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Modeling the Migratory Patterns and Habitat Use of Migratory Coregonids in the Mackenzie River System

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Diadromous coregonids are an important component of aboriginal fisheries in the Canadian north. Broad whitefish *Coregonus nasus*, inconnu *Stenodus leucichthys*, lake whitefish *C. clupeaformis*, and Arctic cisco *C. autumnalis* are the major fish species taken in subsistence fisheries in the Mackenzie River Valley, Northwest Territories (Stewart 1996), with broad whitefish and inconnu being of greater importance. All of these species are highly migratory, moving between coastal feeding areas and upstream spawning areas, and are likely targeted by multiple fisheries along their migration routes (Reist and Bond 1988; Dillinger et al. 1992; Chang-Kue and Jessop 1997; Howland et al. 2000).

Recent oil and gas developments—in particular, the proposed Mackenzie Valley natural gas pipeline—are expected to have impacts on these species, including the disruption of migration patterns, disturbance of spawning areas during pipeline construction and operation, and mortality from seismic activities.

It is important to try to limit impacts to fish populations in areas where fish are most vulnerable and congregate in large numbers, such as spawning grounds, overwintering areas, and migratory corridors. It is necessary to identify where these areas are located, and the critical times for their use by fish species, to mitigate and monitor such impacts. Although principal migratory corridors of the major harvested coregonids have been identified (Dillinger et al. 1992; Chang-Kue and Jessop 1997; Howland et al. 2000), knowledge of spawning and overwintering areas along the proposed pipeline route, and in production areas of the Mackenzie Delta, is limited.

We are using radio telemetry in this study to address the following questions: (1) where are critical spawning and overwintering areas for the key harvested populations of anadromous fish species (broad whitefish, inconnu, lake whitefish, and Arctic cisco) in the Mackenzie Valley, and (2) what is the timing of migration into spawning sites and actual time of spawning for key harvested fish populations?

This study was carried out between 2004 and 2007. Over this time, a total of 118 fish (66 broad whitefish, 30 inconnu, 20 lake whitefish, and 2 Arctic cisco) were surgically implanted with coded radio transmitters and released in the main-stem Mackenzie River (Figure 1). The battery life of transmitters ranged from 10 months to 4.5 years, allowing us the opportunity to follow movements of individual fish over consecutive years. Tracking was carried out in the region between Norman Wells and the Beaufort Sea coast (Figure 1) using a combination of aerial surveys with either a helicopter or fixed wing aircraft and strategically placed remote receiving towers.

We identified four reaches of the main-stem Mackenzie River as potential spawning areas, based on the congregation and staging of fish during the expected time of spawning (Figure 1). Overwintering areas were identified in the main-stem Mackenzie River, inner Mackenzie Delta lakes, and coastal Kittigazuit Bay-outer delta lakes areas. Broad whitefish began to move upstream from coastal overwintering sites by mid-July. Spawning appeared to occur in late October to early November followed by downstream movements to overwintering areas. Three and eight individuals were found in upstream areas on a biannual and annual basis, respectively. Two fish used the same overwintering area in consecutive years.

Specific spawning areas could not be identified due to weather problems with tracking during

