ASSESSING AND MITIGATING THE RISK OF MULTIBEAM ECHOSOUNDER USE NEAR ENDANGERED BEAKED WHALES IN THE GULLY MARINE PROTECTED AREA

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Résumé

Un navire de recherche équipé d'un échosondeur multifaisceaux a permis au gouvernement du Canada de collecter des données bathymétriques et géologiques superficielles dans la zone de protection marine (ZPM) du Gully où se trouve un canyon incisant la marge continentale. Cette opportunité a nécessité des mesures spécifiques pour protéger l'écosystème local, notamment le benthos sensible et les baleines à bec commune menacées d'extinction. Plusieurs mesures réglementaires ont été déclenchées par une proposition d'avril 2017 visant à cartographier à nouveau le canyon. Dans cette étude, nous examinons le projet et les décisions communes prises par le promoteur et les autorités fédérales, notre objectif principal étant d'informer sur l'évolution du dialogue interne sur les impacts du bruit anthropique.

Mots clefs: échosondeurs multifaisceaux, ZPM du Gully, LEP, Baleines à bec commune, évaluation environnementale

Abstract

A charter with multibeam sounders presented the Government of Canada an opportunity to collect bathymetric and surficial geology data in the Gully Marine Protected Area (MPA), locus of a shelf-incising canyon granted broad ecosystem protection with specific measures enacted for sensitive benthos and endangered northern bottlenose whales. Several regulatory processes were triggered by an April 2017 proposal to remap the canyon. Here we review the project and joint decisions reached by the proponent and federal authorities, our primary aim to inform the evolving domestic dialogue on anthropogenic noise impacts.

Keywords: multibeam echosounders, Gully MPA, SARA, northern bottlenose whales, environmental assessment

1 Introduction

The Gully Marine Protected Area (MPA) lays offshore Nova Scotia at 44°N - 59°W, east of Sable Island National Park Reserve. Declaration in 2004 made the Gully Canada's first *Oceans Act* MPA in the Atlantic. Science conducted before and after designation highlights a wide range of habitats and species. Diverse cold water corals and abundant cetaceans remain focal points for research and management [1]. Numerous fish, turtles and mammals listed under the *Species at Risk Act* (SARA) are found in the Gully; most notably, northern bottlenose whales (NBW) belonging to the endangered Scotian Shelf population (n=143). The central canyon is afforded a pair of strict legal protections: the MPA Regulations foreclose commercial extraction at surface, midwater and seabed depths >600m; and SARA prohibits the destruction of NBW Critical Habitat (CH) comprising Zone 1 of the MPA canyon core [2].

The Gully has attracted waves of research since the 1960s, a decade that saw the last of Canada's commercial whale hunt and the dawn of federal offshore geoscience. Contemporary investigations have been broad and multi-disciplinary, covering many scientific fields since the 1990s.

Seabed features, benthic communities and near-bottom processes have been focal [3] as have cetaceans [4]. The MPA co-evolved with intensifying study during a period that saw growing domestic interest in underwater noise as a ubiquitous stressor and jurisprudence in relation to marine geological research [e.g., 5, 6]. Meanwhile, increasing biological consensus that beaked whales are particularly susceptible to noise disturbance made it inevitable that Gully science using sound for mapping, oceanography and fisheries research would come under scrutiny and trigger regulatory reviews.

2 Multibeam-equipped vessel of opportunity

Refit of the CCGS *Hudson* prompted the Bedford Institute of Oceanography to issue a request for vessel services in April 2017. RV *Coriolis II* based in Quebec was awarded the charter. An interdepartmental proposal was assembled to advantage the ship's hull-mounted multibeam echosounders (MBES) coincident with semi-annual Gully oceanography stations of the Atlantic Zone Monitoring Program. The aim was to map depths and seabed properties using standard methods [see 3] along a 59 nautical mile transect starting shallow on Sable Island Bank and progressing downslope in 2 segments: the first running 28 nm along a feeder channel and down the main axis to an upper-canyon sampling station; the second tracing the thalweg for ~30 nm before

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terminating at the canyon mouth. MBES would ensonify the MPA for about 8 hours during total RV occupancy <1 day.

