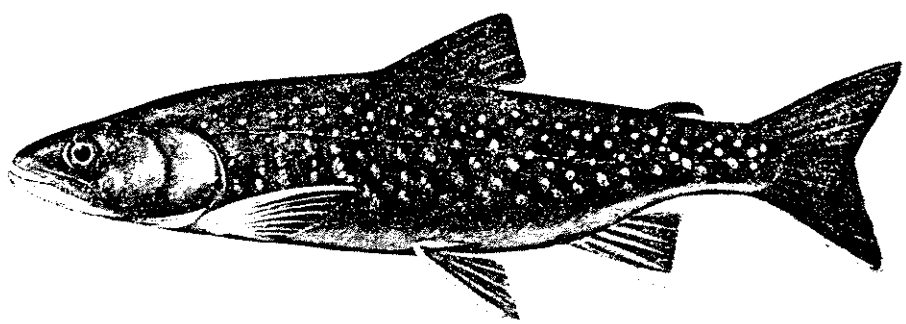
ᐃᖅᑲ ᓗᑉᐱᒃ

Anadromous Arctic Char

Salvelinus alpinus (Linnaeus)



L'Omble chevalier

ᑰᑦᔪᐊᖅ - 1982 - KUUJJUAQ

ᐃᖅᑲᓗᐱᑦ ᑕᕆᐅᓂᐊᖅᑕᑐᑦ ᑯᐸᐃᑉ ᑕᖅᕋᖕᒐᓂ

ANADROMOUS ARCTIC CHAR IN NORTHERN QUÉBEC

L'OMBLE CHEVALIER ANADROME AU NOUVEAU-QUÉBEC

ᑕᓇ ᖃᐅᔨᓴᕐᓂᖅ ᑭᓇᐅᔭᖃᕐᑎᑕᐅᓂᖃᓪᓚᐅᕐᐳᖅ ᐃᓄᐃᑦ ᐅᒪᔪᕐᓱᐅᓂᕐᒧᑦ, ᐃᖃᓗᑦ-ᓱᐅᓂᕐᒧᑦ, ᐊᒪᓗ ᑭᒥᒥᐊᕐᓂᐊᓂᕐᒧᑦ ᓴᐳᒥᔭᐅᓂᖓᑕ ᐱᓇᓱᐊᕐᓂᖓᓄᑦ. ᑕᑦᓱᒪ ᖃᐅᔨᓴᕐᓂᐱᓂᐅᑉ ᐊᓚᑕᐅᒪᐅᓯᖓᑕ ᐊᑦᔨᖏᑦ ᐱᔭᐅᒍᒪᒍᑎᒃ ᐊᑐᐃᓇᐅᕙᑦ ᐊᑭᖏᕐᓗᑎᒃ ᐃᓄᓄᑦ ᑯᐸᐃᒃ ᑕᑦᑐᖓᓂ ᐊᒪᓗ ᐊᓯᖏᓄᑦ ᐱᒍᒪᔪᓄᑦ ᐊᑭᓕᐅᕐᑕᖏᓂ ᐊᑭᖃᕐᑎᓗᒥᑦ.

ᐊᑦᔨᖏᓂ ᐱᔪᒪᒍᑦᓱ ᐅᕙᓗᓂᑦ ᖃᐅᔨᒥᐊᓚᒍᒪᒍᑦᓱ ᐅᐸᕗ ᖃᐅᔨᒥᐊᕐᓗᓱ :

ᑲᑎᕕᒃ ᓄᓇᓕᓕᒫᑦ ᑲᕙᒪᖓ
P.O. Box 09
ᑯᑦᔪᐊᖅ, ᑯᐸᐃᒃ
J0M 1C0

ᓴᒥ ᐃᑯᒥᐊᒃ / ᒪᐃᑯ ᐱᐊᕋᑦ
819-964-2961

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For copies or further information contact :

Kativik Regional Government
P.O. Box 09
Kuujjuaq, Quebec
J0M 1C0

Sammy Ekoomiak / Michael Barrett
819-964-2961

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Administration régionale Kativik
C.P. 09
Kuujjuaq, Quebec
J0M 1C0

Sammy Ekoomiak / Michael Barrett
819-964-2961

LIFE HISTORY AND PRESENT STATUS OF ANADROMOUS ARCTIC CHAR *(Salvelinus alpinus L.)* IN NORTHERN QUÉBEC

WITH CASE STUDIES ON THE GEORGE, PAYNE AND KOVIK RIVERS

by

David J. Gillis, Marc Allard and William B. Kemp
(Makivik Corporation Research Department)

Presented to:

Kativik Regional Government
Inuit Hunting, Fishing and Trapping Support Program

September
1982

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ᖃᐅᔨᓴᐅᓯᒪᔪᑦ ᐊᒪᓗ ᖃᓄᐃᓕᖕᒍᑎᑦ ᓴᐅᔪᑎᓴᐅᔪᑦ

ᐃᖃᓗᐱᒃ ᐱᒪᑎᐅᖃᑕᓯᒪᔪᖅ ᐊᒻᒪ ᐱᒪᑎᐅᕐᓇᖅᑐᖅ ᓯᕋᒪᐃᑦᑐᓯᓂ ᐱᐅᓯᖃᕈᑕᐅᑦᓯᓂ ᐃᓄᓇᓯᐊᕈᑕᐅᔪᖅ ᑯᐸᒃ ᑕᕐᕋᖕᓚᑕ ᐃᓄᕐᓗᑦ. ᑕᓇ ᓵᓚᓗᑦ ᐃᓚᑦᓴᔭᑎᔭᐅᑦᓯᓂ ᑯᐸᒃ ᑕᕐᕋᖕᓚᑕ ᑰᕐᓂ ᐊᒻᒪ ᑕᓯᕐᓂ ᐃᓂᖅᑐᖅ ᑕᓯᕐᓂ ᐊᕐᓂᕐᓂ ᐃᑎᓂᕐᓂᒧ ᐅᑭᐅᕐᓯᐅᕆᓇᐋ-ᒥᔭᒥᓂ ᒪᕆᐃᓚᑎᐅᑦᓯᑎᒃ ᐊᑦᕗᒥᕐᓂᕐᑦ ᑕᑯᐊ ᐃᖃᓗᐱᑦ ᓇᓗᓇᐃᕐᑕᐅᒪᕗᑦ ᐃᑉᐱᒥᑦᓯᒥᑦ ᐱᐅᓯᑎᔭᕐᑦ ᐊᒻᒪ ᓯᑯᑦᓯᒥ ᐃᓂᖃᑕᓂᕐᑦ. ᐱᒪᑎᐅᓂᕐ ᐸᐅᔭᑦ ᐊᕐᓂᕐᓴᐃᑦ ᐱᕆᕆᐊᕐᑐᐃᑦ ᐃᖃᓗᐱᑦ ᒪᔭᕐᑕᑐᑦ ᑕᑎᐅᓕᐊᕐᑕᓯᑎᓗ ᑕᑯᑦᓴᐅᔭᑦ ᑕᓯᕐᓂ ᐊᒻᒪ ᑰᓐᓂ ᑕᑎᐅᒧᓕᖕᔭᓂ. ᐊᐃᐸᐃᕐᑦ ᐊᕐᓕᔪᐊᕐᓂᕐᓴᐃᑦ ᑕᑎᐅᓕᐊᕐᑕᕐᑦᑐᑦ ᐃᖃᓗᐱᑦ. ᑕᑯᐊ ᑕᑯᑦᓴᐅᔭᑦ ᐃᒪᕐᓂ ᑕᑎᐅᒧᐊᖕᓂᖃᓕᑎᕐᑐᓂ ᓴᕐᕿᖃᕐᑐᓂ ᐅᕿᓗᓂᑦ ᐊᓯᕐᓂ ᐊᕐᐋᐊᓗᑕᖃᕐᑐᓂ ᐃᖃᓗᐱᑦ ᑕᑎᐅ-ᓕᐊᕐᓂᓴᕐᓄᑦ.

ᑕᑯᐊ ᒪᕐᕈᐃ ᐃᖃᓗᐱᑦ ᑕᐃᒪᖕᓂ ᐱᒪᑎᐅᓂᖃᕐᑐᑦ ᓂᕿᒥᔭᐅᑦᓯᑎᒃ ᐊᒻᒪ ᐱᐅᓯ-ᑐᖅᖃᕆᑕᐅᑦᓯᑎᒃ ᐃᓄᓄᑦ. ᐃᖃᓗᐱᓂᐊᕐ ᐋᑦ ᐱᒪᑎᐅᕙᑐᐋᓂᑦ ᐱᓂᐊᕐᑕᐅᓂᕐᑦ ᓇᓕᐅᑎᑕ-ᑎᓗᒥᑦ ᑯᐸᒃ ᑕᕐᕋᖕᓂ ᐊᒻᒪ ᓂᕿᑦᓴᓂᐊᕐ ᐋᓚᑎᐅᓂᕐᑦ ᒪᓇ ᓄᓇᓕᐅᓕᕐᑐᓄᑦ ᐱᒥᐊᕐ ᐸ-ᓕᐊᕐ ᐋᐅᓕᕐᑐᓂᑦ.

1960 ᐱᒥᐊᖅᑲᒥᐅᑎᓗᒥᑦ ᕿᓇᐅᔭᓕᐅᕆᑎᑦᓴᐅᓯᑎᒃ ᐃᖃᓗᓂᐊᓂᑦ ᐱᒥᐊᕐᑐᐋᓂᑦ ᑲᐸᒪᓄᑦ ᐃᑲᔪᕐᓯᒪᒍᑕᐅᒐᓯᐊᕐᓯᓂ ᓇᒥᓂᖅ ᒪᕿᑕᒍᓇᒐᓯᐊᕐᓂᐅᐸ ᐱᐸᓕᐊᓂᑦ ᓴᖕᓗᑦ. ᐅᖕᓓᒥ ᑰᒪᑎᐅᓂᑦ ᕿᓇᐅᔭᓕᐅᕆᑎᑦᓴᐅᔪᓂ ᐃᖃᓗᓂᐊᑕᐅᒍᓇᑐᑦ ᖃᓄᐃᓗᐊᑎᒥᒥᐊᖅᑲᕐᒪᖕᑕ ᐊᕿᐋᐅᔭᐋᓂᑦ, 30,000-ᓂ ᐅᖁᒪᐃᓂᖅᑲᕐ ᐸᑎᓗᒥᑦ ᐊᒻᒪ ᓴᓗᒪᓴᐃᓂᖅ ᐊᒻᒪ ᖁᐊᕐ-ᑎᓯᓂᖅ ᐃᖃᓗᓂ ᐊᐅᓚᑎᑦᑕᑦᓴᐅᔭᓂ. ᕿᓯᐊᓂᓕ ᑕᒪᓇ ᕿᓇᐅᔭᓕᐅᕆᑎᑦᓴᐅᔭᓂ ᐃᖃᓗᓂ-ᐊᓂᖅ ᐃᓇᕐᓕᐅᕐᓕᖅ ᒪᓇ ᑲᔭᓯᔭᒥ ᐃᓄᓇᓯᐊᕐᓂᒧᑦ ᓂᕿᑦᓴᑕᕐᓂᒥ. ᐊᒻᒪᑦ ᑕᐅᖅ, ᓄᓇᓕᑦ ᑕᓚᓂᑦ ᓴᐃᓇᕐᓂᓴᐅᓕᕐᓂᖁᑦ ᐊᒻᒪ ᓂᕿᑦᓴᑕᕋᓯᐊᕐᓂᒧᑦ ᐱᐅᓯᑐᖃᐃᑦ ᐊᓯᑦᐹ-ᐸᓕᐊᓯᑎᓗᒥᑦ. ᑕᒪᑯᐊᓕᒪᑦ ᐱᐅᓯᑐᖃᐃᑦ ᐊᓯᑦᐹᐸᓕᐊᓂᕐᑦ ᐱᑦᔭᑕᐅᐸᓕᐊᓕᕐᓂᖁᑦ ᐃᖃᓗᐃᑦ ᐊᒥᓯᓂᕐᓴᒪᑎᑦ ᐱᔭᐅᖃᑕᓕᕐᓂᕐᓄᑦ ᐊᒻᒪ ᑕᒪᑯᐊ ᐊᒥᓯᑦ ᐱᐅᓯᑐᖃᑦ ᐊ-ᑐᕐᑕᐅᐸᑦᑐᐋᓂᑦ ᓯᓚᑐᑐᐊᕐᑐᒥ ᐱᓗᐊᑎᑯᑕᐅᑦᓯᑎᒃ ᐊᑐᕐᑕᐅᔪᓇᐃᓕᕐᓯᑎᒃ.

ᒪᓇᐅᑎᓗᒍ ᐃᖃᓗᐱᑦ ᒪᕙᖅᑕᑐᑦ ᑕᑎᐅᓕᐊᖅᑕᓯᑎᓗ ᑕᒪᓂ ᓄᓇᒥ ᐃᖃᓗᑦᓯᑎᒃ ᐱᒪᑎᐅᓂᖅ ᐸᐅᕗᑦ. 1976-ᓘ 1980-ᐅᓗ ᐊᑯᓂᖏᓂ, ᐃᖃᓗᐱᑦ ᐱᔭᐅᕙᕕᓂᑦ 13-ᓂ ᐃᓄᐃᑦ ᓄᓇᓕᖅᑯᑎᖏᓂ ᐊᖅ ᑫᒍᑕᒪᑦ ᐃᒪᐃᓗᐊᑐᕕᓂᑦ 97.465 ᐃᖃᓗᐃᑦ, ᓂᑎᔭᐅᒍᓇᓂᖏᑦ ᐅᖁᒪᐃᓂᑦ ᐃᒪᐃᓗᐊᑎᓗᒋᑦ 200,000 kg. 1980-ᒥ, ᐅᑦᑐᑎᒥᓗᒍ, ᐃᖃᓗᐱᑦ ᓄᐃᑕᓂᖃᓚᐅᖅᐳᑦ 17.9 %-ᒥ ᐅᓄᖅᓂᖃᖅᓯᑎᒃ ᓂᑎᔭᐅᒍᓇᑐᓕᒪᓂᑦ ᐅᒪᕙᓂ ᐊᒪᓗ ᑐᖕᓕᑎᔭᐅᑦᓯᓂ ᑐᑦᑐᐃᑦ ᓂᖅᑭᑦ ᓴᑕᑎᔭᐅᕙᓂᖕᒐᑕ ᐅᓄᖅᓂᖕᒐᓄᑦ. ᐃᖃᓗᐱᑦ ᐱᒪᑎᐅᓂᖃᖅᐳᑦ ᑎᒥᒥᒃ ᐱᕙᓕᐊᑎᑦᓯᓯᐊᕈᑕᐅᑦᓯᓂ ᐊᒪᓗ ᓄᑭᖃᑦᓯᐊᕈᑕᐅᑦᓯᓂ ᐊᒪᓗ ᐱᒪᑎᐅᑦᓯᓂ ᐱᖅᑭᑎᑦᓯᓯᐊᓂᖅ ᒧᑦ ᐃᓄᓂ. ᑕᐃᒪ ᐃᓯᒪᒋᔭᐅᑦᓯᐊᑎᐊᖅᑯᖅ ᐃᖃᓗᓂᐊᕈᑎᑐᖅᑲᐅᖏᑐᑦ ᐊᑐᖅᑕᐅᓂᖏᑦ ᐊᒪᓗ ᐊᓯᖏᑦ ᓯᑫᐃᒐᔭᖅᑐᑦ ᐃᖃᓗᐱᑦ ᐊᑐᐃᓇᐅᓂᖏᓂ ᐃᓄᓇᓯᐊᕈᑎᑦᓴᐅᓗᑎᒃ.

ᑭᓇᐅᑦᔭᓴᑫᓯᐊᖅᓂᒧᑦ ᐃᖃᓗᓂᐊᑕᐅᓂᖏᑦ ᐃᖃᓗᐱᑦ ᐱᒥᐊᓚᐅᖅᐳᑦ 1960 ᐱᒥᐊᖃᒥᐅᑎᓗᒋᑦ ᑲᕙᒪᓄᑦ ᐊᐅᓚᑕᐅᓂᖃᖅᓯᑎᒃ ᓇᒥᓂᖅ ᒪᑭᑕᒐᓯᐊᖅᓂᒧᑦ ᐱᕙᓕᐊᑎᑦᓯᒐᓯᐊᖅᓂᒧᑦ ᐃᓄᓕᑎᕐᑐᖅᑲᑎᒍᑦ. ᐃᓗᓇᑲᓴᑎᒃ ᑰᓚᑎᐅᓂᑦ ᐅᖓᕙᒥ ᐊᖅᑭᕕᐅᕙᕕᓂᑦ ᖃᓄᑎᒥᒃ ᐃᖃᓗᓂᐊᑕᐅᒍᓇᓂᖅᒥ ᐊᖅ ᑫᒍᑕᒪᑦ 30,000-ᓂ ᐅᖁᒪᐃᓂᓂ. ᑕᐃᒪᐃᓚᓗᐊᖅᑎᓗᒍ ᐃᓯᒪᒋᔭᐅᓐᓂᖏᑦ ᑐᖅ ᖃᓄᐃᓗᐊᑎᒥᒥᐊᖃᖅᒪᖕᒐᑕ ᐃᖃᓗᓂᐊᑕᐅᒍᓇᑐᑦ ᐃᓄᓇᓯᐊᕈᑎᑦᓴᐅᓗᑎᒃ. ᑕᒪᓇ ᐱᑦᕙᑎᒥᑦᓯᒍ, ᐊᑦᓯᕈᕈᑕᐅᑦᓯᓂ ᓄᓇᓕᓄᑦ ᖃᓄᐃᓕᒥᐊᕈᑕᐅᖁᑦᓯᒍ ᑲᐃᒥᑕᐅᓕᓚᐅᖅᐳᖅ, ᐃᖃᓗᑕᐅᖃᑦᑕᑐᑦ ᐃᑭᓕᒥᐊᖅᑕᐅᓴᐅᑎᒥᓕᖅᑐᕕᓂᑦ ᐊᒪᓗ ᑭᓇᐅᑦᔭᓴᑫᓯᐊᕈᑕᐅᑦᓯᑎᒃ ᐱᓂᐊᖅᓂᐅᕙᑦ ᐃᑭᓕᐅᒥᓂᖏᑦ ᓄᐃᑕᓚᑎᓐᓂᖃᓕᖅᓯᑎᒃ. ᓄᓇᓕᑦ, ᐅᑦᑐᑎᒥᓗᒍ ᑲᖏᖅᓱᒃ, ᖃᐅᔨᔭᐅᑎᑦᓯᖃᑕᓕᖅᑐᕕᓂᑦ ᐃᖃᓗᑦᓯᐊᕋᓗᐊᕋᒥ ᑕᐃᒪᑦᓴᐃᓇᖅ ᐃᖃᓗᑦᓯᐊᖃᔭᐃᖅᓂᒥᓂ ᐊᒪᓗ ᒥᑭᓂᖅᓴᐅᓕᖅᑐᓂ ᓇᒥᓂᖅ ᐃᓄᓇᓯᐊᖅᓂᒧᑦ ᐃᖃᓗᖅᐸᓕᖅᓯᑎᒃ ᐊᖅᑫᒍᓂ ᐊᒥᓯᑲᓚᓂᑦ. ᐃᓗᓇᒍ ᐱᕙᓕᐊᕈᑕᐅᓂᖕᒐ ᑕᒪᑦᓯᒪ ᐊᒪᓗ ᖃᓄᐃᓗᐊᓂᑎᔭᖕᒐ ᑭᓇᐅᑦᔭᑫᓯᐊᖅᓂᒧᑦ ᐃᖃᓗᓂᐊᓂᖅ ᑕᐃᒪᐃᓚᖅᑭᐅᑎᐅᕙᑎᔭᐅᕗᖅ. ᑕᒪᑦᓯᒍᓇ ᓄᓇᓕᑦ ᑭᓇᐅᑦᔭᑫᓗᐊᖅᒪᑦ ᑕᑯᐊ ᑭᓇᐅᔭᐃᑦ ᐅᓄᖅᓂᖏᓄᑦ ᓂᖅᑭᑦ ᐃᓄᑦᓯᐅᑎᐅᖏᑐᑦ ᐱᐅᔭᕙᑦ ᐃᓇᖏᒍᓇᖅᑕᓚᐅᖏᓕᑦ ᑎᒥᒥᒃ ᐱᕙᓕᑎᑦᓯᓯᐊᕈᑎᐅᒐᔭᖅᓂᖕᒐᓂ ᑕᒪᑯᐊ ᐃᖃᓗᐃᑦ.

ᓱᓇᑐᐃᓇᐃᑦ ᐅᒪᕙᐃᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᖏᑦ ᑲᖏᖅᓯᐊᓗᑦᕙᐊᒥ, ᑲᖏᖅᓱᒥ ᐊᒪᓗ ᑰᕕᒥ ᖃᐅᔨᓴᕙᓕᐊᕈᑎᑦᓴᐅᕙᓂ ᓄᐊᑦᓯᕕᐅᖃᑐᕕᓂᑦ ᐃᓗᓇᖏᓂ ᖁᒥᕈᑕᐅᒥᐊᓕᓂ ᓄᐊᑦᓯᕕᐅᑦᓯᑎᒃ ᐃᖃᓗᐱᓂ ᒪᕙᖅᑕᑐᓂ ᐊᒪᓗ ᑕᑎᐅᓕᐊᖅᑕᑐᓂ ᑕᑯᑦᓴᐅᕙᓂ ᑕᐱᑯᓇᓂ ᑰᓂ. ᐱᕈᖅ ᐸᓕᐊᓂᖏᑦᑕ ᐊᒪᓗ ᖃᓄᑎᒥᒃ ᐃᖃᓗᑕᐅᖃᑦᑕᑐᑦ ᐊᒥᓯᓂᖏᑦᑕ ᖃᐅᔨᓴᖅᑕᐅᓂᖏᑦ ᐃᒪᐃᑦᑐᐃᑦ ᖃᑦᓯᓂ ᐊᖅᑫᒍᖃᖅᓂᖏᑦ, ᖃᓄᐃᓗᐊᑎᒥᓂᖏᑦ ᐊᒪᓗ ᖃᓄᐃᑎᒥᒃ ᐱᕈᖅᐸᓕᐊᓂᖏᑦ, ᐃᐱᒥᓗᒥᑦ ᑕᐃᑦᓯᒪᓂᓗ ᐊᒪᓗ ᒪᓇᐅᓕᖅᑐᖅ ᐃᖃᓗᑦᑕᐅᕙᑦᑐᑦ, ᓇᓂ ᐱᑕᖃᖅᒪᖕᒐᑦ, ᖃᐅᔨᓴᕋᑦ ᓴᐅᓯᑎᓗ ᓄᐊᑕᐅᓯᒪᕙᕕᓂᑦ, ᐱᕕᖃᖅᑎᓯᐳᑦ ᖃᐅᔨᓴᖅ ᑕᐅᓯᐊᖅ ᐸᓕᐊᖅ ᓂᓴᖏᓂ ᖃᓄᐃᓗᐊᑎᒥᑦᓯᐊᒪᖕᒐᑕ.

ᑯᕕᒃᒥ ᐃᖃᓗᓂᐊᕕᐅᓗᐊᖏᓂᕐ ᐸᐅᕝᑦᑐᒥ ᐃᖃᓗᐃᑦ ᐊᕐᕋᒍᖏᑦ ᐊᒻᒪ ᐊᖏᓂᖏᑦ ᐅᓄᕐᓂ-
ᐸᐅᓂᖏᑦ ᖃᐅᔨᔭᐅᓯᒪᔫᑦ. ᒪᓇᐅᔪᖅ ᑕᑦᓯᒪ ᑰᑉ ᐃᖃᓗᓂᐊᕕᐅᓗᐊᖏᓂᖓ ᐱᑦᔪᑕᐅᔪᑎᔭᐅᔫᖅ
ᐃᖃᓗᖃᑦ ᓯᐊᖏᓇᓂᖓᓄᑦ.

ᑲᖏᕐ ᓯᑉ ᑰᖓᓂ, ᐃᓄᓇᓯᐊᕐ ᓂᒧᑦ ᑭᓯᐊᓂ ᐃᖃᓗᐃᑦ ᐱᓂᐊᕐ ᑕᐅᖃᑦ ᑕᓯᒪᓕᕐ ᑐᑦ ᑕᐃᒪᖓᓂ
ᑭᓇᐅᑦ ᔫᓴᕋᓯᐊᕐ ᓂᒧᑦ ᐃᖃᓗᓂᐊᓂᖅ ᑲᑕᓚᐅᕐ ᓯᒪᒪᑦ 1960-ᑦ ᓇᓂᕐᓂ. ᐃᓄᓇᓯᐊᕐ ᓂᒧᑦ ᐃ-
ᖃᓗᓂᐊᑕᐅᕙᑦ ᑐᑦ ᑕᐃᒪᑦ ᓴᐃᓇᕐ ᑐᑦ ᒪᓇᐅᔪᖅ ᐊᒻᒪ ᐃᓄᐃᑦ ᑲᖏᕐ ᓯᒥᐅᑦ ᐃᖃᓗᓂ ᐊᖏᓂᕐ ᓴᐅᓕ-
ᓂᕋᐃᓯᒪᔪᑦ ᑭᓇᐅᑦ ᔫᓴᕋᓯᐊᓂᕐ ᒧᑦ ᐃᖃᓗᓂᐊᓂᖅ ᓄᖃᓯᒪᓕᕐ ᒪᑦ. ᑕᒪᒥᒃ ᐃᖃᓗᐃᑦ ᐊᕐᕋᒍᖏᑦ
ᐊᒻᒪ ᐊᖏᓂᖏᑦ ᒥᑭᓂᕐ ᓴᐅᕋᐱᑐᐃᓇᓕᕐ ᑐᑦ ᑯᕕᒃᒥᑐᓂᑦ, ᓄᐃᑕᑎᑦ ᓯᓯᓂ ᒪᓇᐅᔪᖅ ᐃᖃᓗᓂᐊᓂᐅᔪᑉ
ᑲᔪᓯᒍᓇᓂᖓᓂ ᐊᒻᒪ ᐃᖃᓗᓂᐊᕕᐅᓂᕐ ᓴᐅᒍᓇᓂᖓᓂ.

ᑲᖏᕐ ᓯᐊᓗᑦ ᔪᐊᑉ ᑰᖓᓂ ᐃᖃᓗᑦ ᑕᐅᕙᑦ ᑐᑦ ᐃᑭᓕᕙᓕᐊᓂᖏᑦ ᓄᐃᑕᑎᑕᐅᔪᑦ ᖃᐅᔨᓴᕐ ᑕᐅ-
ᓂᐅᖃᑦ ᑕᓚᐅᕐ ᑐᑎᒍᑦ ᐊᕐᕋᒍᓕᐅᕐ ᑐᓂ ᑕᓕᒪᓂᑦ (5), ᓇᔪᓂ ᑲᑎᑦ ᓯᑎᒃ 80%ᐅᖓᑕᓄᑦ, ᑕᑯᑦ-
ᓴᐅᓗᐊᕐ ᑎᓇᒍ ᓯᕐ ᕋᓂᖓ ᐃᖃᓗᓂᐊᓂᐅᕙᑦ ᑐᑉ. ᐊᕐᕋᒍᖏᑦ ᐊᒻᒪ ᐊᖏᓂᖏᑦ ᐃᖃᓗᐃᑦ ᒥᑭᓂᕐ ᓴᐅ-
ᔪᕕᓂᑦ ᖃᐅᔨᓴᕐ ᑕᐅᖃᑦ ᑕᑐᕕᓂᕐ ᓂ ᑕᑯᓇᖓᑦ ᑰᓂ ᐅᖃᕐ ᑕᐅᑲᐃᓇᑐᓂ ᕿᓚᓂ ᐊᒻᒪ ᖃᐅᔨᓴᕐ ᓂᐅᔪᕕ-
ᓂᕐ ᒥ ᓯᕗᓂᖓᒍᑦ ᑕᓚᓂ ᑲᖏᕐ ᓯᐊᓗᑦ ᔪᐊᒥ 1959-ᒥ ᐊᒻᒪ 1960-ᒥ. ᐅᑦ ᑐᕋᐅᑎᑐᐃᓇᐅᓚᐅ-
ᑲᑐᓕᓗᐊᖅ, ᑕᒪᓇ ᓄᐃᑕᑎᑦ ᓯᔪᖅ ᒪᓇ ᐃᖃᓗᓂᐊᓂᐅᔪᑦ ᑲᖏᕐ ᓯᐊᓗᑦ ᔪᐊᒥ ᓯᓚᓗᓗᐊᕐ ᑐᑦ ᐊᒻᒪ
ᓯᕗᓂᑦ ᓴᒥ ᑲᔪᓯᓇᓕᖓᕐ ᑐᑦ.

ᐃᐱᒋᔭᐅᓯᒪᒪᑦ, ᑯᐸᐃᒃ ᑕᕐ ᕋᖓᓂ ᐃᖃᓗᐱᑦ ᑭᓇᐅᑦ ᔫᓴᕋᓯᐊᕐ ᓂᒧᑦ ᐃᖃᓗᓂᐊᑕᐅᓕᓯᖃᑦ-
ᑕᓯᒪᔪᖅ, ᐊᒻᒪ ᒪᓇ ᓄᑦᑦ ᐊᑐᕋᑦ ᓴᐅᔪᑦ ᐅᑕᕿᑎᑕᐅᑦ ᓯᑎᒃ ᐊᒻᒪ ᐊᑐᓕᕐ ᑎᑕᐅᓕᓯᑦ ᓯᑎᒃ.
ᑕᐃᒪ ᑕᐃᑦ ᓯᒪᓂᒥᐊᕐ ᑎᑐᑦ, ᓯᓇᑐᐃᓇᐃᑦ ᐅᒪᔪᐃᑦ ᖃᐅᔨᓴᕐ ᑕᐅᓂᖏᑦ ᓄᐃᓯᒪᔪᑦ ᓯᕐ ᕋᐃᓂᖓ
ᑭᓇᐅᑦ ᔫᓴᕋᓯᐊᕐ ᓂᒧᑦ ᐃᖃᓗᓂᐊᓂᐅᔪᑉ ᐃᖃᓗᐱᓂ ᖁᖓᑎᒍᑦ ᑲᔪᓯᓂᖓᑕ ᐃᓄᓇᓯᐊᕐ ᓂᒧᑦ ᐃᖃᓗᓂ-
ᐊᓂᐅᑉ. ᐃᖃᓗᑦ ᑕᐅᖃᑕᐊᖃᕋᔭᕐ ᑐᑦ ᑭᓇᐅᑦ ᔫᓴᕋᓯᐊᕐ ᓂᒧᑦ ᐃᖃᓗᓂᐊᓂᑦ ᖃᖏᕐ ᓂᑯᓕᐅᕌᓇᓯᓕ-
ᔭᕐ ᐸᑕ ᐃᖃᓗᐃᑦ ᐊᒥᓯᓂᕐ ᓴᐅᒥᐊᖃᕋᔭᕐ ᑐᑦ ᒪᓇ ᐱᑕᖃᕐ ᑐᓂ, ᐃᓄᓇᓯᐊᕐ ᓂᒧᑦ ᐃᖃᓗᓂᐊᓂᖃᕋᓗ-
ᐊᕐ ᐸᑦ ᕐᑲᓗᐊᕐ ᐸᓗᓂᑦ. ᐃᖃᓗᓂᐊᓗᐊᕐ ᓂᒧᑦ ᐃᖃᓗᐃᕈᓕᔭᖁᕈᕐᒧᑦ (ᑕᒪᒥᒃ ᐃᖃᓗᓂᐊᓂ ᐊᓯ-
ᐅᑎᓗᒥᒃ), ᒪᕐ ᕈᖅ ᐃᓯᐃᓗᑕᒪᑎᐅᔪᖅ ᑕᑯᓇᑕᐅᓕᓯᐊᑎᐊᖃᕐ ᐳᒃ. ᒪᓇᐅᔪᖅ ᓯᓚᓗᓗᐊᕐ ᑕᐃᓕᓂᕐ-
ᒧᑦ ᓴᐳᒥᐅᑎᑦ ᓴᖃᕐ ᓕᖅ ᑲᑎᓗᒥᑦ ᐃᖃᓗᑦ ᑕᐅᖃᑦ ᑐᑦ ᓇᐅᑐᐃᓇᓄᑦ ᐊᒻᒪ ᐃᓗᓇᒍᑦ ᐊᑐᕋᑦ ᓴᐅᓗᑎᒃ
ᐃᖃᐃᕈᑦ ᔪᒥᑯᑎᑦ ᓴᐅᓕᔭᕐ ᑐᒥ. ᑕᑯᓇᓯᒥᑦ ᐱᐅᓯᐅᖃᑦ ᑕᓯᒪᔪᑦ ᐱᑦ ᓯᐊᕈᓇᓯᒪᓕᕐ ᓂᕐᑎᒍᑦ ᐊᑕᐅᑦ-
ᓯᑯᕐ ᑎᑕᐅᑦ ᓯᑎᒃ ᐃᓄᓇᓯᐊᕐ ᓂᒧᑦ ᐊᒻᒪ ᐊᕐᔪᐃᑦ ᑭᓇᐅᑦ ᔫᓴᕋᓯᐊᕐ ᓂᒧᑦ ᐃᖃᓗᓂᐊᓂᐅᔪᑦ ᓄᐃᑕ-
ᑎᑦ ᓯᔫᑦ ᑕᑯᐊ ᐃᖃᓗᐊᓂᑎᕙᑦ ᑕᕐᑦ ᑕ ᖃᕐ ᐅᑎᓯᒪᑲᓴᒪᑎᓂᕐᓂ ᐃᖃᓗᖃᕐ ᓂᒥ. ᑕᕙ ᐊᐃᐸᖓ ᑕᑐᖓ

ᐃᓱᐃᓗᑕᐅᔪᖅ ᓄᐃᒥᕗᖅ. ᓴᐳᒥᒍᑎᑦ ᓴᐅᒐᔭᕐ ᑐᑦ ᓄᑕᐅᐸᑕ ᐃᖃᓗᐃᕈᑦ ᐹᑕᐃᓕᒐᓱᐊᕐ ᓂᒧᑦ, ᐃᓚᖅᑎᐊᖅᑲᕋᔭᕐ ᐳᑦ ᒪᓕᒐᐅᒐᔭᕐ ᑐᓂ ᖃᓄᖅ ᐊᑐᕐ ᑕᐅᒥᐊᖅᑲᕐ ᓂᖏᓄᑦ ᑕᒪᑯᐊ ᐃᖃᓗᐃᑦ ᐃᓄᐃᑦ ᐱᒪᑎᐅᓂᕐ ᓴᖁᑎᖏᑦ ᐊᑐᕐ ᑕᐅᓯᐊᖁᒐᔭᕐ ᓗᒋᑦ.

