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Meetings to review assessments of groundfish stocks in the Newfoundland Region

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1 Introduction

There were meetings in May and August 1996 to review information relevant to the assessment of groundfish stocks in the Newfoundland region. The May meeting dealt almost exclusively with 2J3KL (northern) cod; the August meeting dealt mostly with 3Ps cod but also considered skates, monkfish, white hake, lumpfish and winter (blackback) flounder. The primary outcome of the meetings is the collection of stock status reports (what people believe), supported by research documents (reasons for belief). Proceedings of the meetings can record discussions that did not get into the above-mentioned documents but are still worth preserving: open questions, reservations about what we are entitled to believe, unresolved disagreements, suggestions for what research would produce useful answers. The order of presentation can reflect the structure of the questions that need to be addressed rather than the chronology of the meetings.

1.1 Purpose

The purpose of stock assessment, and assessment meetings, is to discover and convey information that will help a wise fisheries manager to make decisions. In formulating questions, we are driven by what we think we can usefully answer and what managers and participants in the industry ask of us. Decisions will be made whether scientists are comfortable with them or not. If we say "there is no *scientific* advice" then the minister will turn to some other form of advice, probably less soundly based and more confidently expressed. At least we can convey what we can comfortably rule out. Conveying information entails being aware of who will be using it and what it would take to make it convincing to such people.

There is a generic set of questions that any renewable resource manager wants answers to: What is the resource? How large is it? How fast is it renewing itself (this is the key question, although not the one receiving the greatest attention)? How might these things change? How might human action affect them? (The next question, what we should do about it, involves also information about the people who benefit from the resource; it is answered at another level of the Department.) There is also a specific set of questions for each stock, in terms of current perceptions and problems. Fisheries management is interested in the effect of different size regulations: for example, if there are regulations of the type: "close an area if too high a proportion of small fish is caught", what is the effect (for example on the goal of allowing fish the chance to mature) of different criteria for "small"? The decision ought to be made early enough to be useful to people gearing up for a return to fishing.

The overall management objective is a profitable, sustainable, predictable fishery with minimal fluctuations. This is unlikely to be achieved unless a wide range of ages contributes to the stock. A weight of large fish may be worth more dollars than the same weight of small fish, and computations such as yield-per-recruit might usefully take that into account.

1.2 Process

A growing theme is the need to combine formal scientific information with informal knowledge possessed by fishers. 'Formal' in this context simply means that there exist forms: for testing and possibly rejecting the information; for combining it with other information; for checking the combinations for consistency. There is no suggestion that formal information is better in itself—but information does not exist solely in itself, and the challenge is to find forms for information that is presently informal and often qualitative, so that it can enter the quantitative assessment picture. The role of informal

information is increasing: through participation of individual fishers in assessment meetings, through the university's Traditional Ecological Knowledge research programme, and through the Sentinel programme that was created with the intention of providing information from fishers in a formal way. In future there may be more emphasis on using commercial vessels to collect scientific information.

Assessments have to carry conviction within and beyond scientific circles. As well as providing more information and information of usefully different sorts, another advantage of informal information is that assessments will be persuasive to a wider range of interested people if they use information that those people recognize and value. Thus there is a need to convey to fishers what is inferred from the tags they report, or from the sentinel data they provide. This does not mean that the scientific opinion must be consistent with what fishing communities are reporting. It would be nice if the differences turned out to be small; but it is more important to understand what the differences are, and what the uncertainties inherent in each point of view are. Large differences indicate areas where both points of view, both sets of underlying assumptions, need to be most carefully re-examined: they suggest future areas for research.

Establishing that one point of view is true requires a lot more than establishing that an opposite extreme is false, and science must guard against letting unrefuted speculations drift into becoming accepted as facts. How do we deal with statements we can neither prove nor disprove? "Discount a statement you cannot show to be true." and "Accept a null hypothesis you cannot show to be false." are each appropriate courses of action in some circumstances. Neither is acceptable as a universal rule. What meta-rule determines which of these rules to apply in which circumstances?

2 Northern (2J3KL) cod

2.1 What is the resource?

There was discussion of the inshore–offshore movement of cod, how much of the stock participates in it, and whether the fraction that does has decreased recently. Although various stories can be told consistent with subsets of the available information, it is not clear what work would have to be done to formally test ideas about inshore and offshore components and how they may have changed.

Participants in the industry typically take a more fine-grained view of areas, types of fish and fish behaviour than is common in assessments [1]. Should the assessment try to produce a fine-grained description? Can it? Fishers are a main client of assessments, and therefore an assessment of the stock as they perceive it would be logical, provided it also made biological sense. These questions were not resolved.

