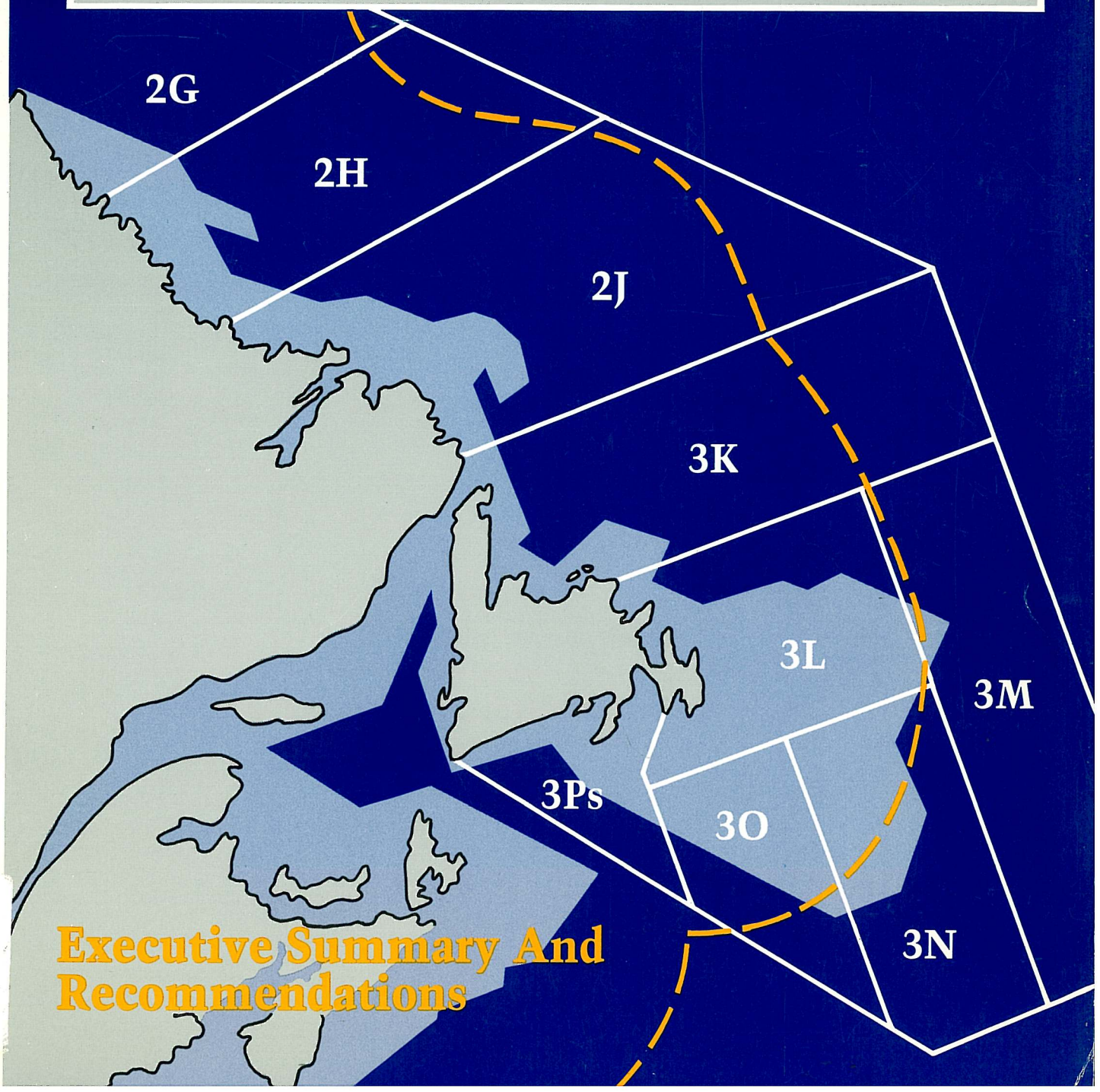
Independent Review Of The State Of The Northern Cod Stock

Prepared For
The Honourable Thomas E. Siddon

Submitted By
Dr. L. Harris



Executive Summary And Recommendations

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

Prepared for
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Minister of Fisheries and Oceans