ᑕᑯᐊ ᐃᓱᐃᓗᑕᐅᔪᑦ, ᑲᒪᒋᔭᐅᑦ ᓯᐊᕈᑎ ᑐᑭᑕᕈᑕᐅᑦ ᓯᐊᓗᑎᒃ ᑐᑭᓯᔭᐅᑦ ᓯᐊᐸᑕ ᐊᑐᓯᓕᒪᓄᑦ ᐃᑲᔪᕐ ᑎᒥᖅᑎᒥᑦ ᓯᐊᐸᑕᓗ, ᓯᕋᐃᔪᑦ ᓴᐅᖏᑐᑦ ᖃᓄᕐ ᓗᓂᑦ ᐱᒪᑎᐅᓂᖏᓂ ᐃᖃ-ᓗᐱᑦ ᑯᐸᐃᒃᒥ. ᐅᑯᐊ ᐊᑐᕐ ᑕᐅᔪᑦ ᓴᐅᓯᑎᒃ ᐃᒪᐃᓕᖓᔪᑦ ᓴᖁᑎᒥᔭᐅᔪᑦ :

(1) ᓱᕗᓂᑦᑎᓂ ᐃᖃᓗᐃᑦ ᐅᓄᕐ ᓂᖏᓂ ᐱᔭᐅᒍᓇᑐᓕᒪᑦ ᑲᑎᓗᑎᒃ ᖃᖏᐅᑎᑎᑕᐅᑦ ᑕᐃ-ᓕᒥᐊᖅᑲᓕᕐ ᑐᑦ. ᐃᖃᓗᐱᓂᐊᕐ ᐆᓗᐊᕐ ᑐᓂ ᑕᑯᓇᓂᑐᑎᑐᑦ ᐊᓚᓂ, ᖃᓄᑎᒥᒃ ᐊᖏᓂᖅᑲᕐ ᓗᑎᓗ ᐊᕐ ᕿᒍᖅᑎᐊᖅᑲᕐ ᒪᖏᑕ ᐊᕿᑕᐅᔪᑦ ᓴᐅᔪᑦ ᒪᓕᒐᑦ ᓴᐅᒐᔭᕐ ᑐᑦ. ᐊᓱᑦ ᐹᓂᑦ ᑕᑯᓇᓂ ᒪᓕᒐᑦ ᓴᐅᔪᓂ ᑲᒪᒋᔭᐅᒥᐊᖅᑲᕙᔭᕐ ᑐᑦ ᐃᖃᓗᓂᐊᓂᑦ ᓯᕙ-ᐸᑕ ᐊᖏᓕᒥᐊᕐ ᓗᓂ 20% ᐅᖓᑕᓄᑦ.

(2) ᑐᑭᓱᓐᓇᓱᐊᕐ ᓗᑎᒃ ᒪᓕᒐᑦ ᓴᐅᔪᑦ ᐊᕿᑕᐅᒥᐊᓕᑦ ᐃᒻᒥᒍᓕᕐ ᑎᓱᒍᑎᑦ ᓴᐃᑦ ᖃᓄ-ᐃᓗᐊᑎᐊᖅᑲᕐ ᓂᖏᓂ ᐃᖃᓗᐃᑦ ᐊᑐᓂ ᐃᖃᓗᖅᑲᕐ ᐆᔪᓂ ᑕᐃᒪ ᓄᐃᑕᑎᑕᐅᒍᑎᖏᑎᒍᑦ 1-ᒥ, ᑭᓇᐅᑦ ᔭᓴᐅᑎᐅᒐᓱᐊᕐ ᓂᒧᑦ ᐃᓄᓇᓱᐊᕐ ᓂᒧᓗ ᐊᑐᕐ ᑕᐅᓂᖏᑦ, ᒪᓕᓗᒋᑦ ᐃᓄᐃᑦ ᐱᒪᑎᐅᓂᕐ ᓴᐅᑎᑕᖏᑦ.

(3) ᐃᖃᓗᓂᐊᓂᖅ ᐊᖏᓕᒥᐊᕐ ᐸᑦ 20% ᐅᖓᑕᓄᑦ ᑲᖏᕐ ᓯᒥ ᑯᐆᒃᒥᓗ ᐊᕿᓱᒪᐆᒥᐊ-ᖅᑲᕙᔭᕐ ᑐᖅ ᑲᒪᒍᑎᒥ ᐱᔫᕐ ᐸᓕᐊᓂᖏᓂ, ᐊᖏᓂᖏᓂ, ᐊᕐ ᕿᒍᖏᓂ ᐊᒪᓗ ᑐᖁᖅᑕ-ᓂᖏᓂ ᖃᐅᔨᓴᖅᑕᔫᑎᐅᒐᔭᕐ ᑐᓂ.

(4) ᐃᖃᓗᓂᐊᓂᖅ ᑲᖏᕐ ᓱᐊᓗᑦ ᔦᐊᒥ ᐊᖏᓕᕌᓕᐊᔪᑦ ᓴᐅᖏᑐᖅ. ᖃᐅᔨᓴᕐ ᓂᖅᑎᐊᓚᓚᑎ-ᑐᓴᐅᔪᑎᔭᐅᕗᖅ ᐊᕐ ᕿᒍᐃᑦ ᐱᖓᓱᑦ ᑕᓕᒪᓗᓂᑦ ᓇᐸᑕ ᑕᐃᒪᑦ ᓴᐃᓇᖅ ᖃᐅᔨᓴᕐ -ᓂᐅᓚᐅᔪᔪᕐ ᑎᑐᑦ ᐃᖃᓗᐱᓂ ᒪᓇᖅᒥ ᐊᒪᓗ ᒪᓇ ᐃᖃᓗᓂᐊᓂᖅ ᖃᓄᐃᓕᕐ ᒪᖓᑦ ᐊᒪᓗ ᐊᑦᐹᒥᖏᑐᓂ ᖃᓄᐃᓗᐊᓕᕐ ᓂᖏᓂ ᖃᐅᔨᓴᕐ ᓗᑎᒃ.

ANADROMOUS ARCTIC CHAR IN NORTHERN QUÉBEC:

FINDINGS AND RECOMMENDATIONS

The Arctic char, Salvelinus alpinus, has been and continues to be an important natural resource in the subsistence economy of the people of Northern Québec. This most northerly distributed member of the salmon family resides in the river and lake systems throughout Northern Québec that are of sufficient size and depth to provide overwintering habitat. Two distinct forms of char are distinguished according to their behaviour and selection of habitat. The most important is the larger, fast-growing anadromous form which is found in the river and lake systems that have unobstructed access to the sea. The second form is the slower growing landlocked char. These are found in the water systems that are not directly connected to the sea or which have a falls or other obstruction that bars the seaward movement of char.

These two forms of Arctic char have traditionally played a substantial role in the diet and culture of Inuit people. Char fishing areas were important places in the seasonal economy of Northern Québec and the most important harvesting locations were often central to the historical development of present day settlements.

In the early 1960's some commercial exploitation was begun under government supported programs of economic development. The major river systems of Ungava Bay were given commercial quotas, usually 30,000 lbs, and a system of harvesting, cleaning and freezing fish for export was set up. Commercial exploitation did not, however, replace the need for continued subsistence harvesting. In addition, settlements were becoming more permanent and traditional harvesting practices were changing. All of these activities led to an increase in catch levels and many of the traditional safeguards against overharvesting were no longer operating.

At the present time the anadromous Arctic char is the region's most important fishing resource. Between 1976 and 1980, the Arctic char harvest, by 13 Inuit communities, averaged 97,465 fish annually, representing an estimated 200,000 Kg of edible flesh. In 1980, for example, Arctic char contributed 17.9% of the total edible weight of all species harvested and was second in significance only to that of caribou. Arctic char is a major source of protein and food energy and it is an important element in maintaining the nutritional health of Inuit. As such, the commercial utilizations and other factors which could affect the availability of this species for subsistence use warrant serious consideration.

Commercial exploitation of char began in the early 1960's under government supported programs of economic development through the Federal Department of Indian Affairs. Most of the major Ungava river systems were assigned quotas of 30,000 lbs annually. No account was taken, however, of subsistence requirements. As a result, heavy localized pressure was exerted, the catch was soon depleted and commercial activity declined significantly. Communities such as Kangirsuk subsequently reported low catch per effort and reduced individual size of catch in the subsistence fishery for some years. The overall benefit of this type and level of commercialization is therefore suspect. Often, the economic return to the community would not meet the cost of replacing, with non-traditional foods, the protein loss from the subsistence catch.

Biological studies carried out on the George, Payne and Kovik River systems provided data bases covering a wide range of parameters for the anadromous Arctic char stocks found there. Study of growth and catch parameters, such as average age of catch, average size of catch and growth rates, when interpreted in light of past and present harvest levels and, where available, previous biological data, permits a tentative assessment of present stock status to be made.

At Kovik, where fishing pressure is known to have been the lowest of the three sites, both the average age of catch and average size of catch were the highest reported. It must be assumed that present pressure on that system is less than what might be sustained.

On the Payne system, only subsistence pressure has been exerted on the stock since the collapse of the last commercial venture in the late 1960's. Subsistence catches are presently steady and local residents confirm that the individual size of the catch has increased since the commercial fishery stopped. Both individual average age and size of the catch are only slightly less than at Kovik, indicating that recent pressure is sustainable with some increase permissible.

The reported harvest from George River over the last 5 years has shown a steady decline, totalling over 80%, without any apparent drop in effort. The average age and size of the catch were markedly lower than in both the other two systems studied and than that reported in a previous study on the George system in 1959 and 1960. Although only tentatively, this indicates that recent pressure on the stocks of the George River system may be excessive and, in the long run, unsustainable.

As noted, there have been past attempts to commercialize the harvest of char in Northern Québec, and presently, ambitious new plans are both pending and being implemented. Now, as in the past, the biological effects of commercial harvests are being superimposed on the continual effects of subsistence fisheries. Often, the harvest levels required to make commercial exploitation economically viable are in excess of what the stock can sustain, with or without the ubiquitous subsistence activities. To avoid the classic result of such overfishing (collapse of both fisheries), two critical problems must be faced. There are, at present, no safeguards to insure that the sum total of the resource harvested from a stock, for any and all utilization, does not exceed the maximum which can be sustained. Reflection upon the history of unsuccessful co-impositions of susbsistence fisheries and large commercial fisheries indicates that these maximum harvest levels are almost invariably exceeded. Thus, a second, related problem arises. If safeguards were put in place to prevent overharvesting, they would have to be accompanied by guidelines governing the type of utilization of the available resource to ensure that the priorities of the people were accurately reflected.

These problems, if dealt with decisively and with the cooperation and understanding of all potential users, should not, in any way, compromise the important status of anadromous Arctic char in Québec. The following measures are recommenaed:

(1) Exceeding sustainable total harvest levels should be avoided in future. Baseline values for age and size of catch distributions should be established for other heavily exploited char stocks, similar to those reported in this document. Changes in these values should be monitored if future harvest patterns result in a harvest increase of more than 20%.

(2) Clear guidelines must be established to divide the amount of fish available from each stock, as detailed in recommentation (1), between commercial and subsistence use, according to the priorities of the local people.

(3) Future increases in excess of 20% harvest from the Payne and Kovik systems should be accompanied by a monitoring programme of key growth, size, age and mortality parameters;

(4) No increase in harvesting pressure should be allowed on the George River system. A study of recent and present effort and a reassessment of the key population parameters within 3 to 5 years is strongly recommended.

L'OMBLE CHEVALIER ANADROME AU NOUVEAU-QUÉBEC:

CONCLUSIONS ET RECOMMANDATIONS

L'omble chevalier (Salvelinus alpinus) a été et est toujours une importante ressource naturelle dans l'économie de subsistance des habitants du Nouveau-Québec. L'omble chevalier est le représentant le plus nordique de la famille des Salmonidés; on le trouve dans la plupart des lacs et rivières suffisamment importants et profonds pour lui offrir un habitat d'hivernage. Il existe deux types d'ombles qui se distinguent par leur comportement et le choix de leur habitat. Le type le plus important est l'omble anadrome, à croissance rapide, que l'on trouve dans les lacs et rivières directement reliés à la mer. Le second type est l'omble non-anadrome, à croissance plus lente; il fréquente les réseaux hydrographiques qui ne sont pas directement reliés à la mer ou dont les chutes ou autres obstructions empêchent l'omble de migrer vers la mer.

Ces ombles ont traditionnellement joué un rôle important dans le régime alimentaire et la culture des Inuit. Les sites de pêche à l'omble avaient une grande valeur dans l'économie de subsistance du Nord québécois, et certains de ces endroits où la pêche était particulièrement fructueuse ont joué un rôle de premier plan dans le développement des collectivités telles qu'on les connaît à présent.

Au début des années soixante, des programmes gouvernementaux d'expansion économique permirent d'entreprendre l'exploitation commerciale de l'omble chevalier. On établit alors des quotas commerciaux atteignant habituellement 30 000 lbs, pour les réseaux hydrographiques les plus importants de la baie d'Ungava. On mit aussi sur pied un système d'exploitation, de nettoyage et de congélation du poisson en vue de l'exportation. L'exploitation commerciale n'a cependant pas éliminé le besoin de poursuivre les activités de subsistance. Les villages nordiques se sont développés et établis de façon permanente, et les pratiques traditionelles se sont transformées. Ces changements ont entraîné une augmentation du niveau des prises, et bien des mesures traditionnelles de protection à l'égard de la surexploitation se sont révélées inopérantes.

À l'heure actuelle, l'omble chevalier anadrome est la plus importante ressource piscicole de la région. Entre 1976 et 1980, les prises d'omble chevalier effectuées dans les 13 villages inuit se sont élevées à 97 465 poissons en moyenne, soit environ 200 000 kilos de chair comestible. Ceci représente 17.9% du poids total des différentes prises, toutes espèces incluses, faites au cours de l'année 1980 dans le cadre de l'économie de subsistance de la région; ce résultat se situe en deuxième place en importance, précédé par le caribou seulement. L'omble est une source importante de protéines et d'énergie; il constitue l'un des principaux éléments du régime alimentaire des Inuit. En tant que tel, l'utilisation commerciale et les autres facteurs qui pourraient affecter la disponibilité de cette espèce dans le cadre de l'économie de subsistance méritent considération.

L'exploitation commerciale de l'omble commença au début des années soixante, sous l'égide de programmes d'expansion économique. On attribua des quotas annuels de 30 000 livres à la plupart des grandes rivières de la région de l'Ungava, sans toutefois tenir compte des besoins dans le cadre des activités de subsistance. Ceci entraîna une surexploitation de l'espèce, les stocks déclinèrent bientôt, et le rendement de la pêche commerciale chuta de façon significative. Des villages comme celui de Kangirsuk enregistrèrent par la suite des prises plus faibles compte-tenu de l'effort de pêche; les résultats de la pêche individuelle du subsistance furent aussi réduits pendant quelques années. L'intérêt de ce type et de ce niveau de commercialisation est donc douteux. Souvent, l'apport économique pour la collectivité ne suffisait pas à couvrir le coût des aliments non-traditionnels, consommés pour remplacer le poisson.

Des études biologiques menées dans le bassin des rivières George, Arnaud et Kovik ont fourni des données de base sur un large éventail de paramètres portant sur les populations d'omble chevalier de ces rivières. L'étude des paramètres de croissance et de prise, tels que l'âge moyen des captures, leurs taille moyenne et leur rythme de croissance, lorsqu'on les compare aux niveaux de pêche dans le passé et à l'heure actuelle ainsi qu'aux données biologiques antérieures dont on dispose, permet de faire une évaluation provisoire de ces populations et de leur état actuel.

À Kovik, où l'exploitation de l'espèce a été la moindre des trois endroits étudiés, les résultats se sont révélés les plus élevés tant en termes de moyenne d'âge que de taille moyenne des prises. On peut donc présumer que l'exploitation actuelle est inférieure au niveau que pourrait tolérer le bassin de la Kovik.

Pour ce qui est de la rivière Arnaud, elle n'a connu que la pêche de subsistance depuis la dernière tentative de pêche commerciale à la fin des années 60. Les prises dans ce secteur sont régulières, et les pêcheurs confirment que la taille des poissons a augmenté depuis qu'on a mit fin aux activités commerciales. Les moyennes d'âge et de taille des prises ne sont que légèrement inférieures à celles de la Kovik, ce qui indique que la pêche peut être poursuivie, et qu'on peut même en hausser le niveau quelque peu.

Les relevés de pêche faits à la rivière George depuis 5 ans accusent une baisse régulière, de plus de 80%, bien que l'effort de pêche n'ait apparemment pas diminué. Les moyennes d'âge et de taille sont nettement plus faibles que dans les deux autres cas étudiés, elles sont aussi inférieures aux résultats relevés dans une étude précédente, exécutée en 1959 et 1960, sur la rivière George. Il semble, du moins pour le moment, que l'exploitation récente de la population d'omble de la rivière George soit excessive et, à long terme, préjudiciable.

Comme on l'a souligné, il y a eu dans le passé des tentatives pour commercialiser l'omble chevalier du Nouveau-Québec, et encore maintenant de nouveaux projets d'envergure sont à l'étude et d'autres en voie de réalisation. Aujourd'hui, comme par le passé, les effets biologiques de la pêche commerciale sur les populations d'ombles s'ajoutent à ceux, continus, de la pêche de subsistance. Souvent, les niveaux de pêche requis pour rendre viables les expériences de pêche commerciale dépassent ce que la population d'ombles peut tolérer avec ou sans l'omniprésence de la pêche de subsistance. Deux importants problèmes doivent être considérés si l'on veut éviter le résultat classique d'une telle surexploitation, c'est-à-dire l'échec des deux formes de pêche. Il n'y a, à présent, aucune garantie permettant de s'assurer que les quantités de poisson pêché pour le commerce et pour la subsistance, ne dépassent pas les prises maximales tolérables. Un regard sur l'histoire des échecs de la juxtaposition de la grande pêche commerciale et de la pêche de subsistance montre que ces niveaux maximums sont presque systématiquement dépassés. Un deuxième problème se trouve ainsi soulevé. Si on devait fixer des limites pour empêcher la surexploitation, celles-ci devraient s'accompagner de directives concernant l'exploitation de la ressource disponible afin de s'assurer que les priorités des résidents soient bien représentées.

Ces problèmes, s'ils sont traités fermement et avec la collaboration et la compréhension de tous les usagers éventuels, ne devraient en aucune façon compromettre l'importance de l'omble chevalier anadrome au Québec. Nous recommandons les mesures suivantes:

(1) On devrait à l'avenir éviter de dépasser les niveaux de pêche tolérables. Des valeurs de base quant à l'âge et la taille des prises selon leur utilisation devraient être déterminées pour d'autres populations d'ombles très exploitées, comme celles décrites dans le présent rapport. L'évolution de ces valeurs de base devrait être surveillée si les pêches devaient augmenter de plus de 20% dans le futur;

(2) Des directives claires doivent être établies pour répartir la quantité de poisson disponible à chaque endroit, tel que cité à la première recommandation, entre l'exploitation commerciale et la pêche de subsistance, en fonction des priorités des résidents;

(3) Les augmentations de plus de 20% des pêches effectuées dans les rivières Arnaud et Kovik devraient s'accompagner d'un programme de relevés des paramètres-clés: croissance, taille, âge et mortalité du poisson;

(4) On ne devrait pas permettre que la rivière George soit encore plus exploitée. Il est fortement recommandé de mener une étude des efforts réçents et actuels en ce sens et de réévaluer les paramètres-clés de la population d'ici 3 à 5 ans.

ANADROMOUS ARCTIC CHAR IN NORTHERN QUÉBEC

LIFE HISTORY AND PRESENT STATUS
OF
ANADROMOUS ARCTIC CHAR
(Salvelinus alpinus L.)
IN
NORTHERN QUÉBEC
WITH CASE STUDIES
ON
THE GEORGE, PAYNE AND KOVIK RIVERS

PROLOGUE

The management of biological resources in the North must establish a balance between the current scientific understanding of those resources and the Inuit knowledge about, and their role with respect to, the resources. Both of these elements are constantly changing. The information base for resource management is improving and there is an acknowledged concern over the need to integrate the knowledge of Inuit with that of the scientific community. On the other hand, the pace of social and economic change in the North is increasing and this has created more diverse interpretations about the meaning of resources and of their role in the development of Inuit society.

The problem is to safeguard the viability of a particular species, and, at the same time, protect the rights of Inuit to harvest according to practices and objectives that are appropriate to their changing lifestyles. Under these conditions, the establishment of a workable balance is difficult. The problem can reflect political and economic strategies as well as those of biology and culture.

The Arctic char populations of Northern Québec are an example of a northern resource that raises important questions about management practices that encompass Inuit knowledge, scientific data and the economic role of resources. These questions must be addressed through a research program that will enable the issues to be identified and the appropriate management steps to be undertaken.

In the past, Arctic char has been an important subsistence resource. In the last two decades, however, subsistence fishing has been combined with a commercial harvest for export in several river systems. Recently, even more ambitious plans for the commercial development of existing char stocks are being formulated. Although the intention of these programs is to strengthen the local economic base of communities, they also involve serious decisions about the relationships between resources, subsistence and commercial development. In order for the communities to make rational decisions that are in the long term self interests of the people and the resources, both information and policies must be developed. Unless this is done quickly, it will not be possible to maintain the options that are necessary in the mixed economy of today's north.

The utilization of char stocks for either local consumption or for export, must be based on management decisions that are biologically sound and culturally relevant, to avoid a deterioration of both commercial and subsistence fisheries. Anadromous char populations are typified by low rates of productivity and thus, in most cases, cannot withstand the sustained harvesting pressures required to justify, economically, the development of a large commercial fishery. In the classic case, severe depletion of the marketable fraction of the stock results not only in the economic failure of the venture, but of more lasting concern for the Inuit, collapse of the subsistence fishery as well.

To ensure that the ultimate use of the anadromous Arctic char resources available in Northern Québec reflects the priorities of the indigenous peoples, decisions regarding the appropriate types and levels of commercial development in Northern Québec must be made. Critical to these decision making processes is a clear understanding of the biological, cultural and economic implications of management. Herein lies the goal of this document. Information from a number of diverse sources has been collected and assembled to provide an overview of the Arctic char resource of Northern Québec and its role in the Inuit lifestyle.

To carry out the program of research and to incorporate such a wide spectrum of information on the Arctic char, the project was organized into three different sections. This report will discuss each of these sections individually, and, by integrating the findings of all, present an overview of the present status and potential for Northern Québec Arctic char.

The first section describes the many aspects of the natural history of the species. Owing to its circumpolar distribution, information on char is available from a large number of international sources. Much of this information may at first appear contradictory; however, this is usually a reflection of the plasticity and adaptability of Arctic char to the many habitat types found throughout its range. From the volume of information available, an attempt was made to summarize the biological and ecological characteristics of char and char populations which one would expect to encounter in Northern Québec. Variations in some key traits that occur across the geographical range of Arctic char are discussed when pertinent to the understanding of the char in Northern Québec.

In the second section of this document, the past and present toll of char in the economy and diet of Northern Québec Inuit will be presented. The description of the changes, from the traditional utilization patterns, which resulted from the introduction of modern technologies is a key to understanding the causes of many present problems. The significant contribution of Arctic char to the Inuit diet, in relation to other subsistence species is quantified in terms of edible weight, protein equivalency and caloric value. Recent examples of commercial harvests in Northern Québec being superimposed on continuing subsistence activities and the resultant effects are also described.

The third and main section of the report presents the findings from a field study of the basic population and biological traits of three Northern Québec Artic char stocks. Detailed field work was carried out on the George, Payne and Kovik River systems. The data from these studies allow two very useful types of interpretations to be made.

First, in light of recent harvest patterns, an assessment is made of the current status of the population in relation to present and past fishing pressure. The results of these studies is sufficient to indicate if and where significant damage is occurring to any of these stocks due to harvesting.

The present status of the char stocks on all three systems will be discussed. In addition, comparison of the present status of the George

River stock with the results of a sampling program completed in 1959 and 1960 by R. Le Jeune will permit a discussion of the changes in the structure of that stock between the two sampling periods.

Second, these studies provide baseline information on a broad range of topics concerning each population. Having established this data base, a monitoring program can then quantify changes in critical population parameters in the future. For example, the effects of increased fishing pressure can be observed by running a relatively simple annual sampling program involving substantially less effort and expense than the original study. Only several key measurements would need to be recorded and interpreted through comparison with the results gathered during the 1981 field study and presented in this report.

By collating the results and conclusions of each section of this report an overview of the problems which now face the char fisheries of Northern Québec has emerged. The biological study has provided an important data base, and the review of the harvesting practices has provided a description of the cultural and economic context of these fisheries. Together, this information will enable the stock to be assessed and the aims of exploitation to be evaluated. Recommendations are put forward, but the decisions necessary for developing a management strategy can only result when the Inuit users take an active role in the management process.

THE NATURAL LIFE HISTORY
OF ANADROMOUS ARCTIC CHAR

INTRODUCTION

The documentation of the natural history of the Arctic char, Salvelinus alpinus, has, in relation to that of most other fish species, presented researchers with a complex and yet rewarding task. Contributing factors in this regard are: the species' attractiveness as a subsistence, commercial and recreational resource; the relative remoteness and beauty of its preferred range; and the plasticity and adaptability that the species exhibits in relation to a wide spectrum of natural habitats within its range.

As a result of the char's circumpolar distribution, information on this species is available from many international sources. Effective synthesis of this information has, therefore, been difficult; a recent successful volume being that of Johnson (1980).

For our present purposes the description of the natural history is confined primarily to the anadromous Arctic char and char stocks typical of Eastern Canadian Arctic regions. Where pertinent, additional information on other char forms such as landlocked or freshwater resident, or information from further afield has been included for comparative purposes. Unless otherwise indicated, all references to char are to the species Salvelinus alpinus in its anadromous form.

BIOLOGY AND LIFE HISTORY

DESCRIPTION

The Arctic char (Salvelinus alpinus) is a species of the family Salmonidae, closely related to the Brook trout (Salvelinus fontinalis) and the dolly varden (Salvelinus malmo). It is a freshwater species that may, where the sea is accessible, become anadromous after individuals reach a certain age and/or size. Anadromous char annually spend a relatively short "summer" period in salt water, but spawn and pass the much longer "winter" period in freshwater.

Arctic char share the elongated tubeform body typical of salmonids but, as a result of their many-faceted life history, exhibit a great deal of variability in most of the other visual traits. Colouration and markings exhibited depend upon where and when the char was taken from the water. In fresh water, char are a relatively uniform dull silver-white colour with unpronounced spots on the flanks. Immature fish display 11 to 13 dark vertical bands or parr marks on their sides. In the estuary or the sea, they have a silvery colour on the lower sides and belly, with deep blue to greenish blue on the back and upper sides. Red, pink or cream coloured spots of varying sizes are prominent on the flanks above and below the lateral line. The flesh is usually red, but may range through pink to almost white. Average weights of anadromous char across Arctic Canada vary from 0.9 to 4.5 Kg (McPhail and Lindsey, 1970). The largest char recorded in Canada weighed 12.2 Kg and was caught in the Tree River, N.W.T. (Hunter, 1966). The angling record for char as recorded by Field and Stream is 9.1 Kg, at 856 mm, taken from Finger Lake in Northern Québec (Scott and Crossman, 1974). There are unverified local reports of char as large as 14.0 Kg being angled at Finger Lake in recent years.

In the fall, fish which are preparing to spawn undergo radical changes in appearance. The red spots intensify and the colour on the sides and belly changes to any of a range of reddish hues from t red to deep vermilion. The spawning colours of the male are more nse than those of the female. The lower paired fins become suffused red and orange-red while the leading edge of these fins and the n of the lower jaw remain conspicuously white. Males, and to a lesser degree females, develop a pronounced kype, or curved fleshy protubence, on their lower jaw, which fits into a slot on the upper jaw.

Freshwater resident and landlocked char retain the more silver-white colouration throughout their life cycles except when preparations for spawning bring about changes similar, if slightly less intense, to those observed in anadromous char.

In the older juvenile and adult phases, the fish most easily confused with the Arctic char in Northern Québec, is the brook trout, Salvelinus fo [redacted] noting that the char has a di [redacted] terned back and fins, while [redacted] l, a distinct barred patte [redacted] a pronounced "marble" eff [redacted] r and brook trout at the parr [redacted] sh from each other or oth [redacted] namaycush.

RANGE AND DI [redacted]

The Arctic char has a circumpolar distribution in the northern hemisphere. Its range encompasses the northern areas of North America, U.S.S.R. and Europe, as well as Iceland, Greenland and other Arctic islands (Scott and Crossman, 1974). In North America, its range extends latitudinally from the northeastern United States in the south, where it is a landlocked, relict species, to the farthest extent of the land mass in the north (figure 1). It is most abundant and successful in the cold waters of the Arctic basin (Johnson, 1980), which also loosely defines the limits of anadromy in the species. The anadromous distribution barrier seems to be determined by temperature in the surface layers of adjacent coastal waters during the summer period.

In Eastern Canada specifically, anadromous Arctic char are found in streams entering Hudson Bay, as far south as the Churchill River on the west side, and the Roggan River on the east. They are recorded from the Belcher Islands, Nottingham Island, Baffin Island, Resolution Island and along the coasts of Hudson Strait, Ungava Bay and Labrador as far south as Gander River, Newfoundland (Scott and Crossman, 1974).