A large component that was discovered in Smith Sound is being studied on its own [2,3]. One can speculate that this is a population that used to aggregate offshore in the North Cape region in winter and has now ceased to do so. If the stock is getting more heterogeneous, then it is more expensive to assess. How many concentrations similar to Smith Sound are there, and how do we find out? Do we manage with less assessment, or hope that when the stock is large enough to fish it is also well-behaved enough to be assessed by cheaper methods?

Genetics can separate northern and southern components of 2J3KL cod [4]. This information is difficult to make consistent with the story that northern components decreased first when southern components were being fished most heavily. The populations clearly mix inshore although they can be distinguished offshore. It can be useful to try to classify fish that have been pre-classified by the criteria that make sense to fishers, to see if informal and genetic categories match. If they do, then

the fishers' criteria can be determined much more quickly and easily; while the scientific work can indicate where the fish so classified have been. One interesting feature of the genetic work was a haul of predominantly 'northern' fish in a 'southern' area—as if the fish might have been travelling in an identifiable group that did not mix much with other components of the stock.

Analysis of tagging data has confirmed a general pattern of clockwise movement: southerly offshore, northerly along the coast [5]. St Mary's Bay caught predominantly age 6 fish, which is the predominant 1989 year-class in 3Ps, suggesting mixing between the two management areas.

2.2 How large is it?

Commercial catch There are attempts to quantify inaccuracies in reporting deaths caused by fishing [8]. They aim to cover as many of the unreported deaths as possible; but opinions differ on how successful the attempt has been. It is not straightforward to use fishers (innovative, creative predators) as an abundance index. As a first step, try asking them about the timing of their innovations—and whether they were driven by new possibilities in technology or by changing status of their prey. Old catch statistics (1960s) may have been inflated to justify allocation shares. It would be useful to check with people who were involved at the time, while they might still remember.

Research surveys [9,10] New survey gear needs to be calibrated. Older gear that didn't catch small fish can never be 'corrected' to new gear equivalents [14]. Calibration of large fish is hampered by the scarcity of appropriate subjects. In addition, the 1995 survey was unusually late, ending almost 6 weeks later than any other fall survey [11]. There has been work on finding out exactly what the net is doing so that abundance indices can be adjusted [12,13]. Work at Woods Hole suggests that the change from 30-minute to 15-minute tows produces no difference in length distribution; so shorter tows are not worse at catching big fish that tire slowly.

Is the dominant part of the remaining stock no longer in the area covered by the survey? And is this a reversible result of small, young population or a shift that will persist even after recovery?

Sentinel programme [15] Information from the sentinel program in this, its first year, could not be incorporated into an assessment of the stock status. What is the potential for using Sentinel to monitor components in deeper-than-traditional water?

Acoustic work [3] Current acoustic work in the region is university research, not designed to be a survey to produce an abundance index. People worldwide are becoming more sceptical of acoustic surveys for giving quantitative estimates. But trawl surveys are not possible inshore. It would be good to intercompare sentinel and acoustic work.

Analysis A single survey is likely to mislead and therefore we use methods that average several surveys measuring the same cohort in different years at different ages. Either trying to take account of catches explicitly as one source of variation in numbers over time (sequential population analysis [6]) or not. How reliable are catch data: do they add information or noise? One line of reasoning suggests that catches have been severely underestimated at the youngest ages [7].

If there is a reopening, tagging studies offer independent estimates of total mortality [26].

2.3 How fast is it renewing itself?

Recruitment indices in 1995 were uniformly bad, even for year-classes that in previous years had looked strong [16,17]. The indices are diverse enough that it is reasonable to suspect real recruitment failure and not just survey failure. Nevertheless, compared to the original Fleming survey, there is more sign of year effects than of cohort effects. Future pre-recruit surveys may benefit from ongoing work on classifying and mapping areas of suitable habitat [18].

Northern cod grow slowly, which we expect because they inhabit cold water [19], and this must be taken into account when thinking about the likely rate of any recovery once one starts.

Growth and egg production trends continue [21-24]. There is a suggestion that small size-at-age is established early in life and then simply persists [25]. Perhaps slow growth is related to the volume of cold water [20].

A fully defensible estimate of seal consumption, when available, won't be much outside the range of 100-130 thousand tons of age 1-3.

2.4 How might these things change?

It is possible that the large-scale movements of the stock change when the oldest individuals are removed.

