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the Northwest Atlantic Fisheries

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Canadian views on the biological sampling of commercial fish
catches in the ICNAF Area

STACRES has repeatedly emphasized the importance of its biological sampling of commercial catches. Such data are essential for assessments of the status of stocks. It is becoming increasingly difficult to base assessments on fishing effort data because fishing patterns often change rapidly as a result, in part, from conservation measures themselves.

An indication of the importance of inadequate biological sampling is that STACRES, in May 1973, found that only 26 of 56 stocks could be assessed on what was described as an "analytical" basis. The difficulties in assessing the remaining 31 stocks were, in large part, attributable to inadequate sampling. It was also clear that even the "analytical" assessments were based on insufficient sampling data. The most serious example may be the Division 3NO cod stock, for which not one usable commercial sample was available from 22,055 metric tons caught in 1971-72.

Canada, therefore, urges the Commission to give its full consideration to means of guaranteeing the provision of at least the minimum biological sampling as defined by STACRES and adopted by the Commission in June 1974. An appraisal of biological sampling in the ICNAF Area is at Appendix I.

ANNUAL MEETING - JUNE 1975Canadian appraisal of biological sampling of fish catches in the ICNAF AreaINTRODUCTION

At its 19th. Annual Meeting in 1969, the Commission adopted its first catch quota regulations, limiting fishing for haddock in Div. 4X of Subarea 4 and in Subarea 5. Only five years later, at the Commission's 24th. Annual Meeting in 1974, almost sixty catch quota regulations were adopted covering virtually all species stocks in the ICNAF Area subject to a directed fishery. This admirable record attests to the success of the Commission as a negotiating body for fisheries regulatory agreements.

Unfortunately, this is not the test on which the Commission's success or failure will be judged - it is only a prerequisite. The major question - are the fish stocks of the ICNAF Area effectively managed to maximise long-term yields? - remains to be answered.

If this answer is to be positive, the Commission must not only be responsive to the scientific advice received from its Standing Committee on Research and Statistics (STACRES), it must ensure that adequate scientific advice can be given.

Since 1968, the Commission's scientific advisers have repeatedly warned that the basic scientific data available to them, particularly biological sampling data from commercial catches, are inadequate to support the management regime the Commission was adopting. These warnings have largely gone unheeded by the Commission.

It is imperative that the Commission examine the matter of inadequate commercial catch sampling most seriously, fully evaluate the implications of inaction, and take appropriate measures to remedy the deficiencies.

HISTORICAL REVIEW OF STACRES ADVICE ON SAMPLING

The first meeting of the Standing Committee on Regulatory Measures in January, 1968 requested STACRES to provide advice on, among other matters, informational requirements for regulation of fishing through limitation of catch (1968 Proceedings No. 16, Appendix I). Pointing out that important inadequacies existed in commercial catch sampling, STACRES replied (in part) by reaffirming " .. the essential need, if good advice on management is desired, for full sampling coverage (length and age composition) of all the major ICNAF fisheries." (Redbook 1968, Pt. I, p. 31). The Assessments Subcommittee of STACRES discussed sampling deficiencies further at its May, 1969, January and May, 1970 meetings, and attempted to stimulate increased levels of sampling through discussions between the ICNAF Secretariat and the responsible authorities in member countries (Redbook 1969, Pt. I, p. 40; Redbook 1970, Pt. I, p. 21). At the 1970 Annual Meeting, STACRES recommended to the Commission adoption of a minimum sampling requirement which was " .. measurement by each country of 200 fish for every quarter of the year and division for each 1,000 tons of each species caught." In adopting the STACRES report (1970 Proceedings No. 15, Item 8), member countries of the Commission made the commitment to meet these minimum sampling requirements.

At the 1972 Annual Meeting, scientific advisers again noted major inadequacies in sampling coverage and emphatically brought this to the Commission's attention in all of the Reports of Scientific Advisers to Panels. For example, the report to Panel 4 states "If the Commission intends to regulate stocks on a scientific basis, responsibility must be accepted to provide the necessary information on which to base scientific assessments." All Panels discussed the matter and agreed that the situation was unsatisfactory. Again, at the 1973 Annual Meeting, continuing deficiencies were again forcefully brought to the attention of the Commission by its scientific advisers.

In May, 1974, STACRES redefined the minimum sampling requirement to read "... one sample per 1,000 tons of fish caught for each division, quarter of year, and gear. As an approximate guideline, such samples should consist of 200 fish from the entire length range for length composition and one fish per centimetre length group for age composition." (Redbook 1974, pp. 70-71). In adopting the STACRES report, the Commission accepted this recommendation.

