖏᑦ ᐊᒥᓱᓂᖅᓴᐅᓪᓗᑎᒃ ᓂᕈᐊᑎᓂᑦ ᒥᑭᑦᑑᑕᐅᓂᖅᓴᓂᑦ ᐃᓂᒋᔭᐅᕙᒃᑐᓂ ᓇᑦᑎᖅᓯᒪᕙᕕᓂᖏᓐᓂ. ᐱᕙᖏᔭᖅᐸᓪᓕᐊᔪᖏᔪᑦ ᒫᓐᓇ ᐱᖓᔪᖖᒐ ᕿᖑᓪᓕᖅᐹᒥᓪᓗ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ ᐱᑎᐊᓛᖅᑐᒥᒃ ᐊᐃᕐᓇᓕ 2017–ᒥ. ᑕᒪᓐᓇ ᐋᖅᑭᑎᐊᖅᓯᒪᓂᓇᔭᕐᖓ ᑲᔪᓯᓂᐅᔫᑉ ᓇᓄᕐᓂᒃ ᖃᐅᔨᓴᕐᓂᐅᔫᑉ ᑖᒦᓂ ᓂᕿᖃᕈᓇᕐᓇᔭᕐᖏᓂ ᓇᒧᓇᕈᓐᓃᖅᐳᖅ ᑕᒪᒃᑯᐊ ᓇᑦᑏᑦ ᓂᕿᕆᓂᖅᓴᓇᓚᓗᐊᕐᓯᒪᔪᒃ ᐃᓚᖏᓐᓂ ᐃᓕᕆᕙᒃᑕᖏᓐᓂ, ᓱᖁᓯᕋᑎᒃ ᐅᓄᐃᓐᓇᖅᑐᑦ ᐱᔭᐅᑦᑕᐃᓕᑎᑕᐅᓇᓱᖏᒃᑲᓗᐊᕈᑎᒃ ᐊᕐᓇᐅᓂᖏᓐᓄᑦ ᐊᖑᑕᐅᓂᖏᓐᓄᓘᓐᓃᑦ ᖃᓄᕐᓗ ᐅᑭᐅᖃᖅᑎᕐᖓᓕᑦ ᐊᒻᒪᓘᓐᓃᑦ ᐃᓚᒌᖑᕐᒪᖔᑦ ᑲᑎᙵᔪᑦ ᓇᓄᐃᑦ. ᓇᓄᐃᑦ ᐊᖑᓇᓱᒃᐸᖅᑰᕗᑦ ᐃᓕᑭᓚᐅᐱᓪᓚᒃᑕᒥᓂ, ᑭᓯᐊᓂᑖᒃᑯᐊ ᖃᐅᔨᓴᖅᑕᐅᔾᔪᑏᑦ

ᓇᓗᓇᐃᖅᓯᐋᓐᓇᖕᒋᓚᑦ ᓇᓕᐊᖕᓂᒃ ᐃᓂᖃᓚᐅᐱᓪᓚᖃᑦᑕᕐᒪᖔᑕ ᐅᕝᕙᓘᓐᓃᑦ ᖃᖓᒃᑯᑦ ᐊᕐᕌᒍᒥ ᐊᒻᒪ ᖃᓄᐃᑦᑑᔪᒥᒃ ᐃᓂᖃᕋᔪᖕᒪᖔᑕ.

(Summary, Inuinnaqtun)

NAITTUMIK

Una Gulf of Boothia (GB) nannut amigaitilaangit atauhiq anginighaq Kanatami munagiyauyuq hapkunani Nunavunmin. Nutangunighaq amigainiit naunaiyaiyut haffumani GB amigaitilaangit itquqniaqhimayuq attautimut qaffiuniit hamanga 1998-2000 naunaiyaqnia imaa 1592 (SE=361) nannut. Butaaq pingahuni ukiuni naunaiyaiyut havaangat aulaqtitauyuq uvanu 2015mi tuniyaangini nutaamik kangiqhidjutinik qanuginiit nannut uvani GBmi. Una naunaitkut-tigutqighimayut aalangayuq hamanga kingungani naunaiyaqniqni pidjutiqaghutik hiningnaqhugit tamaita nannut piyaangini uvalu naunaiyaqhugit. Una naunaiyaut pihimangituq pilugit nannut kihimi piblutik DNAmik pihimayut niqainit uuktuutinik pihimayut atughutik pitiktautinik kataktaaqtunik naunaiyagiangini attautit. Amigaitpangnigiyait anginiit uvalu qanuginiit naunaiyaqtauniaqtuq Kinguvagit titiqnit-tigutqikhaqnit.

Qitqani 20 Qitiqqautiyuq uvalu 14 Qiqaiyarlurvia 2016, habguyugut 99.25 ikaangninik halikaaptakut qinighiabluta nannuqnik. Tamavyaa hamna GB amigaitpangnigit naunaiyaqhimayut kihimi hilaqlukniqmik uvalu ihuaqhautit ayuqhautigivagait kikliqangniit anginighaalu piyaghaq mikinghaani hamani Committee Bay. Tingmiyugut attatutimut 12,867 km ungahiktilaanga qinighialbuta nannuqnik. Attautimut 161 nannut (98 katimaniit) aalakiit ukiungit uvalu angutit/angnat takuyauvaktut, tahamanga 121 ihivgiutauvaktut. Naunaitkutaa ihivgiuniq 1.6 nannut ikaangniqmi qiniqhianiq. Qaffit nannut takuyauyut qiniqhiatilugit upingaami 2016 aadjikiivyaktuq imaavyak 7.6 pusat kingungani 1198-2000 naunaityaqhugit-tigutkikhimayut amigainiit itquqniaqhimayut tadja atuqtauyut anguniaqnikkut munaginiq. Kihimi, qanuginiit naunaitkutit piinagialaqikpata ayungnavyaktuq qaffit aalakiit attautit nannut takuyauvaktut, qaffinluuniit piyauvaktut.

Ihumagiluaqtaini hivuliqni malguuk ukiuuk naunaiyainikkut ihumayut nannut amigaivyaktut uvalu nakuuyutlu uvani GBmi. Hivuliqpaami nayugait atuqtauyut naunaiyaqniq tautuktitauyut nannut akulaitniit uvani 2016 tautuktaungitun amigaiyuumiyunik piyaghait uvalu uaputitailiyut kitut quyaginaq nauygait qanuginiit. Imaalutauq, nattiit tautuktauhimayut ihumagiyaut amigaitut hikuni uvalu ahiquuyaqhimayuni hikuni, amigaitunlu takuyaungitut hinaanilu hikumi uvalu hinaaniingitumi hikumi. Nattiit tuqutauyut amigainiit ihimayut hikup naunaiyautaani ikitqianguqtut hikumi hinaaniingitumi. Kihimi, nattiit tuquhimayut amigainiit pihimayut qanuginiit ilait tamaini hikumi nayugaini naunaiyaqtauyut ikitut tuqulviini. Upalungaiyaliqtut pingahughaanik uvalu kinguliq ukiumi aulagutiniaqtuq uvani Qitiqqautiyuq 2017. Una aulahimaaqtuq nakuuyut nannut takuyauyut tamaini nayugaini ihumagiyauyut taimaangugaluaq nattiit ihumagiyauluaqniaqtut ilaini nauygaini, amigaitut huli tamaini nayugaini namaqtut idjuhia tamaini angnaluit angutit, ukiungit, uvalu ilagiit qanuginiit nannut. Nannut niqighaqhiuqtut ihimayut ikituni, kihimi hapkua naunaitautit ayungnavyaktut naunaiyagiami hunat ikitut pihimayut uvalu hapkua aalangayut ukiuni uvalu nayugaini qanuginiit.

Project Leader

GN Department of Environment

M. Dyck
Polar Bear Biologist II
Department of Environment
Wildlife Research Section
Government of Nunavut
Box 209
Igloolik, NU X0A-0L0
Phone: (867) 934-2181
Fax: (867) 934-2190
mdyck1@gov.nu.ca

Field Biologists

Morgan Anderson (*GN Department of Environment*)
Mitchell Taylor (*contractor*)

HTO Participants

Eric Saittuq (Taloyoak)
Jonah Aiyout (Taloyoak)
Robert Quqqiaq (Taloyaok)
Bill Ekelik (Taloyoak)
Patrick Qagutaq (Kugaaruk)
Lionel Tigvareark (Kugaaruk)
Joanni Uqqarluk (Kugaaruk)

Table of Contents

List of Figures

List of Tables

Person Days

Field work during the 2016 field season (10 April – 15 May) involved approximately 118 person days (40 person days by local assistants, 78 person days by biologists).

Aircraft Hours

We flew a total of approximately 106.2 hours during our field study, of which 6.9 hours (6.5%) was ferry time, leaving a total search time of approximately 99.25 hours.

