RESTRICTED

International Commission for the Northwest Atlantic Fisheries

Serial No. 3895
(D.c.1)

ICNAF Res.Doc. 76/VI/83

ANNUAL MEETING - JUNE 1976

Areal variations in zooplankton volumes on the Northeast Continental Shelf in spring and autumn 1973[1]

by

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Introduction

The importance of inter and intra species predator-prey relationships in understanding the dynamics of multispecies fisheries has been recently reemphasized in a number of reports (Gulland 1970; ICES 1975). Useful models incorporating environmental affects on stock-recruitment problems have also been recently developed (Lett, et al., 1975; Lett, Kohler, and Fitzgerald, 1975; Lett and Kohler, 1976). These models, while they hold promise for accelerating the development of alternative management strategies in fisheries operating at different trophic levels, are dependent on environmental and trophodynamic information which is at present fragmentary.

To expand the trophodynamic data base in the ICNAF area, a series of environmental and planktological observations were initiated in 1971 on the Groundfish Surveys conducted by the Northeast Fisheries Center (NEFC). Initial analyses of these data are now underway. The present report provides a comparison of the zooplankton standing stock of three important fishing areas - western Nova Scotia, Georges Bank, and the Gulf of Maine. Subsequent reports will deal with the species composition, distribution, and dynamics of the plankton communities in these areas.

Methods

During the spring and autumn Groundfish cruises of the NEFC in 1973 paired 60 cm bongo nets fitted with 0.333 and 0.505 mm mesh were towed at selected locations during routine operations. Each tow filtered from 100 - 400m^3 of water and was made from the surface to a variable depth of 25 - 100 meters depending on bottom topography at 3.5 kts for a duration of 5 - 15 minutes. The present analysis is based on the wet displacement volumes of zooplankton from 0.333 tows only. In the laboratory, displacement volumes were determined using the MARMAP method (Jossi, et al., 1975). The plankton sample with its preserving liquid is measured in a graduated cylinder, poured through a mesh cone into a second cylinder, and drained until the interval between drops from the bottom of the cone diminishes to 15 seconds. The volume of the liquid is read and the displacement volume of the sample determined by difference.

Zooplankton Volumes

Zooplankton volumes expressed as cubic centimeters per 100m^3 water strained

[1] Presented as Working Paper 76/IV/110 at Environmental Working Group meeting, Szczecin, Poland, April 1976.

were tabulated by station and area for each season. To obtain measures of the variation among the individual samples, means, ranges, standard deviations, and coefficients of variation were calculated for each area (Tables 1 and 2). Comparisons of the biomass among each of the areas were made with the Kruskal-Wallis one-way analysis of variance (H); Mann-Whitney U Tests (Z) were used to compare between area differences (Siegel, 1956)

During both seasons the sampling was not sufficiently close for adequate contouring of zooplankton volumes. Considering the wide range in volumes in each of the areas, horizontal plots were prepared (Figs. 1 and 2) using a factor of four to indicate increasing volume, following the procedure used in CalCOFI (Smith, 1971).

Areal Comparisons

A summary of H and Z values and associated probabilities are given in Tables 3 and 4. In spring the differences among zooplankton volumes in the three areas were significantly different ($P<.05$). Lowest volumes were in the Gulf of Maine. The biomass values of zooplankton in the Western Nova Scotia area were significantly higher than in the other two areas ($P<0.05$). The number of samples collected from waters off southern New England was too low to adequately represent the area

In autumn the zooplankton was approaching the annual winter minimum (Bigelow, 1926). The standing stock of zooplankton was different among the three areas ($P<.001$). Maximal concentrations of zooplankters were on Georges Bank. The lower volumes in the Gulf of Maine and Western Nova Scotia were not significantly different between these two areas ($P>.05$).

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Table 1: Biomass ($cc/100m^3$) at individual stations in three areas during Spring, 1973.

