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Acoustic GIS-based monitoring of Atlantic cod ecosystems in coastal Newfoundland

George Rose

Memorial Univ. of Newfoundland, Marine Inst., 155 Ridge Rd., St. John's, NL, Canada A1C5R3

Several bays in Newfoundland hold the largest extent groups of overwintering and spawning Atlantic cod (*Gadus morhua*), and are spawning areas for capelin (*Mallotus villosus*), the most important forage species. These species co-exist in coastal ecosystems whose physical features and ecological sensitivities restrict monitoring using conventional fisheries methods. Active and passive acoustic methods, acoustic telemetry, oceanographic instrumentation and ROV video have been used to monitor overwintering and spawning distributions and abundance of cod, using mobile and fixed platforms. Cod behaviour is complex and features high mobility both horizontally and vertically, especially during migratory and spawning periods. Overwintering cod have school packing densities $\gg 1$ fish.m⁻³. Spawning features increased mobility and vertical structures or "columns" of individual fish and sound production captured using stationary hydrophones. Acoustic returns from aquatic vegetation and bottom types have been used to map juvenile habitat. Acoustic telemetry has established the movement patterns of male and female fish during spawning and the homing characteristics of cod as the basis of their stock structure. The movements and spawning behaviour of capelin can also be monitored as can interactions between predators and prey. An experiment using real-time and 3D location telemetry in a comprehensive GIS system will be described.