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MYSTICETI AS CONSUMERS AND INDICATORS OF MARINE PRODUCTION: ONGOING STUDIES AT THE MARINE ECOLOGY LABORATORY.

by

Paul F. Brodie
Marine Ecology Laboratory
Bedford Institute of Oceanography
Dartmouth, Nova Scotia B2Y 4A2
CANADA

INTRODUCTION

Marine mammal studies can serve a double function of providing the basis for management of these stocks plus the additional application to productivity studies and fisheries management.

We have attempted to use marine mammals as research tools, from consumer to indicator, of marine productivity defining areas of high concentrations of both zooplankton and pelagics plus densities which must exist within these areas.

Recent studies of cetacean energetics are encouraging in that we are approaching a concensus on metabolic rates, the advantages and costs of migrations (Brodie, 1975; Kawamura, 1975; Lockyer, 1976; Laws, 1977). The large body size of mysticetes affords them unique behaviour with regard to food storage and extensive periods of fasting and migration. The physiological parameters normally applied to terrestrial mammals cannot be applied directly to marine mammals without modification. Caloric value, rather than biomass, must be the parameter used in energetic studies. For example, a much higher return would be gained by feeding on capelin (Mallotus villosus) when its fat content exceeds 20% wet weight (Jangaard, 1974) than euphausiids at less than 4% compounded by the response of prey to predator behaviour where herding of pelagic fish may occur (Brodie, in press). The response of the prey may vary seasonally according to fat content (Shul'man, 1972).

If marine mammals are to be used to estimate the standing stocks of their prey then we must establish realistic energy profiles or our extrapolation from relatively small stocks of marine mammals could be quite misleading.

It is ironic that theoretical energetic studies might eventually effect marine mammal stocks. The increasing demand for previously unexploited fish and euphausiid stocks using sophisticated and intensive harvesting techniques might provide strong competition for some marine mammal stocks (Sergeant, 1970).

Whale Distribution Off The East Coast Of Nova Scotia

A technical report (Sutcliffe and Brodie, 1977) describes the distribution of commercially hunted whales designating areas of high productivity on the Scotian Shelf. Positions of 2115 kills from 1966 through 1972 were plotted according to species and month plus cumulative yearly catches of all species (see Figs. 1 and 2).

Our interest here was not so much in the biology of the whales and whether they were discrete stocks or transient groups (Mitchell, 1974), but rather that when they were present off Nova Scotia they maintained the highest feeding concentrations in these areas. This fact is underlined by the continued high whale concentration as whales were removed by the fishery.

We have taken into consideration the biases that may exist in such data, such as hunting strategy as markets fluctuate, quality of product for human consumption related to towing times, hunting strategies varying according to the presence of the unpredictable Sei whale plus the variation of skills and effort between hunting vessels.

These data will be used along with both physical and biological oceanographic in the study of slope water dynamics, seasonal and yearly variations and related productivity along the edge of the Scotian Shelf and the banks within.

Euphausiid Densities On The Scotian Shelf As Indicated By Nets, Whale Stomach Contents And Acoustical Surveys

Studies with Sameoto and Sheldon of this laboratory suggest that the densities of Meganyctiphanes norvegica are a minimum of an order of magnitude greater than expected on the areas of whale concentration as indicated in Sutcliffe and Brodie (1977). Densities of 17 gm/m^3 were calculated as the minimal densities required to support a Fin whale (Balaenoptera physalus) feeding at a speed of 5 km/hr with a mouth cross section of $0.8m^2$ and a filtration efficiency of 100%. The mouth aperture seems small for a whale in the 18 meter range; however, studies at this laboratory and those by Pivorunas (1976) conclude that a skimming type of filtration requires that the mandible be lowered no more than 15 degrees otherwise the filtration capacity is lost. Most probably, feeding is by engulfing large quantities of water (Brodie, in press) thus euphausiid densities may be far greater in very localized concentrations than we estimate. Our estimates for skimming by fin whales establish a minimal estimate based on the measured stomach contents of a whale processed at a nearby whaling plant taking into consideration the rate of digestion of stomach contents while the whale is still feeding. Results were compared with the net samples taken during acoustical surveys by Sameoto (manuscript in preparation).

Sampling Device For Zooplankton

Studies of functional morphology and feeding behaviour of mysticetes have led to the development of a sampling device with preliminary tests indicating that a higher confidence in the

quantitative aspect of sampling can be attained. In addition the sampler is both simple and inexpensive to produce.