Georges Bank

Sta.#	Vol.
157	58
158	65
161	26
163	17
164	20
165	11
166	17
168	9
169	27
174	22
175	22
177	137
178	84
180	39
181	103
182	56
183	78
185	68
186	19
188	77
195	63
196	96
197	7
198	10
202	55
206	71
207	59
208	17
210	11
212	6
213	46
214	117
216	16
217	12
218	11
223	6
224	4
226	60
228	41
229	5
230	62
231	49
232	29
233	99
235	9
236	143
237	271
238	19
242	40
255	9

Mean = 48.0
Std. Dev. = 48.3
Coeff. of Var. = 1.01
Range = 267

W. Nova Scotia

Sta.#	Vol.
262	125
263	29
265	170
266	52
268	104
273	48
274	36
276	68
277	63
278	178
279	438
281	57
282	66
283	71
284	46
285	73
286	63
287	37
307	35
308	42
313	54
314	72
319	65
320	64
322	17
324	19
326	22
327	13
328	33

Mean = 74.5
Std. Dev. = 80.4
Coeff. of Var. = 1.08
Range = 425

Gulf of Maine

Sta.#	Vol.
220	36
222	13
239	51
240	70
241	1
243	14
244	20
247	56
248	34
249	27
250	26
251	21
254	50
257	38
258	51
259	43
260	65
264	15
315	78
317	19
318	52

Mean = 37.1
Std. Dev. = 20.9
Coeff. of Var. = 0
Range = 77

Table 2: Biomass ($cc/100m^3$) at individual stations in three areas during Fall, 1973.

Georges Bank

Sta.#	Vol.
126	8
127	10
128	32
129	36
130	85
131	47
133	53
134	78
136	55
137	62
138	47
139	77
140	43
141	78
142	38
143	7
144	19
145	61
151	50
152	39
153	86
155	73
157	37
158	23
159	19
160	4
163	26
164	41
167	74
168	66
169	78
170	14
171	35
172	72
173	68
174	29
175	32
176	55
178	19
181	49
182	83
183	94
184	112
188	42
189	4
191	161
192	35
193	53
209	15

Mean = 49.5
Std. Dev. =30.9
Coeff. of Var. =0.62
Range = 157

W. Nova Scotia

Sta.#	Vol.
217	11
218	15
219	21
220	16
221	5
222	19
223	7
228	9
229	24
230	17
231	22
234	7
235	6
236	30
238	22
239	21
240	14
241	14
242	28
243	28
244	36
246	13
247	12
250	19
255	11
256	8
259	12
260	10
261	13
262	23
263	15
265	8
269	13
270	28
271	17
272	22

Mean =16.6
Std. Dev. = 7.6
Coeff. of Var. = 0.46
Range = 31

Gulf of Maine

Sta.#	Vol.
196	7
199	10
200	63
201	30
202	41
205	12
210	7
211	27
212	27
213	43
214	17
215	11
226	39
232	15
233	12
277	18
281	8
282	6
283	7
284	8
285	8
286	7
289	8
294	11
295	25
296	18
297	9
298	18
299	20
300	16
301	18
302	15

Mean = 18.2
Std. Dev. = 13.1
Coeff. of Var. = 0.72
Range = 57

Table 3: Kruskal - Wallis Test

	H	P
Spring	7.39	≤ 0.05
Autumn	39.63	≤ 0.001

Table 4: Mann-Whitney U-Test

	Georges Bank - Gulf of Maine	Gulf of Maine - W. Nova Scotia	W. Nova Scotia Georges Bank
Spring	Z = .126 P ≥ 0.05	Z = 2.044 P = ≤0.05	Z = 2.33 P ≤ 0.01
Autumn	Z = 5.048 P ≤ 0.001	Z = 0.350 P ≥ 0.05	Z = 5.536 P ≤ 0.001