A review of commercial samples from 1973 catches submitted by member countries to the Secretariat (see below) indicates that major deficiencies in coverage still exist. It must be concluded that member countries have failed to establish the necessary mechanisms, or provide adequate resources to meet their sampling commitments.

DEFINITION OF ADEQUATE CATCH SAMPLING

STACRES has repeatedly emphasised that their recommendations on sampling requirements are minimum requirements, and even if met, the situation would not be entirely satisfactory.

Certain sampling principles are implied in the phraseology of the 1974 STACRES recommendation - particularly that stratified sampling with no large sub-cells left empty is required. Thus, it is necessary (1) that all stocks fished be sampled (sampling by ICNAF Division approximates this) (2) that all national fleets fishing a stock be sampled (3) that each major gear type be sampled (4) that account be taken of seasonal variations in catch composition (stratification by quarter of year as recommended by STACRES is adequate for most groundfish stocks, but species such as herring, mackerel, and silver hake should be stratified by month).

All catches are included in this requirement. Thus, not only stocks subject to a directed fishery should be sampled, but so also should incidental catches, whether retained or discarded. For example, in Subareas 3 and 4, a substantial proportion of flatfish production is harvested incidentally in fisheries for other species (some conducted with small mesh nets) and a significant part of this incidental catch is discarded. These fishery components must be taken account of in estimating potential yields of flatfish species. It should be noted that the comparisons of adequacy of sampling in Tables 1 and 2 are based on "nominal catches" i. e. excluding discards - discard sampling by member countries is rare indeed.

HISTORICAL TRENDS IN COMMERCIAL SAMPLING PERFORMANCE AND DEFICIENCIES IN 1973 SAMPLING OF COD AND HERRING

Historical sampling performance cannot be reviewed in relation to the minimum sampling requirements defined by STACRES in 1974 due to differences in reporting procedures in earlier years. The number of length measurements reported is the only "common denominator" which allows comprehensive comparison among countries and years. Table 1 indicates the number of length measurements required from each country, and the percentage reported measurements were of those required, for the years 1964, 1968, and 1973. Measurements required are calculated on the basis of 200 fish to be measured from each 1,000 metric tons of fish reported by a country from an ICNAF Subarea in a year. This is a considerably less stringent requirement than that of the 1974 STACRES recommendation which requires stratification by Division, gear, and season. Although sampling from research and exploratory fishing vessels are inadequate substitutes for samples from commercial catches (see below), these are also shown in Table 1 to fully represent countries' sampling efforts.

In 1964, of 48 country x Subarea combinations in which sampling was required, in only 8 (17%) were the minimum requirements met. In 1973, of 68 country x Subarea combinations, in only 23 (34%) were the minimum requirements met. Thus, while sampling performance, by this measure, improved by 100% between 1964 and 1973, a further 200% increase is required to bring the level up to the minimum requirement. These comparisons do not include research and exploratory fishing samples.

The 1974 STACRES minimum sampling recommendation is applied to cod and herring commercial sampling performance in 1973 (Table 2). For cod, of 242 country x Division x gear x quarter combinations in which sampling was required, in only 60 (25%) were the minimum requirements met. For herring, of 83 such combinations, in 45 (54%) the minimum requirements were met. Again, these comparisons do not include research or exploratory fishing samples. It should be noted that some countries substantially exceeded the minimum sampling requirements in some sub-cells and also sampled some sub-cells in which the catch was not sufficiently large to generate a sampling requirement. Thus, reallocation of sampling effort would, to some extent, reduce deficiencies in coverage.

Thus, major deficiencies unquestionably exist in the ICNAF commercial catch sampling programme, an improvement of 100 - 200% being required over 1973 levels to meet minimum requirements agreed to by the Commission.

THE NEED FOR ADEQUATE COMMERCIAL CATCH SAMPLING

The confidence STACRES has placed in its advice on species stock catch quota levels has varied widely, (usually) in proportion to the quantity of scientific data available. Whenever possible, analytical models based on analysis of age structure of a stock over time have been employed. Typically, these models utilise data on catch, fishing effort, size and age composition of catches, and research vessel survey data, particularly on prerecruit abundance. Background biological knowledge on stock inter-relationships, growth and natural mortality rates are also required, but parameters of growth and natural mortality are themselves most commonly estimated from the commercial

fisheries data cited above. With rapidly changing fishing patterns, in part as a result of regulations themselves, fishing effort data have become increasingly difficult to interpret. Thus, increasing reliance has been placed in methodology which does not utilise effort data i.e. in virtual population and cohort analysis, which depend largely on estimates of the age composition of removals determined by commercial catch sampling. Thus, sampling data is essential to the construction of analytical models of fish populations. Inadequate catch sampling has, above all other factors, proved the major stumbling block to stock assessment.