The bow wave has been considerably reduced thus greatly reducing the effort in collecting the water for filtration. With reduced bow wave the frame can be made of light material; for example the frame of a half meter diameter opening can be constructed of metal less than 1 mm thickness and could also be made of acetate or other clear plastics. This would reduce sampler avoidance by organisms through visual detection.

In addition, such a device permits sub-sampling of aquarium populations, returning the sample unharmed to the tank, thus reducing one of the problems in laboratory studies. A paper is in preparation regarding this sampler and tests are being conducted in various field situations.

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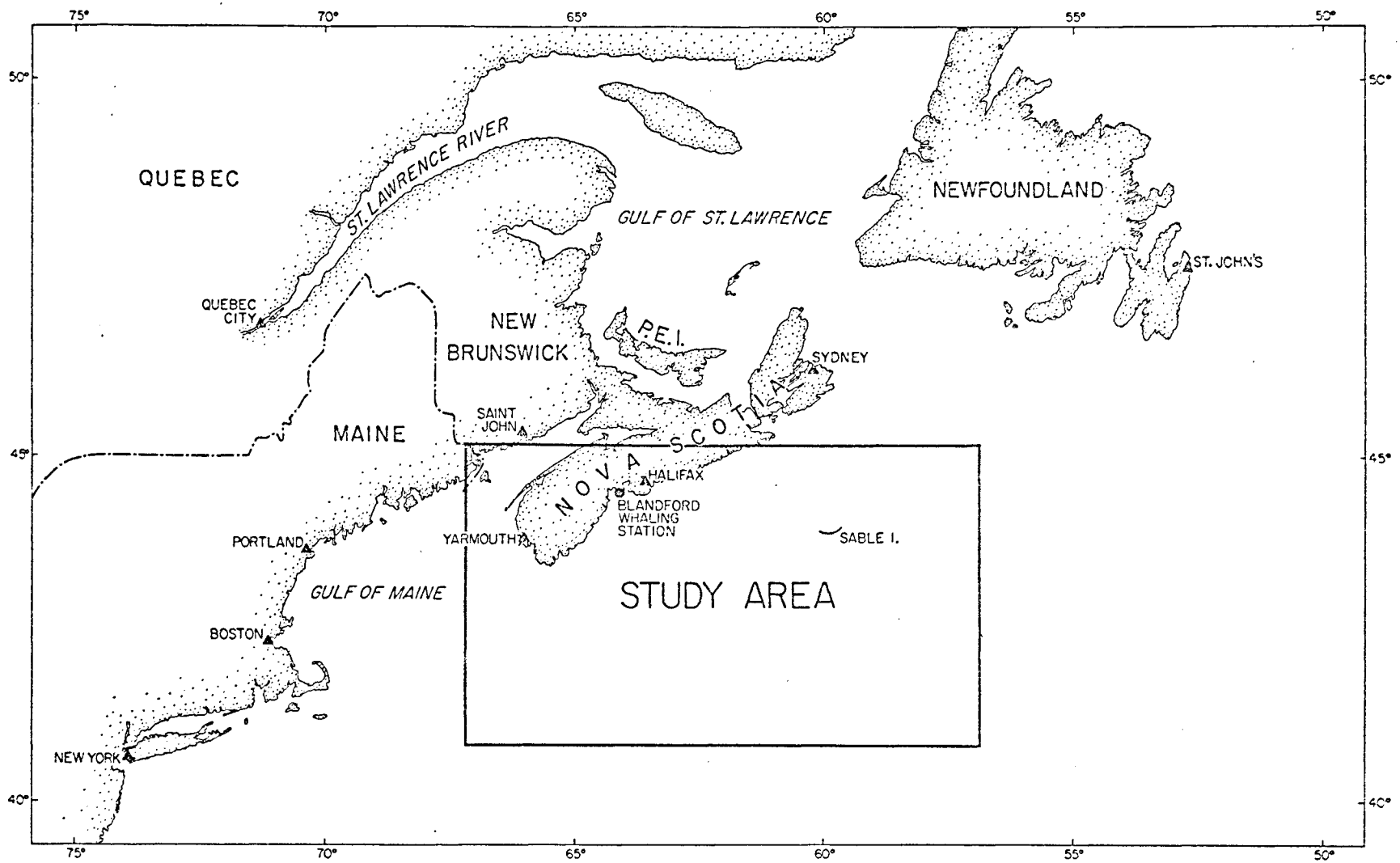