Field Dates

Biopsy sampling for the Gulf of Boothia (GB) polar bear study took place between 20 April and 14 May 2016. The fieldwork was originally scheduled to begin earlier, on April 7, to avoid poor weather later in the spring, but contract arrangements between PCSP and the air carrier had not been completed, then the ferry flight to Resolute was delayed by poor weather. Additionally an engine failure during operations grounded the field crew for an additional 6 days while the engine was replaced at the field camp. During this time frame, GB was mostly ice-covered and we assumed therefore that all bears were distributed across the study area. Out of a total of 18 days of possible search time, we could fly on 14 days due to poor weather conditions. We had a second helicopter for search operations for only one day due to weather delays in positioning, and poor weather after it arrived. The total search times per day also varied according to weather conditions. Our average search time per day was 7.1 hours (range 1.9 to 10.9 hours).

Fieldwork Location

Fieldwork was conducted across the sea ice and smaller islands within the GB study area (Figure 1). Most of the GB subpopulation range was surveyed but poor weather and logistical constraints limited the intensity of the coverage of the whole area. We flew a total distance of approximately 12,867 km searching for polar bears. We covered the northwestern part of the study area using Fort Ross as a base camp and completed the southeastern portion of the area working out of Kugaaruk. Weather prevented us from positioning to and working from Igloolik again this year, so the eastern part of the study area was covered from Fort Ross and Kugaaruk instead.

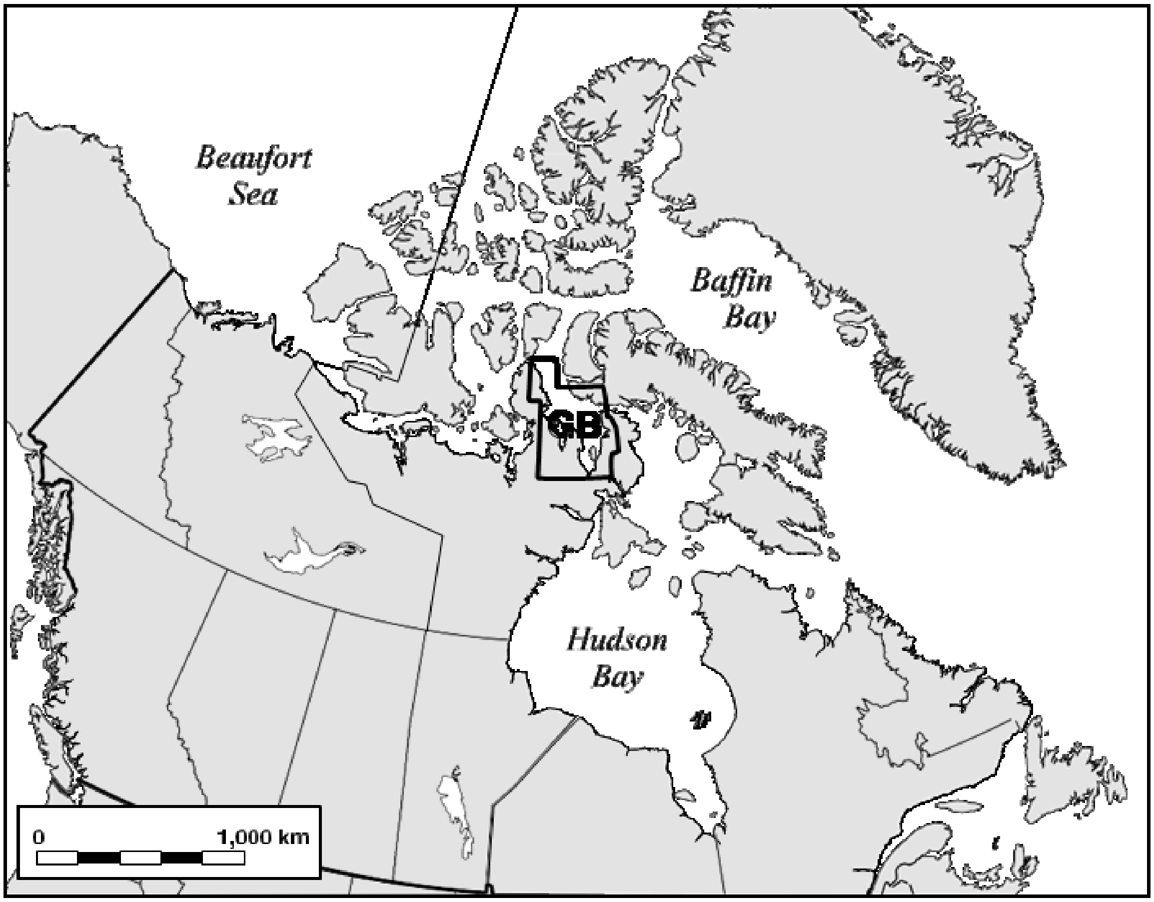


Figure 1. Location of the Gulf of Booth (GB) polar bear subpopulation, Nunavut. Boundaries are defined as in Taylor et al. (2001).

Background

The most recent demographic study on the Gulf of Boothia (GB) polar bear subpopulation estimated the mean total number for the 1998-2000 study period to be 1,592 (SE = 361) bears (Taylor et al. 2009). York et al. (2016) used PVA methods, survival and recruitment estimates from Taylor et al. (2009) and GN harvest data to estimate the number of polar bears at 2013 to be 2946 (SE=1722). The York et al. (2016) PVA estimate incorporates the variance of the population and vital rate estimates from Taylor et al. (2009) and assumes constant (no time trend) rates of survival and recruitment and no density effects.

The geographic bounds of the Gulf of Boothia polar bear subpopulation (Figure 1) were previously delineated based on movements of radio-collared animals from the Gulf of Boothia and adjacent populations (Taylor et al. 2001). These bounds are supported by mark-recapture and mark-recovery movements (Taylor and Lee 1995) as well as DNA analysis (Paetkau et al. 1999, Malenfant et al. 2016). Our study area corresponds to the Gulf of Boothia polar bear population identified in Taylor et al. (2001, Figure 1).

There have been three previous capture programs in the Gulf of Boothia that could potentially provide data for use in this study (Appendix I). The first effort (1976–1978) was part of a general polar bear study conducted in the Canadian central Arctic in the mid-1970s (Schweinsburg et al. 1981, 1982; Furnell and Schweinsburg 1984) and included only the north and west portion of the Gulf of Boothia. For a brief period from 1986 to 1987, a limited number of polar bears (n = 5) were also captured along coastal areas in the study area (Appendix I) for a conventional (VHF) telemetry study of movements. The most recent capture program was conducted from 1994 to 2000, during which capture effort was directed evenly across the entire study area. From 1994 to 1996 the main priority was uniform deployment of satellite-radio collars on adult females over the study area. Captures of other bears occurred only incidentally to the adult females that were given radio collars. The main capture effort was from 1998 to 2000, during which every bear encountered was captured and marked, and the entire subpopulation area was searched.

This mark-recapture study differs from the studies prior to 2015 that relied on chemical immobilization of all bears and their dependent cubs for capture and marking according to procedures described by Stirling et al. (1989). This study utilizes DNA extracted from tissue sampled from Pneu-Dart® biopsy darts to uniquely identify individuals and to determine sex. We followed the Government of Northwest Territories Wildlife Care Protocol No. NWTWCC 2016-004 and we were under the guidance of the Canadian Council on Animal Care. Bears captured from 1976 to 1987 were mainly immobilized with Sernylan® (Furnell and Schweinsburg 1984); bears captured in later years were immobilized with Telazol® (Stirling et al. 1989). Upon initial immobilization capture, a unique identification number was assigned to each bear which was marked accordingly using a plastic ear tag and permanent lip tattoo. For bears captured up to and including 2000, the bear's age was "known" if the bear was captured as a cub-of-the-year (COY) or yearling, or if its age was estimated by counting annular rings of an extracted vestigial premolar (Calvert and Ramsay 1998). The bear's age for DNA biopsy captures was field estimated as: COY, yearling, subadult (age 2-5), or adult (age 6+) at the time of darting. The sex, age, family status, and location of polar bears killed by hunters, killed as problem bears, or found dead from any cause has been recorded for all occurrences since 1993, and was recorded for most occurrences since 1972. Tissue samples containing DNA were taken and archived from all polar bears captured in the 1998-2000 study.

Barber and Iacozza (2004) found no trends in Gulf of Boothia sea ice conditions or ringed seal habitat suitability indices in the interval 1980–2000. Similarly Taylor et al. (2009) found no indication of any environmental trends during their study (1998-2000), although they acknowledge that the 3 year time frame was too brief say anything meaningful about climate change or sea ice trends.

Methods

The sample design was the same as the 1998-2000 study by Taylor et al. (2009) and the first year of sampling for this study. We searched most of the Gulf of Boothia geographic area using a Bell 206 Long-Ranger (Figure 2) following daily pre-planned routes, designed to cover the entire area and to avoid a potential directional movement of bears out of the subpopulation area due to helicopter disturbance. The pre-planned routes were used to guide our search path, but we often deviated from the planned route depending on the habitat and physical features encountered (ridges, leads, iceberg, coast line, etc.) to maximize our chances of finding polar bears. In 2015, flight routes were spaced wider than originally planned to insure that the whole range of the GB area was covered due to weather constraints. In 2016, our flight path transects were approximately 10 to 15 km apart in areas where low bear densities were encountered and approximately 7 to 10 km apart in high bear density areas. As in the 2015 sampling, we also followed bear tracks when they appeared to be very fresh or when they were associated with a fresh seal kill, but we usually did not invest more than a few minutes on a given set of tracks because tracking conditions were poor throughout the entire sampling period due to lack of fresh snow. We "marked" all individual polar bears encountered, except for cubs of the year, by DNA biopsy sampling (Pagano et al. 2014). "Marking" in this study does not involve chemical immobilization and physical marking as was done previously. This study used tissue biopsy darts to collect a small skin and fat sample from each bear.