2.5 How might human action affect them?

When TAGS ends we can expect substantial deployment—licit or not—of the existing fishing capacity.

Tagging studies indicate how gear operates as currently deployed [26]. For example, whether it catches young fish in a higher proportion than they occur in the population (which would be an unwise thing to do). But regulation of gear in future will interact with the innovation and creativity of the predators.

3 3Ps cod

Movements of fish into, out of and within the subdivision are especially complicated for this management unit, and so understanding the origins, affinities and movements of subcomponents of the stock is especially important. This includes both general patterns and apparent recent deviations from them, such as the appearance of cod much closer to shore than is usual. There is interest in food chain considerations, such as the effect of reducing the capelin population by fishing; and also in the effect of extreme environmental conditions such as unusually cold water.

3.1 What is the resource?

Being slightly fussy about words can yield good returns in clarity of ideas. By "*the* 3Ps cod stock", we might mean the fish that are inside the division at any instant, so that a fish that left the division was no longer considered part of the stock. But usually we want to think of a fish as belonging to the same stock throughout its life, a stock having some affinity with the subdivision. Different affinities interest us, so that "the 3Ps cod stock" might mean the fish that

1) will be caught there (This is the quantity that is to be regulated: the 3Ps management unit rather than stock.)

2) are available to the research surveys there (These surveys provide the most careful and consistent design of abundance index.)

3) were born there, return there to spawn (This is the most obvious biological definition, and the one that genetic characters refer to.)

4) spend most of their time, do most of their growing there (This is relevant for environmental (temperature, parasite) and food chain considerations.)

Considerable evidence, both from the experience of fishers and from tagging studies [27], indicates that these 4 concepts refer to different collections of fish, and some of the difficulty of assessing "the" stock derives from this fact. (It would be ironic if the stock owed its comparatively healthy state to the same fact.)

It is more difficult to estimate the degree of mixing and how it varies with time: to move beyond "some fish from here go there" to "this fraction of fish from here go there". For example, it is important to correct tag return rates for amount of commercial activity.

If "the stock" means the spawning stock then tagging of spawning fish gives information most directly related to movements of a stock component. Tagging at any other time may sample a mixture (by this definition). Of course, a spawning concentration may similarly be a mixture of components that do their growing in very different places or contribute to fisheries in different management units.

Inshore tagging experiments give better return rates, perhaps because fish tagged offshore are hauled up from greater depths and suffer greater tagging mortality.

From the timing of onset one might infer a movement of fish: from the places where they are first caught towards the places where they are caught later. However, other patterns of movement are consistent with the same observations: for example, a 'wave' moving towards shore but hitting it at an angle so that one end hits first. What can one say from observations of directed swimming and the lateral speeds that would be required?

3.2 How large is it?

Ideally we seek an unbiassed, random, proportional abundance index of the stock, the whole stock and nothing but the stock. When we can't have it, which desirable feature do we give up first?

An abundance index has to be intrinsically good; it also has to be calibrated. Changes in the timing of the survey to reduce the problem of mixed stocks, although in the long term they might lead to a more interpretable index, in the immediate term lead to an index that means different things for finished and active cohorts, so that calibrations in SPA are unreliable.

Offshore research surveys [28,29] It has long been known that the offshore surveys are not a wonderful index in 3Ps. Many of the potential causes have long been appreciated, especially the seasonal movements into and out of the area—movements of more than one stock—and how their timing and magnitude can change between years. There is a long history of things tried that didn't succeed in producing a survey time series that is easier to understand. Is there a record of what has already been tried? Either to save people trying the same things again, or to inspire them with old ideas that might work in new combinations.

Gear conversion between Engel and Campelen nets was reported [30]. Comparative fishing in the early 80's used far fewer tows than the 1995-96 exercise.

Commercial catch per unit effort [28] Bycatches in gillnets are not aged. So when this is the major portion of the catch then the commercial catch is poorly sampled and we have poor data for assessing status. Aging comes from logbooks of vessels >35′ inshore for the period 1987-93. Aging of offshore catches began around 1960.

Catch-rate analysis was based on commercial sets in which cod was the main species sought and the main species caught. This could bias the results high by omitting rare sets in which cod was sought and not found.

Juveniles and adults are not caught together in the commercial inshore fishery. (So are protocols to avoid catching juveniles needed?) Patterns over time of inshore and offshore abundances are vastly different, but the age distributions of the two are similar.