Fig. 1. Study area on Scotian Shelf where commercial whaling was carried out. (Sutcliffe and Brodie 1977)

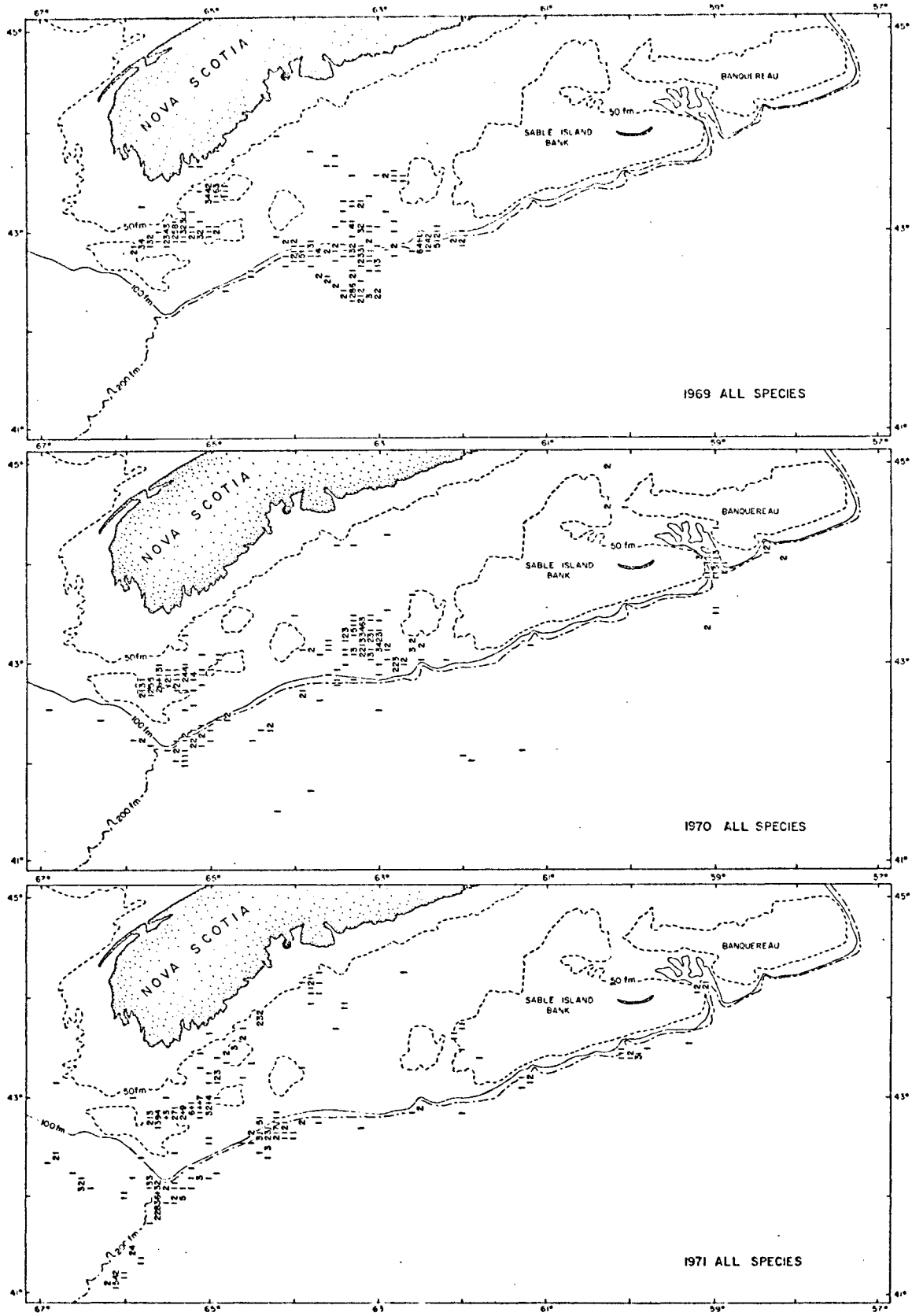

Fig. 2. Total yearly catches of whales (fin, sei, minke, sperm). Catches greater than 9 indicated by +. (Sutcliffe and Brodie 1977)