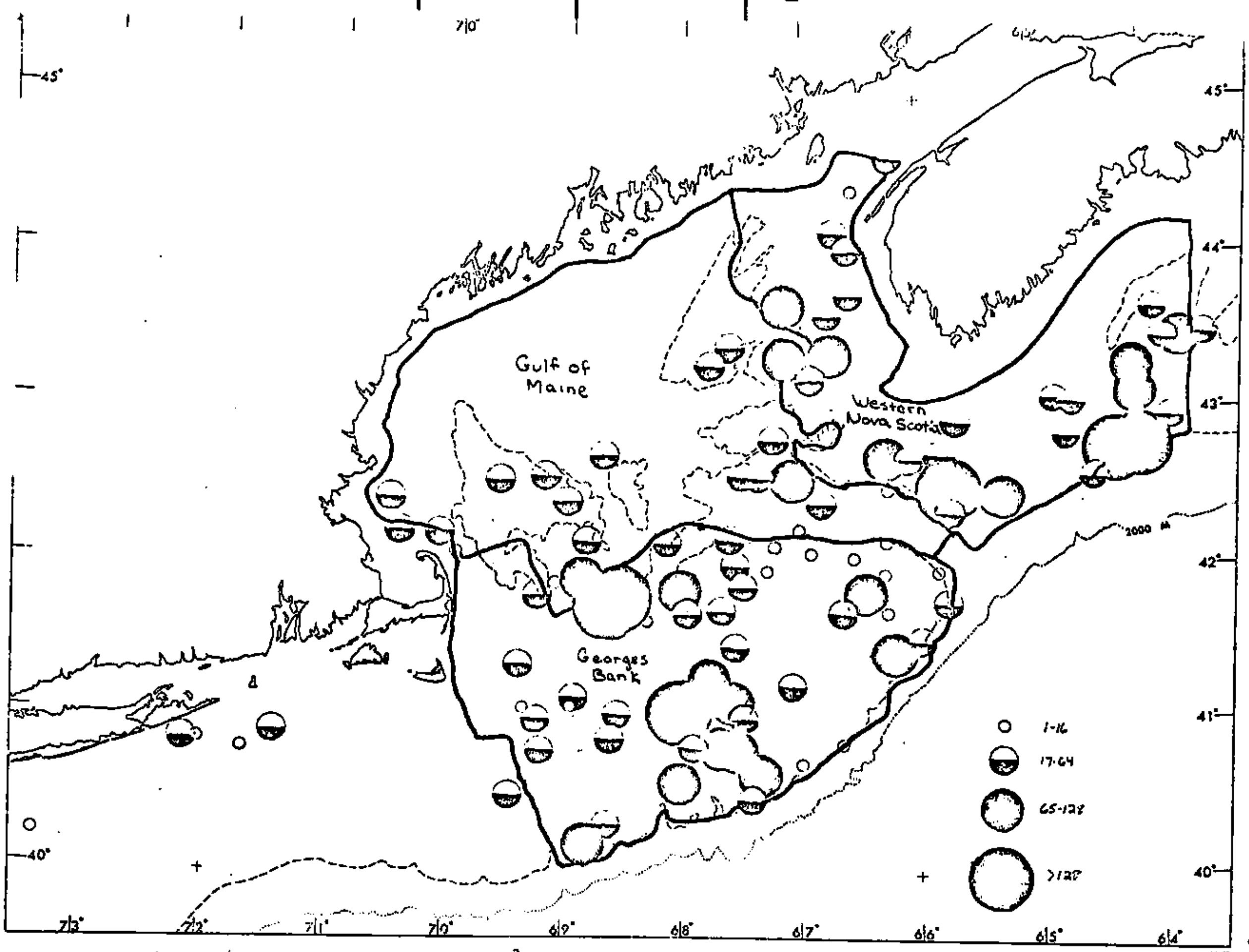

Fig. 1: Distribution of Volumes(cc/100m^3) in Spring 1973 in 3 Areas off Northeast Continental Shelf