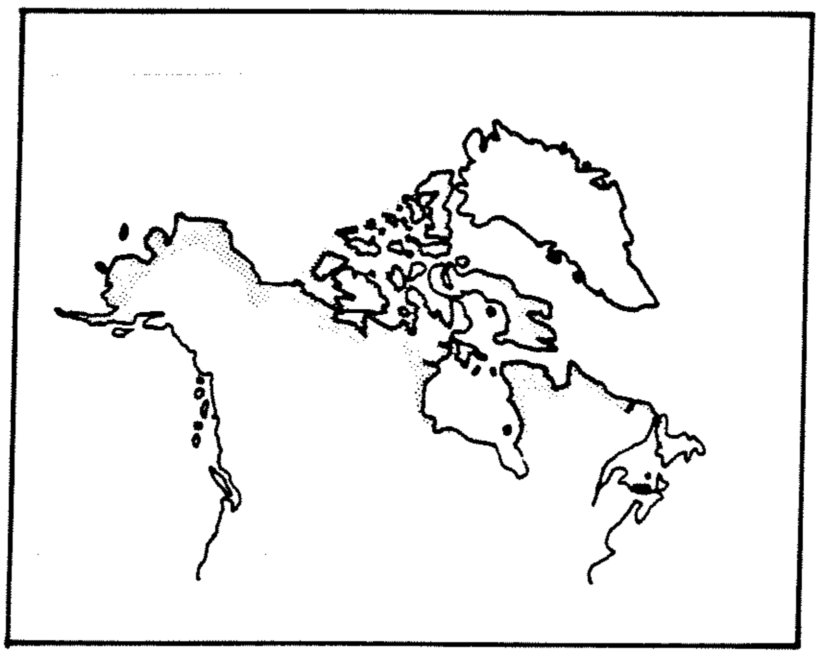


Figure 1: North American distribution of Arctic char (Salvelinus alpinus)

HABITAT

Suitable lake systems in Northern Québec coastal areas which were at one time accessible from the sea can be expected to contain Arctic char. Successful overwintering requires water depth of 3 to 4 meters. Preferred spawning habitat is over gravel and rocky shoals in lakes or in quiet pools of larger rivers with a water depth of 1 m to 4.5 m and a water temperature of approximately 4°C (Scott and Crossman, 1974). Anadromy in Arctic char is found only in those river systems of gentle slope, less than 1.0%, and no vertical barriers in excess of approximately .50 m, since the char is not a strong swimmer compared to other salmonid species. A number of Northern Québec rivers are only accessible to sea-run char during highest fall tides.

REPRODUCTION

In Arctic Canada, char spawn from September to October. Spawning takes place during the day. (Scott and Crossman, 1974). Fish which will reproduce in a particular year develop primary and secondary spawning characteristics during the fall upsteam migration from the sea. Although males establish and guard territories, it is the female that prepares the redd or nest, by using her tail like a paddle to clear debris and make a depression in the gravel. Each female is attended by at least one dominant male when she lays her eggs. The eggs are immediately fertilized by the male and the female then covers the eggs with gravel, again using her tail. Males may mate with more than one female.

Anadromous char may become sexually mature over a wide range of lengths and ages. Depending on their size, females usually lay between 3 000 to 5 000 light orange eggs, each 5.0 mm in diameter (Hunter, 1966). Mature females from the Sylvia Grinnell River, Frobisher Bay, averaged 560 mm in length, and produced approximately 3 600 eggs, while an earlier study at George River showed that spawning females there averaged 412 mm in length, and released approximately 2 700 eggs (Scott and Crossman, 1974). Anadromous char usually spawn only every second or third year and may, in some situations, not migrate to sea during reproductive years (Johnson, 1980).

The eggs develop over the winter, buried in the gravel, at temperatures of 0.0° to 2.2°C. There is a high rate of mortality in eggs exposed to temperatures above 7.8°C (Hunter, 1966). Hatching occurs around the beginning of April. The young fish, or alevins, remain in the gravel, feeding on their egg yolk for some time and may only emerge as fry, following the break-up of ice cover, usually between mid-June and July. At this time, the young fish are approximately 25 mm in length.

THE ANADROMOUS HABIT

All young char spend their first years of life in freshwater. As the fry grow, they develop vertical bands on their flanks, parr marks, and become referred to as parr. Once they reach a minimum size of 150-200 mm (Scott and Crossman, 1974), many of these parr, now known as smolts, make their first seaward migration and become anadromous. Age at this first seaward migration varies greatly, depending on location. In Eastern Canada, it may vary from 5 to 7 years on Baffin Island (Johnson, 1980) to 3 to 4 years in Labrador (Glova and McCart 1978). Some char do not migrate to sea and remain continuously in freshwater. Anadromous Arctic char run to sea in the spring, slightly before or during ice break-up, and return to freshwater in the autumn of the same year (Figure 2). Younger char show a tendency to move downstream and upstream, later than older mature fish. Most char remain within 40 to 50 km of their home stream (Moore, 1974), but some tagged char have been caught as far away as 125 km (Hunter, 1966). While at sea, char from different rivers may mix but usually always return to natal streams, possibly to spawn at the same location their parents spawned. There is no evidence that char ever overwinter in the sea.

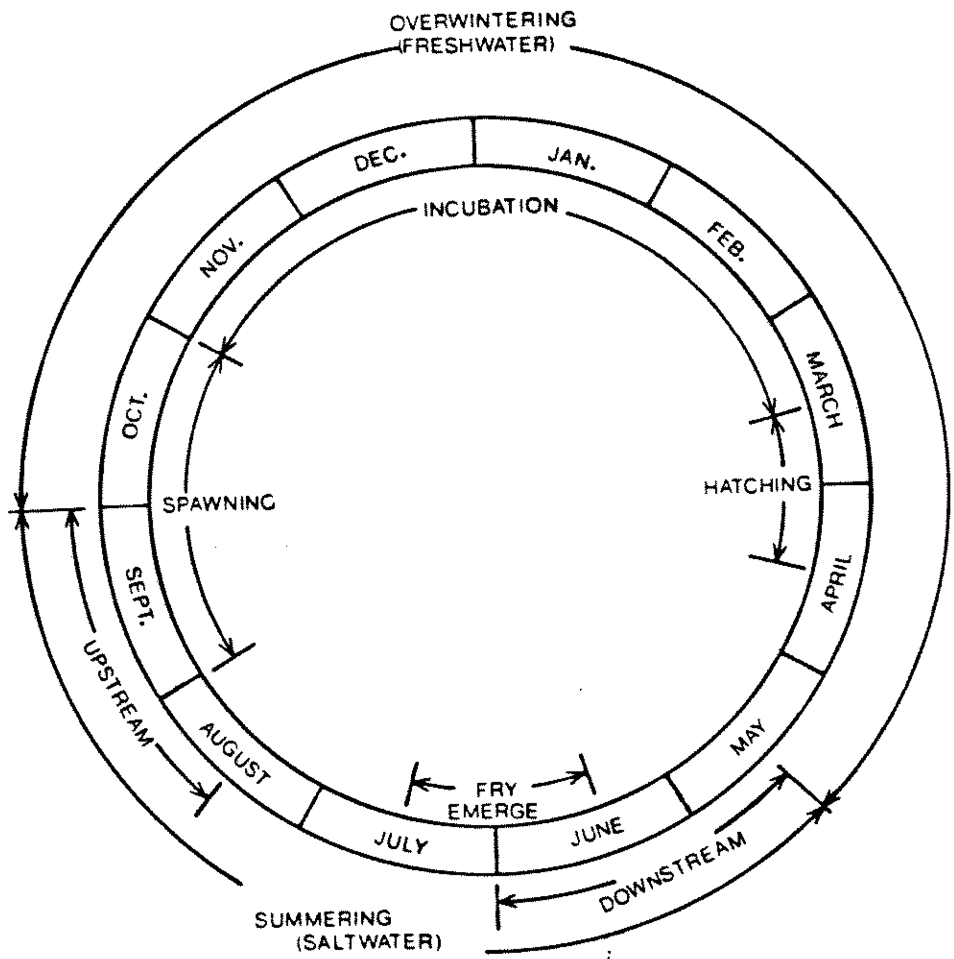


FIGURE 2: Diagramatic annual life cycle of anadromous Arctic char

The upstream migration to freshwater usually begins in mid-August and is largely completed by the end of September. Anadromous char probably do not range far inland but little information exists on this subject. Arctic char are only moderately strong swimmers and while they can hold their position in swift water, they cannot leap as well as other anadromous salmonids such as Atlantic salmon, Salmo salar.

FEEDING

Arctic char are basically carnivorous, the specific diet depending on location, food availability and competition from other species. Young char start feeding on minute organisms, microcrustaceans and insects. As the fish increase in size, larger food items are eaten. Over 30 different species of invertebrates and vertebrates have been recorded in the diet (Grainger, 1953). The most widely reported invertebrates eaten by anadromous char are amphipods and mysids. Vertebrates food items include capelin, sand-lance, polar cod, sculpins, seasnails and lumpfishes. No clear preference between vertebrate and invertebrate food items is indicated. Invertebrates have been recorded as most important at the Sylvia Grinnell river (Grainger, 1953) and Nachvak Fjord (Glova and McCart, 1978), while vertebrates (invariably fish) predominated at some other Labrador locations (Andrews and Lear, 1956) and at Term Point on Hudson Bay (Sprules, 1952). Young of their own species can be a significant fraction of the diet of char, especially for resident and pre-anadromous individuals in freshwater.

Anadromous char feed intensively during the summer while at sea, but very little or not at all during the overwintering period in freshwater. As a result, individual seasonal differences as great as 30% occur in length-weight ratios, as fat reserves are accumulated during the summer for use during the fall and winter.

Landlocked and freshwater resident char feed on a variety of invertebrates including amphipods, larval and adult aquatic insects, gastropods and clams. Vertebrate food items include sticklebacks (family

Gasterosteidae) and other salmonid fry (Johnson, 1980; Saunders and Power, 1969).

GROWTH

Char have adapted to low water temperatures and take advantage of a wide range of feeding circumstances but in general, growth is very slow, especially for freshwater resident populations. Wide variations in the rates of growth across the Canadian Arctic can make generalizations misleading. Growth rates may vary among individuals in a population, between different populations, and from year to year within a given population. Exploitation rates can also influence the apparent growth rate. There is a considerable range of lengths within age groups, because of different individual life histories, i.e. number of years in freshwater, number of years in seawater and number of spawnings. Growth rate increases dramatically when smolts move into seawater for the first time, undoubtedly because of the increased abundance of food.

Most of the annual increase in length occurs while at sea, during the summer. Lengthening continues slowly during the winter, although the fish loses weight at the same time (Johnson, 1980). Annual growth rate decreases with age, to the point where fish may not grow appreciably in length after 20 years of age.

The age of a char is most accurately estimated by counting alternating light and dark bands on the otoliths or ear stones. These bands represent summer and winter growth periods, respectively. Scales are only reliable for the first 3 or 4 years of life, after which they become difficult to interpret.

MORTALITY

There are two significant classes of mortality which act on Northern Québec char populations. Natural mortality includes non-human predation, competition, post-spawning debility, diseases and parasites, while fishing mortality is the result of subsistence, commercial and recreational utilization by man.

The most serious natural predation may be cannibalism, which seems to be restricted to periods of freshwater residence (anadromous or land-locked). It is known that any eggs improperly covered with gravel after spawning may be eaten but no deliberate excavation of eggs has ever been documented. Greatest mortality probably occurs after the emergence of fry through competition for available food, cannibalism, and predation by other fish species. Cannibalism is not an important cause of mortality once char have attained a length of 150 mm. Young char may also fall prey to loons, gulls and terns. Larger char are eaten by ringed seals and even beluga whales.

Moore (1975) states that the greatest cause of natural mortality in adult char is physical deterioration as a result of spawning. He reported 14% natural mortality between ages 10 and 11 and 28.6-30.0% between ages 15 and 17 for char from Cumberland Sound. Nordeng (1961) estimated a 50% total mortality rate in sea-run char in the Salangen River in Norway, but 36% was fishing mortality. LeJeune (1967) reported a total annual mortality rate of 60% for George River char, of which he estimated 10% was due to fishing mortality.

PARASITES

Over its range, a wide variety of parasitic animals have been associated with Arctic char, however, relatively little information exists on parasites of this species in eastern Canada. From five locations in Labrador, Andrews and Lear (1956) noted light infections by roundworms (<u>Philonema</u> sp.). Adult stages occurred in the body cavity while immatures were encysted in liver, gonad, spleen and other viscera.At all locations sampled, heavy infestation by the tapeworm (<u>Eubothrium</u> sp.) was reported.

The following is a brief description of some of the most common parasites which may infect char. Small copepods of the genus Salmonicola, referred to as "fish lice", are common, external parasites. These parasites pierce the skin of their host and suck blood through the wound. They also inject a toxin which, in heavy infestations, can kill the fish. Parasitic copepods can reduce growth in smaller char and may lower fish condition, inhibit reproductive development and perhaps prevent spawning in older char. They are usually found in mouth, gills and on the ventral surfaces near the fins.

Roundworms, long unsegmented worms often tapered at both ends, are common internal parasites of fish. A common roundworm found in body cavities of trout, salmon and char is Philonema sp. Often 50 to 100 mm in length, they move about in the flesh and viscera, sometimes passing right through body organs, causing much damage. Surviving hosts are sometimes found with scar tissue which binds organs together, fusing them into a single mass, often leaving the individual sterile.

Many intestinal parasites are acquired by fish as a result of feeding on infected aquatic invertebrates and smaller fish. One very large and diverse such group are the tapeworms. These long, segmented worms anchor to the wall of the digestive tract and release eggs to be passed from the gut to other hosts. The most common species of intestinal tapeworm in char is Eubothrium sp. It may be so numerous in juveniles as to almost completely block the digestive tract. Such infestations may restrict the growth of small fish and impair their ability to withstand environmental stress. Intestinal tapeworms seem less harmful to the fish than parasites which burrow through flesh and organs. However, they do consume a valuable portion of the food passing through the gut and may contribute to nutritional deficiencies, especially in young fish.

Tapeworms of the genus Diphyllobothrium are infective to man and other mammals. They are commonly referred to as "the fish tapeworm of man" and, as the intermediate carrier is the stickleback, are found mostly in freshwater resident char. They are usually seen as small, whitish cysts implanted on the fish's organs, or more rarely, on the body cavity wall. Human infection is uncommon but can occur from eating heavily infected fish in a raw or incompletely cooked or cured form. These cysts are completely destroyed by cooking or by freezing at -20°C for 24 hours. The infestation is easily eliminated by a mild drug administered by a physician. This parasite is greatly reduced in char which co-occur with lake trout, as lake trout compete very successfully with char for sticklebacks as a food item, forcing char to turn to other food sources.

THE TRADITIONAL HARVEST AND PRESENT UTILIZATION OF ARCTIC CHAR

Traditional Exploitation of Arctic Char

In Northern Québec, the Arctic char has always been a significant resource in the subsistence economy of the Inuit. The people of the region, especially those living along the major river systems, have depended upon the harvest of Arctic char to provide an important part of their food supply, in all seasons of the year. Inuit identify three major forms of char; the "Ikalukpik" or anadromous char, the "Aupiliak" or red spawning char, and the "Nutilik" or land-locked and resident char. Although biologists may group all of those forms together, the distinction made by the Inuit is a useful classification of char as related to habit form, and it illustrates the principal characteristics that Inuit use to systematize their knowledge of resources.

In the last century, new fishing technologies have superceded the traditional patterns and modes of Arctic char harvests. Prior to the introduction of gillnets, the fish spear was the implement that could be most effectively used. The fish spear has been an essential part of Inuit technology for at least 2,500 years. Since 1,200 A.D., there has been little change in its design and with the exception of using nails rather than bone for the "barbs", even the materials have remained much the same. If the technology has persisted, then the skills and knowledge that surround its use must also persist.

The choice of fishing areas was limited by the technology available. The estuaries and deep waters of the major river systems could not be used for spear fishing; instead, fishing was carried out in the small open water areas and leads that formed along the coast, usually adjacent to the mouths of the larger river systems. Special fishing places existed at that time, but the access to those preferred areas was often dependant upon the position of the ice.

The kayak was used to move through the open water areas, to reach stable ice or large moving pans. From here the fisherman would use a small lure that would attract the fish for spearing. There is little precise data to determine how productive this type of coastal fishing may have been. Comments from older Inuit, recorded during discussions of historical patterns of harvest and land use, indicated that it played an important part in the utilization of coastal resources during May and early June. This activity formed part of a complex that in most areas stressed the hunting of basking seals and other marine mammals.

The use of inland waters for the harvest of Arctic char preceded and followed coastal fishing. In the spring, the areas in which char overwinter in the larger river systems were exploited, since the people could move easily on the stable freshwater ice. These overwintering areas were known in both the rivers and the lakes, although specific places were favoured by different family units. In spring fishing, the location of the holes chopped through the ice was critical, since the Inuit knew that the char did not move around much at that time. The ice was often four to six feet thick and thus the skill to see and to spear dark char in dark water was considerable. Again, a jig was used to attract fish for spearing. Some quantitative data is available for this type of fishing which indicates that the catch per unit of effort was substantial in the more favoured areas.

Where the upstream fall migration of anadromous char passed through a suitably shallow and relatively narrow river, the fish could be entraped in a stone weir. A wall of stones spanning the stream was used to funnel the migrating fish into a small enclosure where they could be speared in some numbers with considerable ease. Given the labour involved in weir construction, though, this practice was carried out at a relatively small number of places, the majority of Northern Québec char rivers being much too large.

The widespread introduction of the outboard-powered canoe and the gillnet have altered the mode and pattern of the Inuit char harvest profoundly. Previously unexploitable areas, particularly in the estuaries where the anadromous char spend the summer foraging, have become the focal point of subsistence and, ultimately, commercial harvests. These new technologies have also introduced to the Inuit fishermen the means to harvest the stocks so efficiently as to locally deplete the desireable fractions of the char stocks. Where this has become a recurring problem, simple management techniques are necessary to replace the safeguards which were inherent in the more traditional methods of harvest.

The Commercial Exploitation

Throughout most of the history of Inuit culture in Northern Québec, there was no attempt to export Arctic char to outside markets. In the early 1960's this situation changed and several commercial char fisheries were started in Ungava Bay. The char stocks of the George River, False River, Whale River and Payne River all supported some commercial harvest. The development of these initial char fisheries coincided with the re-establishment of commercial harvests of Atlantic salmon by local Inuit cooperatives. Commercial salmon operations had been discontinued since the late 1930's (Power 1976)

The level of commercial exploitation varied between the river systems. Each system had a quota of approximately 30,000 pounds established on the commercial harvest, but there is little doubt that the subsistence harvest also continued, thus significantly increasing the total pounds of fish landed. As these commercial catches were shipped out as frozen, cleaned fish, fishing efforts had to be concentrated near the village in order to get the fish into a freezer while they were firm. Thus, tethered to the community in this way, the people superimposed their subsistence fishery on the commercial harvest, but over a reduced area. There is also the impression that the emphasis on commercial exploitation tended to reduce the subsistence effort. Although this would probably have partially offset the negative effects on the fish stocks, it may well have significantly reduced the protein supply that was available to those households that participated in the commercial operations. It is obvious that at least part of this supply could have been made up by the increased utilization of other species, especially marine mammals, but in reality this probably did not occur. On all the systems where the harvest was substantial, a marked change in, first, the average size of fish and ultimately, catch per unit of effort was experienced. By the 1970's, large scale commercial exploitation was discontinued on some systems and severely curtailed on most others.

Present Harvest

Present levels of total harvest for all Northern Québec communities involved in the native harvest study from 1976 to 1980 (Makivik Research Department 1976-1980) are given in Table 1. The average total annual harvest, over the period from 1976 to 1980, was 97,465 individual fish, the majority of these being anadromous char. The figures (in numbers of char) reported from Kangiqsualujjuaq and Kangiqsuk are almost directly applicable to those respective river systems. The harvest from the Kovik River system is a component of the Akulivik figures and is therefore masked by catches from other areas more adjacent to that community. It was determined from local interviews that the harvest from the Kovik system is a small fraction of the annual catch at Akulivik, and therefore must be quite light. Annual harvests from Kovik may be greatly influenced by ice and weather, as access is normally gained by a sea voyage along 80 km of exposed coast.

Present harvesting levels at Payne Bay appear quite steady over the last five years, at just under 10,000 fish/yr. A pronounced decline in total harvest is indicated at Kangiqsualujjuaq. Effort can only be approximated by comparing the number of hunters involved annually in the fishery however this number actually rose slightly over this same period. This does not mean that a portion of the decline in catch could not be attributed to an increase in community related jobs in Kangiqsualujjuaq but it is unlikely that a drop of 61% over five years could be a result of that single trend.

Table 1 - Harvests of Arctic char by Northern Québec communities, 1976 to 1980*

COMMUNITY	1976	1977	1978	1979	1980	Average
Kuujjuarapik	1,423	1,499	695	334	381	866.4
Inukjuak	19,445	15,284	9,405	13,835	13,287	14,251.2
Akulivik	21,007	8,267	11,317	14,035	13,361	13,597.4
Salluit	19,638	7,525	7,792	12,527	17,789	11,211.8
Kangiqsujuaq	10,426	8,141	6,340	9,975	15,650	10,106.4
Quaqtaq	2,357	2,387	678	1,786	1,453	1,732.2
Kangirsuk	12,961	8,600	9,580	8,770	8,743	9,730.8
Aupaluk	2,371	1,881	2,717	2,685	2,112	2,353.2
Tasiujaq	5,817	4,525	8,775	7,948	4,521	6,317.2
Kuujjuaq	9,328	10,050	4,329	3,202	4,676	6,317
Kangiqsualujjuaq	28,972	20,896	17,509	16,461	11,231	19,013.8
Killiniq	217	366	-	-	-	291.5
Chisasibi	32	-	14	-	-	15.3
Total	133,994	89,421	79,151	91,558	93,204	97,465

* JAMES BAY AND NORTHERN QUÉBEC NATIVE HARVESTING RESEARCH COMMITTEE

1982 Research to Establish Present Levels of Native Harvesting. Harvests by the Inuit of Northern Québec. Phase II (Yr. 1979 and 1980). Montréal.

1981 Research to Establish Present Levels of Native Harvesting. Harvests by the Inuit of Northern Québec. Phase II (Yr. 1977 and 1978). Montréal.

1978 Research to Establish Present Levels of Native Harvesting. Harvests by the Inuit of Northern Québec. Phase II (Yr. 1976). Montréal.

Sport fishing camps catering to southern fishermen presently operate on most major rivers adjacent to Inuit communities. Strict controls on this harvest (5 fish per fisherman/week; all other fish being released) reduce the biological effects on the stock to insignificance. These operations are a significant source of revenue for the area, providing jobs at the community level.

Food Value

The large annual harvest of Arctic char in Northern Québec represents a very important component of the annual subsistence food budget. At an average of 2.0 Kg of edible flesh per anadromous char, approximately 200,000 Kg of edible flesh is harvested from this one source. Some of this is used to feed dogs and inevitably some fish are spoiled. It is likely that 150,000 Kg of char flesh is eaten by the human population each year. This food resource is abundant throughout the region. Out of thirteen communities participating in a detailed harvest study (Makivik Research Department, 1976-1980), eight localities reported catches in excess of 5,000 fish annually and five of those reported in excess of 10,000 fish annually. Given a total population of approximately 5,000 people, the char harvest represents, on average, 19.5 fish per year, for every inhabitant of the region. In 1980, edible flesh of Arctic char represented 17.9%, by weight, of all subsistence foods harvested in Northern Québec. Of 26 individual species recorded in the study, its contribution was second only to the caribou.

Further insight into the dietary role of Arctic char is gained by looking at the contribution to the total protein requirement and total energy requirement which can be provided from this one source. Twenty-five percent of the edible weight of Arctic char flesh is protein. Thus, the average annual protein contribution is approximately 37,500 Kg. Daily requirements for protein in the human body, according to the World Health Organization, vary from 0.7 and 3.0 grams per Kg of body weight per day, depending on the individual and his/her activities.

Assuming an average requirement of 2.5 gm per Kg of body weight per day and an average body weight within the Northern Québec population of 70 Kg, the total annual protein requirement becomes 319,375 Kg. By division, the potential contribution of protein from Arctic char to the total requirement represents 11.75%.

Char is also a good source of energy for the human body. Metabolising the protein, carbohydrate and fat components of 100 gm of char flesh provides about 575 Kcal of food energy. The average male Inuk requires about 3,300 Kcal of food energy per day during normal activities; females and younger individuals would require less. Assuming an average requirement, per individual, of 3,000 Kcal/day, the total annual requirement for the Northern Québec population would be 5,475,000,000 Kcal. Arctic char flesh can provide 862,500,000 Kcal annually or 15.75% of the total energy requirement.

Quite aside from the abstract traditional importance of these foods to the Inuit lifestyle, their significant contribution to the food budget can be appreciated on more concrete terms by considering the cost of replacing the protein and energy derived from char with the equivalent amount of non-traditional foods such as beef and flour. Where commercial harvests in a particular situation remove char from the subsistence catch, the cost of buying replacement protein and food energy must be considered when measuring the true economic benefit of that fishery.

THE BIOLOGY AND POTENTIAL OF ARCTIC CHAR - CASE STUDIES ON THE GEORGE, PAYNE AND KOVIK RIVER SYSTEMS

INTRODUCTION

The work described in this report was designed to provide biological information from three Northern Québec river systems. With this information we can assess the health and status of the anadromous char populations, and help make decisions on the proper types of harvests and ways to prevent the harvest of too many char. These rivers, the George River, Payne River and Kovik River (Figure 3), are well separated from each other and were known to have large differences in the size of the harvests from them.

Two important types of information are now available as a result of these studies. First, a great deal of general scientific knowledge on the anadromous char in this region was recorded. In particular, results of the studies of parasites, feeding, genetics and growth help the study of all Northern Québec char populations. Secondly, population information from each river, growth rate, average age and average size of catch show how the fish in each river are affected by fishing.

The results from each river are interpreted by comparing them with present and past harvesting levels. In addition, the George River information is compared with that of a studies completed on that River in 1959-1960. These interpretations were used to create a list of recommendations to help the people of the area harvest char in the future without taking too many fish.

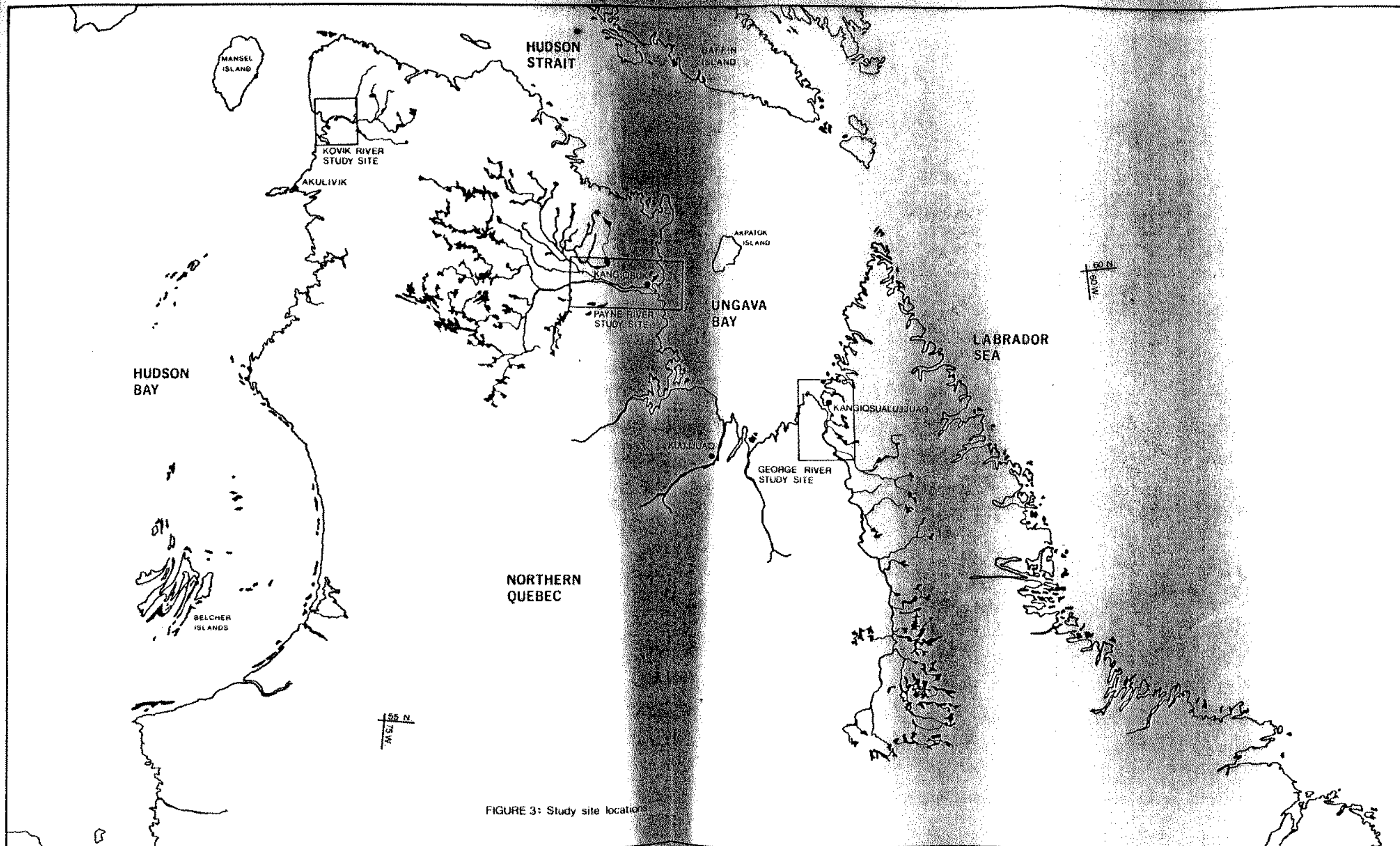


FIGURE 3: Study site locations

DESCRIPTIONS OF THE RIVERS

George River

The George River (Figure 4) flows from near the Labrador - Québec border, just NE of Schefferville to the south-eastern corner of Ungava Bay, a distance of approximately 510 km. There are three major tributaries, with a combined length of 450 km. The land around this river is approximately 31 000 km^2.

Ikalupik can't swim up past Helen's Falls, just upstream of where the first major tributary enters the river. As a result, ikalupik can only live in the Ford River and the George River downstream from Helen's Falls.

Below Helen's Falls, the George River flows through a series of high hills, creating a noticeable river valley. Tides in the area of the river mouth rise and fall an average of 8.0 meters (maximum 14.0 m). As a result, water with salt may extend more than 45 km upstream from the river mouth, creating a long, deep, fiord-like estuary.

The Inuit settlement of Kangiqsualujjuaq is situated on the east side of the estuary, about 16 miles south of the mouth of the estuary.

Payne River

The Payne River (Figure 5) flows from Payne Lake, in the center of the Ungava Peninsula, and flows east, then north, then east again before it reaches Ungava Bay midway along its western shore. The length of the Payne River is about 295 km. There are three major tributaries of a total combined length of almost 1 000 km. The land around the Payne River system is more than 46 000 km^2, the largest of the three study sites.