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Northern Cod Review Panel

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EXECUTIVE SUMMARY

Northern cod, that is the cod stock(s) inhabiting NAFO statistical divisions 2J, 3K, and 3L and spilling over into divisions 2GH and 3NO, has been exploited by fishermen since c. 1481. Though patterns of exploitation have varied, these stocks were, through four centuries at least, the economic foundation for the growth of a settled community along the east and northeast coast of Newfoundland and the coast of Labrador. Though supplemented by comparatively modest contributions from other marine species such as salmon, herring, seals, and whales, the cod stocks were the **raison d'etre** for the existence of Newfoundland as a colony, and subsequently as a Dominion, and contributed in a lesser way to the well-being of several Nova Scotian coastal communities.

Though there has been, throughout the past century, some economic diversification, it is true even today that the vast majority of the Newfoundland coastal communities that were built upon a foundation of cod are still utterly dependent upon that resource for their continued existence.

Although foreign fishing fleets and a smaller number of Newfoundland based vessels have, throughout the centuries concentrated their fishery upon the northern cod sub-groups that frequented for some part of each year the shallow offshore banks of what are now known as divisions 3LNO, the vast majority of Newfoundland fishermen were reliant upon the seasonal feeding migration that brought the codfish to shallow coastal waters where they were accessible to fixed gear deployed in traditional berths or on traditional near shore fishing grounds.

Though annual harvests fluctuated in accord with changing environmental conditions and to some extent with the vagaries of the international market, the northern cod stock(s) yielded, in the century prior to 1950, for example, an annual production varying about an average of some 250,000 tons. In general, the harvest level gradually moved upward as populations grew and fishing effort increased. Nevertheless, except for environmentally induced disruptions of migratory patterns that resulted in localized failures of the fishery, sometimes for a number of

consecutive years, the overall historical record indicates that the stock(s) could sustain the fishing pressures imposed upon them without exhibiting any obvious sign of decreasing abundance.

By the middle of the twentieth century, however, new fishing technologies were being introduced at an increasingly rapid rate. Chief among them was the comparatively heavily powered vessel equipped with otter trawls that was capable of fishing in deeper waters than were heretofore accessible and of exploiting the large concentrations of fish that at the end of their autumn migrations were assembled for spawning in the outer shelf regions of the several offshore banks. Subsequently, inshore fishermen, too, began to acquire larger diesel powered vessels (the long-liner fleet) with extended range and seakeeping capacities, equipped with electronic navigational and fish finding instruments and with hydraulic net haulers that permitted utilization of long "fleets" of gillnets. This new fleet extended the "inshore" effort into deeper waters, upwards of fifty miles from shore. Did the fish thus made accessible to inshore gear constitute the older elements of the population that terminated their feeding migration in those deeper "middle-distance" waters? Or on the other hand, did they constitute discrete inshore spawning populations? This, regrettably, is still a matter for speculation. In any case, they represent elements of the northern cod spawning biomass that were, for the first time, subjected to intense fishing pressure.

Then came the burgeoning of offshore technology, with West Germany in the vanguard and other European nations quickly following and the notorious assault upon the spawning aggregations on the northern banks during the late 1960s and 1970s. With catches reaching 800,000 tons in the peak year of 1968, the predictable result was a collapse of the stock with inshore landings falling to figures lower than any recorded in the previous centuries.

The Law of the Sea Convention, though still unratified in 1977, prompted Canada in that year to declare a two hundred mile management zone. This provided the opportunity to begin the process of rebuilding depleted stocks and of establishing fishing strategies that would ensure continuing long-term viability for both an inshore and offshore fishery. With the objective of building spawning stocks to a biomass capable of sustaining a harvest at historical levels, the Department of Fisheries and Oceans (DFO) adopted a management strategy designated as $F_{0.1}$ which would have permitted annual fish landings of approximately 20% of the exploitable biomass.