The May, 1974 report of STACRES coded assessments into categories (Redbook 1974, pp. 66-67). Of fifty-six stocks coded, only twenty-five (45%) were described as analytical assessments. Although not all of the difficulties in assessing the remaining thirty-one stocks are attributable to inadequate sampling, almost all of the analytical assessments are based on insufficient sampling data. Perhaps the Div. 3 NO cod stock provides the most serious example. Only 313 length measurements of otter trawl catches were collected from 202,400 metric tons removed from the stock in 1971-72 by this gear.

The Commission has begun to address itself to the problems of fishery interactions, particularly in relation to bycatch problems and mixed fisheries in Subarea 5 and Statistical Area 6. STACRES has been severely limited in giving advice through deficiencies in available information. In part, these difficulties result from inadequate breakdown of catch and effort data, but insufficient biological sampling prevents a full appreciation of the magnitude of the problems faced by the Commission. Serious bycatch problems undoubtedly exist in Subareas 3 and 4 fisheries also. They are difficult to identify, and virtually impossible to quantify, due to lack of information.

STACRES has been criticised on occasion for the simplistic approach it has taken to assessment problems. Little account has been taken (with exceptions) of density dependent factors, particularly stock-recruitment relationships, in species assessments, of species interactions, of the effects of fishing on ecosystem dynamics, in deriving the advice given the Commission. STACRES must consider these matters. However, these more complex population and ecosystem models require higher levels of data input. A subset of these data are those required for the simpler population models now employed.

IMPLICATIONS OF FAILURE TO PROVIDE ADEQUATE SAMPLING DATA

Over 4,000,000 metric tons of fish are removed from the northwestern Atlantic each year, requiring large investments by member countries in fishing fleets and processing facilities, and employing large numbers of people. Management costs have so far been very small for most countries. It is time to realise that establishment and maintenance of the complex management scheme adopted by the Commission implies a substantial increase in management costs including research costs. If wisely allocated, revenues directed to management expenditures will be more than repaid through increased stability of yields, increased economic efficiency, and protection of investments and employment.

These benefits are far from guaranteed under present circumstances. Most of the major fish stocks in the ICNAF Area have a recent history of heavy over-exploitation. The continuing productivity of many stocks depends critically on present management actions, particularly those for herring.

mackerel, haddock, and yellowtail. The Commission cannot afford to accept the wide confidence intervals scientific advisers must place on their advice. Despite the many very difficult management problems to which the Commission, through long negotiations, has obtained agreed solutions, we face the real prospect of some spectacular management failures by ignoring to build on the sound foundation of a comprehensive, high-quality data base.

SOLUTIONS

While every effort should be made to develop technology to automate commercial catch sampling, for the present, this function remains labour-intensive, logistically difficult, and monetarily expensive. These are difficulties faced by all countries including coastal states. The logistic problems faced by distant water fleets in transporting samplers among fleet components are indeed great - so also are the difficulties of Canada in attempting to distribute sampling activities over the very numerous ports of landing distributed throughout the Atlantic Provinces, some of which are accessible only by sea.

A partial solution adopted by some countries has been the use of research and scouting vessels, fishing commercially rigged gear and usually fishing with the commercial fleet, to obtain samples considered representative of commercial fleet catches. We have difficulties, however, in accepting this as a valid alternative to sampling commercial catches. Only a very few vessels are involved and these usually have different characteristics than those involved in commercial fishing. No comparative studies have been conducted to establish the errors and biases associated with the method. The seasonality of sampling coverage often differs greatly from that of the commercial fleet - there are "commercial" samples in Secretariat files for months and areas in which no commercial catches are reported!

Catch sampling could be incorporated into the international inspection scheme but there are a number of undesirable implications to such a proposal. Virtually all international inspection is currently conducted by the coastal states. Thus, it is they who would carry the additional burden of providing manpower and financial resources. The frequency of international inspections is not presently sufficiently high to provide adequate sampling levels by this means alone. International inspection vessels concentrate their activities in relation to different priorities than those dictated by scientific requirements. It is undesirable to confuse scientific data collection and enforcement roles in the minds of those engaged in the fishing industry.

As a further alternative, the coastal state or the ICNAF Secretariat could administer an international sampling scheme financed jointly by all member countries. The technical difficulties of setting up and running such a scheme are very great and the cost would undoubtedly be very high.