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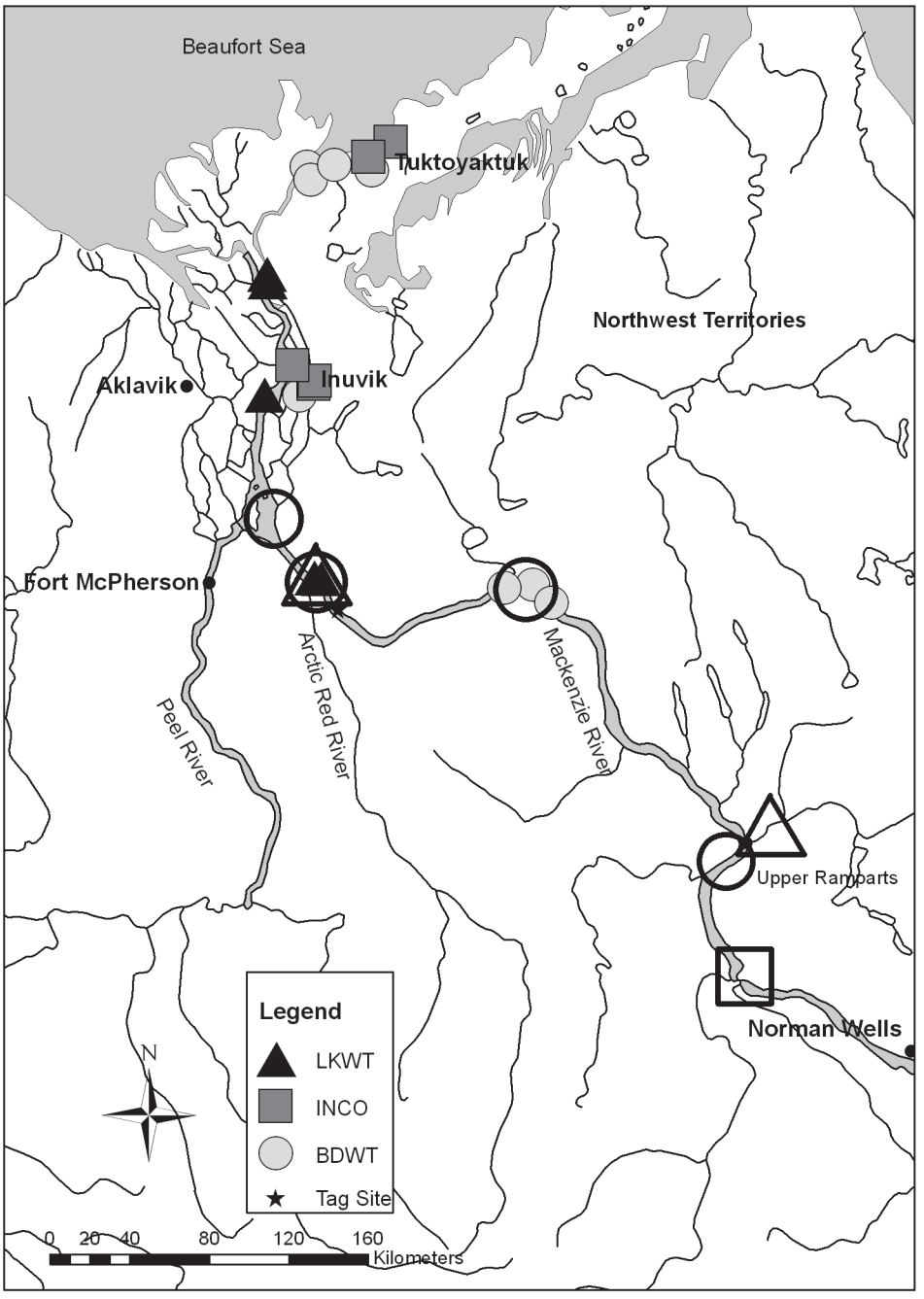

Figure 1.—Map of the lower Mackenzie River system indicating locations of potential spawning (open shapes) and overwintering (filled shapes) areas for broad whitefish (BDWT), inconnu (INCO), and lake whitefish (LKWT).

the expected spawning period in late September; however, patterns and timing of movements suggested that spawning areas for inconnu were located upstream of the Upper Ramparts (Figure 1). Overwintering areas were identified in the inner delta lakes and the Kittigazuit Bay–outer delta lakes area.

Inconnu began to move upstream from overwintering areas by mid-July and were found beyond the Upper Ramparts by August. Downstream movements towards overwintering areas were recorded in October. Four inconnu were found upstream in consecutive years, and three used the same overwintering areas in consecutive years.

Spawning areas were identified in the main-stem Mackenzie and the Hare Indian rivers (Figure 1). Overwintering areas were identified in the main-stem Mackenzie River and the inner Mackenzie Delta. Lake whitefish began to move upstream by late July. Spawning appeared to take place in late September–early October followed by downstream movement to overwintering areas. Four lake whitefish were found upstream in consecutive years.

Insufficient data were available to make any conclusions regarding this species.

Late June to early December is the most critical time for movements between spawning and overwintering sites for diadromous coregonids in the Mackenzie River system. Critical spawning habitat for diadromous coregonids is located in the main-stem Mackenzie River upstream of Point Separation and in the Hare Indian River. Critical overwintering areas include the Mackenzie Delta, Kittigazuit Bay, and outer delta lakes; however, some broad and lake whitefish ovewintered in the main-stem Mackenzie River, suggesting the possible existence of riverine populations. Some individuals, for all three species, were found in upstream areas in consecutive years, suggesting possible unsuccessful spawning, the existence of a riverine population, or annual spawning. Broad whitefish also showed evidence of biannual spawning suggesting that there is variability in spawning frequency. Some broad whitefish and inconnu returned to the same overwintering areas in consecutive years, suggesting that they may have fidelity to these locations.

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