During the next seven years the euphoria that had been engendered by the declaration of the exclusive economic zone was reinforced by the steady growth of the stock, by continually improving catches, and by the belief that the $F_{0.1}$ objective was, indeed, being met. In those circumstances, scientists, lulled by false data signals and, to some extent, overconfident of the validity of their predictions, failed to recognize the statistical inadequacies in their bulk biomass model and failed to properly acknowledge and recognize the high risk involved with state-of-stock advice based on relatively short and unreliable data series. Furthermore, the Panel is concerned that weaknesses in scientific management and the peer review process permitted this to happen.

Such blunt criticism is, of course, itself the product of hindsight. In fairness, we must recognize the simple enormity of the task of taking a census of fish populations over so vast a territory. We must recognize as well that DFO scientists had to do the best they could with short data series since longer ones were simply not available to them. As well, they had to contend with misreporting of catches, bycatches, and discard rates and other significant inaccuracies in the

commercial catch data; with their own inability to modify certain research vessel data to account for changes in the time of the survey and for fluctuating environmental conditions; with unanticipated changes in recruitment levels; and with a substantial number of lesser variables whose consequences are easier to identify in retrospect than they were to forecast. Nevertheless, it is possible that if there had not been such a strong emotional and intellectual commitment to the notion that the $F_{0.1}$ strategy was working, the open and increasing scepticism of inshore fishermen might have been recognized as a warning flag demanding more careful attention to areas of recognized weakness in the assessment process.

In any event, by the late autumn of 1988, it was apparent that the more sophisticated analytical methodologies recently adopted and the acquisition of two additional years of data combined to indicate that the actual fishing mortality rates since 1977 had in fact been at least double those projected in the $F_{0.1}$ strategy. That the population did, in spite of this relatively intense fishing, continue, at least until 1984, to show substantial growth was, for the most part, attributable to good earlier recruitment. Now, however, it was apparent that the more recent trend in recruitment was definitely downward. Thus, it is apparent that, even though there is not an immediate threat to the survival of the northern cod stock, recent catch levels simply cannot be maintained without causing a significant and potentially very serious decline in the exploitable and spawning biomass.

On the positive side, the Panel is persuaded that the current modelling methodology employed by DFO scientists is superior to that previously used. Further, the Panel is reasonably confident that the range of fishing mortalities provided by that methodology are in the right domain. This position is supported by results obtained when the data are subjected to a number of independent analytical techniques.

Nevertheless, the data themselves are still to some considerable degree unreliable or, at least, subject to strong suspicion of unreliability; and, this stricture applies, though perhaps not with equal force, to both the Research Vessel (RV) data and the commercial catch per unit of effort (CPUE) data. The former, it is believed, might be improved through increased sampling effort, by appropriate correction for time of survey, and for environmental variability. The latter are, perhaps, distorted by underestimation of the significance of technological changes in catching effectiveness when fishing is conducted primarily upon spawning or other aggregations.

In light of this, the Panel would emphasize that a vital aspect of management strategy must be the improvement of the quality of data used in assessment and the establishment of additional independent indices of abundance including an inshore CPUE index, and the incorporation into the assessment process of such additional elements as acoustic survey data and environmental indices of availability and abundance. Further, DFO should expand its computing power to remove current restrictions on timely data processing and should include in the scientific assessment process a rigorous peer review by other scientists drawn from the university or industrial communities, for example, and who are not directly involved in departmental processes.

The Panel would also urge DFO not to place too much reliance upon mathematical models alone to solve the problems of the northern cod assessment. Good mathematical models are of course a central part of the assessment process, but they cannot compensate for inadequate or missing data. There is a need to both develop appropriate models and to collect the appropriate data with

sufficient precision and accuracy. In such modelling a danger to be avoided is the tendency to forget the distinctions between convenient mathematical abstractions, for example, constant catchability rates and the living fish whose behaviour may well be variable in response to varying environments.

Thus, the Panel believes that more biologically detailed modelling, based upon a broader and deeper understanding of the biology of the animals involved and of the physical environment in which they function, is essential to the proper management of the ecosystem of which northern cod is but one element. Indeed the Panel sees as necessary a long-term goal of a properly integrated systems approach to stock management.