The most viable solution is for all member countries to provide adequate resources to maintain national sampling schemes for their northwestern Atlantic operations. Co-operative ventures among countries could result in decreased costs. To this end, Canada is prepared to make her international inspection vessels available whenever possible in relation to their primary duties to transport samplers between vessels of other national fleets to help provide the mobility they require.

Table 1. Historical summary of commercial sampling performance for all finfish and squid in the ICNAF Area. The number of measurements required from each country from each ICNAF Subarea (and from the ICNAF Statistical Area) is based on the requirement to measure 200 fish per 1,000 metric tons of fish reported (irrespective of Division, gear, or quarter of year when caught). The extent to which this requirement is met is shown as the percentage reported measurements were of required measurements. Reported measurements from commercial catches or landings (% Comm) are shown separately from those from research or exploratory catches (% Res). (Statistical Area 6 catches are not included in 1964 summary.)

Country	Subarea	1964			1968			1973		
		Measurements required	% Comm	% Res	Measurements required	% Comm	% Res	Measurements required	% Comm	% Res
Bulgaria	5	-	-	-	-	-	-	6,000	84	-
	6	-	-	-	-	-	-	1,600	89	-
	Total	-	-	-	-	-	-	7,600	85	-
Canada	2	3,200	271	-	3,800	179	-	1,200	470	-
	3	48,000	159	-	77,000	106	-	44,600	168	-
	4	85,800	76	-	142,400	66	-	112,600	170	-
	5	5,200	102	-	12,000	40	-	3,400	105	-
	6	-	-	-	200	0	-	-	-	-
	Total	142,200	110	-	235,400	79	-	161,800	170	-
Den(F)	1	13,200	0	-	9,200	0	(132)	1,000	0	-
	2	-	-	-	-	-	-	200	0	-
	3	4,400	0	-	3,600	0	(0)	2,200	0	-
	4	200	0	-	-	-	-	1,400	0	-
	Total	17,800	0	-	12,800	0	(95)	4,800	0	-
Den(G)	1	6,600	5	(316)	5,400	104	(337)	6,600	152	(518)
	3	-	-	-	-	-	-	400	282	(0)
	Total	6,600	5	(316)	5,400	104	(337)	7,000	159	(488)
Fra(M)	1	7,000	0	-	9,400	0	-	-	-	-
	2	7,400	0	-	7,800	0	-	200	0	-
	3	12,200	0	-	12,200	0	-	1,200	0	-
	4	3,800	0	-	4,600	0	-	5,200	0	-
	5	-	-	-	-	-	-	800	0	-
	Total	30,400	0	-	34,000	0	-	7,400	0	-
Fra(SP)	3	1,400	0	-	800	3,035	-	600	0	(3,116)
	4	400	0	-	600	2,511	-	400	0	(16,507)
	Total	1,800	0	-	1,400	2,810	-	1,000	0	(8,473)
FRG	1	26,000	26	(29)	29,000	15	(8)	1,800	669	(121)
	2	1,800	0	(0)	11,000	0	(0)	2,000	0	(165)
	3	1,000	0	(0)	-	-	-	7,200	86	(16)
	4	800	0	(0)	2,000	12	(0)	400	0	(156)
	5	-	-	-	14,200	6	(0)	7,200	833	(133)
	6	-	-	-	-	-	-	600	0	(246)
	Total	29,600	23	(25)	56,200	10	(4)	19,200	408	(95)
GDR (1964 & 1968 may include some other non- member catches)	1	3,600	0	-	5,800	0	-	600	1,292	(0)
	2	4,000	0	-	12,800	0	-	800	254	(390)
	3	8,600	0	-	1,800	0	-	5,600	107	(0)
	4	-	-	-	1,600	0	-	-	-	-
	5	-	-	-	14,200	0	-	25,400	70	(0)
	6	-	-	-	200	0	-	4,800	65	(0)
	Total	16,200	0	-	36,400	0	-	37,200	98	(8)
Iceland	1	1,000	0	(0)	-	-	-	-	-	-
	2	200	0	(637)	-	-	-	-	-	-
	3	600	0	(360)	-	-	-	-	-	-
	Total	1,800	0	(191)	-	-	-	-	-	-

(continued)

Table 1 (continued)