These samples were used to establish a unique identity for each bear based on nuclear DNA fingerprinting methods (Chambers et al. 2014, Jefferys 2005). To minimize chances of injuries, we did not dart cubs of the year but yearlings and two-year old cubs were biopsied. We used a Bell 206 Long-Ranger helicopter to locate and to dart the bears.

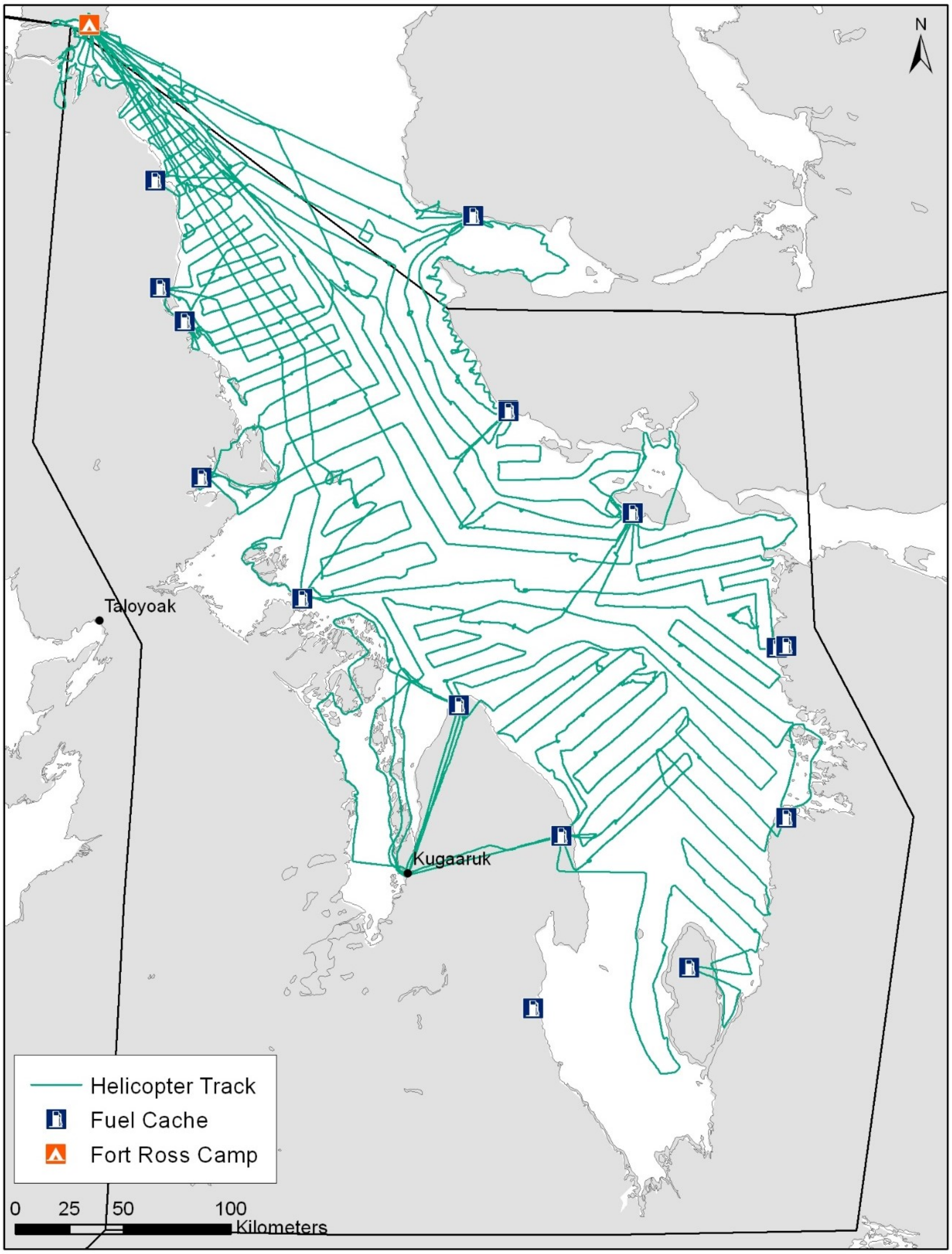


Figure 2. Helicopter track log and location of camp and fuel caches used to search the entire Gulf of Boothia polar bear subpopulation.

We used 4 cc PneuDart® biopsy darts (Figure 3) spray painted black (to increase sightabilty for retrieving darts) fired from a PneuDart Model 196 capture rifle to collect tissue specimens. We used power setting 1 on all yearlings as well as most bears but occasionally used power setting 2 on adults, especially individuals that appeared more fat, to maximize the chances of obtaining a good sample. The dart has a small stainless steel cutter located on the tip of an aluminum nose cone. The cutter encompasses a barbed capture claw to ensure sufficient sample retention. Upon impact, the DNA Dart cuts, extracts, and retains the tissue sample, and falls to the ground. Cutter dimensions were 15 mm length and 4 mm diameter. The barbed claw was 17 mm long and extended 2 mm beyond the leading edge of the cutter.

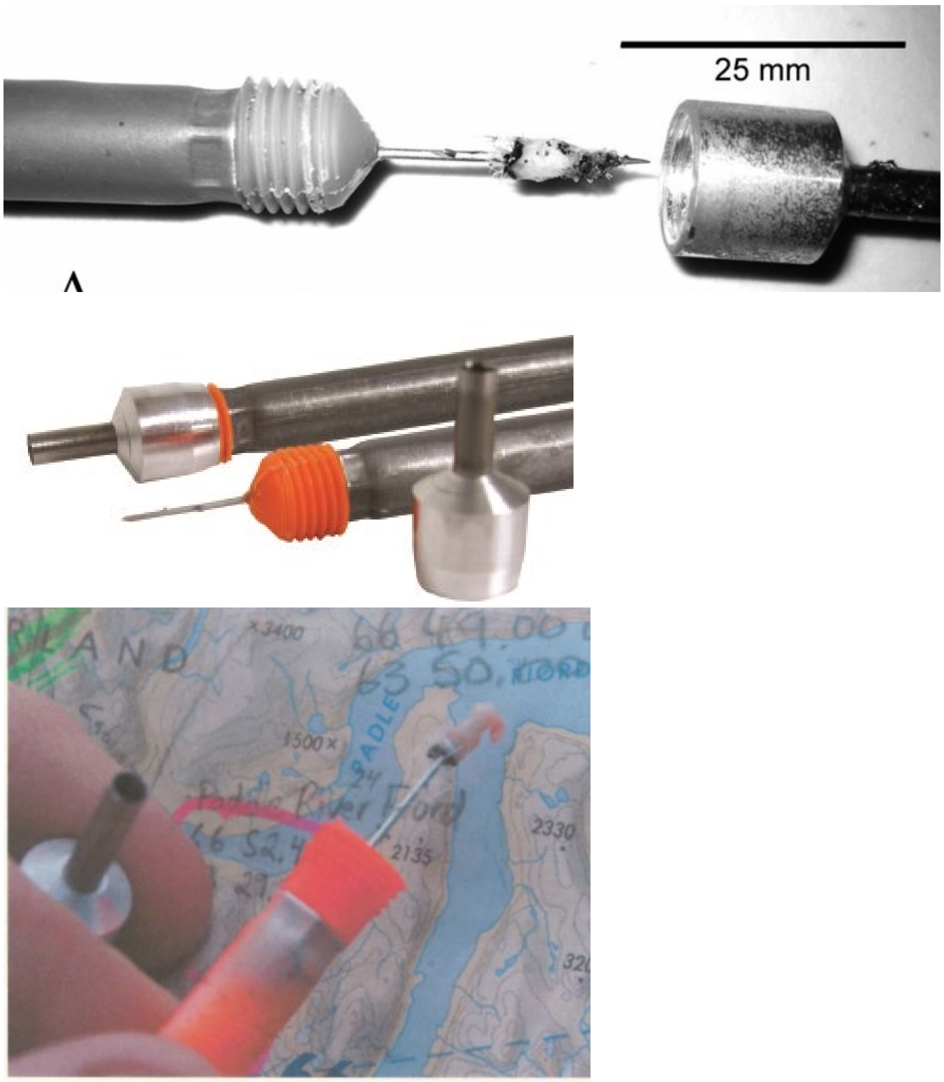


Figure 3. PneuDart® Biopsy Darts and example of sample collected.