In the meantime, it would appear to be imperative that a very considerable research effort should be mounted and that, in the management of that effort, DFO should ensure that all its best resources are brought to bear through planned collaborative approaches to a hierarchy of particular problems that are cooperatively identified as demanding early resolution. Beyond this, the Panel would urge DFO to mobilize the resources of the broader scientific community as well as those of the fishing industry to address the enormously important scientific challenges facing Canadians in respect of their oceans and the life systems within them. The Panel, of course, is not unaware that DFO has already, in response to our Interim Report, committed considerable additional resources to its research efforts and that in taking such action has given consideration to the appropriate reallocation of existing resources.

In short, both the management of the scientific effort and the management of the fish stocks must be set in the context of clearly enunciated sets of biological, economic and social goals and objectives. Our intrusion into the natural domain can be justified only in terms of human reliance upon the resources that the oceans afford. At the same time, all such intrusions must be sensitive to necessities of the environment and to our obligations to protect and conserve. Because the technology we control gives us the power to be utterly destructive, we must be all the more aware of the heavy moral responsibilities we bear. Among those responsibilities is that of seeking and acquiring the knowledge that is within our grasp and that will alone enable us to manage as we ought. We can only pray for the wisdom to use our knowledge wisely.

In the opinion of the Panel, the beginning of wisdom is acceptance of the proposition that the fishery based upon the northern cod stock(s) will not be saved unless the spawning biomass is permitted to grow. This implies the urgent necessity to reduce the rate of fishing mortality from its current value of 0.45 or higher to a value below 0.30. Even if such a reduction were to be achieved, the pace of recovery would probably be still very slow and, perhaps, of such a marginal nature that natural environmental fluctuations might at any time tip the balance in the other direction. Thus, the Panel believes that the rate should, as soon as it is feasible, be reduced to 0.20 and that this should be the goal of DFO management strategy for the foreseeable future.

In the meantime, every reasonable effort must be directed to whatever tactics are available to encourage the survival of cod to increase the spawning population. This implies the rigid enforcement of regulations respecting gear types, fishing areas, allocations, bycatches, discards, etc. and the implementation of policies specifically aimed at a very considerable reduction in mortality of two, three, four, and five year old cod. It implies as well a very determined effort to

restrict or eliminate the actual catch of cod by foreign vessels operating under Canadian licence within the two hundred mile zone and a determined Government of Canada initiative either to bring the entire Canadian shelf under Canadian management or to reach an effective international agreement that will curb the irresponsible and destructive activities of certain countries fishing the "Nose" and "Tail" of the Bank.

In respect of both foreign and domestic fisheries, the Panel would urge consideration of the dangers of compartmentalization. Indeed, if the case for an integrated approach to science is well made, so will be the case for a similar approach to management. That is to say, we cannot contemplate a crab fishery, a capelin fishery, or a shrimp fishery, for example, that does not impact upon cod population and biomass, either directly or through bycatch possibilities, or indirectly through weight-at-age or density dependent, or other analogous relationships. In this context, foreign licences to take allegedly underutilized species should be carefully examined. By the same token, it is incumbent upon DFO to undertake a serious study of predator-prey relationships within the northwest Atlantic ecosystem with a view both to expanding essential knowledge and of refining management objectives. At the very least, we should know, for example, how many harp seals there currently are and, in terms of their bioenergetics, what their current tax upon the system may be. In a similar vein, the status of the capelin and shrimp stocks may be of enormous importance to the long-term health of the cod populations and, through weight-at-age relationships, for example, may not be entirely without significance to the process of cod biomass assessment.