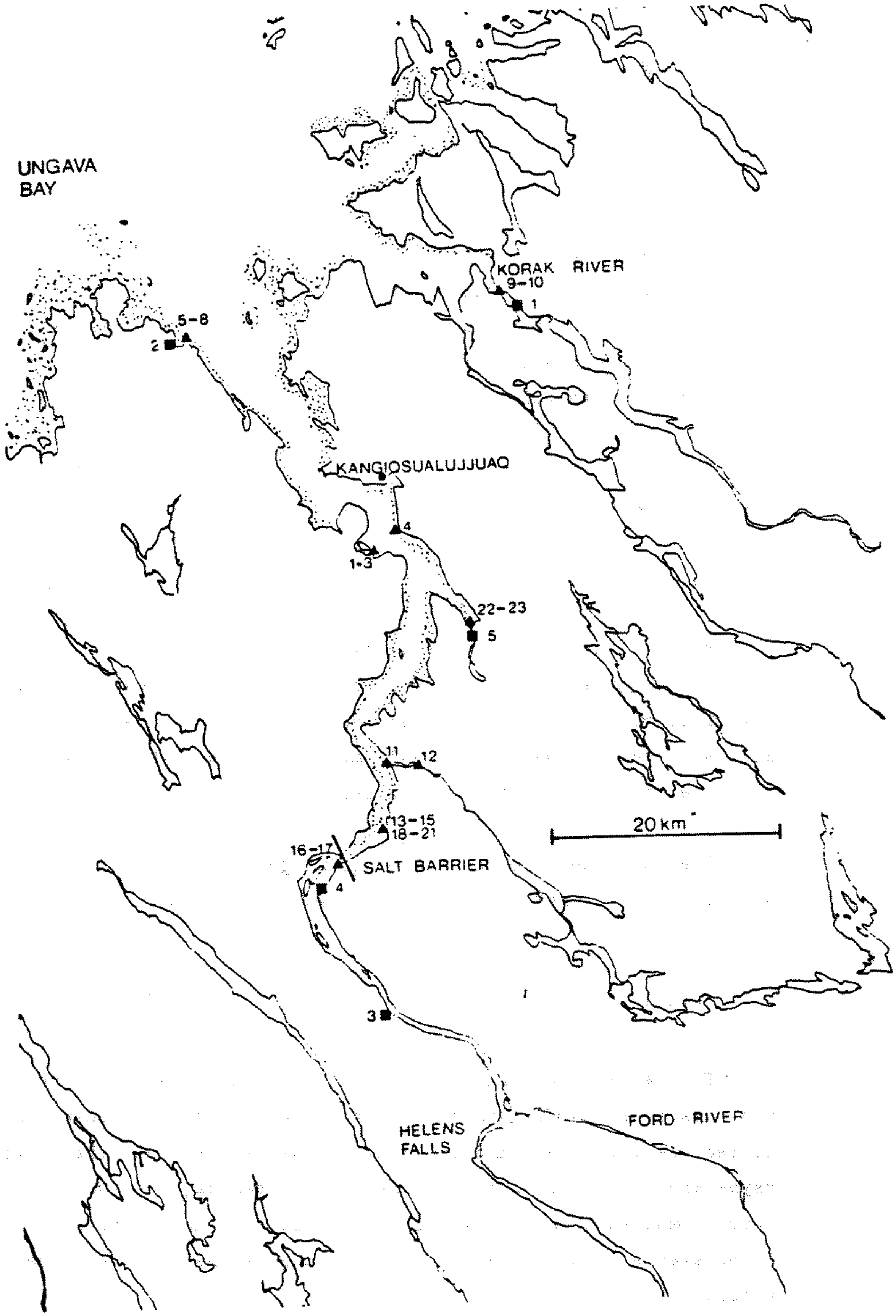


FIGURE 4: George River study site

▲Fishing sites
■Water chemistry s

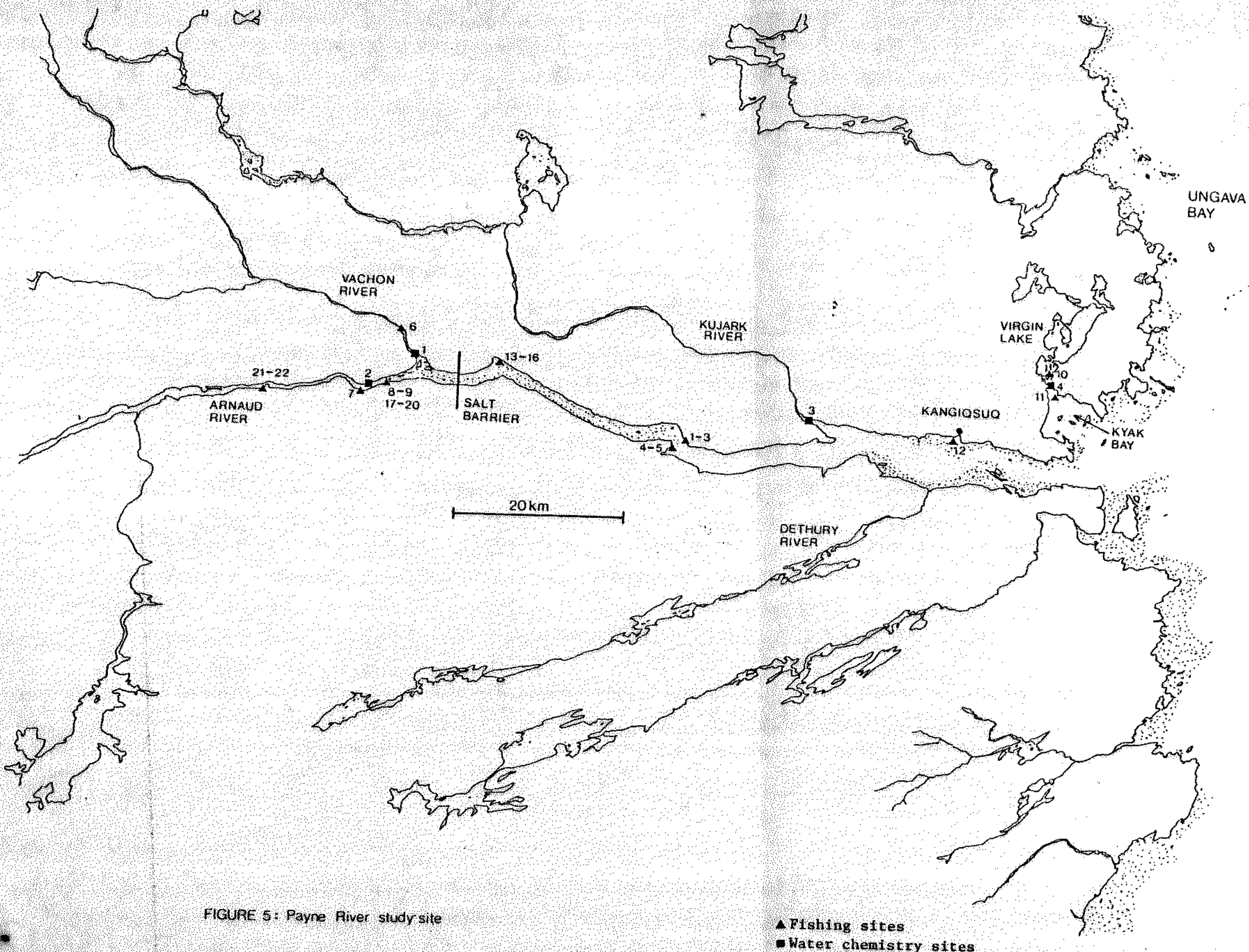


FIGURE 5: Payne River study site

There do not appear to be any places where ikalupik cannot pass on either the main stem of the Payne River or its major tributaries. No lakes where ikalupik can get in were found, however, many areas upstream on both the main river and tributaries are very much like lakes.

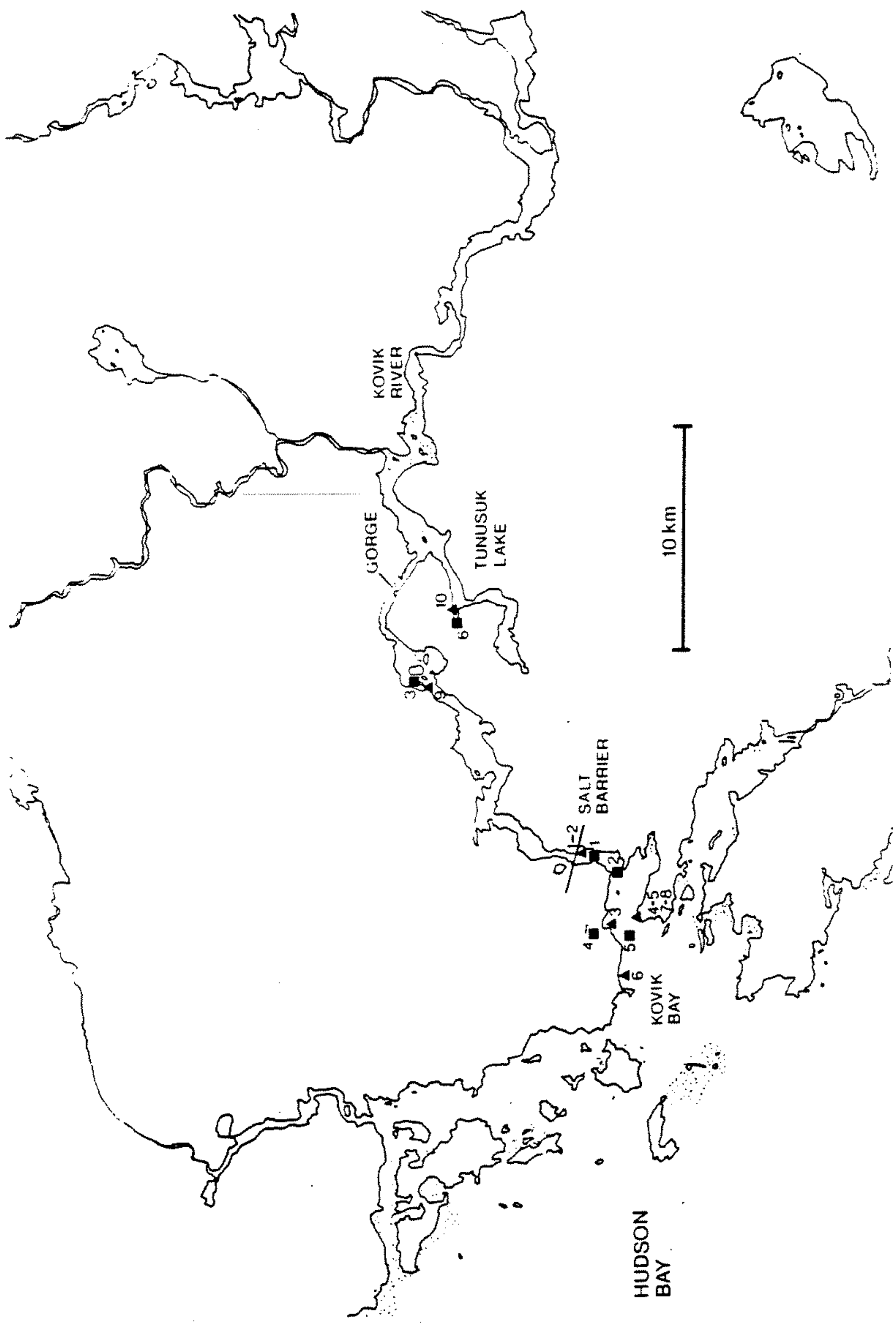
The lower sections of the Payne system are very similar to those of the George River. The hilly surrounding terrain and high tides in Ungava Bay (mean 7.5 m; maximum 12.0 m) create a long salt water fiord. The salt water was observed to flow more than 75 km upstream from the river mouth.

The Inuit settlement of Kangirsuk is located on the north shore of the estuary, approximately 13 km west of the mouth.

Kovik River

The Kovik River system (Figure 6) is much smaller than the other two rivers. The land around the river is approximately 8 700 km^2. The main river is 145 km and the one major tributary is 100 km. The water flows from the Ungava Peninsula about 45 km south of the community of Salluit. The river flows south, then west, eventually discharging into the east coast of Hudson Bay at about 62° north latitude.

Tides on this section of the Hudson Bay coast are not nearly as high as those of Ungava Bay; the mean and maximum range is generally less than 3 ft. As a result, the boundary between the river water and the seawater is much more clear than in the other study sites. Salt water was found to be only 5 km upstream of the head of the estuary. The lower sections of the Kovik flow through a low, fairly flat land. The River is usually very shallow (5 ft.) with no clearly defined channel. The area surrounding the lower sections of the river has many lakes and some these were quite large. Like the river, however, these are generally shallow and where they are connected with the Kovik, these outflows would be very shallow or dry during the summer-fall dry period.


KOVIK RIVER
GORGE
TUNUSUK LAKE
10 km
SALT BARRIER
KOVIK BAY
HUDSON BAY

We did not see any places where the ikalupik could not pass for a long distance upstream in the Kovik system.

There is no permanent Inuit settlement near the Kovik River system; however, the area is visited sometimes by people from several communities, usually Akulivik, because the fishing for ikalupik is very good.

METHODOLOGY

Two sampling periods on each of the three river systems were planned. These were to be scheduled so as to encounter the anadromous "spring" downstream run and the late summer "fall" upstream run. Due to an unusually late break-up of sea ice in the estuaries, the downstream migration was sampled only on the Kovik River. The entirety of both the George and Payne samples and approximately one half of the Kovik samples were actually "summer" samples as the fish had already entered the estuaries and were actively feeding.

Samples of the "fall" upstream migration were collected on the Payne and George Rivers. Severe weather prevented access to the Kovik region by sea, until well beyond the anticipated time of the "fall" run; consequently, no fall sample from that system is available.

The following table summarizes the dates of the sampling periods on the various rivers.

System	"Spring" sample	"Fall" sample
George	June 15 - July 4	Sept 2 - Sept 11
Payne	July 2 - July 21	Aug 28 - Sept 15
Kovik	July 2 - July 23	No sample

The field sampling team at each site consisted of a field biologist, two Inuit student/research trainees and an Inuk guide. Each team was equipped with a complete field sampling kit and a laboratory/accomodation tent. Canoes and additional tents were provided by the Inuit guides.

Fish were collected with several types of gillnets. Heaviest effort was expended with multifilament nylon gillnets (GN type), having a mesh (stretched) size of 127 mm (5 in) and "hung" dimensions of 2 m x 50 m. Smaller size classes were sampled with six-panelled gangs (GG type) containing a near-geometric progression of sizes (32, 38, 51, 64, 76, 95 mm). "Hung" dimensions of these nets were 2 m x 45 m. Sporadic use was made of nets belonging to the Inuit guides or other local fisherman but due to the variability in mesh sizes and dimensions of these, data from these sources was included only in calculations where the resultant sampling bias were irrelevant.

Pole seines with a sweep of 3 m and a mesh size of 12 mm (.5 in) were used sporadically but with very little success. Gillnets were set, upon consultation with local fisherman, to sample a variety of locations within the area of known distribution of the char at each site. To provide sufficient numbers for meaningful analyses, the target for the total number of char to be studied in each sampling period was set at 300 fish.

A complete record of catch information for each net set was maintained. This included a complete time series, set location, net type and number, and the total number and weight for each species.

Each Arctic char caught was fully examined and the following measurements or samples taken.

(1) Fork length - To the nearest millimeter;
(2) Round weight - To the nearest 50 grams;
(3) Markings - Body markings, normal and abnormal;
(4) Sex - Visual inspection;
(5) State of maturity - Visual inspection classified by the following code scheme:

Code		Maturity state
1	Immature	Undeveloped
2	Mature	25% developed
3		50% developed
4		75% developed
5		100% developed
6		Spawning condition
7		Spent

(6) Age - Otoliths, retained dry;

(7) Stomach fullness - Visual inspection, expressed as a percent;

(8) Stomach contents - Visual inspection, major food groups expressed as percents of total contents;

(9) Parasites - Visual inspection. Occurance of major types noted;

(10) Blood sample - Retained in 100 microliter pipettes for "blood serum esterase" genetic evaluation;

From each site, samples were retained in 5% buffered formalin for speciation of stomach contents and visceral parasites.

Interviews with local people were conducted to determine the utilization, by char, of various sections of each system and the timing and extent of their movements in so far as they were known. Direct assessment of important sites such as spawning and overwintering locations and migration routes was achieved by shoreline/canoe survey and/or float-down, where these sites were accessible. Water quality parameters such as temperature, salinity, dissolved oxygen content and pH were tested at several key sites on each system.

Otoliths were read by refracted light against a black background, after cleaning in either a glycerol water mixture or beechwood creosote.

RESULTS

CATCH DATA

The results obtained in this study are the product of detailed analysis of 1 498 Arctic char from the three study sites. The number of char sampled in each field period is given below. A complete record of the catch data and a summary of all sets are presented as companion volumes to this report. Site locations are indicated as triangles on the site maps (Figures 4 to 6).

	George River	Payne River	Kovik River
"Spring"	269	274	310
"Fall"	383	262	N.A.

Length frequency

Figures 7 to 9 are relative frequency length class histograms for each river sample. Where several types of nets were used to collect samples, separate histograms were constructed for each gear type (Figure 10, George River; Figure 11, Payne River).

Overall, the George River sample was weakly bimodal with a strong mode at 500-525 mm F.L. and a weaker mode at 325-350 mm F.L. (Figure 7). This weaker mode comprises fish which were sampled almost entirely with the geometric gang during a two-day period late in the fall sampling program. It must be assumed that the migratory "runs" of anadromous char may include mixtures of smaller immature and larger maturing fish in varying proportions.

For Payne River, the distribution of lengths (Figure 8) provides a slightly bimodal distribution as well; however, the weaker mode at 175 to 200 mm F.L. is almost entirely made of fish caught "summering" in

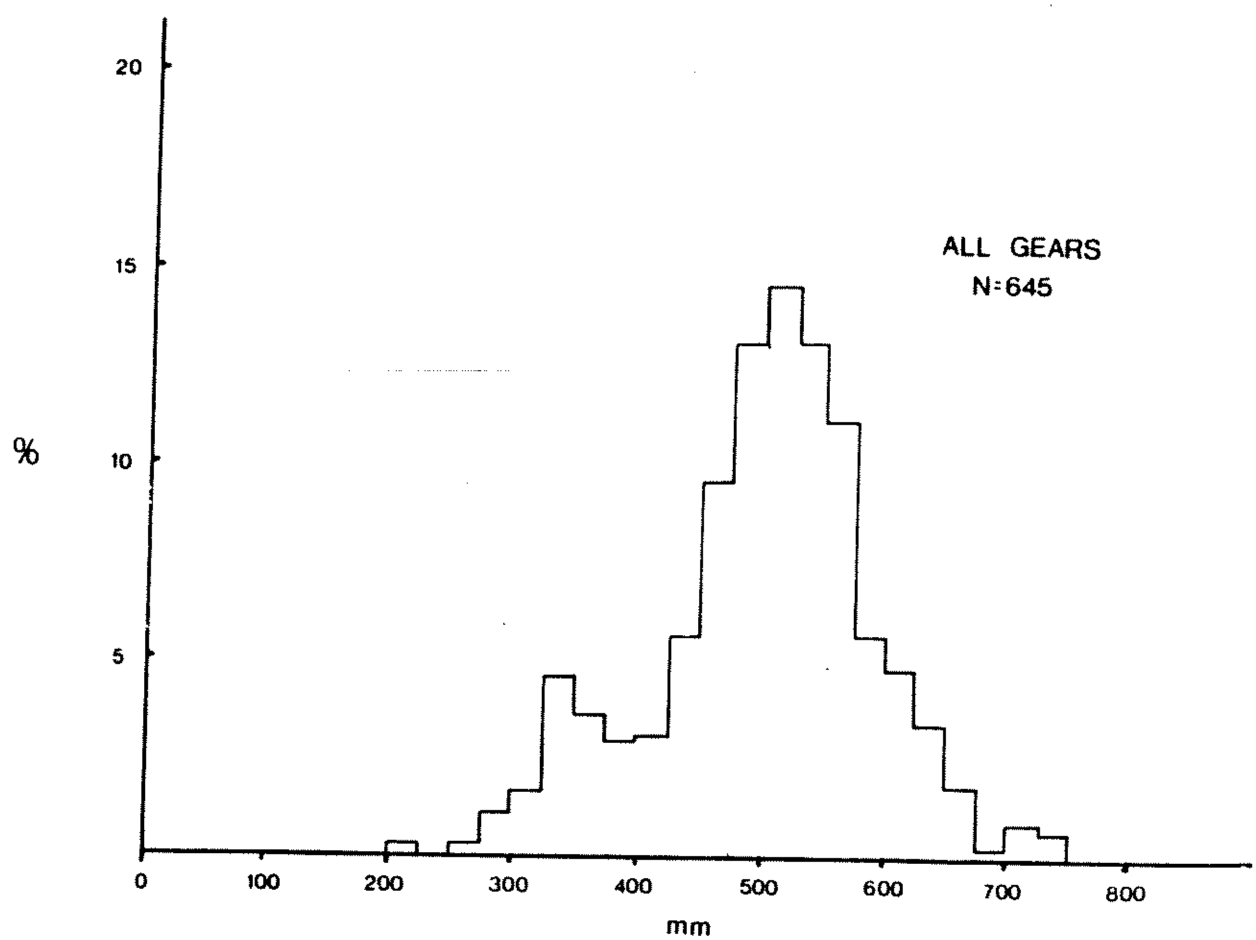


FIGURE 7: Relative length frequency catch histogram, all gear types, George River

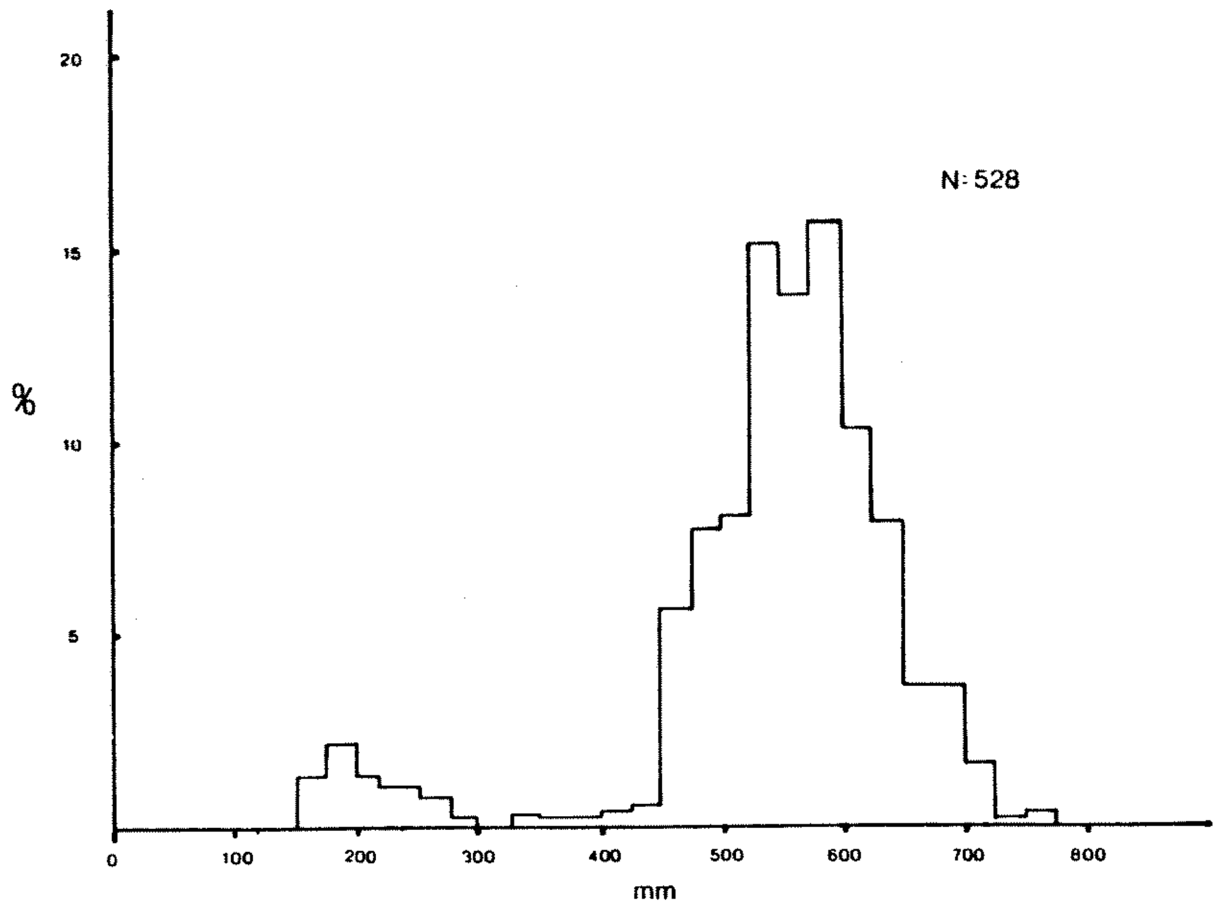


FIGURE 8: Relative length frequency catch histogram, all gear types, Payne River

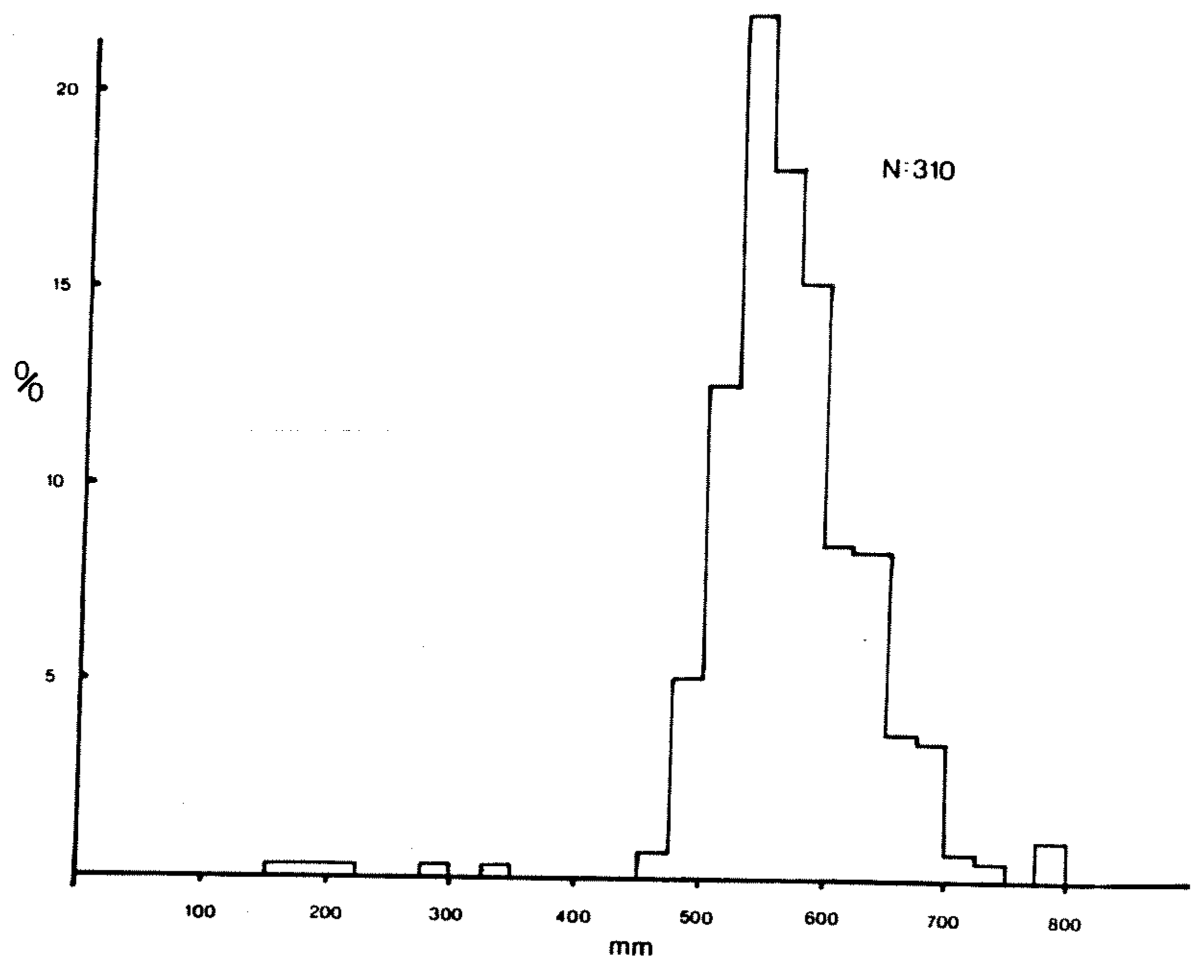


FIGURE 9: Relative length frequency catch histogram, all gear types, Kovik River

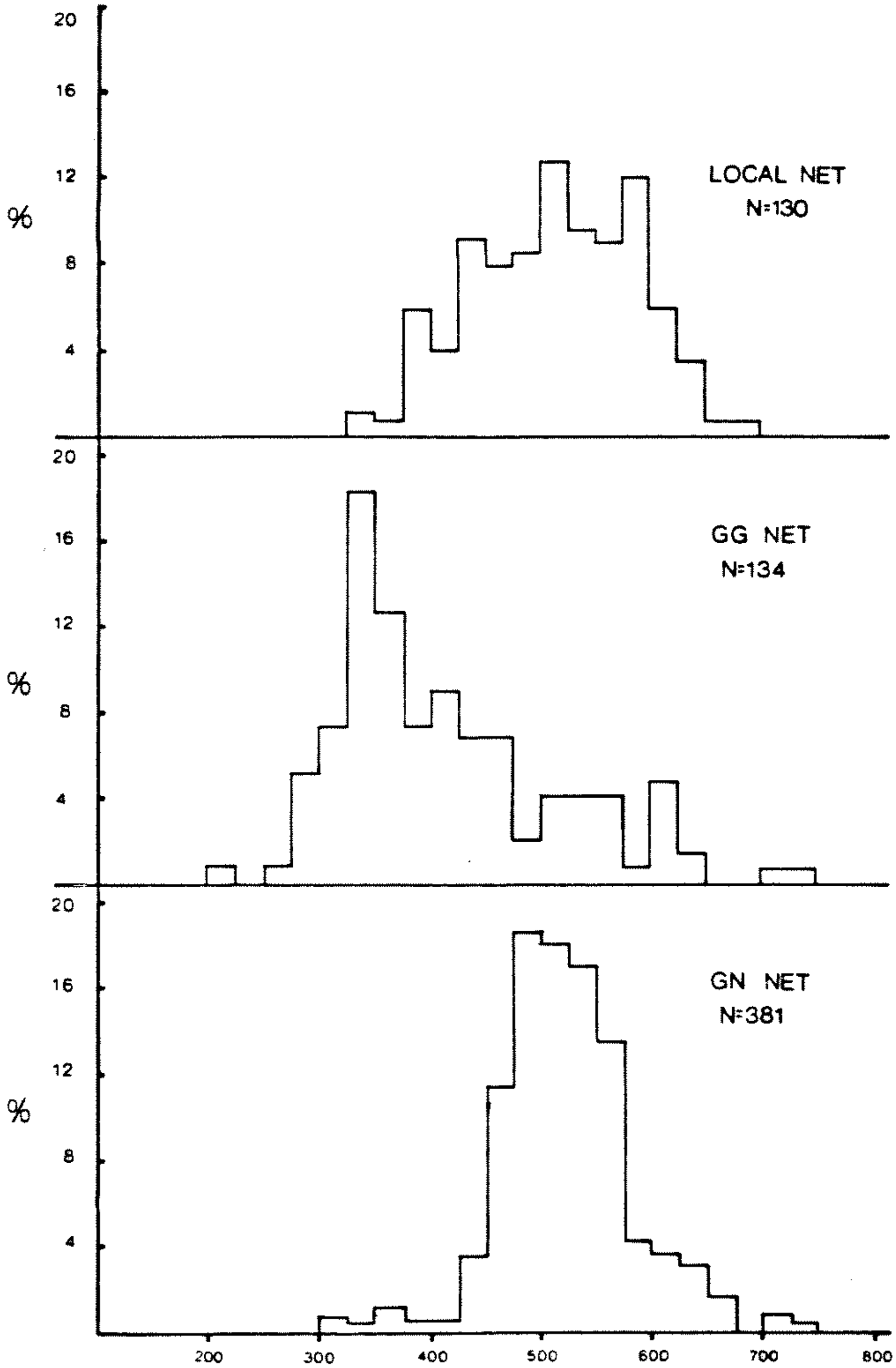


FIGURE 10: Relative length frequency catch histograms, by gear type, George River

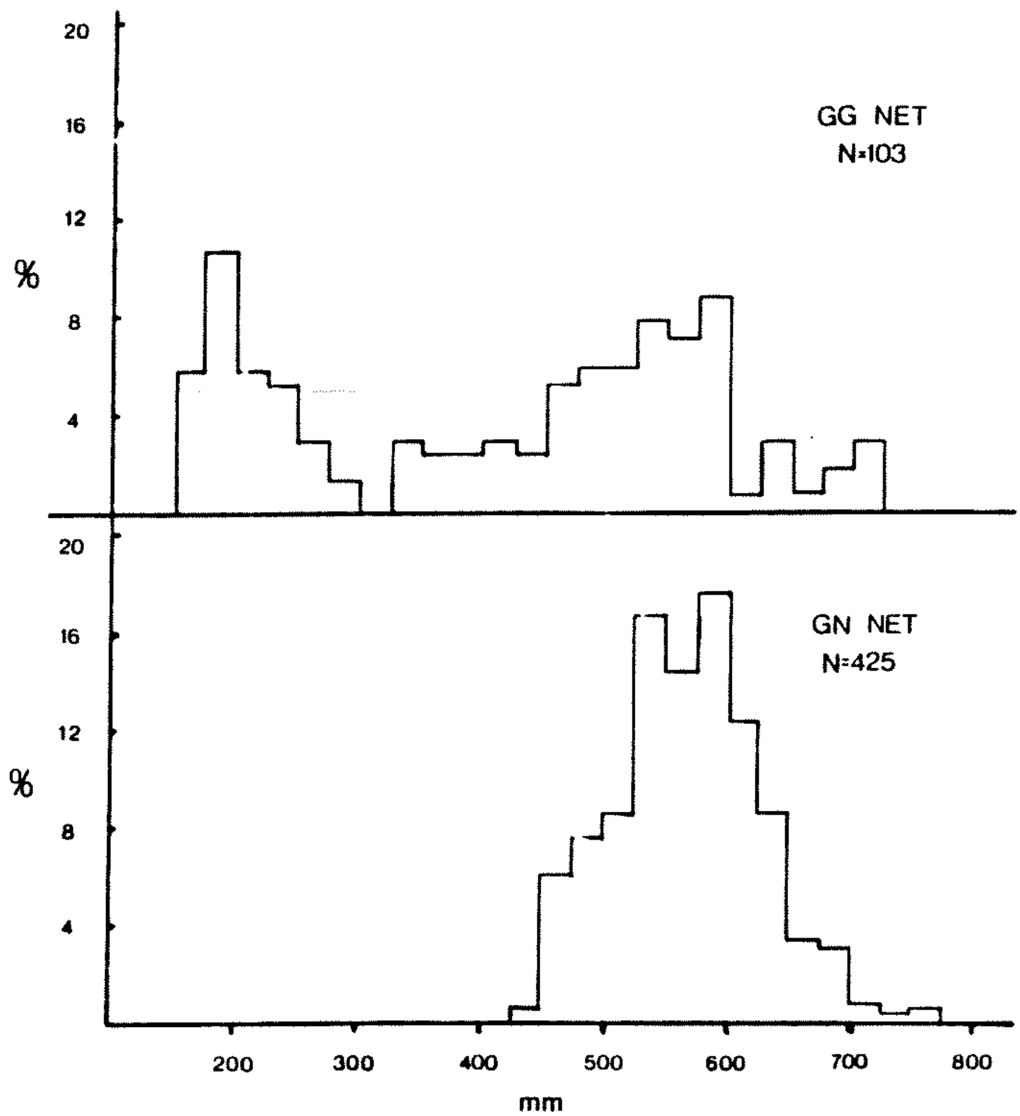


FIGURE 11: Relative length frequency catch histograms, by gear type, Payne River

fresh water, presumably pre-migrants and/or residents. The larger mode at 525-600 mm F.L. represents the anadromous fish sampled.