We selected rump shots that were within 5 meters and could be administered such that the dart strike was at 90° to the skin surface. We selected flat pans of ice or level ground when possible to minimize lost darts. If necessary, a similar PneuDart® biopsy/fur-marking dart was used to allow the capture team to identify individual dependent yearlings or older dependent offspring once biopsied. Dye can be injected through side ports on marking darts, and is forced out on impact, leaving a visible mark on the darted bear and ensuring that it is not recaptured. Once retrieved, each biopsy dart was checked to confirm the presence of an adequate tissue sample. Occasionally, a dart did not successfully collect a tissue sample or the dart could not be located, in which case the darting procedure was repeated. Each biopsy dart was then stored in a pre-labeled envelope with a unique sample ID. The samples were processed each evening to separate the skin from the fat portion of the sample. The skin sample was stored in a paper coin envelope, air-dried for a minimum of 24 hours in a warm and dry location and stored for subsequent DNA analysis. The fat portion of the sample was placed in a 2-cc Cryotube® and kept frozen for subsequent fatty acid, contaminant, or other analysis. DNA samples will be analyzed by Wildlife Genetics International (WGI) Inc. (Nelson, British Columbia, Canada). WGI will amplify DNA extracts at 20 microsatellite loci and the ZFX/ZFY sex identification marker (Aasen and Medrano 1990) using methods and primers as described by Paetkau (2003) and Kendall et al. (2009).

We recorded the following information for each bear encountered: date, time of sighting, time when pursuit began, time when darted, biopsy sample collected or not, biopsy label number, location when bear first seen (latitude, longitude), age class (COY, yearling, subadult, adult), age confidence (low or high), sex, sex confidence, body condition index (ranked 1-5 from poor to excellent condition, Stirling et al. 2008), topography (1=flat, 2=flat with pressure ridges, 3= mostly pressure ice and/or multi-year ice), habitat structure (interference with sightability where 1=low, 2=medium, 3=high), general habitat description, visibility/weather (1= excellent, 2=reduced, 3=poor), fecal sample collected or not, bear feeding or not, bear detected by tracks or not, and any additional comments. For any bear where sex or age confidence was uncertain, an alternate classification was also provided. As a convention, individuals field-aged as 2 year olds were classified as subadults because they were either already weaned or would be weaned in the next few weeks. Sexual dimorphism in polar bears is apparent by the time cubs are yearlings and sometimes as COYs. We recorded our impression of sex of COYs and yearlings based on size, but the field-identification of the sex of COYs and yearlings was reported as “unknown”. Photographs of polar bears were taken occasionally to support the field age classification. The field sex classification will be confirmed as part of the DNA analysis for all bears that were biopsied. All data records were entered into an Excel file and verified by both biologists each night to ensure that any errors or uncertainties were identified and corrected on the same day the samples were taken. Additionally the number of helicopter hours used for searching was recorded separately from time used for ferry flights. Datasheets are provided in Appendix III.

We also recorded georeferenced habitat type and all seal observations. Habitat type was recorded continuously along our flight path and a GPS position was recorded each time a habitat transition occurred. Reconnaissance sampling of the sea ice suggested that most of the Gulf of Boothia spring polar bear habitat could be classified as four sea ice categories. The four sea ice types were: SF= shore-fast ice, IP= inactive pack ice (large stable pans with few ridges), AP = active pack ice (many ridges and leads), BR = brash-ice/floe-edge (see Appendix II for photographic examples of these habitat types). The habitat and seal observations were also entered daily.

ESRI ArcGIS© software was used to produce a habitat map and to associate polar bear sightings and seal sightings to habitat types. Flight paths were converted into a series of points 100m apart with associated habitat type. We used supervised IDW (Inverse Distance Weighting) interpolation in ArcGIS Spatial Analyst to create the habitat types layer that was used to estimate habitat preference or avoidance by bears, seals and seal kills. The IDW method that we applied is not ideal for categorical data; we classified each habitat type in order of heterogeneity (1 for shorefast, 2 for inactive pack, 3 for active pack, and 4 for brash ice) and used these values in the IDW calculations. The resulting raster layer was therefore a continuous rather than categorical surface, which introduces artificial gradients between the habitat types (e.g. the sharply defined break between brash and shorefast ice at the shear zone).

The interpolated layer includes narrow bands of active/inactive pack ice. A nearest-neighbor interpolation approach for categorical data would be more appropriate. We used the same raster reclassification scheme as for the 2014 habitat layer, with cells of value 1 classified as shorefast, up to 2 as inactive pack ice, up to 3 as active pack ice, and greater than 3 as brash ice. Habitat areas were estimated using the North Pole azimuthal equal area projection centered over the study area (latitude of origin 70°N and central meridian 89°W) to maximize precision of area estimates.

Habitat preference or avoidance was estimated as the ratio of the observed number of individuals in a habitat type to the expected number assuming no preference or avoidance (i.e., total individuals/total area). Fisher's Exact Test was used to determine whether preference or avoidance was significant ($p<0.05$) by rounding the expected number to the nearest whole number. Logistic constraints prevented complete surveying of shorefast ice areas in the backs of some bays and inlets. The unsurveyed shorefast ice areas were mapped as shorefast ice, but these unsurveyed areas were not included in the preference/avoidance calculations.

All data collected were archived on multiple GN digital storage devices and all samples that were not sent to commercial laboratories for analysis are archived in the Wildlife Research Section tissue bank in Igloolik, NU.

2016 Results

The total number of hours spent searching for polar bears in Gulf of Boothia from April 20th to May 14th of 2016 was 106.2 hours. The total number of polar bears encountered was 161. Of the 161 sighted, 121 were sampled successfully (DNA sample confirmed). All bears darted provided sufficient tissue for DNA and fat samples. Most (34/40) of the bears that were not sampled were not sampled because they were COYs. Three of the bears sighted but not sampled (mother with 2 COYs) were not sampled because the weather was declining when they were sighted, and it was unsafe to dart them. Two adult bears were encountered but not sampled with a biopsy dart because they came to camp during the night and escaped before they could be darted. On both occasions, nose-prints were left on the helicopter and the nose-prints were sampled with swabs (results unknown at this time). One adult bear was not darted because it went into a lead and refused to come out, so the dart could not be recovered. The sex and age distribution of polar bears seen in the 2016 Gulf of Boothia survey is provided in Table1. Table 2 lists the percentage of adult females with COYs, yearlings or unencumbered as well as mean litter size of cubs of the year (COYs) and yearlings and their associated standard error. Table 3 lists the mean body condition and associated standard error for all sex and age groups.

Table 1. The field-estimated sex and age distribution of 161 polar bears seen in 2016 is listed.

Sex	**COYs**	**Yearlings**	**Subadults**	**Adults**	**All Ages**
Male		3	6	39	48
Female		3	12	52	67
Unknown	37	8	0	1	46
Total	**37**	**14**	**18**	**92**	**161**

Table 2. Total number of adult female with cubs of the year (COY), yearlings and unencumbered adult females seen during the 2016 survey. Also listed is the mean litter size of cubs of the year (COYs) and yearlings and their associated standard errors (SE). Proportion of COYs and yearlings in the population is indicated in square brackets.

	Female with COYs	**Female with Yearlings**	**Unencumbered adult females**	**Total**
Total number observed	24	10	18	52
Percentage of all adult females	46.2%	19.2%	34.6%	100%
Mean Litter Size (SE)	1.54 (0.10) [0.230]	1.40 (0.16) [0.087]	NA	

Table 3. The field-estimated mean body condition and associated standard error (SE) for all sex and age groups where and all age groups pooled is listed for groups where the field sex could be determined with high confidence.

Mean Body Condition	**COY**	**Yearling**	**Subadult**	**Adult**	**All Ages**
Male	NA	NA	3.0 (0.12)	3.3 (0.08)	NA
Female	NA	NA	3.0 (0.26)	3.0 (0.04)	NA
M & F & unk.	2.6 (0.08)	2.6 (0.13)	3.0 (0.11)	3.1 (0.05)	3.0 (0.04)

The distribution of sea ice types by area, and the observed and expected number of adult polar bears, seals and seal kills for each sea ice type are given in Table 4. In 2016, the highest density of polar bears was recorded in the "Active pack ice" habitat where more ridges and leads were present compared to the "Inactive pack ice." However in 2017, Inactive pack ice was preferred although the preference was not significant (p = 0.089) (Table 4). In 2017 the lowest densities of polar bears were observed in brash ice (Table 4), however the densities were only marginally less than expected from the null (no preference) model.

In contrast, in 2017 seals avoided both fast ice and inactive pack ice, and strongly preferred active ice and brash ice (Table 4). However, seal kills were distributed in proportion to habitat area using the IDW method to map sea ice habitats. The actual microhabitats where the kills were observed suggested that polar bears were using active ice microhabitats in inactive sea ice and were most successful hunting seals in active sea ice (Table 4). Shorefast ice had more seal kills than expected because polar bear densities were generally low on shorefast ice relative to other habitat types (Table 4). This result was influenced by sightings on 1 May 2016 of a shorefast ice area between Crown Prince Frederick and Baffin islands that had been heavily hunted for seal pups and adults.

We found differences between the distributions of seals and distributions of seal kills identified by IDW mapping and by actual microhabitat observations. We recorded microhabitats of polar bears as individual microhabitat descriptions rather than the 4 sea ice categories we used for seal and seal kills and to map the sea ice throughout the study area. For that reason, we could not compare microhabitat preference results with general mapping results for polar bears. The main difference between microhabitat and IDW methods for seal and seal kill distribution was that the microhabitat method picked up a significantly lower than expected frequency for seal kills on inactive pack ice and a significantly higher than expected frequency of seal kills in active ice (Table 4).