		1964			1968			1973		
Country	Subarea	Measurements required	% Comm	% Res	Measurements required	% Comm	% Res	Measurements required	% Comm	% Res
Italy	6	-	-	-	-	-	-	800	0	-
	Total	-	-	-	-	-	-	800	0	-
Japan	3	-	-	-	200	0	-	600	0	-
	4	-	-	-	200	0	-	1,000	0	-
	5	-	-	-	200	0	-	1,200	150	-
	6	-	-	-	800	0	-	1,800	228	-
	Total	-	-	-	1,400	0	-	4,600	129	-
Norway	1	7,000	0	(27)	8,000	0	-	3,200	0	-
	2	-	-	-	1,600	0	-	400	0	-
	3	1,400	0	(0)	2,400	0	-	9,800	75	-
	4	-	-	-	-	-	-	200	0	-
	NK	1,600	0	(0)	-	-	-	-	-	-
	Total	10,000	0	(19)	12,000	0	-	13,600	54	-
Poland	1	-	-	-	200	0	(0)	-	-	-
	2	1,400	0	(286)	14,800	22	(0)	2,800	0	(179)
	3	6,000	0	(173)	6,200	302	(15)	9,800	225	(34)
	4	-	-	-	200	2,594	(855)	400	0	(277)
	5	-	-	-	16,000	142	(0)	34,000	28	(22)
	6	-	-	-	2,400	0	(0)	4,000	23	(425)
	Total	7,400	0	(193)	39,800	126	(7)	51,000	64	(66)
Portugal	1	10,600	0	-	6,600	13	-	1,600	225	-
	2	8,200	97	-	12,000	9	-	3,000	0	-
	3	20,600	48	-	23,800	19	-	18,800	38	-
	4	2,600	0	-	1,400	0	-	3,400	0	-
	Total	42,000	42	-	43,800	15	-	26,800	40	-
Romania	3	-	-	-	-	-	-	600	0	-
	5	-	-	-	600	0	-	200	0	-
	6	-	-	-	-	-	-	1,200	0	-
	Total	-	-	-	600	0	-	2,000	0	-
Spain	1	200	0	-	4,400	0	-	2,000	885	-
	2	9,000	103	-	6,600	68	-	200	0	-
	3	24,000	75	-	41,200	53	-	21,400	57	-
	4	12,800	15	-	12,600	21	-	8,000	60	-
	5	-	-	-	3,600	0	-	3,400	44	-
	6	-	-	-	-	-	-	1,000	0	-
	Total	46,000	63	-	68,400	42	-	36,000	101	-
USSR	1	-	-	-	400	0	(0)	1,200	0	(658)
	2	13,400	0	(888)	23,800	0	(211)	21,200	0	(25)
	3	19,000	0	(491)	54,400	0	(89)	73,600	0	(87)
	4	22,600	91	(0)	13,200	74	(0)	84,600	342	(0)
	5	66,000	146	(0)	55,800	98	(0)	78,000	346	(0)
	6	-	-	-	10,400	0	(0)	12,200	284	(0)
	Total	121,000	97	(212)	158,000	41	(62)	270,800	219	(29)
UK	1	5,600	+	-	2,000	255	-	200	272	(2,723)
	2	400	0	-	2,400	172	-	200	0	(0)
	3	4,000	0	-	5,000	173	-	1,400	148	(0)
	4	200	0	-	-	-	-	-	-	-
	5	200	0	-	-	-	-	-	-	-
	Total	10,400	+	-	9,400	190	-	1,800	146	(303)
USA (excludes Menhaden catches)	3	1,000	100	(0)	-	-	-	-	-	-
	4	8,000	291	(0)	5,200	534	-	2,800	453	-
	5	54,200	149	(5)	45,200	164	-	29,000	229	-
	6	-	-	-	12,400	0	-	12,200	15	-
	Total	63,200	166	(4)	62,800	162	-	44,000	184	-
Country x Subarea Combinations versus those sampled adequately		48	8	(17%)	59	13	(22%)	68	23	(34%)

Table 2. Sampling performance for cod and herring in 1973 by country. No. of sub-cells = number of Division, gear, quarter, sub-cells in which a country catch was sufficiently large to require samples to be collected. No. adequately sampled = number of these sub-cells in which the minimum sampling requirement was met, (i.e. one sample per 1,000 metric tons of fish caught).

Country	COD		HERRING	
	No. of Sub-cells	No. adequately sampled	No. of Sub-cells	No. adequately sampled
Bulgaria	-	-	1	0
Canada	85	27	40	29
Denmark (F)	8	0	-	-
Denmark (G)	13	6	-	-
France (M)	6	0	2	0
France (SP)	1	0	-	-
FRG	11	3	4	2
GDR	4	2	5	1✓
Japan	-	-	3	0
Norway	10	0	-	-
Poland	4	1	7	0
Portugal	34	4	-	-
Romania	1	0	-	-
Spain	39	9	-	-
USSR	14	2	16	9
UK	2	2	-	-
USA	10	4	5✓	4✓
Totals	242	60 (25%)	83	45 (54%)

✓ Possibly 3 if samples contained less than 200 fish.

✓ Does not include gear breakdown.