The distribution of lengths from Kovik River (Figure 9) is definitely unimodal. There, fishing with the geometric gang resulted in very high catches of whitefish species, and so was discontinued.

The occurance of much smaller individuals in the anadromous population at George River is of interest and will be discussed in light of other results in succeeding sections.

In studying the length distribution of catches by GN nets from all the rivers (Figures 9, 10 and 11), the length above which fish are heavily recruitable using these heavy mesh gears can be definitively placed between 450-475 mm (F.L.). Where reasonable effort was expended with nets presently used by native fishermen, (George River, Figure 10), proportionately much higher frequences of smaller length classes (down to 375-400 mm F.L.) were observed.

Subsamples

At each study river, char were collected from several types of environment, in both the spring and fall seasons. As a result, for meaningful analysis, fish from each river had to be divided into subsamples. In Figure 12, the relationship of these subsamples to various aquatic environments is depicted by locating them on a typified diagram of the study rivers where samples were taken. The subsample codes assigned in Figure 12 will be referred to throughout this report.

Catch per unit of effort

Individual rates of catch, standardized for effort, are presented for each net type in each subsample (Figure 12) in Table 2. The rate of catch is expressed both in terms of number and weight. Vast differences

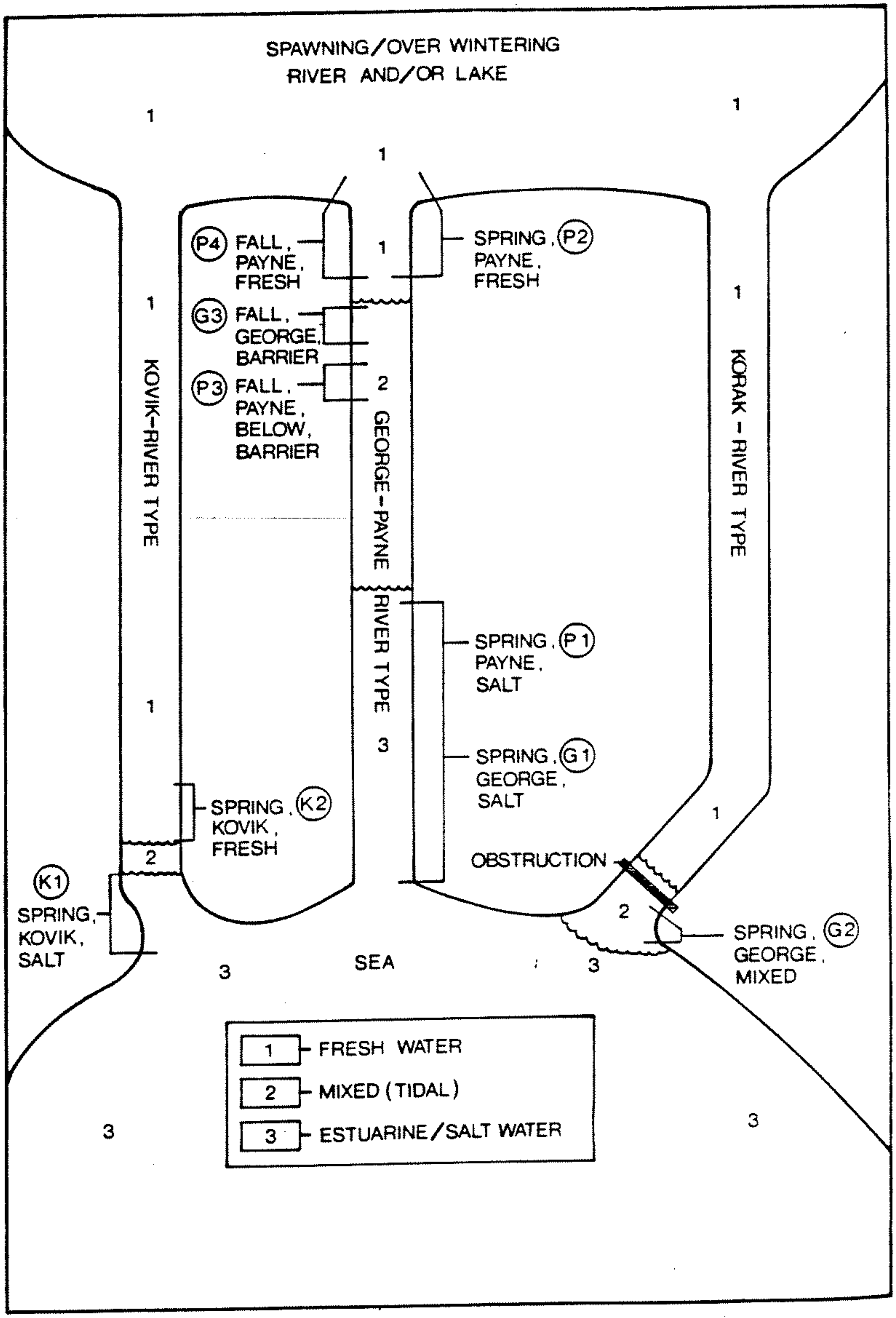


FIGURE 12: Study rivers typified to indicate the relationship between

TABLE 2: Catch per unit of effort by net type in subsamples of Arctic char captures

	SAMPLE		NET TYPE GN	NET TYPE GG	NET TYPE Native
SPRING	GEORGE - SALT	G1	0.055 0.097	0.069 0.105	0.153 0.304
	PAYNE - SALT	P1	0.211 0.429	0.193 0.341	- -
	KOVIK - SALT	K1	0.169 0.309	0.036 0.052	- -
	KOVIK - FRESH	K2	0.446 0.924	- -	- -
FALL	GEORGE - BARR.	G3	0.155 0.244	0.347 0.182	0.142 0.220
	PAYNE - BARR.	P3	0.049 0.114	0.047 0.035	- -
	PAYNE - FRESH	P4	0.078 0.178	0.026 0.065	- -

Units = No/M/12 hrs
Kg/M/12 hrs

in conditions, especially tidal action, between study sites render inter-river comparisons, for population studies of density derived from gillnet data, risky at best. Gillnets set from shore in either Payne or George River estuaries, where tidal ranges are large, are invariably stranded on exposed flats for a length of time. Moreover, the lenth of this exposure is very site specific. Tidal range on the Kovik system is low enough to have no influence on the effective fishing time of any gillnet set. The units chosen, average number of fish per meter of gil-lnet (standard depth) per twelve hours and a similar figure for average weight, do have some practical application. The influence of the tidal cycle is incorporated into the units just as the influence of tidal cycles cannot be avoided by any gillnet fisherman in the Payne and George estuaries.

The highest spring CPUE values were recorded at Kovik River in fresh water (0.446 fish/m/12hrs). This was the only subsample of the downstream run of anadromous fish. In the estuaries, highest catches were recorded in the Payne system and lowest in the George system.

The upstream run in fall would appear to be denser at George River (0.155 fish/m/12hrs) than at Payne (0.049 fish/m/12hrs). However, results from migratory runs would be expected to vary temporally as well as spatially.

The GG type nets were approximately as effective as the GN type nets in terms of average numbers caught, but as expected, the average weight was generally much lower. Local native nets were of equal or considerably higher effectiveness, compared with the GN nets.

FEEDING

Gut fullness

The feeding habits of anadromous Arctic char are closely linked to their annual migratory cycles and are generally well documented (p.15, this report). Feeding appears to be almost, if not completely, restricted to that time spent in the marine environment. It was therefore expected that a great deal of variability in feeding intensity would be encountered in the various subsamples in this study. Individual gut fullness data, expressed as percents of stomach volume occupied, were grouped into five classes for each subsample. This information, contained in Table 3, illustrates this variability. Lowest feeding intensity was observed in the downstream spring run of anadromous fish at Kovik River, K2, and the upstream anadromous run at Payne, P4; while the heaviest feeding activity occurred in Payne, P1, and George, G1, estuaries in summer.

Stomach contents

Individual stomach contents were divided visually in the field into major food groups, the volume of each being described as a percent of the total contents. Stomach content data is presented in several ways. Table 4 expresses, for each subsample, the percent of stomachs containing each major food group. Table 5 expresses the percent of all food occurrences represented by each major food group. Both of these tables show that fish and crustaceans, particularily amphipods, are the most widely recorded marine foods.

Volumetric importance

A more accurate indication of the relative importance, based on volume, of each food group is achieved by integrating the stomach fullness with the relative percent of each food item. The sum, for each food group, of all of these actual percentages of individual volumes, expressed as a percent of the total available stomach volume, N, of that subsample becomes a measure of the volumetric importance of that food group. These results are displayed in Figures 13 through 17.

Figure 13 compares the volumetric importance of the various food groups between the three "summer" estuary subsamples. It shows that fish and crustaceans are by far the most important food items. In George River, fish are far more important than crustaceans, while at Payne River, this dominance is somewhat less. Fish are less important than crustaceans at the Kovik River. The total of undigested food decreases from over 65% of available volume at George River to less than 25% at Kovik River. This may reflect the fact that the Kovik estuarian subsample was obtained quite close to the river mouth and may contain a large component of newly arrived downstream migrants. This is borne out by noting that 24.7% of fish in this subsample had totally empty stomachs (Table 3) as opposed to 14.9% at Payne River and 3.1% at George River.

The George River mixed water subsample, G2 (Figure 12), showed comparatively low feeding activity (Figure 14) but what they were eating was divided between marine (fish and crustaceans - 40%) and freshwater (insects - 60%) food items. This subsample was taken in the George estuary, immediately below the outflow of an obstructed tributary, the Korok River (Figure 12), where there is a large influx of freshwater into a bottlenecked estuarian basin (Figure 4).

Subsample P2 (Figure 12) was obtained in freshwater after the downstream anadromous run and comprised char that were resident, at least that summer, in fresh water. Many of these fish were small (170 mm to 300 mm, Figure 8) and likely pre-migrants. They were feeding moderately heavily, with over 35% of available stomach volume filled (Figure 14). Ninety-seven percent of food occurrences were insects (Table 5). Less than 10% of these stomachs were empty; however, 83.9% were less than 50% filled (Table 3). This probably illustrates the relative scarcity of food items in freshwater as compared to the marine environments in these areas.

The only sample of downstream spring migrants is from the Kovik system, K2 (Figure 12). These fish were feeding at an extremely low

TABLE 3: Percent of subsamples of Northern Québec Arctic char in each class of stomach fullness

	SUBSAMPLE		N	DEGREE OF FULLNESS (%) 0	1-25	26-50	51-75	76-100
S	GEORGE - SALT	G1	162	3.1	13.0	15.4	30.2	38.3
P	PAYNE - SALT	P1	228	14.9	28.5	32.0	10.1	14.5
R	KOVIK - SALT	K1	154	24.7	44.2	20.8	4.5	5.8
I	GEORGE - BARR.	G2	67	67.2	28.8	3.0	0	1.5
N	PAYNE - FRESH	P2	37	8.1	56.8	18.9	8.1	8.1
G	KOVIK - FRESH	K2	153	90.8	6.5	2.0	0	0.1
F	GEORGE - BARR.	G3	364	25.5	60.2	11.3	1.4	1.6
A	PAYNE - BARR.	P3	85	44.7	36.5	10.6	4.7	3.5
L	PAYNE - FRESH	P4	168	98.2	1.8	0	0	0
L								

TABLE 4: Percentage of stomachs with occurrence of major food groups for subsamples of Northern Québec Arctic char

FOOD GROUP	SPRING						FALL		
	GEORGE		PAYNE		KOVIK		GEOR.	PAYNE	
	Salt G1	Mixed G2	Salt P1	Fresh P2	Salt K1	Fresh K2	Barr. G3	Barr. P-3	Fresh P4
FISH	93.1	10.3	72.8	-	28.6	-	2.5	48.8	1.2
AMPHIPODS	18.4	2.9	30.7	-			1.6	25.0	-
DECAPODS	1.1	1.5	-	-	35.7	7.2	-	2.4	-
COPEPODS	-	-	1.8	-	(1)	(2)	-	8.3	-
INSECTS	1.7	22.1	-	86.5	-	0.6	0.5	-	0.6
CHAETOGNATHES	-	-	1.8	-	-	-	-	-	-
GASTROPODS	-	-	-	2.7	-	-	-	-	-
WORMS	0.6	-	0.4	-	-	-	-	-	-
DIGESTED MAT.	5.2	-	(2)	(2)	20.8	0.6	61.0	(2)	(2)
DEBRIS	-	-	0.4	-	-	1.3	0.3	-	-
NO. OF FISH	174	68	228	37	154	153	364	84	167

(1) Crustaceans not differentiated.

(2) Not recorded.

TABLE 5: Major food groups as a percentage of total food occurrences for subsamples of Northern Québec Arctic char

	SPRING						FALL		
	GEORGE		PAYNE		KOVIK		GEOR.	PAYNE	
FOOD GROUP	Salt G1	Mixed G2	Salt P1	Fresh P2	Salt K1	Fresh K2	Barr. G3	Barr. P-3	Fresh P4
FISH	77.5	28.0	67.5	-	33.6	-	3.8	56.9	66.7
AMPHIPODS	15.3	8.0	28.5	-			2.5	29.2	-
DECAPODS	1.0	4.0	-	-	42.0	73.3	-	2.8	-
COPEPODS	-	-	1.6	-	(1)		-	9.7	-
INSECTS	1.4	60.0	-	97.0	-	6.7	0.8	-	33.3
CHAETOGNATHES	-	-	1.6	-	-	-	-	-	-
GASTROPODS	-	-	-	3.0	-	-	-	-	-
WORMS	0.5	-	0.4	-	-	-	-	-	-
DIGESTED MAT.	4.3	-	(2)	(2)	24.4	6.7	92.5	(2)	(2)
DEBRIS	-	-	0.4	-	-	13.3	0.4	-	-
NO. OF FISH	174	68	228	37	154	153	364	84	167
TOTAL FOOD OCCURANCES	209	25	246	33	131	15	240	72	3

(1) Crustaceans not differentiated.

(2) Not recorded.

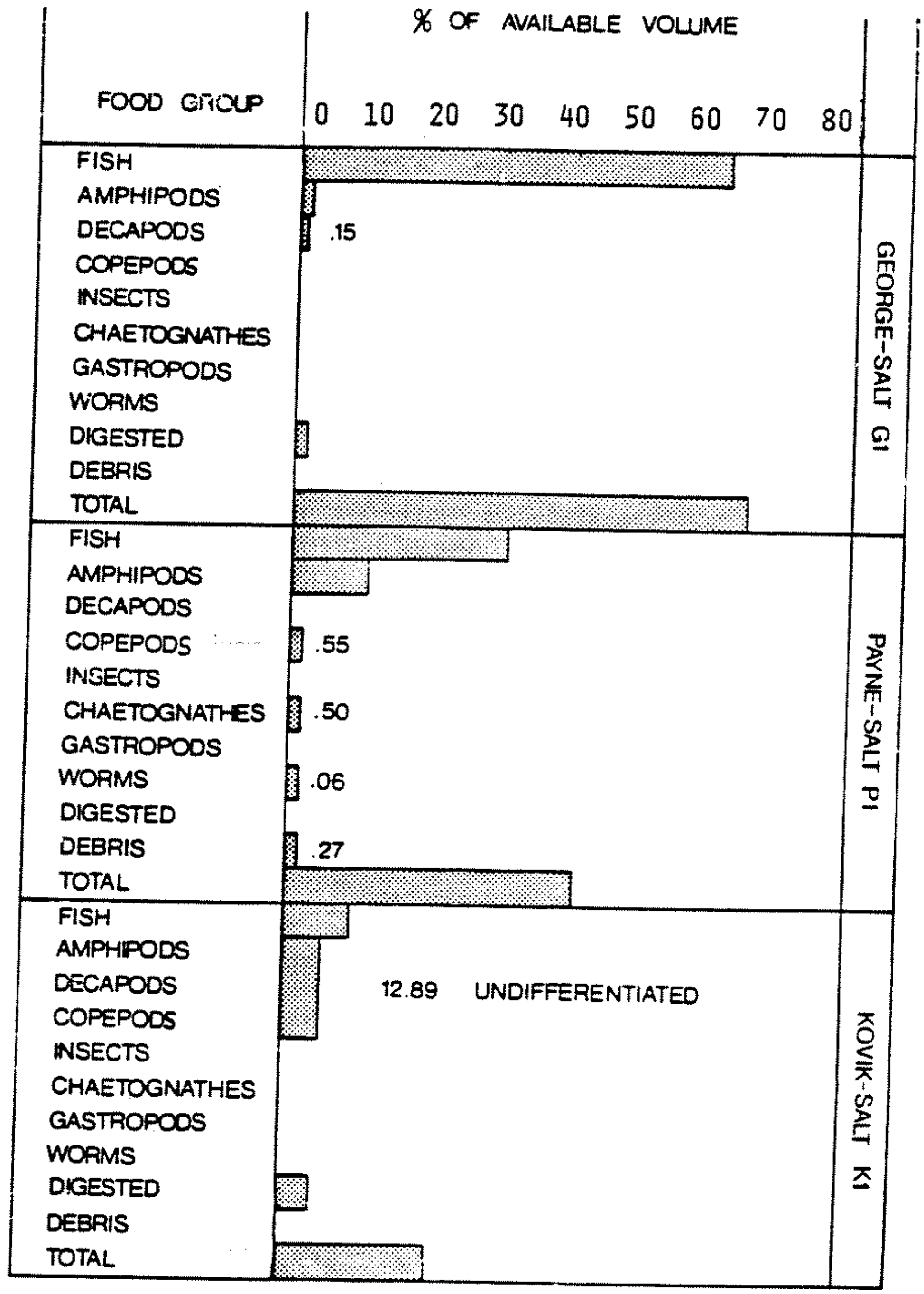


FIGURE 13: Major food items as a percentage of available total volume in subsamples taken from salt water in "spring"

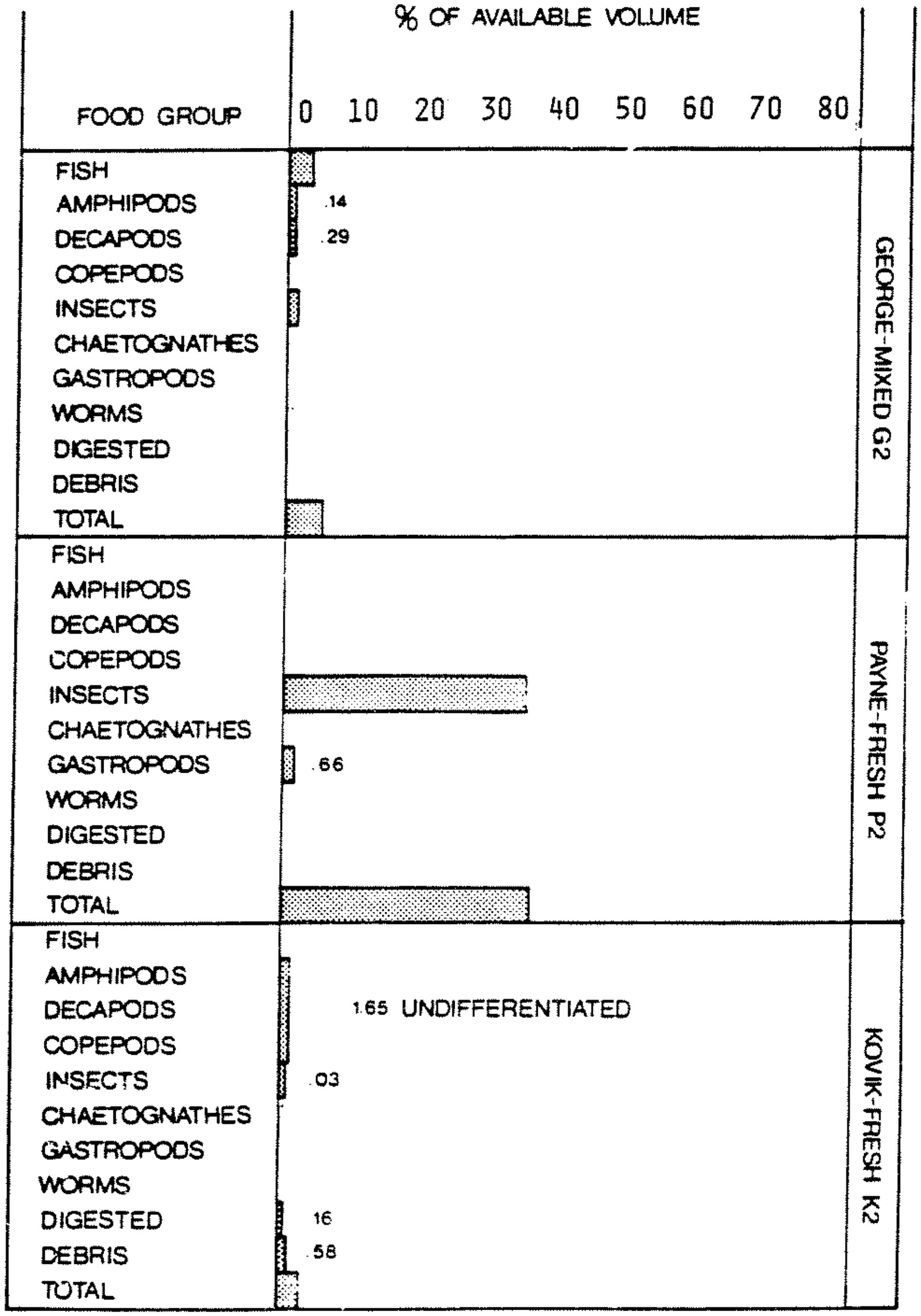


FIGURE 14: Major food items as a percentage of available total volume in subsamples taken from fresh and mixed waters in "spring"

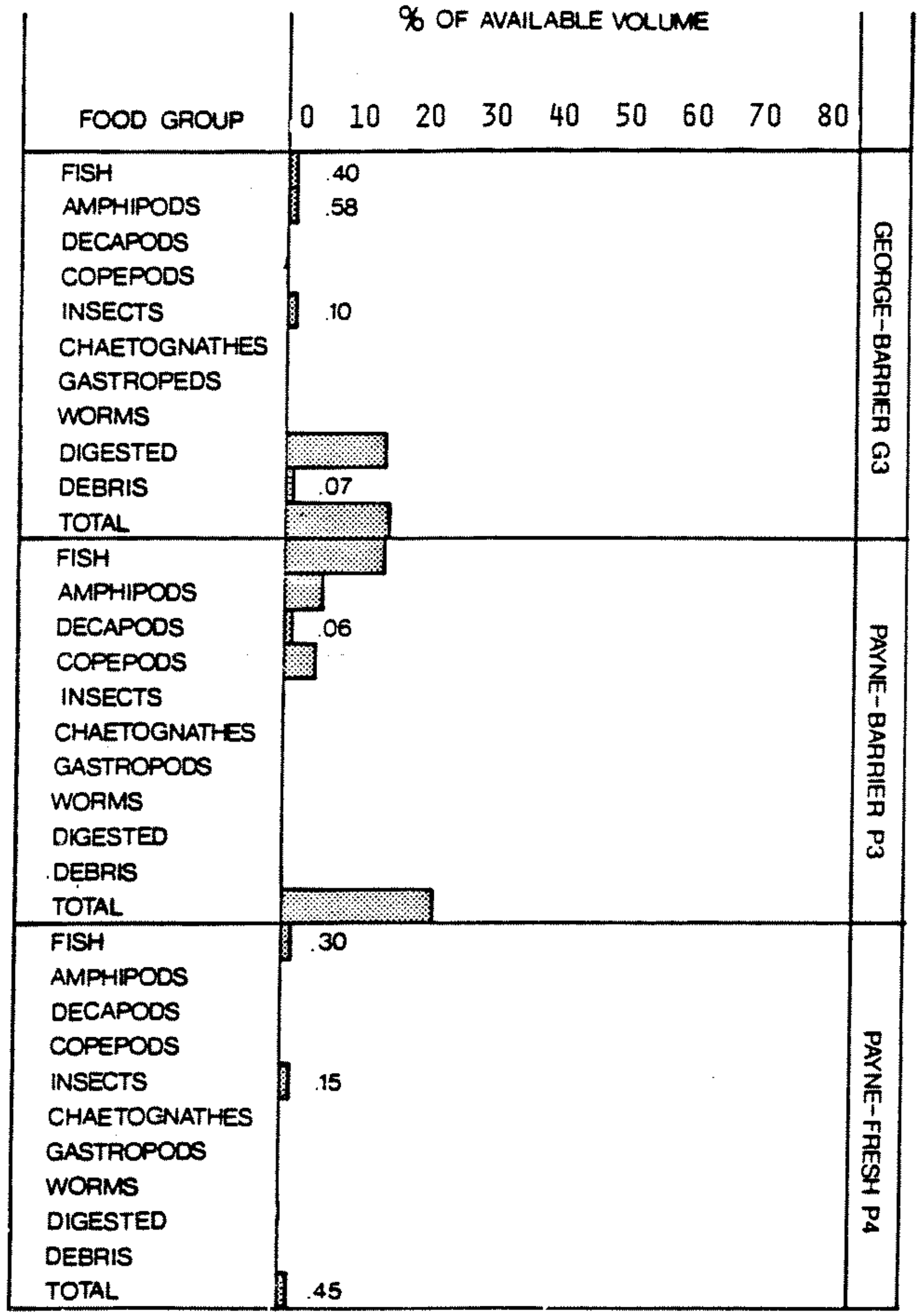
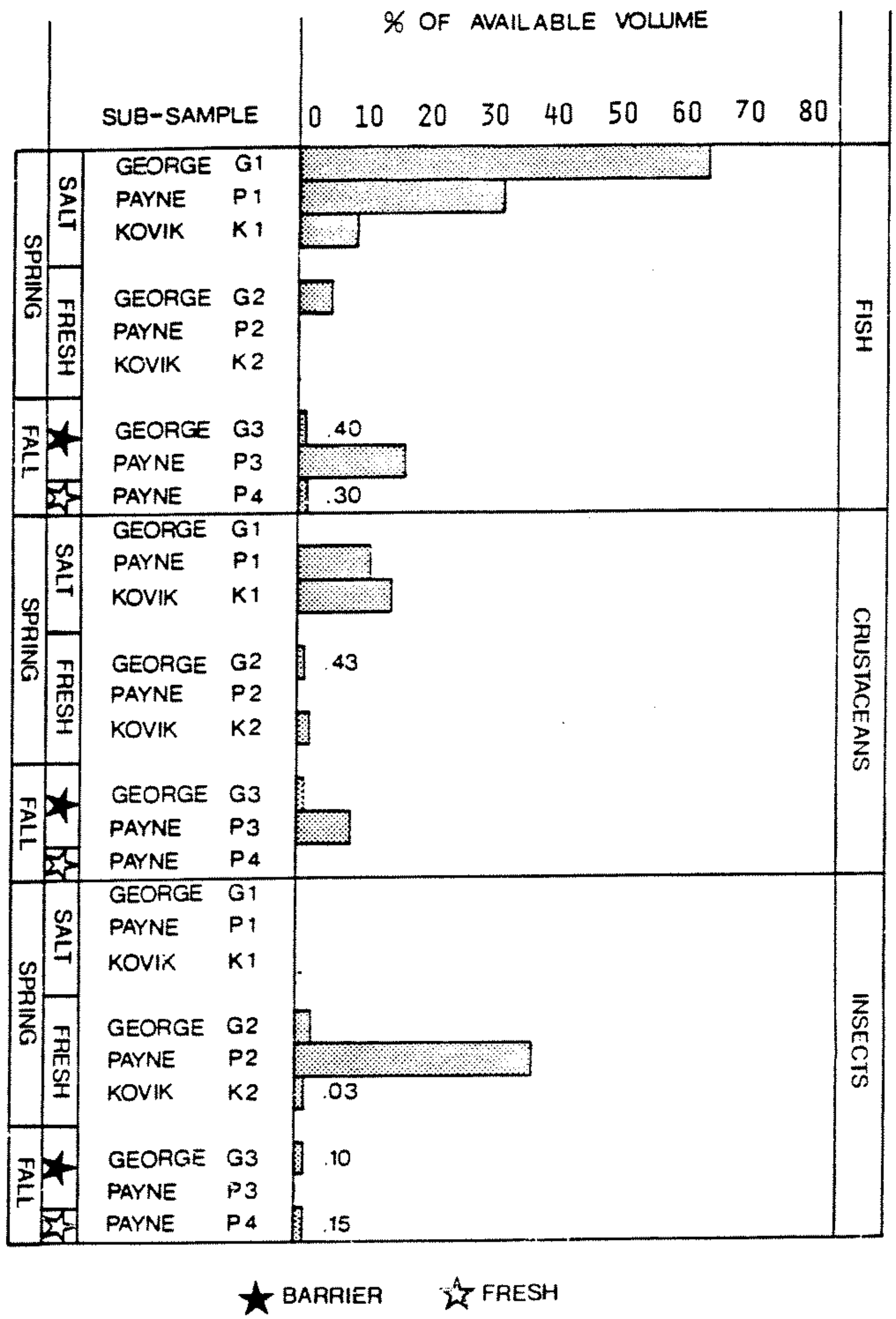


FIGURE 15: Major food items as a percentage of available total volume in subsamples taken from fresh and mixed waters in "fall"



IGURE 16: The percent of available total volume occupied, in each subsample, by each of the three most important food groups

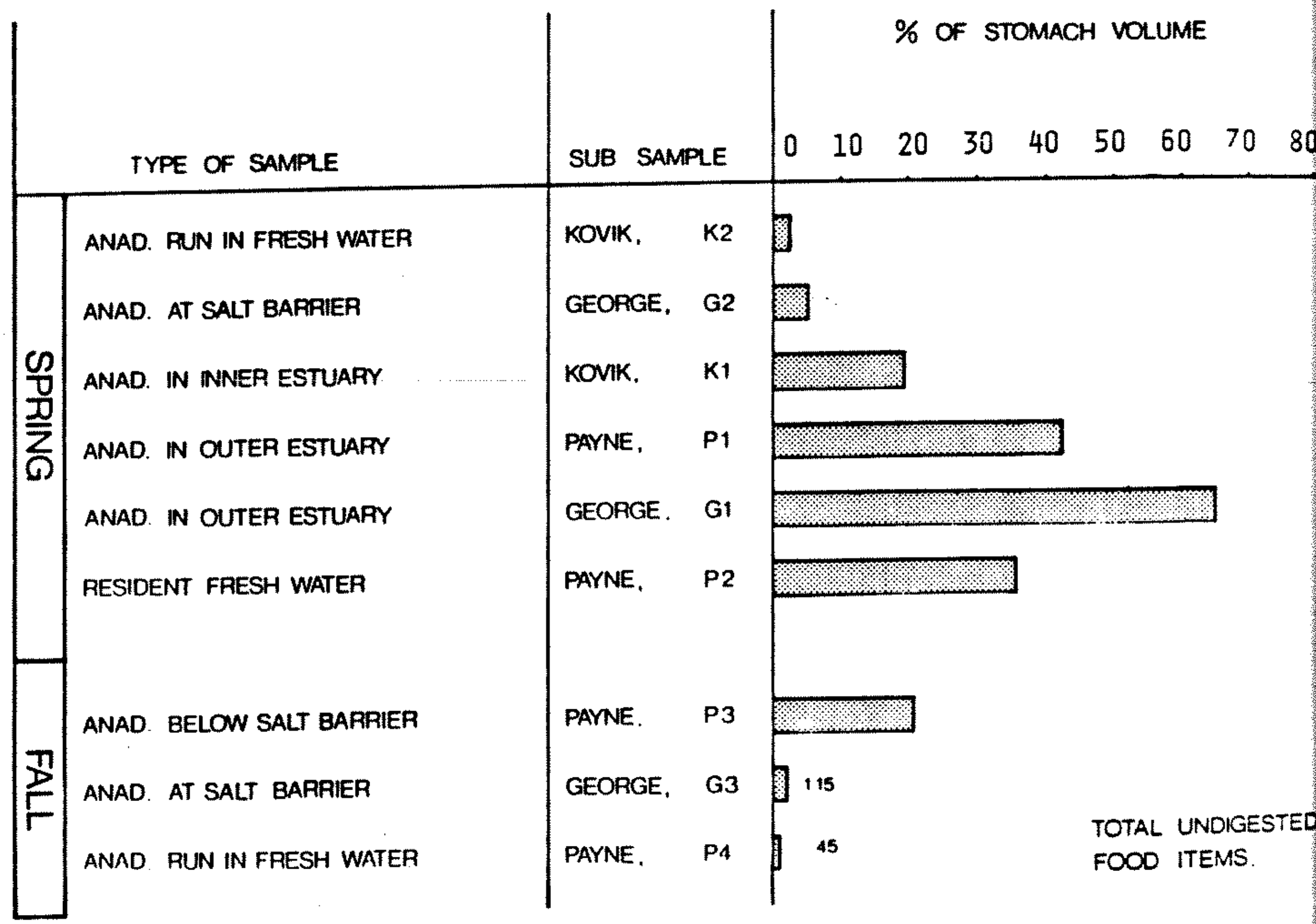


FIGURE 17: Volume of total undigested food items as a percentage of total available stomach volume for each subsample, related to annual migratory movements

intensity of less than 3.0% of available volume (Figure 14). What they were eating was predominantly crustaceans, based on 15 food occurrences (Table 5).