Figure 2 shows the helicopter search track. Figure 4 maps the distribution of habitat types and also includes the helicopter search track. Figure 5 maps the distribution of habitat types and shows the locations of polar bear sightings during our 2016 survey of the Gulf of Boothia subpopulation. Figure 6 shows the distribution of seal sightings on habitat type during our survey. Figure 7 maps the location of harvested polar bears for the last 5 years.

Table 4. The area of habitat types (SF= shore-fast ice, IP= inactive pack ice [large stable pans], AP = active pack ice [many leads and ridges], BR = brash-ice/floe-edge) in the Gulf of Boothia subpopulation area is listed. Also listed are the observed/expected number of polar bear sightings (excluding dependant COYs and yearlings), seal sightings and seal kills by habitat type. Preference/Avoidance was calculated as the ratio of observed to expected, and the Fisher's Exact Test probability (p value) of no preference/avoidance was calculated from the 2X2 contingency table of observed and expected (O & E) sightings for habitat type versus all other habitats pooled. Significant ($p \leq 0.05$) preference (O/E > 1) or avoidance (O/E <1) of habitat types are **bolded**. For seals and seal kills both simultaneous (actual) observations of habitat type, and habitat type as assigned by the Interpolated Distance Weighting (IDW) sea ice map were included.

Habitat Type	**SF**	**IP**	**AP**	**BR**	**TOTAL**
Habitat Area (km^2)	20,907	20,189	17,589	10,690	69,375
IDW Polar Bear Sightings (O/E)	37 / 46	59 / 44	39 / 38	16 / 23	151
O/E Ratio (p value)	0.813 (0.302)	1.343 (0.089)	1.019 (1.0)	0.688 (0.303)	
Actual Seal Sightings (O/E)	83 / 144	21 / 139	248 / 121	125 / 74	477
O/E Ratio (p value)	**0.577 (<0.001)**	**0.151 (<0.001)**	**2.051 (<0.001)**	**1.701 (<0.001)**	
IDW Seal Sightings (O/E)	66 / 146	106 / 141	209 / 122	102 / 74	483
O/E Ratio (p value)	**0.453 (<0.001)**	**0.754 (0.012)**	**1.707 (<0.001)**	**1.370 (0.024)**	
Actual Seal Kills (O/E)	27 / 26	10 / 25	35 / 22	15 / 13	87
O/E Ratio (p value)	1.030 (0.740)	**0.395 (0.008)**	**1.587 (0.052)**	1.119 (0.837)	
IDW Seal Kills (O/E)	28 / 28	30 / 27	25 / 23	9 / 14	92
O/E Ratio (p value)	1.010 (1.0)	1.121 (0.750)	1.072 (0.864)	0.635 (0.373)	

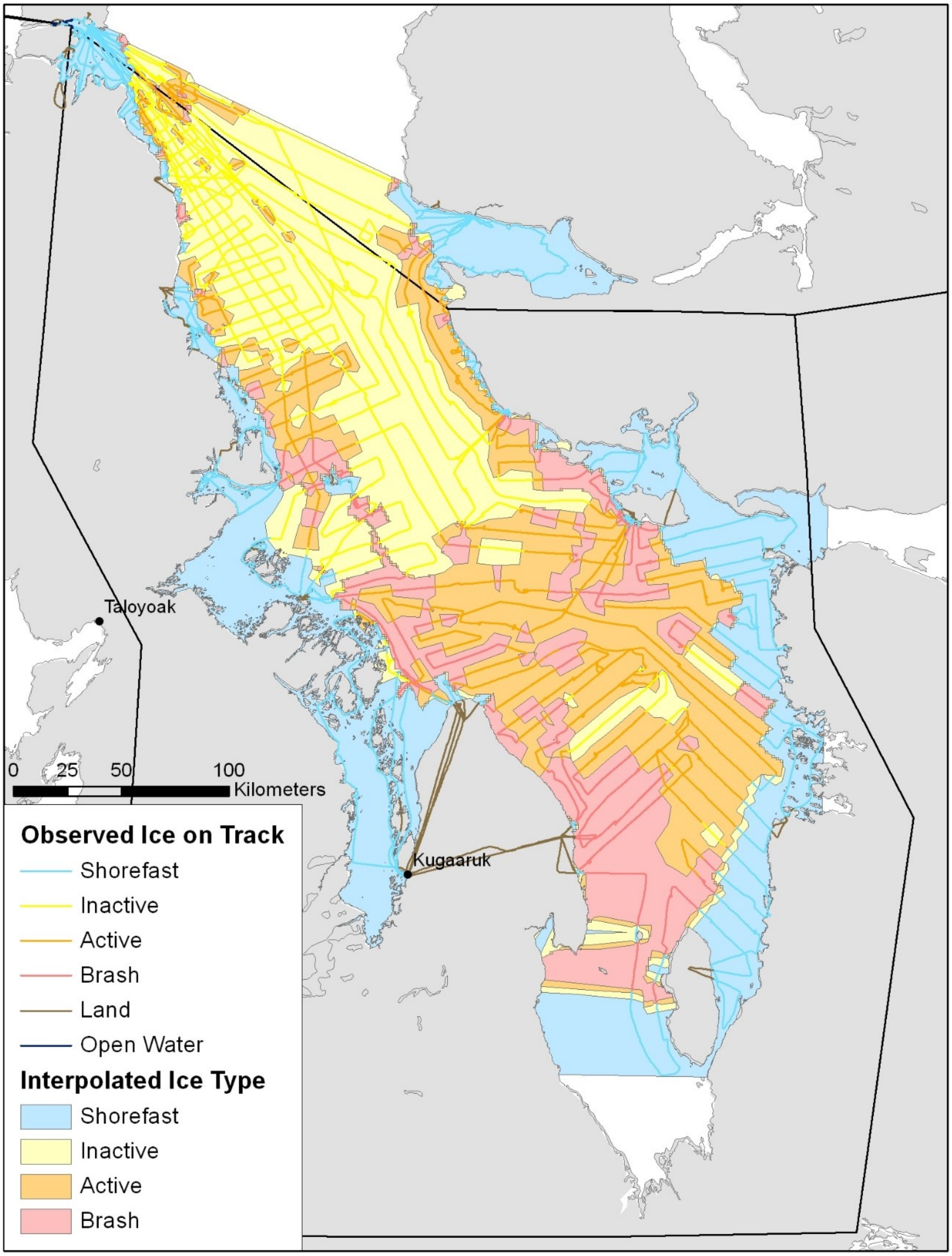


Figure 4. Habitat classification recorded along helicopter flight path (line colours correspond to habitat types) and resulting habitat classification through the whole Gulf of Boothia subpopulation area using IDW interpolation.