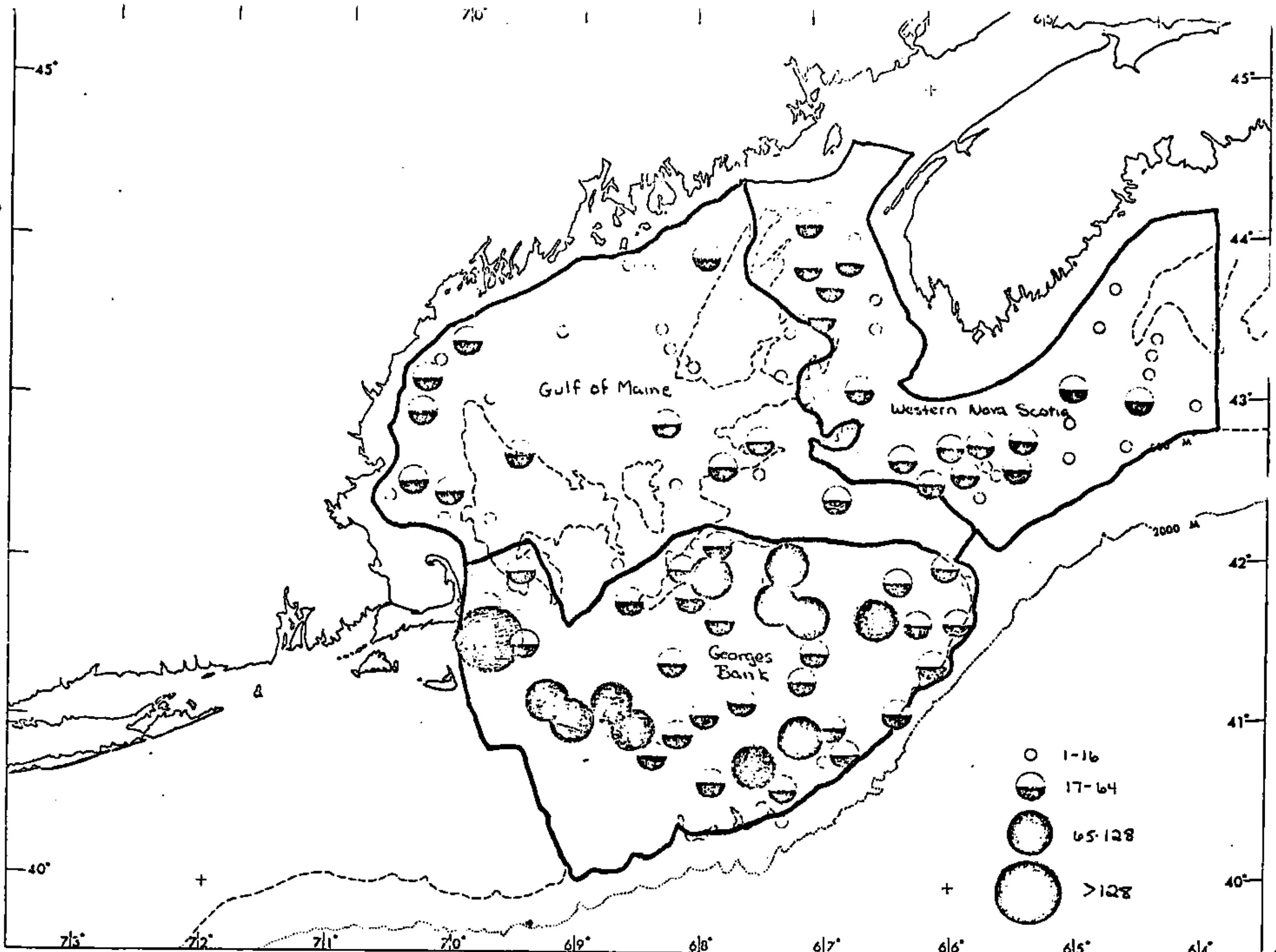

Fig. 2: Distribution of Volumes(cc/100m^3) in Fall 1973 in 3 Areas off Northeast Continental Shelf