The three fall subsamples were taken from below the salt barrier (P3), at the salt barrier (G3) and well above the salt barrier (P4). As might be expected, the total available volume occupied by food drops from 21% in P3, to 14% (mostly digested material) in G3 and to less than 0.5% in P4 (Figure 15). This drop in feeding intensity is clearly in response to crossing into a fully freshwater environment from the estuary.

Figure 16 is a realignment of data presented in Figures 13 to 15 to highlight the relative volumetric importance of insects, crustaceans and fish between all the subsamples. Where significant feeding activity takes place, fish are the most important food item in the marine environment with crustaceans of secondary importance, while insects predominate in stomachs from freshwater residents.

In Figure 17, the percentage of available stomach volume occupied by undigested food items, as a measure of feeding intensity, is compared for all subsamples. This figure shows clearly the relationship between feeding intensity of anadromous char and their annual seaward migration or more accurately, their proximity to freshwater.

Food species

Laboratory analysis of some stomach contents was carried out to determine a list of specific food species utilized by char in Northern Québec rivers and estuaries. Four fish species and 6 species of amphipods represent the two major marine food groups, while char feeding in freshwater, at Payne River only (P2), were feeding on 20 species from 3 families of insects. Several non-aquatic organisms were taken by char feeding in fresh water. The complete list of food species identified from the study sites is found in Table 6.

Table 6 - List of food species from stomachs of Arctic char from Northern Québec.

SALT WATER

VERTEBRATES			
	Fish		*Myoxocephalus scorpoides*
			Lumpenus lumpretaeformis
			Ammodytes sp.
			Boreogadus saida
INVERTEBRATES			
	Amphipods		
		Hyperiidae	*Parathemisto* sp.
		Gammaridae	*Ischyrocerus* sp.
			Gammarus sp.
			Gammaracanthus sp.
			Acanthonotozoma serratum
		Lysianassidae	Unidentified sp.

FRESH WATER

INVERTEBRATES				
	Insects			
		Ephemeroptera		
			Meptageniinae	*Meptagenia* sp.
				Phithrogenia sp.
			Ephemerellinae	*Ephemerella* sp.
			Baetidae	*Baetis* sp.
				Unidentified sp.
		Plecoptera		
			Perlodidae	*Isoperla* sp.
				Isogenus sp.
				Unidentified sp.

Diptera		
	Simuliidae	
		Simulium sp.
		Cnephia sp.
	Tipulidae	
		Two unidentified sp.
	Chironimidae	
		At least three unidentified sp.
	Culicidae	
		At least two unidentified sp.
	Muscidae (terrestrial)	
		Unidentified sp.
	Coleoptera	
		Two unidentified sp.
Arachnidae		
	Theridiidae (terrestrial)	
		Unidentified sp.

Condition factors

Fulton's condition factors, $K = w/l^3$, were calculated to study the fitness of the Arctic char caught during the project. The spring and fall sample averages of K factors for each system, for males and females, are illustrated in Figures 18 and 19 respectively. For females, last year's (1980) spawners were separated from the spring sample, and the remainder were assumed to be non-spawners in 1980. 1981 spawners and non-spawners were separated, in both sexes, for fall data. Average K factors for each of these subsamples are also depicted on Figures 18 and 19.

With the exception of the Kovik sample, males maintained somewhat higher K factor values than females (Figures 18 and 19) in the spring samples. In fall samples, this gap had narrowed substantially, due to the fact that the net average change in K over the summer was greater for females (George: 0.201; Payne: 0.237) than for males (George: 0.167; Payne: 0.197). Post-spawning males are difficult to distinguish in spring; however, post-spawning females, identified by the occurrence of unspent mature eggs or egg membranes in the body cavity, had considerably lower K factors in all rivers. In the fall, spawning fish of both sexes had slightly higher K factors in all cases, except for George River males where only four spawning individuals were sampled. Presumably, almost if not all of the 1981 spawners were drawn from the fish who were non-spawners in 1980 and who, thus, had a higher K factor at the onset of the 1981 spawning season.

The greater seasonal increase of K indicated in female subsamples may reflect a greater energy requirement for egg mass production and maturation than that required during the male maturation process.

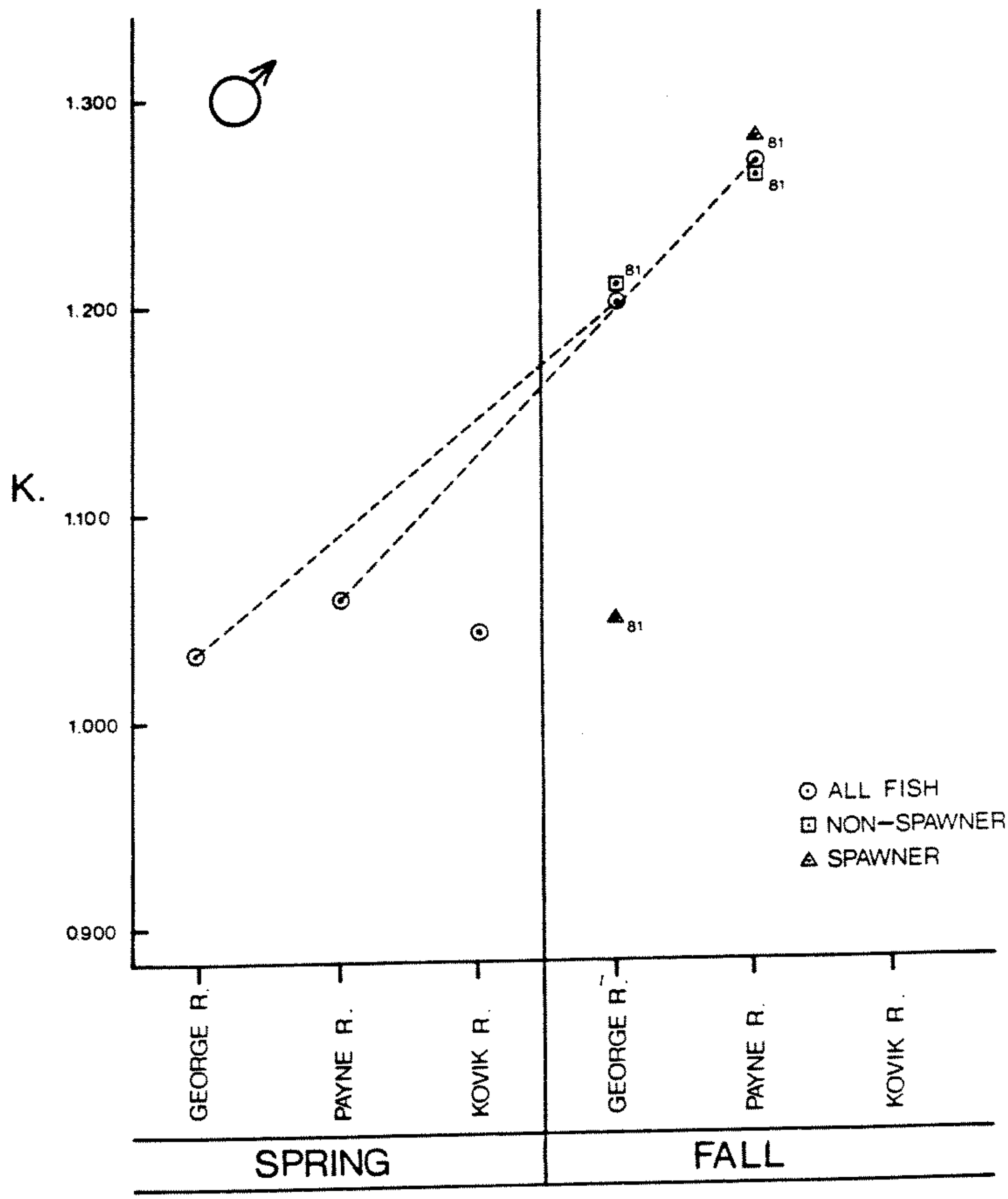


FIGURE 18: Seasonal changes in condition factors, K, of male Arctic char from each study river

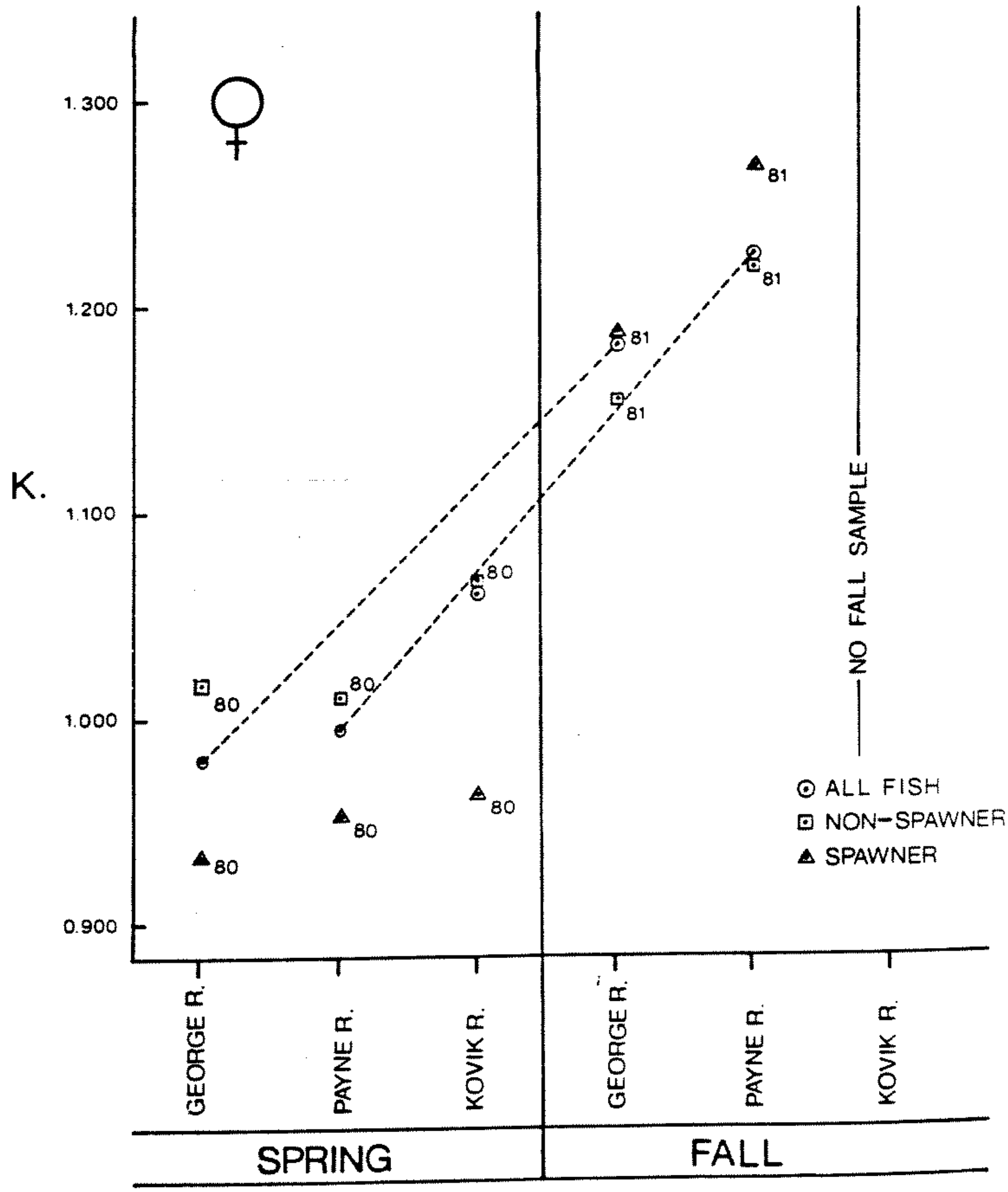


FIGURE 19: Seasonal changes in condition factors, K, of female Arctic char from each study river

GROWTH

Length-age relationship.

Mean, range and standard deviation of fork lengths, by sex, in each ages class are illustrated in Figures 20 to 25. Males over 6 years of age were consistently larger than their female counter-parts. Since this difference was often significant (t-test), data from the different sexes were not combined.

Growth curves for both sexes were extremely similar between all river systems for fish over 6 years of age. For fish less than 6 years of age, those from George River were substantially larger than those of similar age in Payne River. Age classes less than 7 years were poorly represented in the Kovik River sample. It is likely that juveniles in the George system may run to the sea earlier and benefit from the increased growth rate experienced in the sea. The largest increase in mean length in the Payne sample occurs between 5 and 6 years. This is especially evident in males (Figure 21). The ranges and standard deviations for male char are proportionately high for the 5, 6 and 7 year classes, so it is likely that this is when most of the char migrate for the first time. Females in both systems do not show such pronounced growth increases during the early years.

This information must be interpreted in light of the fact that most of the small fish in the Payne sample were collected in freshwater while all the George River fish were part of the anadromous run. No freshwater sample is available from George River; however, on the Payne River, considerable sampling effort with the small mesh, GG type nets in the estuary yielded only one specimen (237 mm, 5 years old), with a fork length less than 450 mm.

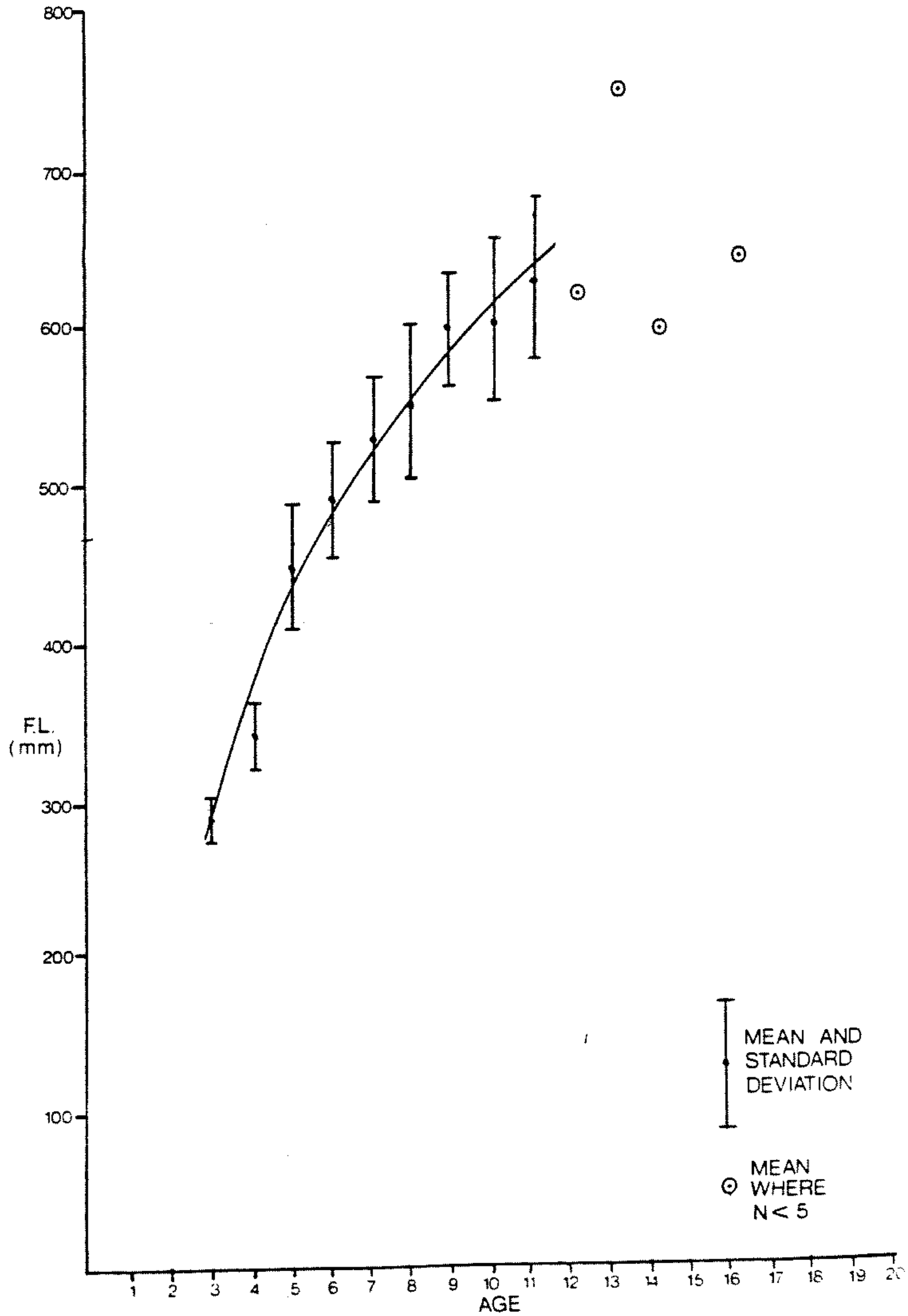


FIGURE 20: Age-length relationship and anadromous growth (length) equation for male Arctic char, George River

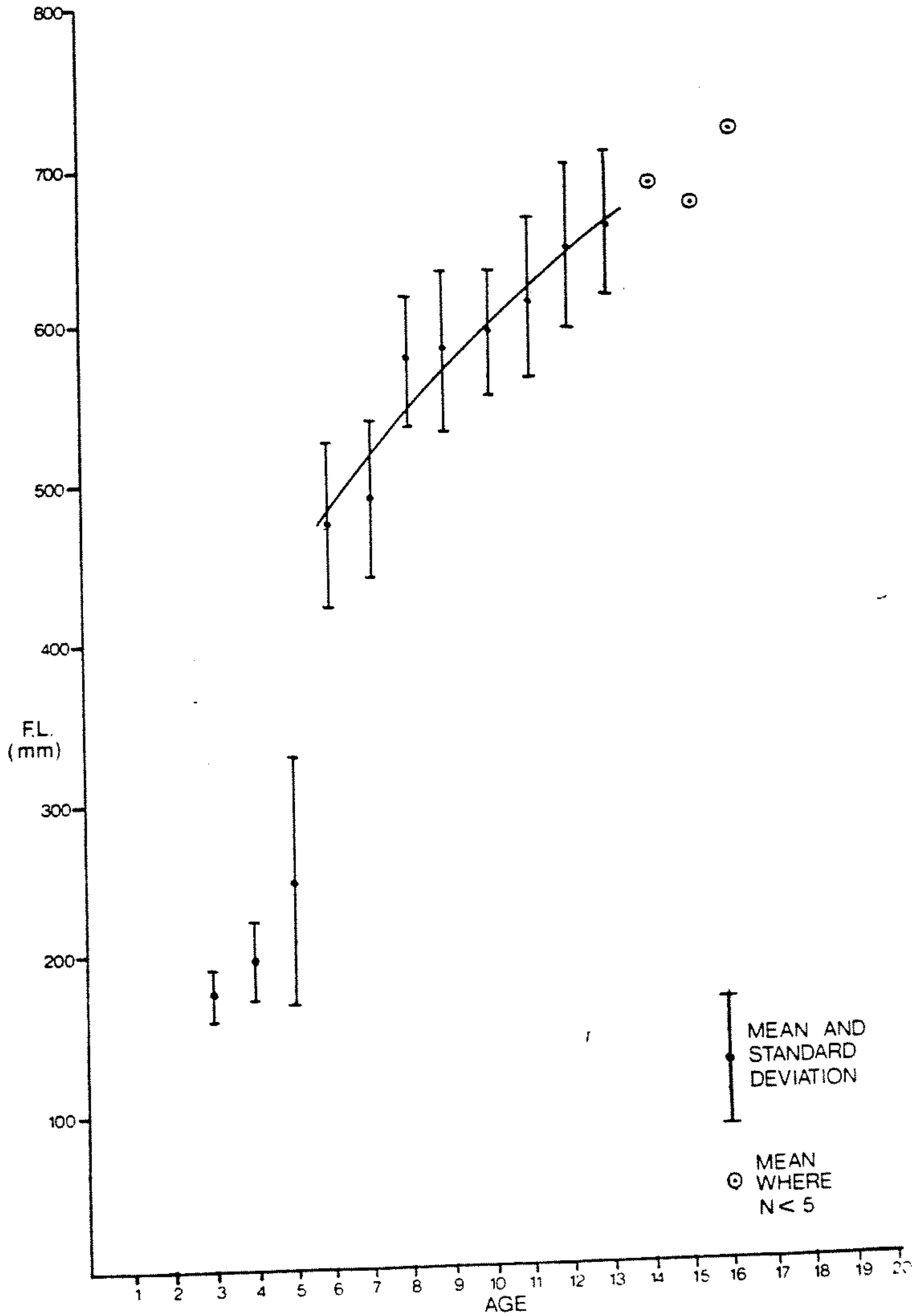


FIGURE 21: Age-length relationship and anadromous growth (length) equation for male Arctic char, Payne River

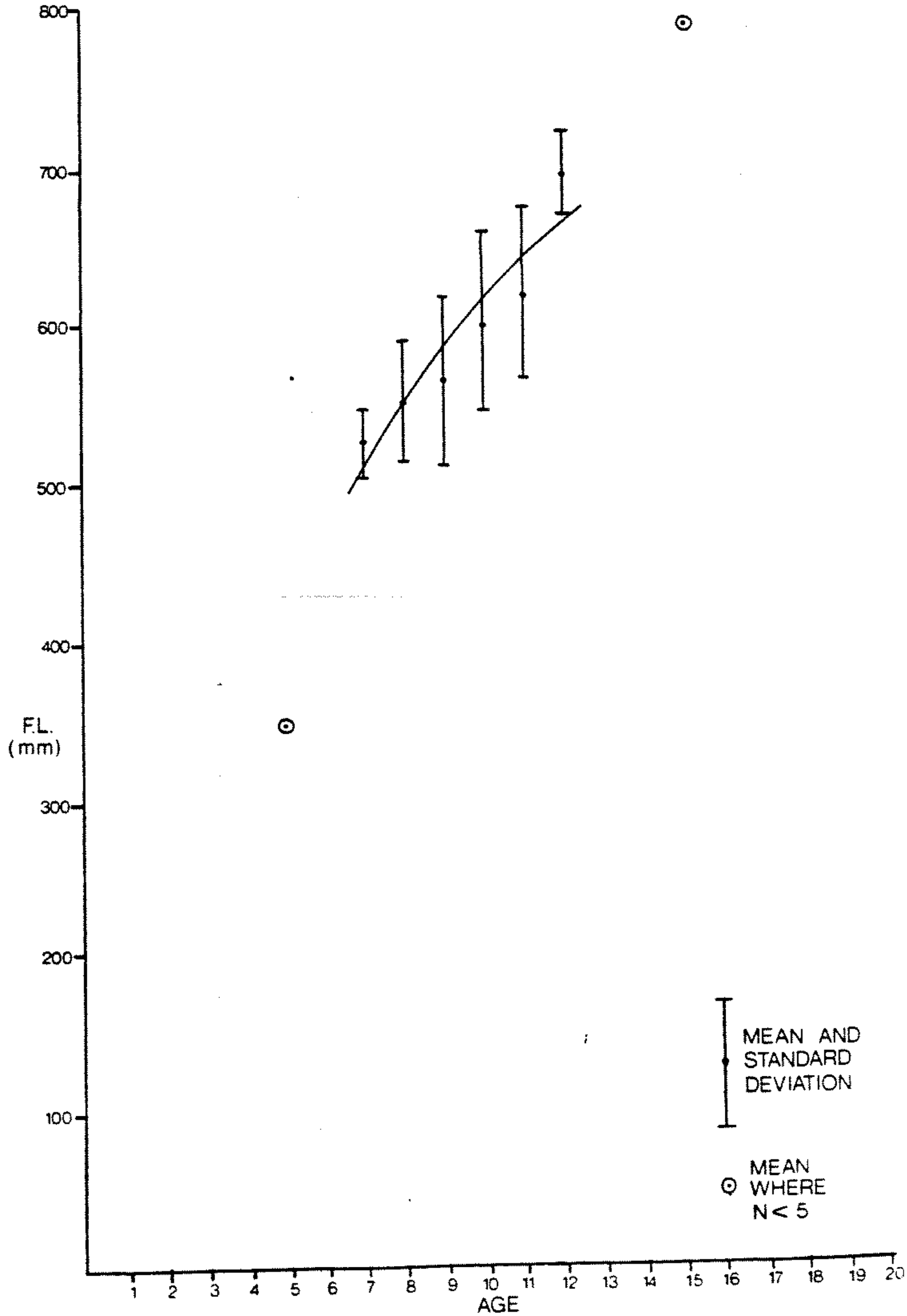


FIGURE 22: Age-length relationship and anadromous growth (length) equation for male Arctic char, Kovik River

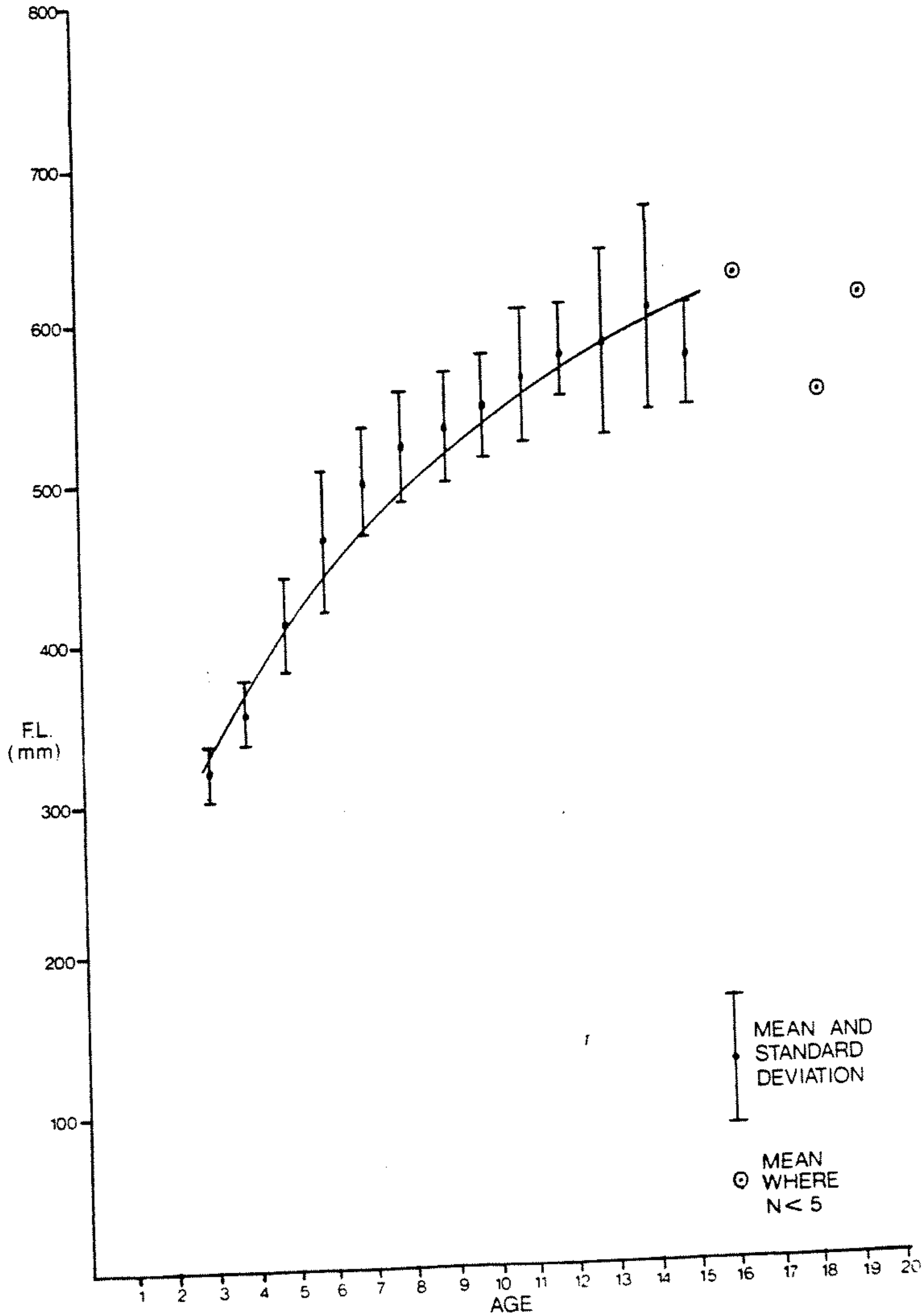


FIGURE 23: Age-length relationship and anadromous growth (length) equation for female Arctic char, George River

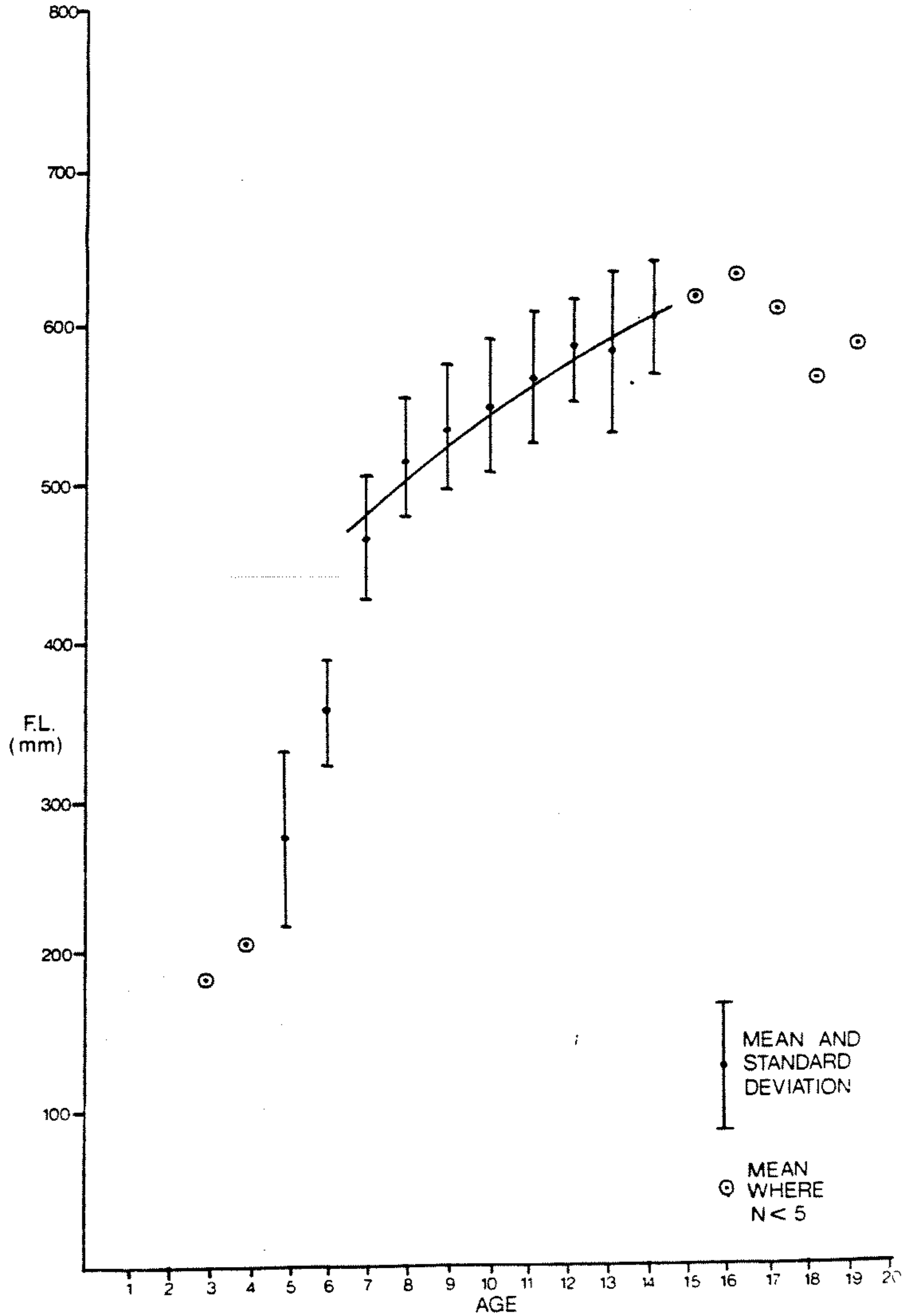


FIGURE 24: Age-length relationship and anadromous growth (length) equation for female Arctic char, Payne River