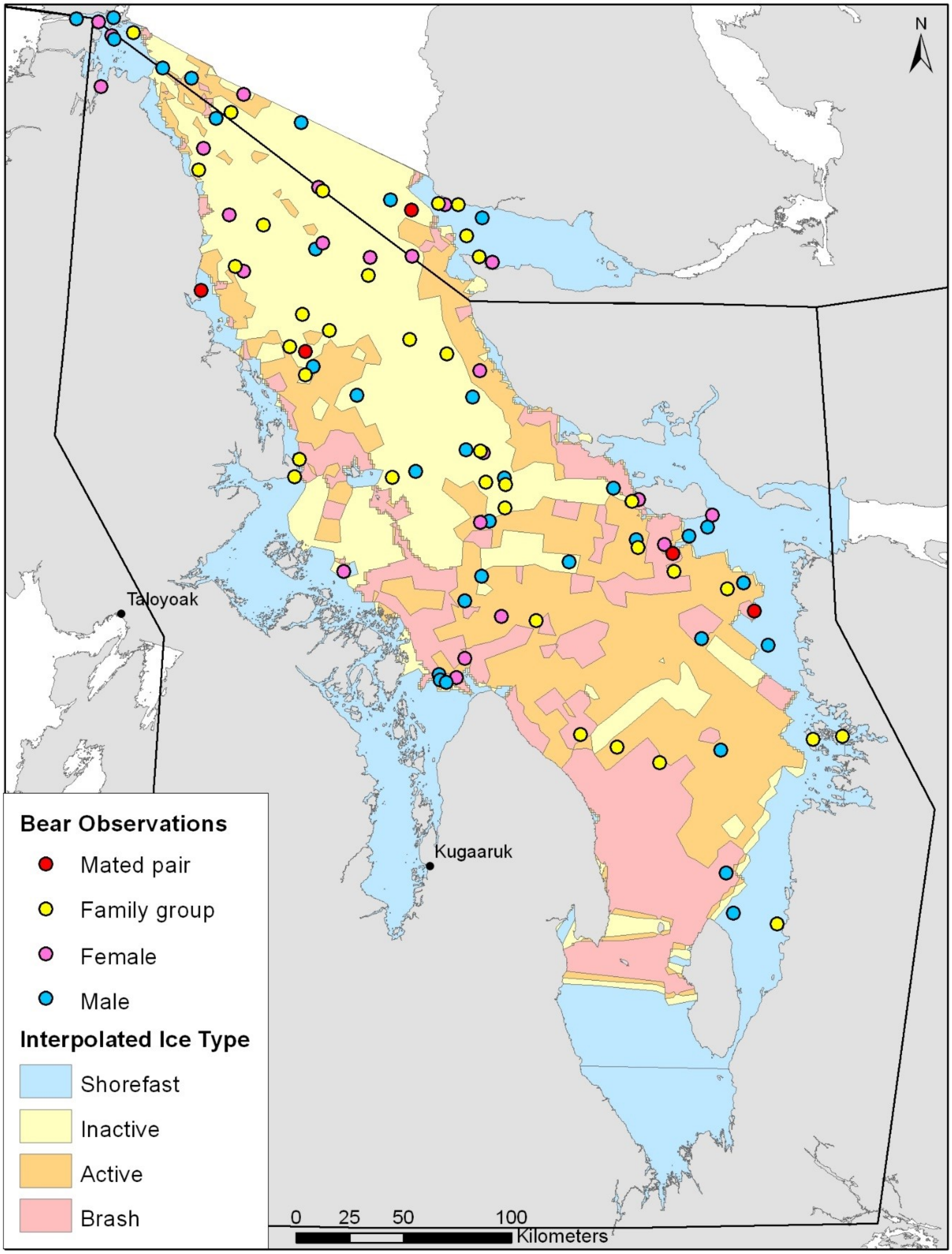


Figure 5. The distribution of habitat types and the locations of polar bear sightings during our 2016 survey of the Gulf of Boothia subpopulation are depicted.

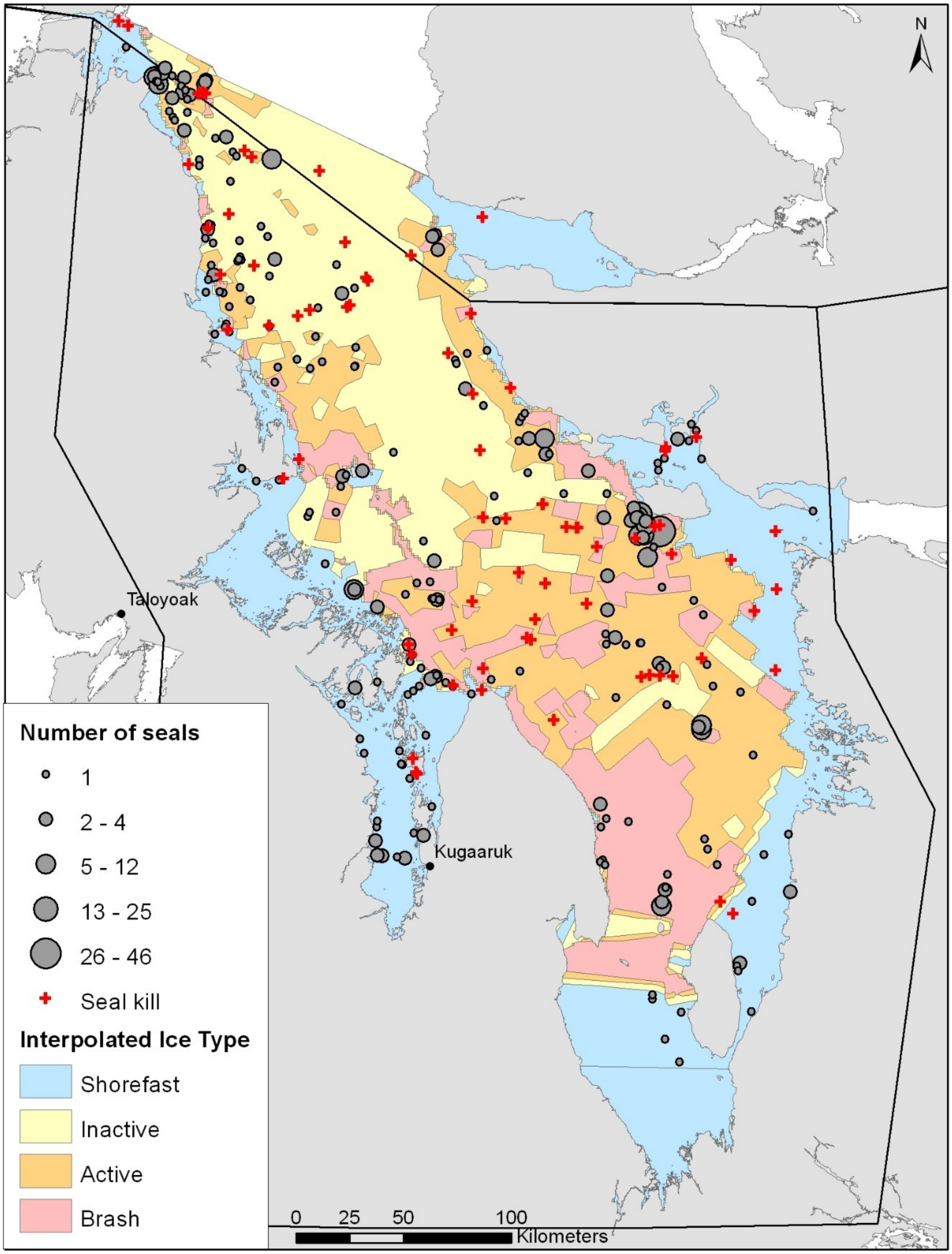


Figure 6. The distribution of habitat types and the locations of seal sightings during our 2016 survey of the Gulf of Boothia subpopulation are depicted.

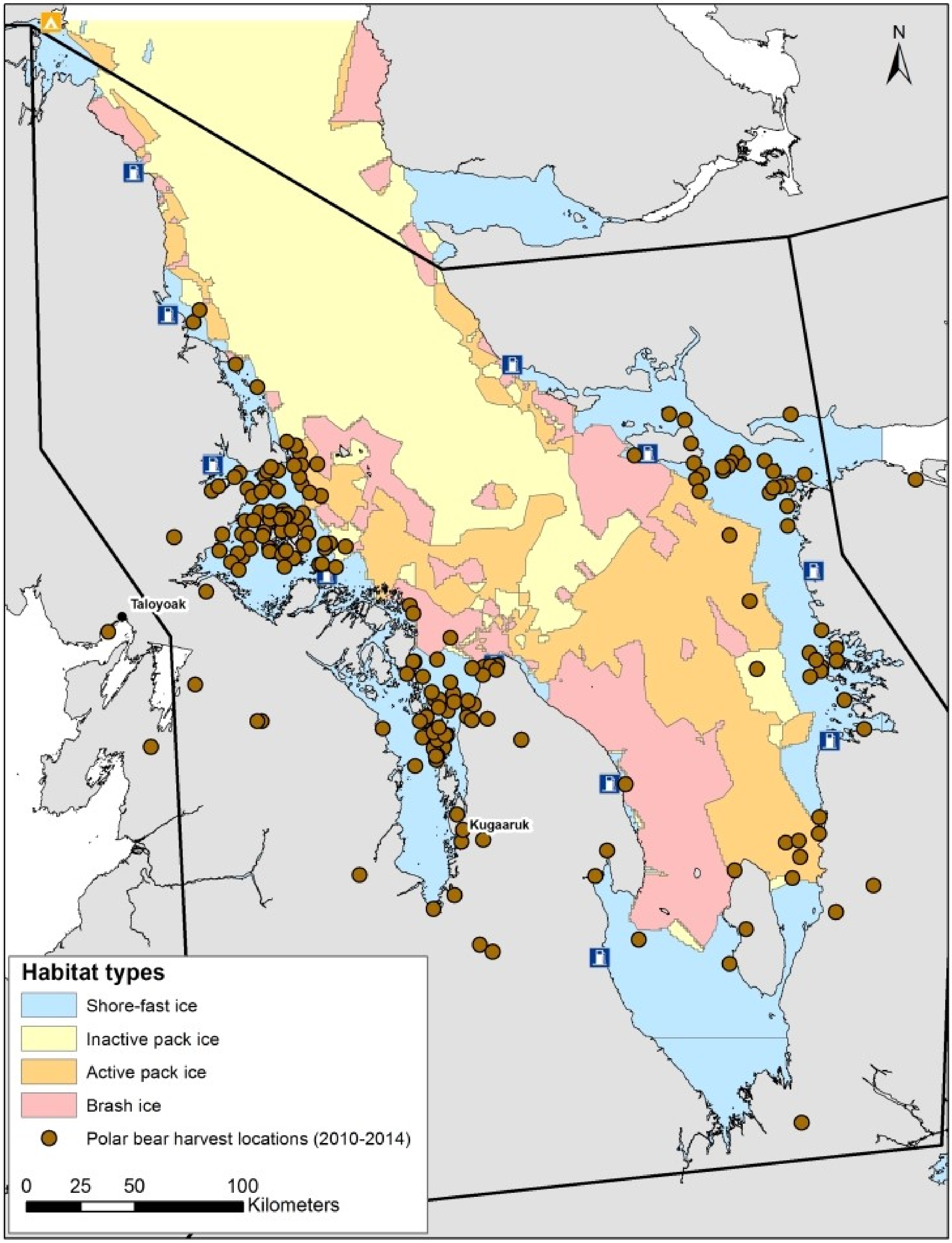


Figure 7. The distribution of polar bears harvested from Gulf of Boothia between 2010 and 2014 is mainly restricted to the shore fast ice (habitat layer for 2015 field season shown).

