Methods in Oceanography 12 (2015) 18–35

Contents lists available at ScienceDirect

Methods in Oceanography

journal homepage: www.elsevier.com/locate/mio

Full length article

Assessment of trawlable and untrawlable seafloor using multibeam-derived metrics

Jodi L. Pirtle [a,*,1], Thomas C. Weber [a], Christopher D. Wilson [b], Christopher N. Rooper [b]

[a] University of New Hampshire, Center for Coastal and Ocean Mapping, 24 Colovos Road, Durham, NH, 03824, USA

[b] National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA, 98115, USA

ARTICLE INFO

Article history:
Received 28 January 2015
Received in revised form
22 May 2015
Accepted 5 June 2015

Keywords:
Acoustic backscatter
Multibeam echosounder
Terrain analysis
Seafloor characterization
Bottom-trawl survey
Groundfish habitat
Trawlable
Untrawlable
Gulf of Alaska

ABSTRACT

Groundfish that associate with rugged seafloor types are difficult to assess with bottom-trawl sampling gear. Simrad ME70 multibeam echosounder (MBES) data and video imagery were collected to characterize trawlable and untrawlable areas, and to ultimately improve efforts to determine habitat-specific groundfish biomass. The data were collected during two acoustic-trawl surveys of the Gulf of Alaska (GOA) during 2011 and 2012 by NOAA Alaska Fisheries Science Center (AFSC) researchers. MBES data were collected continuously along the trackline, which included parallel transects (1–20 nmi spacing) and fine-scale survey locations in 2011. Video data were collected at camera stations using a deployed camera system. Multibeam-derived seafloor metrics were overlaid with the locations of previously conducted AFSC bottom-trawl (BT) survey hauls and 2011 camera stations. Generalized linear models were used to identify the best combination of multibeam metrics to discriminate between trawlable and untrawlable seafloor for the region of overlap between the camera stations or haul paths and the MBES data. The two best models were developed using data collected at camera stations with either oblique incidence backscatter strength (S_b) or mosaic S_b in combination with bathymetric posi-

* Corresponding author. Tel.: +1 907 789 6603; fax: +1 907 789 6094.
E-mail address: jodi.pirtle@noaa.gov (J.L. Pirtle).

[1] Present address: National Academy of Sciences, National Research Council, Visiting Scientist at National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, 17109 Point Lena Loop Road, Juneau, AK, 99801, USA.

http://dx.doi.org/10.1016/j.mio.2015.06.001

tion index and seafloor ruggedness; these described over 54% of the variation between trawlable and untrawlable seafloor types. A map of predicted seafloor trawlability produced from the model using mosaic S_b and benthic-terrain metrics demonstrated that 58% of the area mapped (5987 km^2) had $\geq$50% probability of being trawlable and 42% of being untrawlable. The model correctly predicted 69% of trawlable and untrawlable haul locations. Successful hauls occurred in areas with 62% probability of being trawlable and gear damage occurred in areas with a 38% probability of being trawlable. This model and map produced from multibeam-derived seafloor metrics may be used to refine seafloor interpretation for the AFSC BT surveys and to advance efforts to develop habitat-specific biomass estimates for GOA groundfish populations.

1. Introduction

Multi-species bottom-trawl surveys are a common fishery-independent assessment method to obtain biomass estimates for demersal fish populations. Inherent in trawl survey biomass estimates is the issue of catchability, which is influenced by the relative proportion of trawlable and untrawlable ground in a survey area, or the area accessible by the survey (Cordue, 2007). Management areas like the Gulf of Alaska and US West Coast have a mix of trawlable and untrawlable seafloor types (Zimmermann, 2003; Von Szalay et al., 2010). Certain groundfish species, such as rockfishes (*Sebastes* spp.) have mixed distribution in trawlable and untrawlable habitat or prefer rugged habitat inaccessible to bottom-trawl gear (Stein et al., 1992; Clausen and Heifetz, 2002; Jagielo et al., 2003; Rooper et al., 2007). Consequently, the proportion of the population in untrawlable habitat is undersampled or not sampled at all, and the sampled population is assumed to be representative of the entire population for the purpose of the stock assessment. Disproportionate survey access to all areas occupied by the harvested population can introduce non-random error to biomass estimates from trawl survey time-series (Cordue, 2007). Thus, more accurate accounting of the extent of trawlable and untrawlable survey area is needed as a first step toward assessing and correcting this potential bias.

National Oceanic and Atmospheric Administration (NOAA) Alaska Fisheries Science Center (AFSC) Resource Assessment and Conservation Engineering (RACE) Division researchers conduct a biennial area-wide bottom-trawl survey (BT survey) for groundfish in the Gulf of Alaska (GOA), from the Islands of Four Mountains (169°59′0″W 52°43′11″N) in the Aleutian Islands to Dixon Entrance (133°13′53″W 54°30′38″N) (Von Szalay et al., 2010). The RACE BT survey is conducted aboard chartered commercial fishing vessels. Stations in 59 survey strata are allocated from a sampling grid in a stratified-random design. A survey vessel skipper searches to locate trawlable ground within a station grid cell for a minimum of two hours, or abandons that cell and searches within another until trawlable ground is located. The sampling grid is populated with the locations of known trawlable and untrawlable features. However, knowledge of seafloor trawlability is not comprehensive across a survey grid cell and is qualitative at best. Untrawlable seafloor is often encountered in areas thought to be trawlable, which can result in considerable gear damage and loss of the sample and survey time. Given the difficulties in selecting trawlable seafloor, we know that there are similar difficulties associated with identifying untrawlable seafloor. A better estimate of the areal extent of trawlable and untrawlable ground in the GOA will improve biomass estimates for groundfish, increase survey efficiency, and reduce damage to gear and benthic habitat. In this study, we test metrics derived from multibeam echo sounder (MBES) data for their ability to discriminate between trawlable and untrawlable seafloor types in the RACE BT survey area.