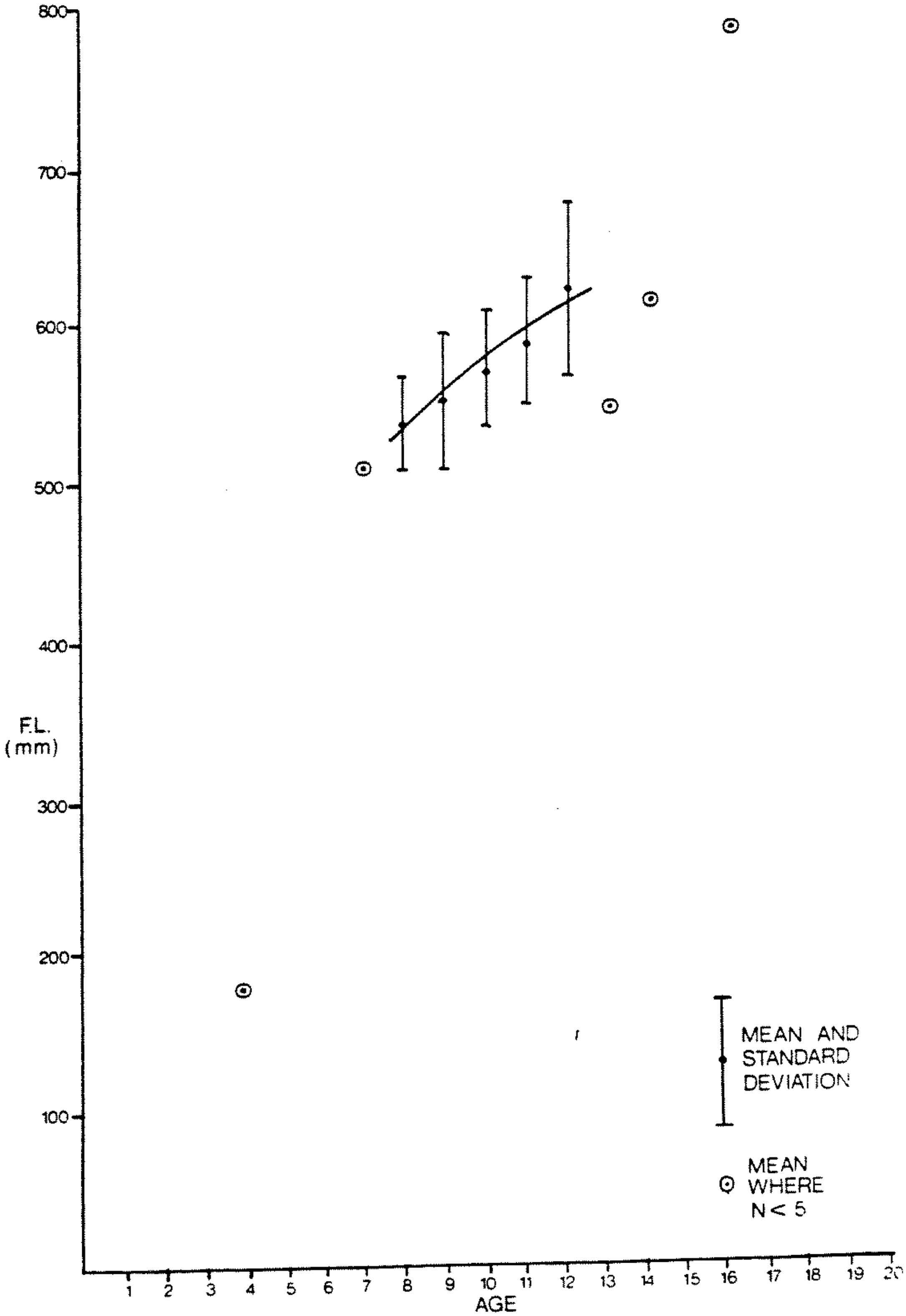


FIGURE 25: Age-length relationship and anadromous growth (length) equation for female Arctic char, Kovik River

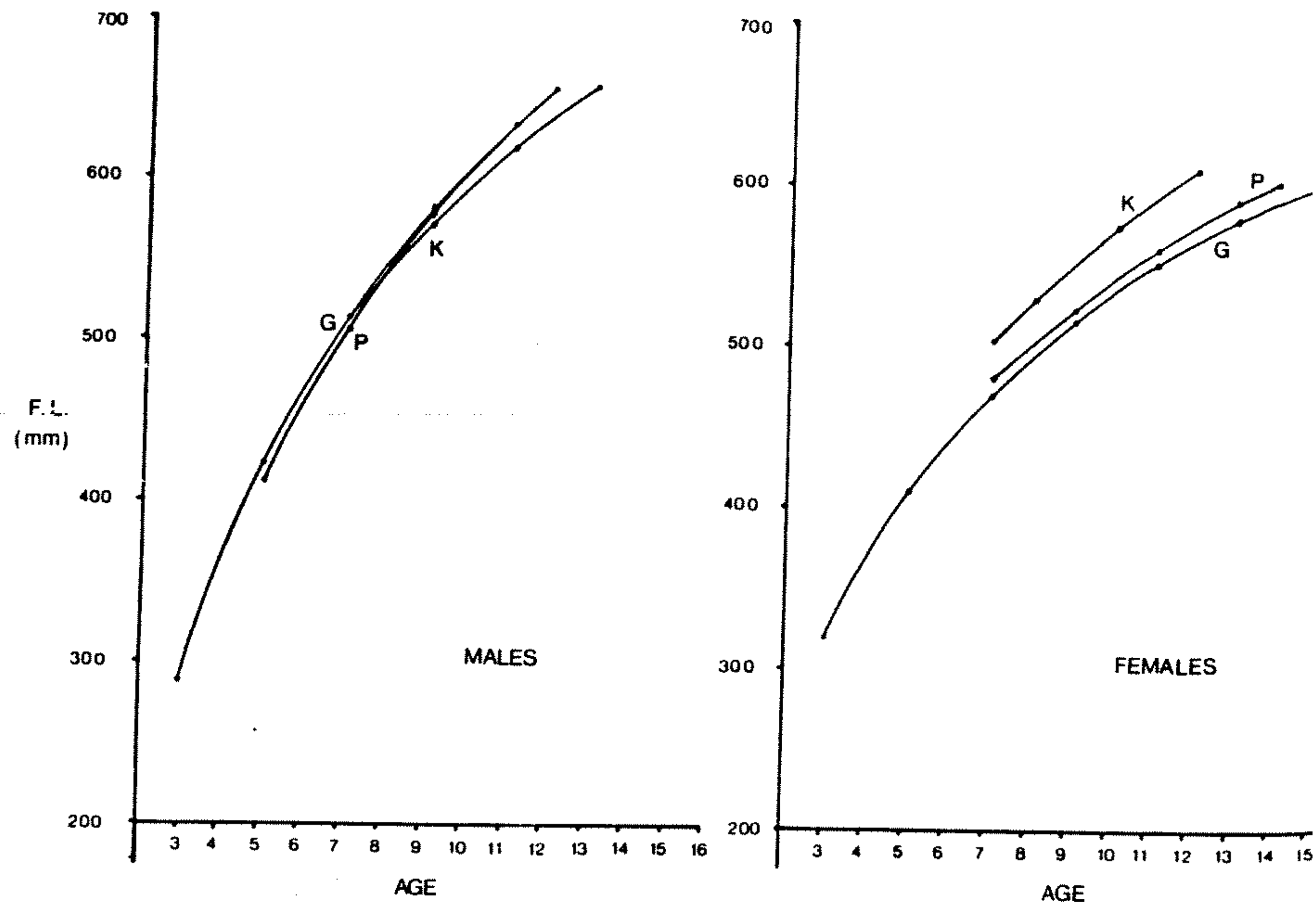


FIGURE 26: Growth curves generated from calculated anadromous growth (length) equations for males and females, George River (G), Payne River (P) and Kovik River (K)

Growth (length) equations for the samples of the anadromous populations of each river were calculated and are given below.

George River	Males	Length = − 6.94 + 267.70 ln age r = .991
	Females	Length = 129.10 + 175.40 ln age r = .983
Payne River	Males	Length = 51.92 + 236.67 ln age r = .974
	Females	Length = 129.30 + 179.61 ln age r = .982
Kovik River	Males	Length = − 30.97 + 276.24 ln age r = .939
	Females	Length = 111.88 + 200.80 ln age r = .972

Curves generated from the growth equations are compared in Figure 26. In general, growth was extremely uniform between systems. Anadromous females from the Kovik system were growing marginally faster than other females. Males grew faster than females in all cases.

Age-weight relationships

Age specific average weights followed the same general trends observed with age specific average fork lengths. Males (Figures 27, 28 and 29) showed consistently higher weights than their female counterparts (Figures 30, 31 and 32). Standard deviations are very large, reflecting seasonal fluctuations in K factors and individually different life histories.

Age specific average fork lengths and average weights were logged and plotted. The regression of these points produced the following equations describing the relationship between length and weight.

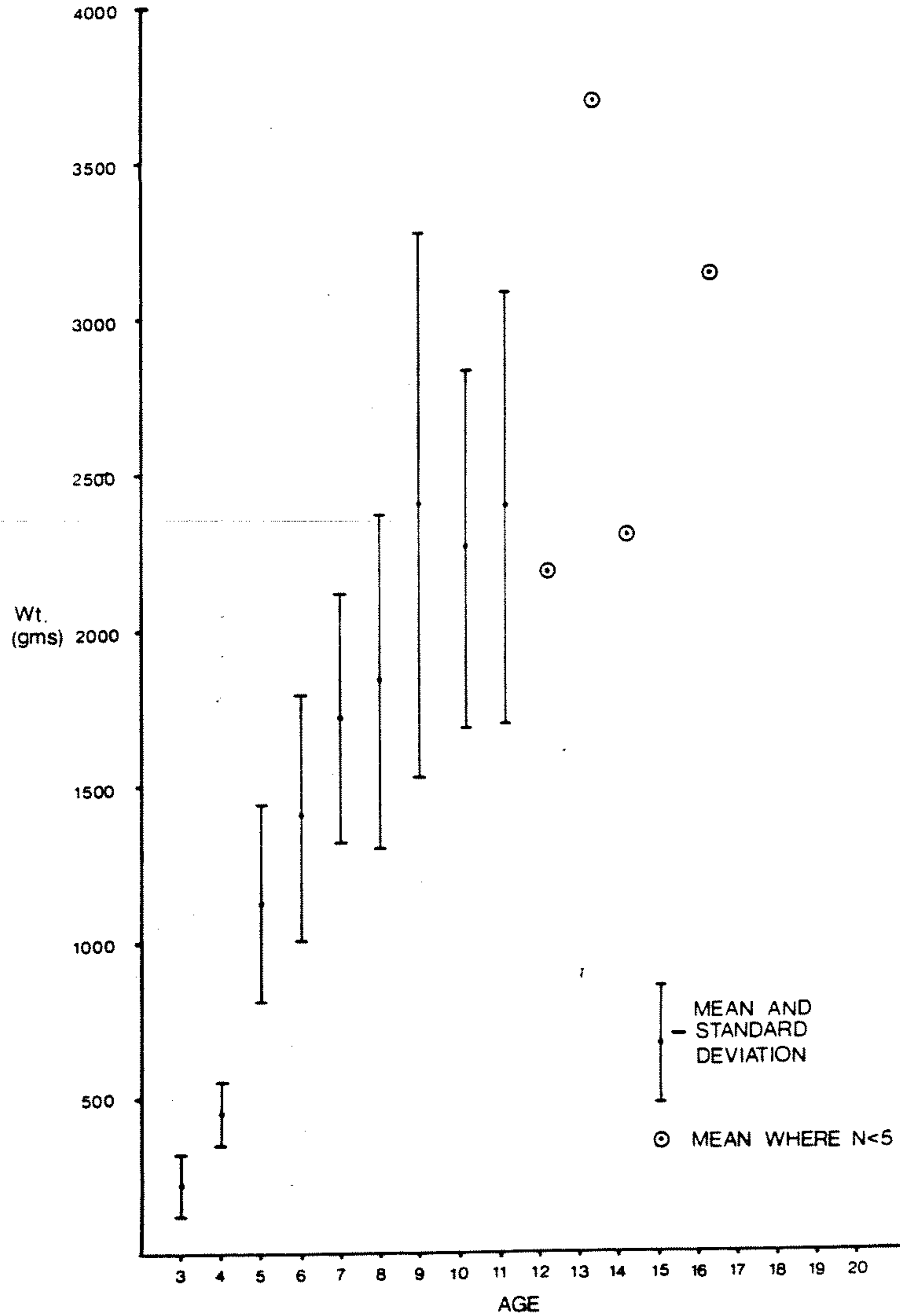


FIGURE 27: Age-weight relationship for male Arctic char, George River

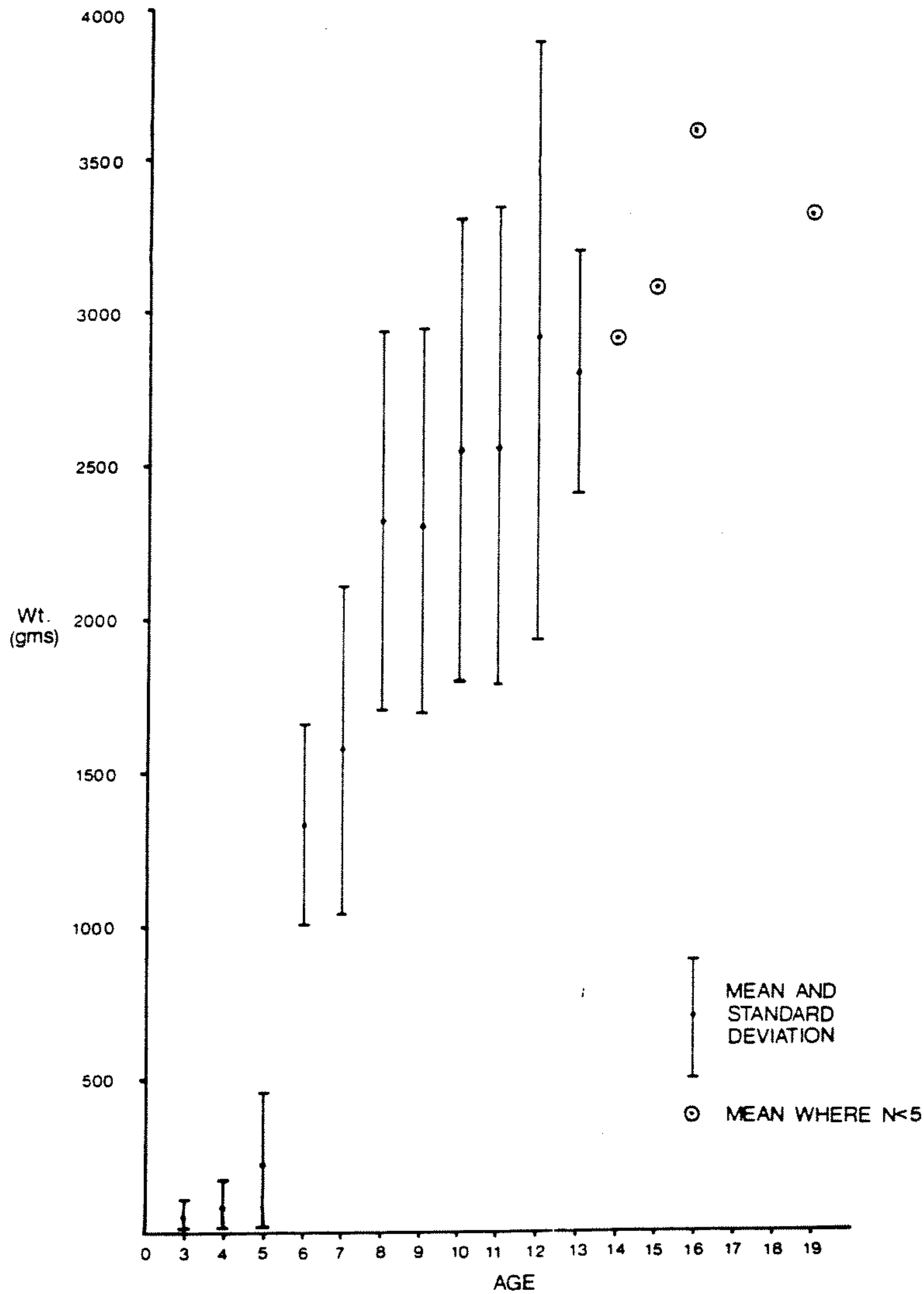


FIGURE 28: Age-weight relationship for male Arctic char, Payne River

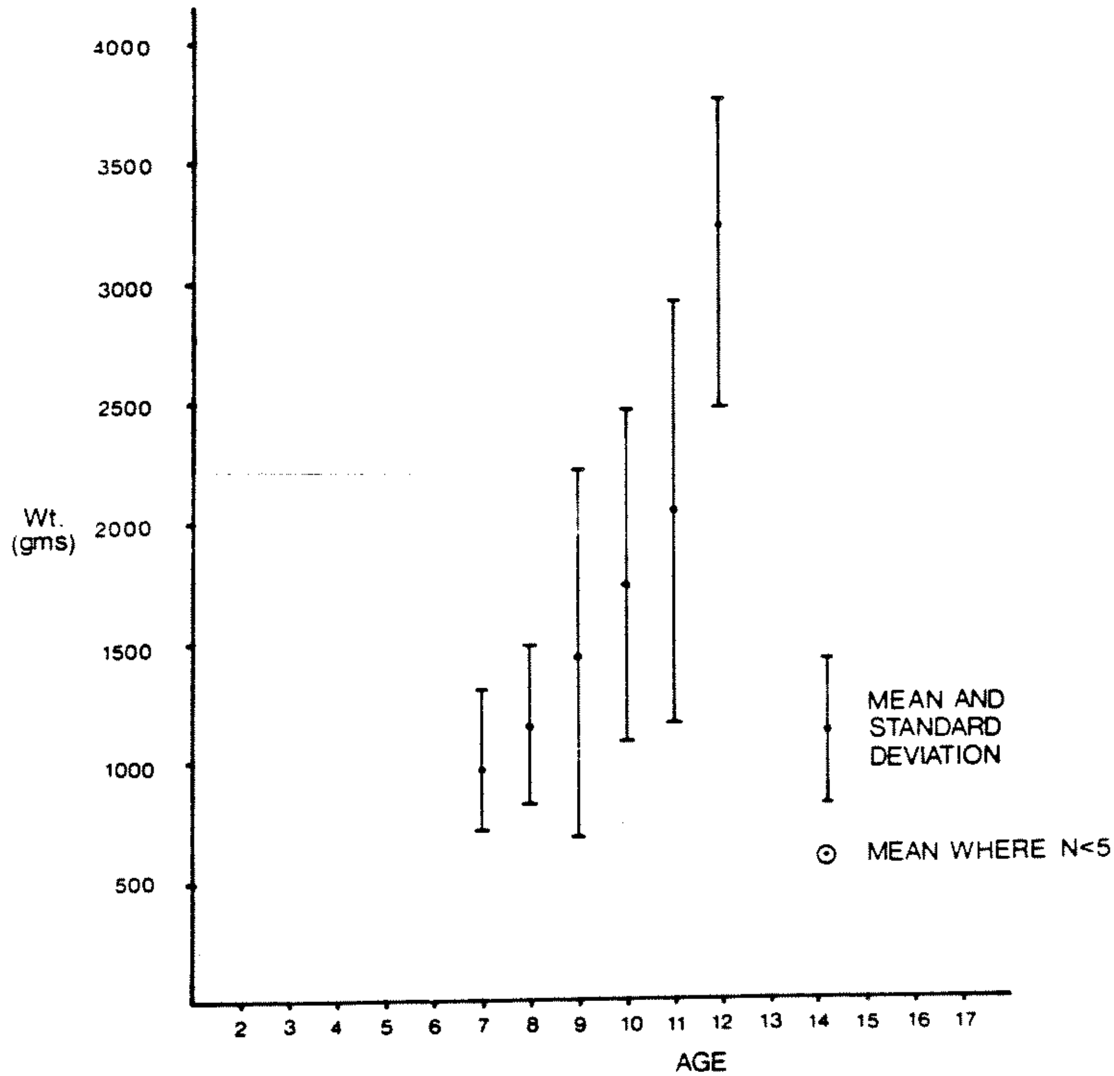


FIGURE 29: Age-weight relationship for male Arctic char, Kovik River

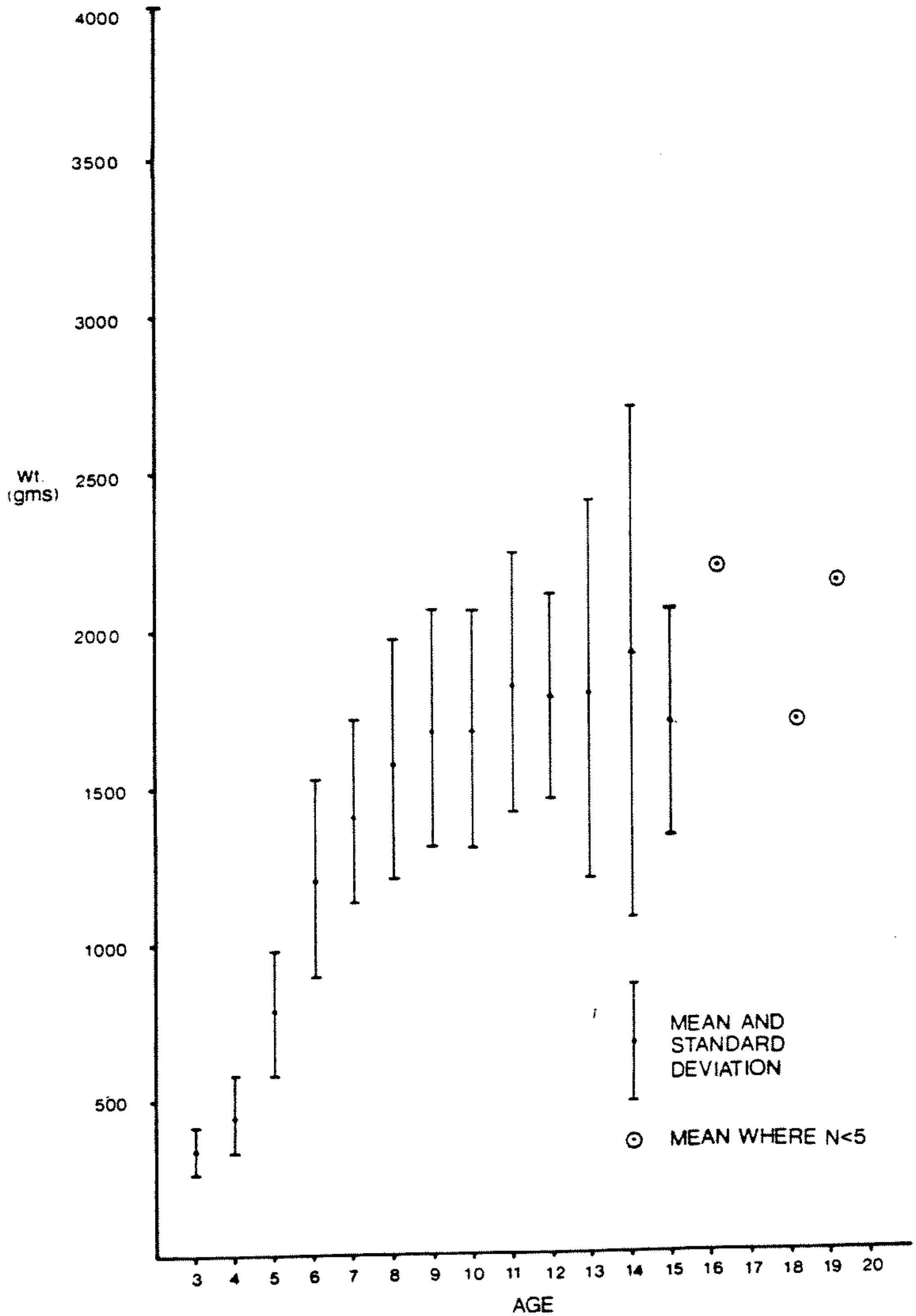


FIGURE 30: Age-weight relationship for female Arctic char, George River

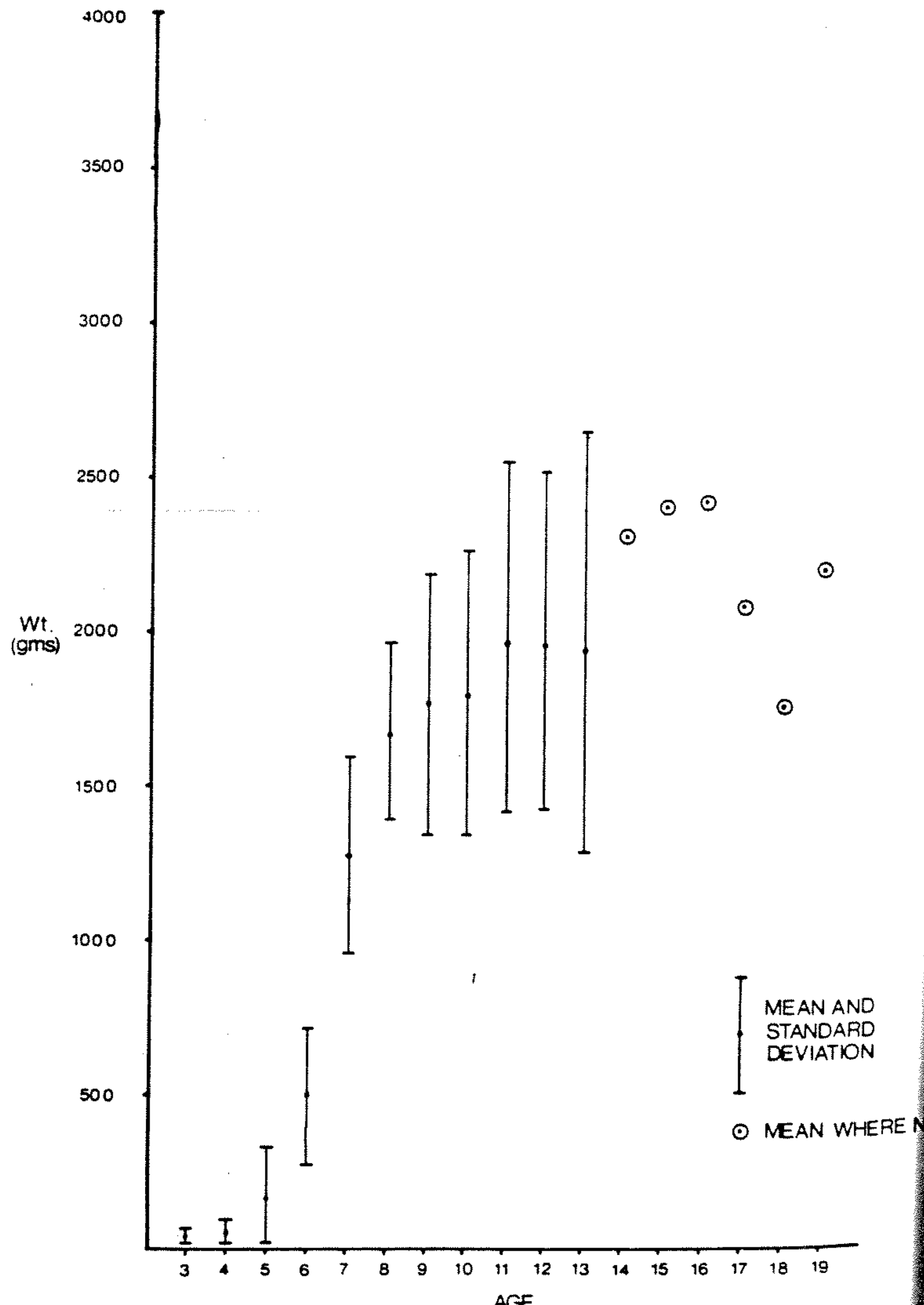


FIGURE 31: Age-weight relationship for female Arctic char, Payne River

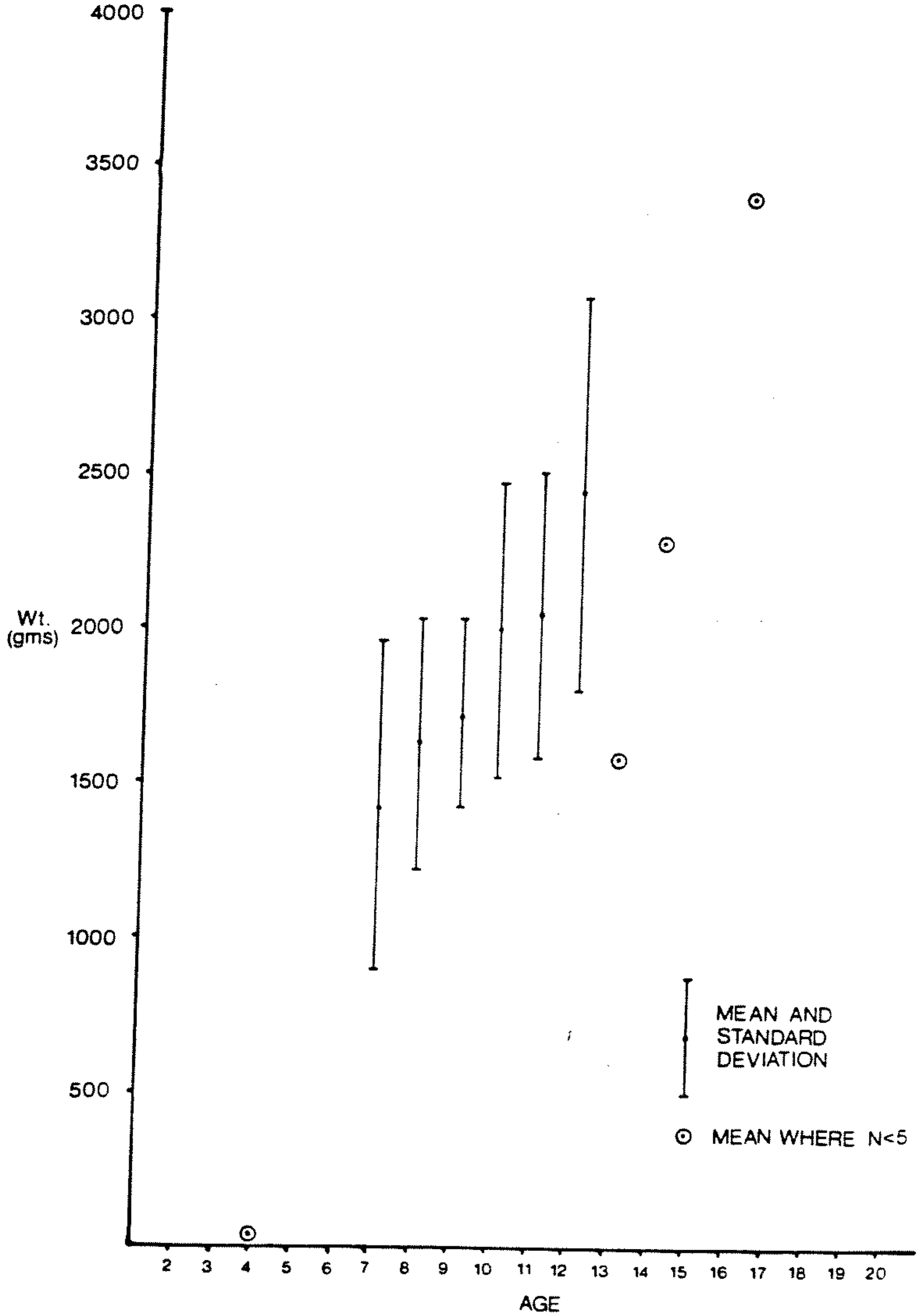


FIGURE 32: Age-weight relationship for female Arctic char, Kovik River

System	Equations	Correlation coefficient
George River	Log w = -4.441 + 2.806 Log l	r = .989
Payne River	Log w = -4.748 + 2.925 Log l	r = .997
Kovik River	Log w = -5.193 + 3.070 Log l	r = .995

MATURITY

Sex ratios

Age specific sex ratios from all three study sites show a bias favouring males throughout earlier age classes which shifts to a particularily strong bias to females in older age classes (Tables 7, 8 and 9). This may result from differential mortality rates, especially gill-net fishing mortality, between males and females, due to the larger average size of males beyond the 6th age class.