Discussion

2016 was the second year of a three year study that is planned to conclude field work in spring 2017. Thus no quantitative conclusions on polar bear numbers or the trend of the Gulf of Boothia subpopulation are possible at this time. However, qualitative observations of polar bear densities and sea ice conditions do not suggest a decline in numbers, poor body condition, or discernable loss of spring sea ice in this area for the past two years. Polar bears were generally in good condition (Table 3). Females with COYs were under-represented in our 2015 sample, but occurred more frequently in the 2016 capture sample. This suggests reproductive synchrony, but the data are currently insufficient to determine if this is a regular phenomenon in Gulf of Boothia, or just a response to variable environmental conditions.

A qualitative impression of the sea ice dynamics in Gulf of Boothia (Figure 4) suggests a relatively consolidated sea ice mass that extends from Bernier Bay south to Fury and Hecla Strait, and is bounded east and west by shore fast ice. Movement of the central ice mass against the shore fast ice and a similar central ice mass in Prince Regent Inlet create a shear zone that can vary from a few kilometers in width to a 15-20 km band of brash ice, open water, and small floes. The shear zone provides an effective sanctuary for polar bears on the central ice mass from Inuit hunters because hunters have no possibility to cross the shear zone with a snow-machine or dog team. The northern shear zone between Gulf of Boothia and Prince Regent Inlet may provide a barrier for movements between the Gulf of Boothia and Lancaster Sound subpopulations (Taylor et al. 2001) Polar bear hunting in Gulf of Boothia occurs almost exclusively on the Gulf of Boothia shore fast ice (Figure 7).

Although polar bears appeared to be abundant and in good condition in Gulf of Boothia, the subjective opinion of the 2016 capture team and the capture rate per hour searching in both 2015 and 2016 did not suggest that population numbers had almost doubled since the 1998-2000 estimate as suggested by the York (2014) PVA projections. The observed body condition (quite good for polar bears just prior to the hyperphagic period) does not suggest a nutritional limitation to Gulf of Boothia population numbers. However, socially-mediated density effects (e.g., increased cub mortality from intra-specific predation) could explain the relatively low litter size for COYs and yearlings as density-restricted population growth.

As discussed in the 2015 field report, our identification of sea ice habitat types was qualitative and ad hoc. Certainly other habitat classification schemes could be identified. Our choice of categories was deliberately coarse grain so that observations made during polar bear search operations could be made quickly and accurately, and to maximize the likelihood that we could identify differences in habitat use. However, we found the sea ice categories identified from the 2015 field season to be useful descriptors of sea ice in 2016. This was our second field season, so quantitative and definitive consideration of the annual variability in habitat distribution or habitat use by polar bears and seals was not possible. We were not able to confirm our 2015 results that polar bears avoided shore fast ice and preferred active pack ice. None of the preference/avoidance habitat measures were significant for polar bears in 2016, although a preference for inactive pack ice was nearly significant. In contrast, all preference and avoidance measures for seals were significant and consistent for both the microhabitat and IDW methods for assigning habitat types to seal observations. Active pack ice and brash ice were preferred by seals and fast ice and inactive pack ice were avoided by seals in 2016. Active pack ice had a higher than expected number of seal kills using both the IDW and microhabitat methods, but Inactive pack ice had a higher than expected seal kill frequency using the IDW method, but a low frequency of seal kills using the microhabitat method. We interpret this difference as selection for microhabitats of active ice within larger regions of inactive ice by polar bears for seal hunting.

All observed polar bear hunter activity occurred on the shore fast ice because it was not feasible to cross the brash ice that separated the shore fast ice from the active pack ice. Polar bears probably avoided the shore fast ice in order to minimize encounters with hunters. Seals (mostly ringed seals) preferred the more active pack ice and brash ice in 2016, perhaps because it was the most stable sea ice. Seal kills were the least frequent on the stable portions of the inactive pack ice, probably because polar bears were clearly most successful hunting active ice in 2016. Although brash ice was not preferred by bears or seals, brash ice had a higher (but not significantly higher) expected frequency of seal kills. We observed that polar bears had difficulty moving in the brash ice because it was so rough and broken and drifted with deep, soft snow. Open water and recently re-frozen leads were common in the unconsolidated brash ice (Appendix II). We wondered why so many kills had occurred in an area that was not preferred by bears or seals, and with so many options for breathing holes and haul-out locations? We hypothesize that seals may use the same breathing holes and haul outs rather preferentially, which would make them more predictable to the bears. The high structural heterogeneity of this habitat might also make it more difficult for seals to detect polar bears. These habitat data are insufficient and too preliminary to resolve these interpretations, but identifying significant habitat preference for both bears and seals suggests that our choice of sea ice categories did identify functional habitat types.

In summary we found both methodology issues and between year inconsistencies that made it difficult to offer a general description of polar bear and seal habitat use with confidence. We suggest that the microhabitat approach to characterizing sea ice when a bear, seal or seal kill is sighted may produce more reliable and repeatable results. However the inter-annual variability and seasonal variability in sea ice poses a significant challenge to identification of a cohort of sea ice categories that would be sufficient to capture the types of habitat present, yet simple (few categories) enough to allow a meaningful analysis with the sample sizes that are possible.

Community Involvement

Following consultation meetings in 2014, the project received support from the Kurairojuark HTA (Kugaaruk), Spence Bay HTA (Taloyoak), Igloolik, Hall Beach and Repulse Bay. Four members from Spence Bay HTA and three members from Kurairojuark HTA participated in the fieldwork out of Fort Ross and Kugaaruk respectively. Unfortunately HTO members from Igloolik were not able to be involved this season, because weather prevented the helicopters from reaching Igloolik.

Literature Cited

Aasen, E. and J. F. Medrano. 1990. Amplification of the ZFY and ZFX genes for sex identification in humans, cattle, sheep and goats. Biotechnology 8:1279–1281.

Barber, D. G. and J. Iacozza. 2004. Historical analysis of sea ice conditions in M'Clintock Channel and Gulf of Boothia; Implications for ringed seal and polar bear habitat. Arctic. 57:1–14.

Calvert, W. and M. A. Ramsay. 1998. Evaluation of age determination of polar bears by counts of cementum growth layer groups. Ursus 10:449–453.

Chambers G. K., C. Curtis, C. D Millar, L. Huynen2 and D. M. Lambertal. 2014. Investigative Genetics. 5 (3) 1-11.

Furnell, D. J., and R. E. Schweinsburg. 1984. Population dynamics of central Arctic polar bears. Journal of Wildlife Management 48:722–728.

Jeffreys, A.J. 2005. Genetic fingerprinting. Nature Medicine. 11:1035–1039.

Kendall, K. C., J. B. Stetz, D. A. Roon, L. P. Waits, J. B. Boulanger and D. Paetkau. 2009. Grizzly bear density in Glacier National Park, Montana. Journal of Wildlife Management 72:1693–1705.

Malenfant, R. M., C. S. Davies, C. I. Cunningham, and D. W. Coltman. 2016. Circumpolar genetic structure and recent gene flow of polar bears: a reanalysis. PLoS ONE 11(3): e0148967. Doi:10.1371/journal.pone.0148967

Paetkau, D., S. C. Amstrup, E. W. Born, W. Calvert, A. E. Derocher, G. W. Garner, Messier, I. Stirling, M. K. Taylor, Ø. Wiig and C. Strobeck. 1999. Genetic structure of the world's polar bear populations. Molecular Ecology 8:1571–1584.

Paetkau, D. 2003. An empirical exploration of data quality in DNA-based population inventories. Molecular Ecology 12:1375–1387.

Pagano, A. M., E. Peacock, M. A. McKinney. 2014. Remote biopsy darting and marking of polar bears. Marine Mammal Science 30: 169-183.

Schweinsburg, R. E., D. J. Furnell and S. J. Miller. 1981. Abundance, distribution, and population structure of polar bears in the lower Central Arctic Islands. Wildlife Service Completion Report Number 2. Government of the Northwest Territories, Yellowknife, Northwest Territories, Canada.

Schweinsburg, R. E., L. J. Lee and P. B. Latour. 1982. Distribution, movement, and abundance of polar bears in Lancaster Sound, Northwest Territories. Arctic 35:159– 169.

Stirling, I., C. Spencer and D. Andriashek. 1989. Immobilization of polar bears (*Ursus maritimus*) with Telazol in the Canadian Arctic. Journal of Wildlife Diseases 25:159–168.

Stirling, I., G. W. Thiemann, and E. Richardson. 2008. Quantitative support for a subjective fatness index for immobilized polar bears. Journal of Wildlife Management 72: 568-574.