3 Environmental risk assessment

Three interrelated permitting processes were triggered by the proposal: activity plan approvals required by the MPA Regulations; adverse impacts and allowable harm permit considerations pertaining to SARA; and a determination under the serious harm provisions of the *Fisheries Act*. All had in common a single assessment of risks posed by the MBES. Reference materials were drawn from DFO advisories; reviews of impacts and global thresholds; manufacturer specifications and documentation; and prior Gully clearances issued in 2006 for a 12 kHz MBES survey.

RV Coriolis II carries 2 Kongsberg MBES: an EM 2040 acquires at user-selected frequencies between 200-400 kHz to 600m; an EM 302 utilizes 30 kHz signals capable of sounding to several kms. The EM 2040 emits at 218 dB re 1 µPa @ 1m producing a 140° fan of 0.5°x1° beams. The nominal EM 302 source level (SL) is 237 dB re 1 µPa @ 1m with a transmission pattern composed of 1°x1° beamforms. Simultaneous operation was proposed to depth maxima for the EM 2040. Serious effects on fish and turtles were not anticipated. While baleen whales use the Gully, including endangered North Atlantic right and blue whales, MBES were not expected to mask vocals and assumed hearing spectra. Toothed whales vocalizing and hearing at higher frequencies were expected to discern and possibly react to MBES. Beaked whale risk factors were assessed to be of greatest concern given direct EM 302 frequency overlaps.

Prudent best-practice mitigation measures were adopted to minimize risk in the MPA: power ramp-up; daytime operations; wildlife observation; and a shallow-to-deep sail path offering theoretical egress to the open ocean via the canyon mouth. Two measures were central to decisions that allowed the survey to proceed: SL reductions and CH avoidance. A reportedly new Kongsberg mammal protection function was enabled to attenuate SLs by the -20 dB maximum thereby achieving a hypothetical 180 dB safety threshold for cetacean injury or harm at 20m below the hull. The survey line was truncated at the upper-canyon sampling station as per recommendations made and agreed to at a meeting of the Gully MPA Advisory Committee, a multistakeholder group that also provides input to DFO on NBW recovery. Segment 2 was less essential to specific project goals (e.g., off-shelf transport), so restricting MBES from deep parts of the MPA avoided potential CH stressors.

4 Discussion

Statutory obligations and implications for marine scientific research are in a state of evolution domestically and internationally. The present case study illustrates how scientific investigators using sound energy in MPAs known to support acoustically sensitive species are becoming increasingly subject to the same environmental assessment and permit requirements imposed on commercial ventures. In this instance, the research goal—high quality bathymetry and interpretable surficial geology in relation to bedforms and sediment transport dynamics—was partially met in the upper reaches of the Gully. Not surveying the canyon core leaves knowledge gaps that may need to be addressed with further surveys, especially if MBES data analyses reveal active transport of sediment from the sandy bank tops to the canyon deeps. The crucial role of seabed maps in benthic science and conservation planning is largely self-evident; less obvious is how MBES might contribute to endangered cetaceans. One illustration: contaminants detected in tissue samples [7] have been speculatively tied to pollution arriving via the off-shelf vectors under study here.

With its linked science and conservation histories, the Gully MPA offers a testbed for policy development and regulatory application without, it is hoped, incurring legal challenges. The Gully and similarly protected habitats present opportunities for collaborative fact-finding and interdisciplinary research. Acousticians and corresponding engineering capacities in Halifax and elsewhere in Canada appear ready to tackle many remaining challenges; e.g., sound loss models examined for this project [8] could be revisited for MPAs and domestic research platforms, with predictions made for -10/-20 dB SL attenuations where available. Purposeful MBES signal processing to actively detect vocalizing whales or those swimming close enough to be imaged is another frontier. Considerable potential also exists for designing and implementing coupled aural-visual studies of cetacean behavioural response in the presence of overt noise commanded and controlled by qualified personnel, not least in the Gully where cetaceans have been studied intensively since 1988 and autonomous acoustic recorders deployed nearly continuously since 2003.

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