Age of maturity

The percentages of fish in each age group classed as mature are listed in Tables 7, 8 and 9. George River char are shown to mature much earlier than those in Payne River. Fifty percent maturity in the George River sample was reached at 4 years for females and at 6 years for males, while the corresponding figures for the Payne sample were 8 years for both sexes. Early age classes are poorly represented from Kovik River, but all females 7 years of age and older were mature (Table 9). Maturity of male char in the Kovik samples was not classified in the same way as the other samples, making comparisons misleading.

TABLE 7 - Age specific sex ratios and percent maturity for male and female Arctic char from George River

	MALES			FEMALES		
Age	N	%	% mat	N	%	% mat
3	5	38.5	40.0	8	61.5	37.5
4	19	45.2	15.8	23	54.8	52.2
5	33	49.3	21.2	34	50.7	88.2
6	53	64.6	56.6	29	35.4	89.7
7	40	54.1	70.0	34	44.9	100.0
8	37	46.8	75.7	42	53.2	100.0
9	23	33.8	95.7	45	66.2	100.0
10	14	29.8	85.7	33	70.2	97.0
11	8	28.6	87.5	20	71.4	100.0
12	2	15.4	100.0	11	84.6	100.0
13	1	8.3	100.0	11	91.7	100.0
14	1	11.1	0	8	88.9	100.0
15	0	0	-	9	100.0	100.0
16	1	33.3	100.0	2	66.7	100.0
17	0	-	-	0	-	-
18	0	0	-	1	100.0	100.0
19	0	0	-	1	100.0	100.0

TABLE 8 - Age specific sex ratios and percent maturity for male and female Arctic char from Payne River

	MALES			FEMALES		
Age	N	%	% mat	N	%	% mat
3	6	66.6	0	3	33.3	0
4	5	62.5	0	3	37.5	0
5	5	50.0	0	5	50.0	0
6	12	75.0	8.3	4	25.0	0
7	28	60.9	7.1	18	39.1	22.2
8	27	50.0	55.5	27	50.0	88.9
9	59	61.5	64.4	37	38.5	89.2
10	72	69.9	83.3	31	30.1	96.8
11	34	61.8	91.2	21	38.2	100.0
12	21	58.3	100.0	15	41.7	93.3
13	7	53.8	71.4	6	46.2	100.0
14	1	16.7	100.0	5	83.3	100.0
15	2	40.0	100.0	3	60.0	100.0
16	1	25.0	100.0	3	75.0	100.0
17	0	0	-	1	100.0	100.0
18	0	0	-	1	100.0	100.0
19	1	50.0	100.0	1	50.0	100.0

TABLE 9 - Age specific sex ratios and percent maturity for male and female Arctic char from Kovik River

	MALES			FEMALES		
Age	N	%	% mat	N	%	% mat
3	0	-		0	-	-
4	0	-		1	100.0	0
5	1	100.0		0	-	-
6	0	-		0	-	-
7	5	71.4		2	28.6	100.0
8	19	55.9		15	44.1	100.0
9	41	48.8	No	43	51.2	100.0
10	46	41.8	data	66	58.2	100.0
11	16	41.0	see	23	59.0	100.0
12	7	41.2	text	10	58.8	100.0
13	0	-		1	100.0	100.0
14	0	-		1	100.0	100.0
15	1	100.0		0	-	-
16	0	-		1	100.0	100.0
17	0	-		0	-	-
18	0	-		0	-	-
19	0	-		0	-	-
Total	136	45.5		163	54.5	99.4

Age distribution of spawners.

For each age group, spawning fish were expressed as a percentage of mature fish to compare spawning activity between age groups. This information, generated from fall data only, is found in Table 10. There would seem to be a tendency for peak spawning activity to occur in "middle" age classes. Over 50% of all mature 9 year old fish in the Payne River sample were going to spawn in 1981. Spawning frequency seems to decrease with increasing age, for both males and females; however, good sample sizes are generally lacking.

Fork length - maturity relationship

The relationship of age-specific fork lengths to mature and immature char for males and females is described in Table 11. Mature individuals of both sexes generally are larger than immature siblings; this gap increases with age.

Parasites

A large number of visceral and whole fish samples were retained for expert analysis of the parasites carried by char from each study system. As this report is completed, final results of these analyses are not available. As a consequence, presentation of these data will be made under separate cover at a later date, as a companion volume of this main report. All discussion of the results of the parasite analyses and their implications will also be included in that document.

Genetic Studies

Research by Swedish scientists at the Institute of Freshwater Research at Drottningholm, Sweden, has indicated the co-occurrence of

TABLE 10 - Spawning fish as percentage of mature fish, age specific, for Arctic char from George and Payne Rivers. Fall data only.

	MALES				FEMALES			
	GEORGE		PAYNE		GEORGE		PAYNE	
Age	N	% spawner	N	% spawner	N	% spawner	N	% spawner
3	2	0			3	0		
4	3	0			12	0		
5	7	0			30	0		
6	25	0	1	0	26	7.7		
7	23	17.4	2	0	28	7.1	5	40.0
8	10	10.0	10	10.0	26	26.9	22	31.8
9	8	0	18	50.0	26	26.9	24	58.3
10	1	0	26	30.8	13	7.7	16	25.0
11	2	0	9	11.1	7	28.6	7	14.3
12			6	33.3	1	0	3	0
13			2	0	2	100.0	3	33.3
14			0	-	0	-	4	25.0
15			1	0	0	-	1	0
16					0	-	1	0
17					0	-		
18					1	0		
19								
Total	81	6.2	75	28.0	175	13.1	86	34.9

TABLE 11 - Age specific mean fork length (mm) for immature and mature Arctic char males and females from George and Payne Rivers.

MALE

	GEORGE		PAYNE	
Age	Immature	Mature	Immature	Mature
3	291.0	275.0		
4	337.6	335.7		
5	449.4	447.9		
6	484.1	484.1	485.9	337.0*
7	509.8	531.7	486.7	546.0
8	531.6	548.4	554.0	591.6*
9	500.0	595.9*	559.9	587.3*
10	586.0	598.2	555.9	602.2*
11	615.0	629.9	541.0	618.0*
12				
13			642.0	659.2
14				

* Difference significant

FEMALE

	GEORGE		PAYNE	
Age	Immature	Mature	Immature	Mature
3	312.2	316.3		
4	352.5	348.8		
5	386.5	405.2		
6	365.7	467.1*		
7			458.7	478.5
8			493.3	512.3
9			473.0	536.0*
10			620.0	543.6*
11				
12			596.0	581.2
13				
14				

* Difference significant

different strains of char in complexes of landlocked char populations. In some landlocked populations, as many as three sibling species have been identified. These sibling species of char may exhibit significantly different growth rates and ecological resonses (Gydemo, 1982). It was observed recently by Gydemo (pers. comm.) that anadromous char may also be separated into several groups. The method of distinguishing these chars is based on the frequency of occurrence of genotypes influencing the electrophoretic mobility of a blood esterase-producing gene allele (Nyman, 1972). This is determined by starch gel electrophoresis of blood samples from individual char from the population under study.

Blood samples were retained from approximately 500 Arctic char sampled during this study. These were sent to Dr. Rolf Gydemo at the Institute of Freshwater Research at Drottningholm, Sweden, for analysis.

The starch gel electrophoresis method used has been described by Nyman (1972). The esterase analysis is based on a two-allele polymorphism with the genotypes FF, FS and SS, where F stands for Fast and S for Slow (derived from the electrophoretic mobility of the alleles). Data on length, weight, sex, sexual maturity, age, location, date sampled, and net used and set were used in combination with the individual esterase genotypes in order to investigate the possible presence of more than one population.

Preliminary results indicate that there may be two distinct sub-populations within the samples collected from Kovik River and George River. Only one population was indicated in the Payne River sample. Differential growth rates were observed for the two sub-populations in each case, however the relationship between the gene frequency mode and growth rates was inverted between the two river systems.

In order to analyse the results in detail, it would be necessary to break it down into separate portions, each portion consisting of all individuals collected at one location and on one occasion. Unfortunately, this is not possible to do with the material present. In only a few instances are numbers large enough to give any statistical significance to the results. When analysing the result it is therefore in some cases necessary to assume that the cumulative material sampled reflects several populations present in each river system and not necessarily an influence caused by straying or by other factors. In George River and Kovik river, two populations seem to be present, one with a gene frequency around 0.53, the other with a gene frequency probably around 0.30. The low frequency population is possibly of the same type as the one in Payne River.

Because the material indicates the presence of more than one population of Arctic char, this must be kept in mind for the future development of the fisheries. Care must be taken not to damage one or other of the populations or otherwise change genetic diversity. There could be differences in population sizes, as well as in other valuable features such as better growth for one of the populations, or earlier maturation, more favourable migration pattern for the fisheries or differences in parasite infestation such as shown by Henricson and Nyman (1976).

Habitat assessment

Over the accessible range of each system, assessments of various habitats were made by shoreline survey, floatdowns using wetsuits and measurement of basic water quality parameters. These last are summarized in Table 12. Water temperatures were quite variable but generally cool in the estuary and main rivers and much warmer in mouths of smaller tributaries. George River samples were slightly alkaline (pH 7.1-7.3) as opposed to Payne River (pH 6.3-6.5) and Kovik River (pH 6.0-7.0). Dissolved oxygen levels were all high. Sample locations are depicted on Figures 4 to 6 as small squares.

Descriptions of specific habitats surveyed from the shoreline or by floatdown methods will be presented as part of a discussion of habitat utilization following.

TABLE 12 - Water quality parameters as determined at sites on the study systems.

SYSTEM	LOCATION	DAY/MO	TEMP[1]	pH	D.O.[2]	COND.[3]	SAL.[4]
George Fig. 4	WC 1	27/6	7.2	7.2	12	5	NA
	WC 2	28/6	11.5	7.3	9	10	NA
	WC 3	1/7	11.7	7.1	9	8	NA
	WC 4	1/7	11.7	7.1	8	8	NA
Payne Fig. 5	WC 1	13/7	7.5	6.4	11	0.6	NA
	WC 2	15/7	13.5	6.3	11	2.4	NA
	WC 3	15/7	12.5	6.4	10	4.8	NA
	WC 4	17/7	12.5	6.5	10	16.0?	NA
Kovik Fig. 6	WC 1	7/7	5.5	6.0-6.5	14	3.1	0
	WC 2	7/7	5.0	6.5-7.0	13	275.0	3.0
	WC 3	9/7	7.0	6.0-6.5	14	9.5	0
	WC 4	16/7	14.0	6.0-6.5	9	30.0	0
	WC 5	14/7	8.0	6.5-7.0	12	142.0	13.0
	WC 6		10.5	6.5	10	21.0	0

Units:

1 = Degrees Celcius

2 = Mg of oxygen/l of water

3 = Mg of NaCl/l of water

4 = Salts in parts/thousand

Habitat utilization

A picture of the spatial and temporal utilization by anadromous char of various habitats in each system emerges by drawing on information obtained through field sampling, habitat assessment and interviews with local fishermen.

The following accounts, largely based on local information, are quite subjective; however, supporting evidence obtained from field studies will be presented where it exists.

George River

Anadromous Arctic char, in the George River system (Figure 4), are barred from the section of the river upstream of Helen's Falls. This obstacle restricts the area available for utilization in this system to the Ford River and to a number of small tributaries entering the system downstream of the natural barrier.

A number of these small tributaries were surveyed during field studies. The lower reaches were generally of moderate slope (less than 2%) with gravel and sand substrates, but typically shallow runs (less than 2 m). Areas around the mouth of these tributaries have been traditionally fished in the fall for "aupiliak" (red, spawning char), which would indicate spawning activity nearby. Flows would likely be sufficient for the development of egg and fry in the lower reaches of these small tributaries, but "spent" adults would have to retreat to the deep sections of the George River to find overwintering habitats.

The Ford River is not easily navigable by canoe; consequently, it was mostly inaccessible during this study. Local knowledge regarding the utilization of this large tributary by anadromous char was scarce; it was simply stated that the fish was known to occur there.

Char from the Korok River and other adjacent systems probably mix with George River char in the outer estuary, in summer. A small sample of char taken in the Korok system was undistinguishable from the bulk of the George River sample, except in their feeding habits, the latter presumably being related more to the water regime from which they were obtained (Figure 12), than anything else.

Payne River

There appear to be fundamental differences in the patterns of habitat utilization by anadromous Arctic char in the Payne River (Figure 5) and in the George River, despite the many superficial physical similarities in the two systems.

The anadromous char population summering in the Payne River estuary originate from at least three large tributaries with spawning stocks. Unlike the George River system, none of the small streams and rivers emptying into the Payne system are of sufficient size or have the minimum slope required to allow access of spawning char. All the major tributaries of the Payne River have numerous deep slow-running sections in their lower and middle reaches. Residents of Payne Bay indicated that large char could be caught in many of these places during the winter ice fishery. None of these areas were easily accessible during the study. Floatdowns in superficially similar sections on the lower reaches of the Vachon and the Arnaud rivers revealed a substrate of cobble and small boulders on a sandy base strewn with occasional large boulders. The quiet sections of the lower Arnaud River, in particular, were quite deep (10 meters +) and lake-like and they apparently form an excellent overwintering habitat. It seems most likely that anadromous Arctic char in the Payne River system utilize the many suitable lower reaches of the Kujark, Vachon and Arnaud rivers for spawning and overwintering, although the upstream extent of that utilization has not been determined.

During summer, fish from outside the Payne system, particularly fish from the Broissant River immediately to the south and from the Virgin Lake/Kyak Bay system to the north, likely range into the outer estuary of the Payne River, and therefore mingle with indigenous stocks.

Kovik River

Little insight into the pattern of utilization of the Kovik River system (Figure 6) by anadromous Arctic char could be provided by the fishermen of Akulivik, as only a small number of them regularly used the river and then, only in the lower reaches. They were, however, quite sure that the narrow gorge just west of Tunusuk Lake was not a barrier to anadromous migrations, and their accounts of catches of large char from that lake in mid winter would support their statements. No water bodies adjacent to the lower reaches of the Kovik were judged suitable for spawning or overwintering habitat. Lakes in this area were typically shallow and only tenuously connected to the main river. It is likely that many char migrate some distance beyond the gorge in search of suitable spawning and overwintering areas.

Most rivers in the vicinity of the Kovik River mouth have anadromous char runs. As no large, semi-enclosed estuary is present to partially segregate fish from separate systems, as is the case at Payne River and George River, the summering, coastal population of this section of Hudson Bay is likely to be much more heterogeneous in origin.

DISCUSSION

POPULATION STATUS

The rates of growth observed for anadromous Arctic char from these three systems, are generally faster than those of many other eastern char stocks (Figure 33). The present rates for George River compare closely with those calculated by Le Jeune (1967) from samples taken in 1959 and 1960. Food supply and water temperatures at these latitudes are likely more conducive to growth than at Cumberland Sound (Moores, 1975) and the Silvia Grinnell River (Hunter, 1958). The difference in growth rates compared to that of Nachvak Fjord (Glova and McCart, 1978) is not so easily explained, but may be climatological in nature, as the George watershed extends well to the south of the more mountainous origins of the Nachvak system.

Age distribution of catch, length distribution of catch and apparent growth rate are three parameters of a population which can be influenced by fishing activities. The study of changes in these parameters over time in response to various types and levels of harvest has and is presently being used as a management tool where char are heavily harvested. The present biological results can be interpreted in light of recent harvest levels and, in the case of one system, previous biological studies.

Comparing data from identical net types only (GN type), average length of catch is lowest at George (516.1 mm), highest at Kovik (571.3 mm) and intermediate at Payne (565.9 mm), a similar progression of modal age in catch can be shown to be 7 years at George, 9 at Payne and 10 at Kovik. Previous work on these rivers is limited to Le Jeune's study at George River (Le Jeune, 1967). Modal age in his catch distribution (taken in 1959 and 1960) was 11 years, while average length in the 1960 catch was 550 mm. This indicates that the present George River char fishery is dependent on younger and smaller fish than is the case on

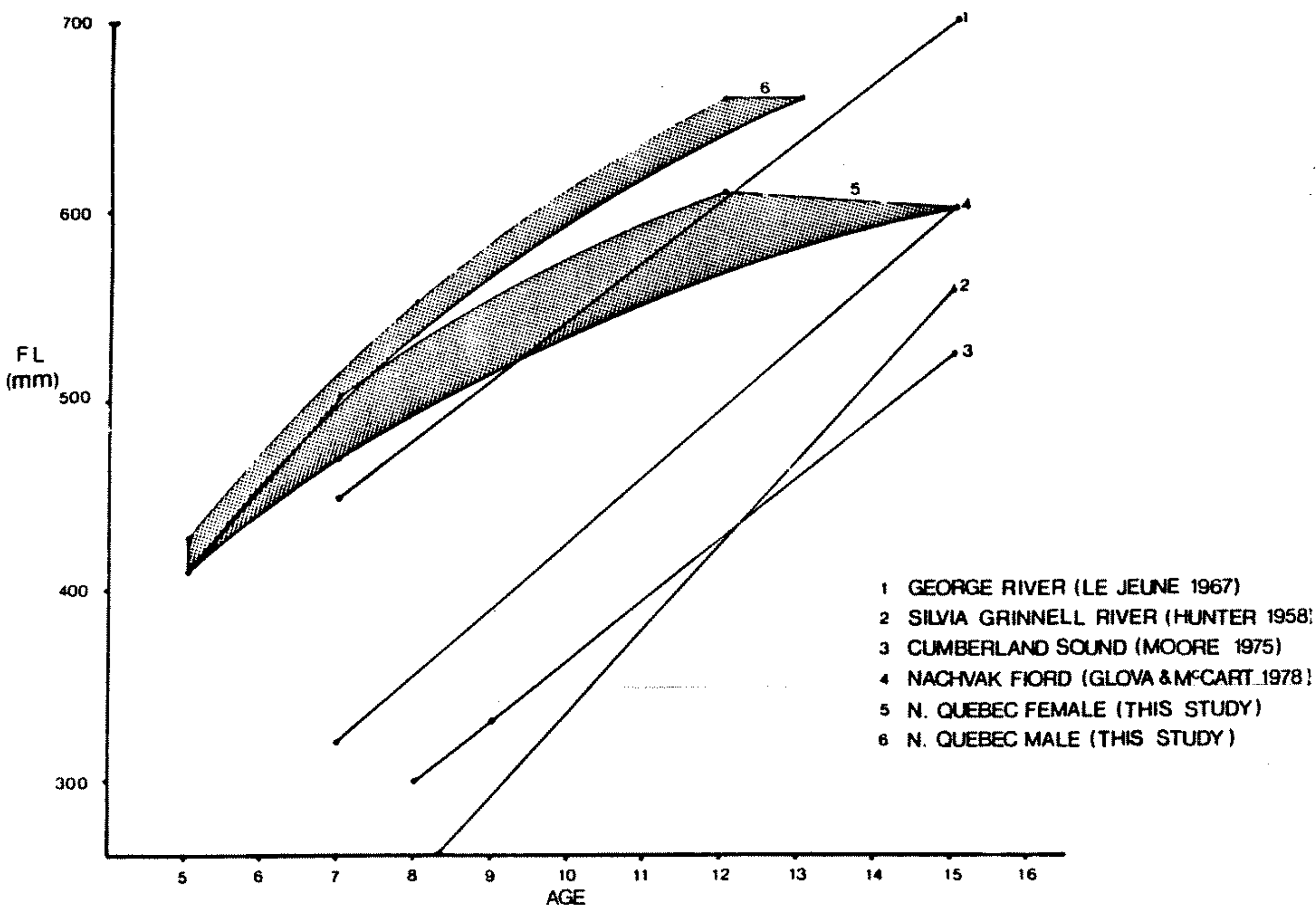


FIGURE 33: Calculated growth (length) curves for a number of eastern Canadian Arctic char populations

either of the other two systems under review. The average catch is apparently also younger and smaller than that recorded 20 years ago from the same system.

As previously summarized, subsistence pressure has been (from 1976 to 1980) substantially heavier, on average, on the George system than on the Payne, while the Kovik has been subjected to substantially less pressure than either. Of particular concern is the pronounced trend toward decreased subsistence char catches at George River in recent years. There has been no apparent drop in effort, although this parameter can be only crudely quantified.

The drop in apparent catch per unit of effort of char in the George system combined with the changes in several basic population parameters over the intervening 20 years since Le Jeune's study, throw the present status of the George River char into question. More detailed information on total effort and harvests and a program to monitor further changes in length and age distributions may be necessary to confirm these potentially detrimental trends.

The Payne system was heavily fished during the early 1960's when a commercial fishery removed as much as 13 832 Kg (round weight) per year. This fishery collapsed after several years, when the catch per unit of effort and average fish size dropped, the classic response of an anadromous char population subjected to over-harvesting. Since then, fishing strategies on the Payne have been restricted to subsistence and limited sports fishing. Indications from local residents, backed by the findings of this study, are that the fish have rebounded to a quite healthy state in the intervening years. Many more larger fish are presently reported than in the years following the collapse of the commercial fishery.

The Kovik system, with no adjacent permanent community, experiences the lightest fishing pressure at present. As a result, it was expected and proved to have a larger average size of catch and an older age distribution than the George and the Payne Rivers. The distribution of ages in the catch was broad (4 to 19) but much more strongly centered around the modal age class. This may be a result of having caught most of the sample in a relatively short time frame, especially when approximately one half of the sample were downstream migrants. The patchy nature of the components of migratory runs has been demonstrated.

In summary, it is likely that the Kovik system is under relatively little stress at present; however, any significant increase in fishing pressure should be monitored so as not to exceed the ability of the population to recover quickly.

The Payne system appears almost fully recovered from overfishing in the 1960's; recent subsistence catches are steady and an increasing number of larger fish are being observed.

The George River system may be overfished at present. Modal age, average length and, apparently, recent subsistence harvest catch per unit of effort have all decreased measureably.

IMPLICATIONS FOR MANAGEMENT

Few definitive management directives can be made based solely on the results of this type of study. However, rational interpretation of these results in view of the experience gained from research and the results of harvesting strategies attempted on other anadromous char populations can help guide those responsible for deciding on the most appropriate harvesting strategy.

The record of commercial Arctic char fisheries in Canada has been, on the whole, dismal. Often the sheer, apparent, size of the resource belies its low productivity, with the classic result of commercialization being the collapse of the venture in a relatively short time, because of declining quantity and quality of the catch.

On the other hand, it can be extremely difficult and expensive to predetermine accurately the long-term sustainable yield of a particular char population. This leaves the fisheries manager with little recourse but to monitor both effort and its effects; ultimately regulating the former to shape or fit the latter into what is acceptable.

Traditionally, char from Northern Québec were subjected exclusively to subsistence harvesting stategies. Before the mid-twentieth century, the Inuit lifestyle tended to be much more nomadic and as such included, inherently, an effective management technique; the harvest-fallow method. Char populations, if they became locally depleted, would rebound when the people moved to other areas. With the establishment of permanent townsites, this natural form of management was interrupted, and subsistence fishing has been, in the last 30 years, largely concentrated in the waters most immediately accessible from these townsites.

As noted, a more recent development, facilitated by an expanding southern market and modern transportation methods, is the commercial harvest of char stocks. Unfortunately, the stocks most accessible for commercial development are the same ones supporting the subsistance harvest. The unrestrained imposition of both of these harvesting strategies on a resource with generally low productivity invites collapse of that resource with the result that the goals of neither strategy can be met. In addition, the introduction of monofilament gillnets has, for the first time, given the Inuit the means with which to, possibly, albeit inadvertently, inflict serious damage to char stocks through only subsistence activities. Thus, to the fisheries manager, the only salient difference between modern subsistence fisheries and commercial fisheries becomes the harvest level required to satisfy each strategy; this being, usually, much lower for subsistence needs.

Since the removal of the natural management processes inherent in a more nomadic life style, no substitute process has been put into place. The results of this study indicate that these three char stocks are, in general, quite healthy, and feature a relatively high individual rate of growth. Some lessons should be taken from the past, however, to avoid the pitfalls of previous harvesting strategies such as happened in the Payne River commercial fishery during the 1960's. The types of management techniques required to maintain populations which are presently not excessively impacted are generally unobtrusive.

The first and most important duty for the persons vested with the responsibility of monitoring these stocks is to set firm priorities governing the use of that amount of fish available on a sustained basis. Specifically, the relative importances of subsistence fishing and commercial fishing must be defined. Effective safeguards must be put into place to make sure that the level of each type of harvest respects those priorities.

Once priorities have been set and protected, it must be ensured that, in meeting those goals, total harvest does not exceed that point beyond which it cannot be sustained. This can be facilitated by periodically monitoring key population parameters and adjusting the controls on the levels of harvest in response to the results.

The following list of recommendations is presented. Recommendations (1) and (2) pertain to Northern Québec anadromous Arctic char stocks in general while points (3) and (4) are directed at the systems presently under direct consideration.

LIST OF RECOMMENDATIONS

(1) Exceeding sustainable total harvest levels should be avoided in future. Baseline values for age and size of catch distributions, should be established for other heavily exploited char stocks similar to those reported in this document. Changes in these values should be monitored if future harvest patterns result in a harvest increase of more than 20%.

(2) Char guidelines must be established to divide the amount of fish available from each stock, as detailed in recommendation (1), between commercial and subsistence use, according to the priorities of the local people.

(3) Future increases in excess of 20% in harvest from the Payne and Kovik systems should be accompanied by a monitoring programme of key growth, size, age and mortality parameters;

(4) No increase in harvesting pressure should be allowed on the George River system. A study of recent and present effort and a re-assessment of the key population parameters within 3 to 5 years is strongly recommended;

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GLOSSARY OF BIOLOGICAL TERMINOLOGY

This glossary contains many of the biological terms used throughout this document. Where several interpretations of a term may be correct, only the one applicable to the context of this report will be given.

ALEVIN:	A very young fish with the yolk of the egg still attached.
AMPHIPOD:	Small invertebrate aquatic animal which generally resembles a very small shrimp.
ANADROMOUS:	A freshwater population which migrates to and from salt water.
AQUATIC:	Of the water.
CANNIBALISM:	Predation of own kind; such as char eating char.
CARNIVOROUS:	Eats other animals.
CAUDAL:	The tail region.
COPEPODS:	Very small shrimp-like aquatic invertebrates, generally smaller than amphipods.
CRUSTACEANS:	A large group of invertebrates which have segmented external shells; includes copepods, amphipods, shrimp and lobster.
CYSTS:	Small capsules; some parasites form cysts around themselves in the flesh of animals.
DISSOLVED OXYGEN:	The amount of oxygen in the water which is available for animals to breathe.
DORSAL:	The top or back.
FERTILIZATION:	The uniting of the egg from the female with the sperm or milt from the male to produce eggs which will develop into young fish.
FORK LENGTH:	The length of a fish from the tip of the nose to the fork (if there is one) in the tail.
FORMALIN:	Poisonous substance used by researchers to preserve animals for long periods.
FRY:	A young fish generally during the first year.
GASTROPOD:	Small animal living in a coiled shell; i.e. snail.

INVERTEBRATES: Animals with no backbone or spinal column; including insects, amphipods, shrimp.

K FACTOR: or CONDITION FACTOR. A measure of how fat a fish is for its length, an indication of its health.

KYPE: A hooked extension of the lower jaw of spawning fish.

LANDLOCKED: A freshwater population which is physically isolated from access to salt water.

MESH SIZE: The size of the opening in a gillnet measured when stretched fully.

MORTALITY RATE: The rate at which fish die. May be further defined by the causes: natural, fishing, total.

MYSIDS: Shrimp-like aquatic invertebrates, generally larger than amphipods.

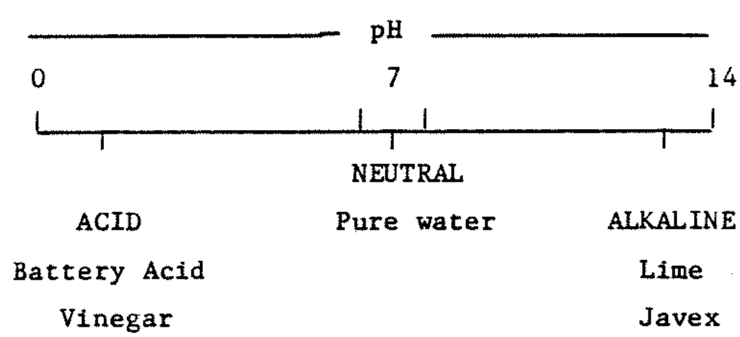
NATAL: For fish, pertaining to hatching; a natal stream is the one where a fish was hatched.

OTOLITHS: Small bones in the heads of fish; the fish uses them for balance, the researcher uses them to tell the age of the fish.

PARASITE: An animal which lives in or on another animal without helping that animal in any way.

PARR: A juvenile salmonid while distinct vertical bands or parr marks are visible.

pH: A number which describes the acidity or alkalinity of a substance.



PIGMENTATION:	Colouring and marking.
POLE SEINE:	A small mesh-size net with a long pole at either end for catching very small fish in shallow water.
PREDATION:	The act of killing for food.
REDD:	A nest or depression into which fish eggs are deposited.
RESIDENT:	A freshwater population which, while not physically barred from salt water, does not migrate to salt water.
SALMONID:	Collectively, all species of trout, salmon and whitefish.
SCALES:	Small plates over the skin of all fish; very noticeable on some fish such as whitefish; can be used to tell age of some fish.
SMOLT:	A young anadromous salmonid during its first seaward migration.
SPAWNING:	The act of depositing fertilized eggs in a redd.
TOXIN:	A toxic or poisonous substance.
VERTEBRATE:	Animal with a backbone and spinal column; includes fish, birds, mammals.
VISCERA:	Internal organs and supporting tissues found in the body cavity.

LIST OF CONTRIBUTORS

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MAKIVIK RESEARCH DEPARTMENT (1)

Johnny Peters	Vice-President, Research
William Kemp	Senior Science Advisor
Lorraine Brooke	Department Head
David Gillis	Fisheries Biologist
Marc Allard	Renewable Resources Technician
David Murray	Field Researcher
Johanna Galler	Researcher
Sylvie Côté	Word Processing
Bob Regimbal	Draftsperson
Andrée Oliva	Secretary

CONSULTANTS

Dr. Geoffrey Power (2)	Senior Fisheries Consultant
Dr. Mark Curtis (3)	Parasite Analyses
Dr. Rolf Gydemo (4)	Blood Genetics Analyses
Geoffrey Smith (5)	Fisheries Biologist
Noel C. Fraser c/o (2)	Otolith Analyses
Les Lowcock c/o (2)	Stomach Content Analyses

ADDRESSES

(1) Makivik Corporation
4898 de Maisonneuve Blvd West
Montréal (Québec)
H3Z 1M8

(2) Department of Biology
University of Waterloo
Waterloo (Ontario)

(3) Institute of Parasitology
MacDonald Campus
McGill University
Sainte-Anne de Bellevue (Québec)

(4) Institute of Freshwater Research
S-170-11 Drottningholm
Sweden

(5) Hatfields Consultants Ltd,
201 1571 Bellevue Avenue
West Vancouver (British Columbia)