Inshore catches do not show the catastrophic drop of offshore surveys, except perhaps near the boundary with 3L. If they had, this would have been a flag. However, the absence of a drop in CPUE cannot be taken as strong evidence against a decline in stock size: there are many examples of fish stocks that have declined without triggering a drop in commercial CPUE. Possible reasons why CPUE might be a bad index: variety of skills of inshore fishers and in poor conditions only the good ones stay at it; decision to fish based in part on qualifying for UI; improper recording of zero catches.

In future we should collect more information from more of the fishery. All parties have an interest in having the job done right, without misreporting. What is the scope for a voluntary observer programme on small vessels? This entails a commitment to get the data not only collected but also processed, analysed, thought about, brought into assessments, value of the data conveyed back to those who cooperated in making it available.

Past average gillnet catch rate of 40 lb/net corresponds to fishers' perceptions that 100 lb/net is a good day's work.

Sentinel programme [31-33] Abundance indices are taken from fixed control sites only, and these sites are to be kept fixed in future Sentinel work. Need to move beyond "We can't think of any obvious reason why it's not a good index" to demonstrate that it is good. Despite, for example, the problem in non-fishing years of lack of gear competition. Need a project to think about the source of competition: is it interference, or local depletion that is not reflected in overall depletion (i.e. the signal we seek, not an artefact) or what? Possibly the shoulders of the commercial season offer a period when gear competition is reduced or absent, and could be compared with sentinel catches at what would have been the same time.

Compared to commercial CPUE, Sentinel has better effort data, no change in location of control sites.

Acoustic trip [34] This trip to the north end of Placentia Bay was not designed as a survey; they wanted to be in the bay when fishers expected fish. There is no reason to suppose that fish were migrating (that there was a danger of chance of double counting) during the time of the surveys: the vertical distribution is not what one would expect of migrating fish, and Sentinel catches stayed high through January, well after the November survey. Fishers were right about the bottom depths (20-100 m) that fish would be found in. Used an automatic jigger that lets you take a sample from exactly where you see something particular on the echo sounder. Within the east and west blocks a sort of random survey design was used, but the blocks themselves were chosen where there was an expectation of a large catch.

Spatial information along transect as fine as you want it but nominally analysed in 50 m bins. Problems of best estimating what's in your beam: technical details of acoustics, target strength per fish and per kilogram, not getting confused by the bottom. Problems of best extrapolating what's not in your beam: statistical details of spatial structure, sampling design and inferences. Uncertainty; especially because much of the estimated biomass comes from a very small length of transect.

The results presented were extrapolated to the sides of the transects (typically 1 km on either side, half the distance to the next transect) but not beyond the ends of the transects. Extrapolation from the area surveyed acoustically to the whole subdivision was carried out as a purely formal exercise, with no attempt to quantify all the uncertainties involved and no faith in the number produced: "it's a bit desperate".

Where did the fish that aren't in Placentia Bay in April (according to bottom trawl survey and Sentinel) come from by November, and go to?

There were two Sentinel line trawl sites at the time of the acoustic survey. The ratio of catch rate to acoustic signal at the two sites differed by a factor of 6.

Informal indications of abundance Bycatch rate in blackback and lumpfish nets, lobster traps, sounder records. It is easy to think of reasons why these indices *might* mislead; but hard to make them quantitative.

The patterns of fishing gill nets or line trawls vary between communities. Some of it may be tradition whose cause is a historical accident of no current relevance. Some may be an intelligent reaction to current conditions. For example, fish that are glutted are silly and will blunder into gill nets; fish that are hungry will take the hooks on line trawls.

Over the past 10 years there have been shifts to later in the season and to catches in shallower water. Also coming inshore more since 1993. Are both true—more over 10 years and more still over 3 years?

The selectivity of long lines depends on bait size, not hook size.

Analyses [28] Projections require an 'analytical' assessment (code term for numbers and weights at age by year), which in turn require agreement on how to use catch and survey data.

Estimates of cohort strength SPA takes account of reported catches; other methods use survey information alone. Two analyses of relative cohort strength (an approach pioneered by Alan Sinclair) were performed. This method produces average indices of the cohort over several years without attempting to take account of the amount removed from the cohort by human activity and whether that may have changed between cohorts. The conventional, intrinsically uninformative name for the approach is multiplicative model.

$$\begin{aligned} \text{catch} &= \text{factor depending on gear} \times \text{factor depending on age} \\ &\times \text{factor depending on cohort} \times \text{factor depending on survey month} \\ &\times \text{lognormal error term.} \end{aligned}$$

Sometimes two factors are treated as one—i.e. a separate value for each pair rather than decomposed into a product. The extreme is a separate value for each combination of all the variables, in which case there is no redundancy and no chance to estimate anything (perfect fit—you don't see the error or the structure).