In conclusion, the Panel having concluded that the population, the biomass, the spawning population, and the spawning biomass of northern cod are all currently in decline and that the fishing mortality rate is currently at the level of 0.45 or higher would stress the following recommendations:

- that in respect of the northern cod stock(s) and as a matter of urgency there should be an immediate reduction of fishing mortality to the level of at least 0.30 and, at the earliest feasible date, to the level of 0.20;

- that DFO must establish regulations to limit fishing mortalities imposed during the spawning period proportionally with the general reduction in total fishing mortality and should explore with the affected sectors of the fishing industry whether this objective can be best achieved through a straight reduction in the winter catch (i.e. during the spawning period) or through a combination of seasonal closure coupled with a catch reduction proportional to the reduction of the TAC during the remainder of the spawning period;

- that DFO should for both biological and economic reasons examine immediately the selectivity of traps, small and large trawlers, gillnetters, and other gear types with the intent of improving the yield in cod fisheries; the goal should be to eliminate the harvest of two, three, four, and five year olds and to reduce the bycatch of these year classes;

- that DFO review its management structures and approaches with the end of establishing a more focused and coordinated approach to the management of the northern cod stocks;

- that while we must work assiduously to refine our mathematical modelling techniques, it is also urgently important to acquire, through research, a more profound biological and general environmental knowledge of the system we seek to manage;

- that, in particular, we must address the problems of stock discrimination and of migratory and distributional patterns and adjust our fishing effort to bear with proportionate weight upon the several stock components;

- that we must convince the domestic and foreign fishermen that conservation is a matter of the utmost importance and that violations of appropriate regulations will not be tolerated;

- that the Government of Canada must be convinced of the imperative necessity of regulating, through agreement or otherwise, foreign fishing pressure upon northern cod;

- that predator-prey relationships be accepted as a matter of considerable importance and that, in particular, a seal census be initiated as a matter of urgency;

- that the management of DFO science be reorganized to recognize the necessity for the clarification of goals and priorities and for the appropriate integration of services and facilities and expertise to serve established priorities;

- that the DFO assessment process be submitted to peer review by independent scientists and that DFO should seek to involve the broader scientific community in its overall research programme;

- that the Government of Canada and the relevant provincial governments be encouraged while recognizing the importance of conservation to identify in unequivocal terms the socio-economic and cultural objectives of the Atlantic coast fisheries and so to coordinate their respective areas of jurisdiction to improve the collection of objective biological and economic data and to obviate conflict in terms of stock management;

- that the principles of adjacency and of essential needs be adopted as a fundamental premise underlying quota allocations.

RECOMMENDATIONS

Management Actions

1. That the Panel strongly recommends that in respect of the northern cod stock(s) and as a matter of urgency there should be an immediate reduction of fishing mortality to the level of at least 0.30 and, at the earliest feasible date, to the level of 0.20.

2. That DFO must establish regulations to limit fishing mortalities imposed during the spawning period proportionally with the general reduction in total fishing mortality and should explore with the affected sectors of the fishing industry whether this objective can be best achieved through a straight reduction in the winter catch (i.e. during the spawning period) or through a combination of seasonal closure coupled with a catch reduction proportional to the reduction of the TAC during the remainder of the spawning period.

3. That DFO should for both biological and economic reasons examine immediately the selectivity of traps, small and large trawlers, gillnetters and other gear types with the intent of improving the yield in cod fisheries; the goal should be to eliminate harvest of two, three, four and five year olds and to reduce the bycatch of these year classes.

4. That DFO should reexamine current regulations requiring equal levels of effort in each of statistical divisions 2J, 3K and 3L with the objective of distributing fishing effort by large trawlers throughout the statistical divisions in the manner that is to the greatest degree possible relative to the distribution of the exploitable biomass.

International Issues

5. That Canada should seek international agreement to permit its management of all fish stocks indigenous to the Canadian Continental Shelf, and that extend beyond the two hundred mile

economic zone; and, that failing achievement of this objective, Canada should take unilateral action to acquire management rights in accordance with provisions of the Law of the Sea Convention.

6. That the Government of Canada should reexamine its policies regarding the authorization of foreign fisheries within the Canadian economic management zone with the clear intention of eliminating any catch or bycatch of cod.

7. That Canada officially adopt a policy analogous to the Hague Preferences that would take into account in respect of stock allocations both the principle of contiguity and the "vital needs" of particular communities particularly dependent upon fishing and industries allied thereto.

Scientific Research

8. That DFO should develop means to estimate stock or relative stock trends beyond current RV and large trawler CPUE data and should place particular emphasis on establishing a CPUE index for elements of the inshore fishery, e.g. small trawlers, gillnetters, etc.