Taylor, M. K., S. Akeeagok, D. Andriashek, W. Barbour, E. W. Born, W. Calvert, S. Ferguson, J. Laake, A. Rosing-Asvid, I. Stirling and F. Messier. 2001. Delineating Canadian and Greenland polar bear (*Ursus maritimus*) populations by cluster analysis of movements. Canadian Journal of Zoology 79:690–709.

Taylor, M.K., Laake, J., McLoughlin, E.W., Cluff, and Messier, F. 2009. Population demography and conservation of polar bears in Gulf of Boothia, Nunavut. Marine Mammal Science. 25(4): 778-796.

Taylor, M. and Lee J. 1995. The distribution and abundance of Canadian polar bear populations: a management perspective. Arctic. 48: 147-154.

York, J., Dowsley, M., Cornwell, A., Kuc, M., and Taylor, M. K. in review. Demographic and Traditional Knowledge Perspectives on the Current Status of Canadian Polar Bear Subpopulations. Submitted for publication in Ecology and Evolution.

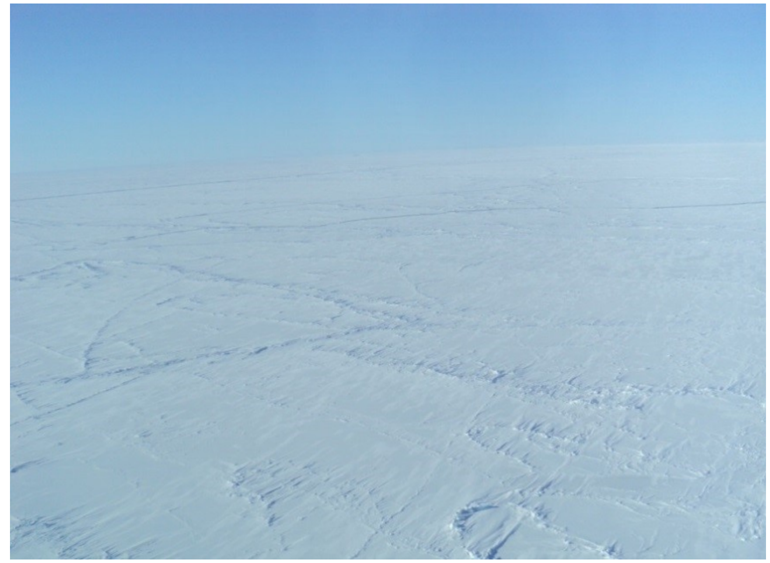
Appendix I. Number of captures and recaptures of bears classified by sex and age for Gulf of Boothia polar bears (1976-2000). Initial captures are shown for each year; recaptures are shown for the period 1998-2000 as 'initial captures/recaptures'.

	1976	1977	1978	1986	1987	1994	1995	1996	1998	1999	2000	Total
Female												
Cub	6	5	5	1	0	0	2	0	19	10	20	68
Yearling	3	3	0	0	0	0	4	0	10	7/2	11/2	38/4
2 yr	0	2	0	0	0	1	0	0	4	2	0	9
3 yr	2	2	0	0	0	0	0	0	1	10	5/1	20/1
4 yr	2	1	0	0	0	0	0	0	4	9/1	5/2	21/3
5–9 yr	9	10	3	2	0	1	1	0	21	13/5	17/6	77/11
10–14 yr	1	9	0	0	0	0	2	1	16/1	15	17/1	61/2
15–19 yr	2	0	1	0	0	1	1	1	7	12/1	4/4	29/5
20+ yr	1	0	0	0	0	0	0	0	5/1	7/1	4/1	17/3
Total	26	32	9	3	0	3	10	2	87/2	85/10	83/17	340/29
Male												
Cub	5	3	1	0	0	0	2	0	15	10	18	54
Yearling	1	2	0	0	0	0	1	0	6	16/3	6/1	32/4
2 yr	3	6	0	0	0	1	0	1	6	5/1	5/1	27/2
3 yr	1	1	0	1	0	0	0	0	1	4/1	4/1	12/2
4 yr	2	0	2	0	0	0	0	0	4	3	5/1	16/1
5–9 yr	1	4	5	0	1	0	2	0	10	9/4	18/1	50/5
10–14 yr	6	7	3	0	0	0	1	0	14	15/1	10/3	56/4
15–19 yr	4	3	1	0	0	0	0	1	7	4/1	7/2	27/3
20+ yr	1	7	0	0	0	0	0	0	5/1	2/1	1/3	16/5
Total	24	33	12	1	1	1	6	2	68/1	68/12	74/13	290/26

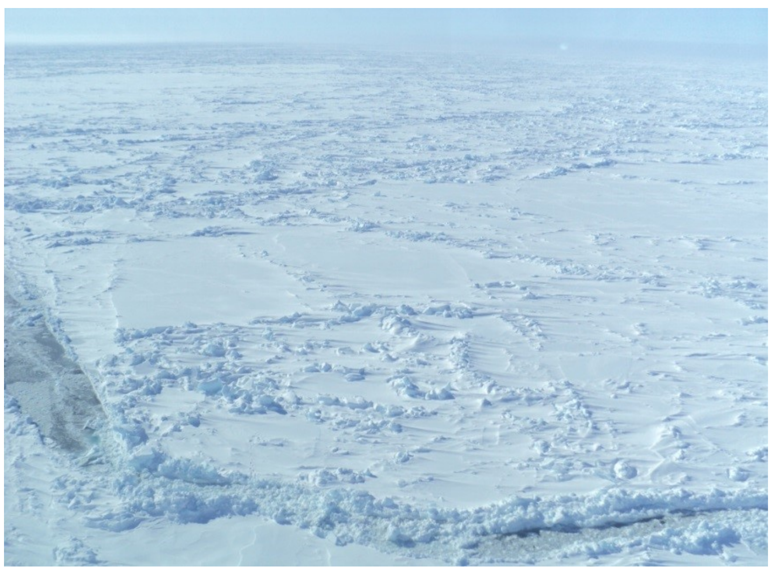
Appendix II Photographs of the four different sea ice categories recorded during the 2015 and 2016 Gulf of Boothia polar bear surveys: A) Shore Fast Ice (SF), B) Inactive Pack Ice (IP), C) Active Pack Ice (AP), and D) Brash Ice/ Floe Edge (BR).

A)

B)



C)



D)

GB Polar Bear Biopsy Spring 2016

Appendix III. Field datasheet for recording observations of polar bears. Date:________________2016

Region/Location_________________________ Page:____ of ____ Project Lead: M. Dyck

Daily Record Number	Time bear(s) seen	Start pursuit	Time darted	Biopsy (Y/N)	Biopsy Label	Way-Point	Age Class	Conf AC	Sex	Conf Sex	BCI	# in Grp	Topo (sea-ice).	Structure	General habitat Description	Visibility/ Weather	Poop (Y/N)	Feed Y/N	Comment*

Way Pt Locn: Record a waypoint where bear was first spotted
Age class: AD, SA, COY, YRL, IND
Sex: M, F, U (Unknown)
Confidence (subscript noted with Age and Sex): a – positive; b – probable
Body condition (1-5): 1 (poor); 3 (average); 5 (fat)
Feeding – is bear on a seal kill when spotted
Poop – shit collected from this bear? – put label with same ID in shit bag

Topography (sea-ice): flat -1; mostly flat with few pressure ridges – 2; multiyear ice chunks and lots of pressure ice-3
Habitat structure: within 30 m radius obstructing visibility, such as rocks, snow fields, ridges; Low -1; moderate -2; high -3
General habitat: along lead? Flat ice? On pressure ridge? Open water?
Visibility: 1 – excellent; 2 – reduced; 3 – poor (note also specific weather conditions like fog, very cloudy, rain, snow, clear, etc.)

Entered into data base:
Date:_________

By:_________

Need L-#s

More comments:

NOTES FOR THE DATA SHEET:

1. EVERY DAY START WITH A NEW DATA SHEET; I.E. SO THAT WE HAVE CAPTURES AVAILABLE PER DAY – IF THERE ARE MORE BEARS CAPTURED IN A DAY THAN FIT ON THE SHEET OBVIOULSY HAVE ADDITIONAL SHEETS FOR THAT DAY.
2. WRITE DOWN TIME OF WHEN BEAR WAS SEEN
3. Write down time when direct pursuit of bear began for the darting process – i.e., after the crew has been dropped off, and heli begins to follow bear in approach to dart
4. Write down time when bear was darted to examine length of pursuit time frame
5. Abort pursuit if bear has to run at fast pace for >2 mins and is heavily panting
6. WAS IT BIOPSIED? Y-N
7. REMEMBER THAT EACH BEAR NEEDS TO GET AN L-NUMBER ASSIGNED FOR RECORD KEEPING AND STORAGE OF SAMPLES -assigned by Lab staff
8. POOP – THIS INDICATES WHEN WE COLLECT FECAL SAMPLES OF THE BEAR BIOPSIED FOR HEALTH ANALYSIS AND BACTERIAL INTERNAL FAUNA
9. Feeding? Y/N – if the bear was encountered on a seal kill or feeding on something, what is it feeding?
10. Comment section for each row – if any of the age class or sex is a confidence level b the comment section MUST have an alternative explanation for what the individual bear could have been besides of what has been assessed (this will help later with the genetic data and field data to tease apart the individual bear)