9. That DFO should expand scientific efforts to understand the integrity and interrelationship of spawning aggregations as they relate to recruitment and the distribution of spawning fish to feeding grounds and their availability to inshore fisheries. The goal should be to attain a clearer understanding of the effectiveness of current area management strategies as they relate to rebuilding the spawning stocks and potential gear/area or other allocational goals.

10. That DFO should examine in detail current and past stock recruitment relationships.

11. That DFO should undertake an in-depth analysis of cod bycatch losses in inshore and offshore target fisheries, as well as in other fisheries taking cod as a bycatch, including fish caught and not sold because of quality and/or operational problems; and estimate bycatch losses for each component of the Canadian and foreign directed cod fisheries, shrimp, capelin, and herring fisheries, and ground fisheries not targeting on cod.

12. That DFO should increase the RV sampling level in order to improve the level of precision of the estimate of minimum stock size and should, also, give consideration to RV surveys during other times of the year.

13. That DFO arrange, as a matter of urgency, for a harp and hooded seal census commencing with an aerial survey of pup production in the spring of 1990.

14. That DFO scientists should pay greater attention to the integration of information from the biological and oceanographic disciplines into the assessment process so that all available data may be employed to reduce the risk of future errors in estimating key population parameters.

15. That research be undertaken or commissioned to establish seal feeding patterns and consumption rates throughout the year.

16. That every reasonable effort be made to understand the cod-capelin-seal interactions and to incorporate appropriate data into cod population assessments.

17. That DFO should expand data collections to improve the knowledge of effort levels and factors influencing quality of data on inshore fisheries and landing records.

Technology

18. That DFO institute a dedicated systematic effort to improve and expand relevant technologies in the annual assessment process and in management activities; and that the Government of Canada investigate the use of satellite or other advanced technologies for purposes of surveillance; and that arrangements be imposed or negotiated as appropriate for fitting all vessels involved in the Canadian shelf fisheries with transducers for ease of monitoring their movements and location.

Goals

19. That the Government of Canada should carefully reexamine its biological, ecological, and socio-economic goals in respect of the fisheries to ensure that they are clearly defined, internally consistent, and attainable.

Institutional Arrangements and Procedures

20. That DFO review its management structures and approaches with the end of establishing a more focused and coordinated approach to the management of the northern cod stocks.

21. That DFO should expand the observer programme to include observation on the inshore sector of the fleet and to expand support services for analyzing observer data.

22. That the Government of Canada undertake the provision of additional patrol vessels for offshore surveillance to provide adequate on-site action in respect of violations reported by aircraft or by observers and that helicopters be employed in conjunction with smaller patrol boats for inshore surveillance.

23. That the Government of Canada and the Government of Newfoundland and Labrador should jointly establish a Board or Commission in the context of which information can be shared, management objectives clarified and coordinated, policy directions set, and strategies developed.

24. That the Government of Canada should urge the appropriate authorities to treat violations of fisheries regulations aimed at conservation as serious offenses and to ensure that penalties imposed upon convicted violaters be sufficiently onerous as to fully offset any potential gain from violations.

25. That DFO should develop an educational programme and improve lines of communication through which appropriate information concerning the scientific process and management decisions may be communicated more effectively to client groups.

26. That DFO should establish a process for the regular reappraisal of various research activities and their potential contribution to the overall scientific understanding of the population dynamics, behaviour, life history, and ecological relationships of the northern cod stocks.

27. That DFO should ensure that when enterprise allocations are made, adequate surveillance must be maintained to guarantee accurate reporting of catches.

28. That DFO should review the process and methods by which scientific advice is developed within the Research Centre to ensure that the spectrum of scientific disciplines and skills available and applicable to state-of-stock analysis and interpretations are being utilized.

29. That DFO should resolve the ambiguities involved in the current designations of inshore and offshore and provide for the proper evaluation of the impact of various management strategies upon different harvesting areas and sectors of the industry by

(a) categorizing fishermen in terms of gear types employed;

(b) identifying catches taken by various elements of the fishing fleets by coding in terms of areas or sub-areas of capture.