Method accounting for seasonality Assume the survey catch is the product of one factor depending on cohort and another factor depending on the combination of month of survey and age of fish caught (times another factor which is random lognormal error). Except for one year in which there were two surveys (only one of which was analysed) there is no overlap between month of survey and age of fish caught for a given cohort. A model with fewer parameters (or finer time resolution) rather than one value for each survey month (and some normalization because you can only estimate differences between months). This was done for surveys between 1983 and 1996. So the oldest (1977) cohort is seen in only one survey whereas the middle ones are seen in 5 (ages 2 to 6) and the youngest (1994) again only in one (and a Campellen one at that). There is no explicit recognition of a decrease in catch after 1993, so that for two cohorts of the same size at age 2, the post-1991 cohort should have a higher index than the mid-80s cohort. Depending, of course, on the amount of death due to fishing of fish aged 6 and less, whether reported or not. This makes sense if ages 2-6, because they are only partially recruited, are not affected by fishing. That is 'partially recruited' is equated with 'essentially not recruited'; this contradicts ideas about unreported discarding of small fish [7]. There was a recommendation to decouple the components of the combination of survey month and age and examine effects of each separately. There is a confounding of year and month because any year is represented by only one month.

Method accounting for inshore catch rate The age composition of the catch *rate* is assumed to be the same as that of the catch. Assume the inshore catch rate is the product of one factor depending on cohort and another factor depending on the combination of gear type and age of fish caught (ages 3 to 6) for commercial catches from 1987 to 1993 (thus cohorts from 1981 (observed once for each gear type) to 1990 (ditto)).

In 1992 trap catches were bad because capelin was bad and did not attract cod inshore. This produced hungry fish and a good line trawl catch. We have the responsibility to look at the observations that have potential to disprove, rather than those that have potential to confirm—in this case, look for other years when capelin did not come inshore: were any of them also poor line trawl years? Trap catches also small because the cohort at the dominant trap age (4?) was intrinsically small.

Sequential population analyses For the first time, the inshore–offshore nature was approached by making a number of extreme analyses. First assume there is no separation: an SPA as if total catches and offshore surveys referred to one and the same population. Then assume there is complete separation: an SPA as if offshore (=mobile gear) catches and offshore (Canadian and French) RV surveys referred to one and the same population; and an SPA as if inshore (=fixed gear) catches and fixed gear commercial CPUE referred to one and the same population. The assumption is that fish caught, say, offshore are not removed from the stock that might have been caught inshore later. The second two analyses should sum to the first. The truth lies in between, but it is much easier to look at the extremes first and learn what we can (both about fish stocks and about methods) from them. (The combined SPA was not done this year, although it was other years.) Many methods were invented almost on the spot, and their implications and performance need a more careful review by a wider forum. How do we use tagging to modify the extreme assumptions of full mixing or full separation?

For the inshore SPA, there were 3 CPUE indices. In each of the last 3 years (1991-93) one of them was out of line high compared to the other two. This has to cause the populations estimated at the end go up. It was suggested too late (both too late to perform the analysis and also too late logically:

an ad hoc fix of the symptoms of a problem, with no demonstrated intrinsic merit) that one could form a series of the median of the three suitably scaled indices.

The correlated error model of Myers and Cadigan is worth applying. If people believed that ADAPT was a sensible thing to do, and only the year effects in residuals gave them pause, then there is no objection to running the correlated error model and the chances are it will be more useful.

3.3 How fast is it renewing itself?

Growth [36,37] What temperature is relevant to growth? Where do fish do most of their growing? There are inshore temperature data as well as the offshore work reported here.

Condition [35,36] The trigonometric series that is used to adjust for seasonal patterns in temperature might be applicable to patterns in things like condition. This is important when the time of the survey has varied so much.

Liver condition is lower west of Burin than in Placentia Bay. For sentinel fish, is there an effect of gear type or spawning state? Sentinel provides the first commercial weight data (although there may be information from plants on the number of fish per 100 lb).

In 1988 or 1989 lots of fish from 3L trucked into St. Bride's for processing was much skinnier than 3Ps fish.

Maturity [38] Relevant to choosing length for small fish protocol. Maturities are derived only from offshore research surveys. We need inshore maturities as well. We might need to relate the length at 50% mature to the median date of the survey.

3.4 How might these things change?

One thing that managers would use, were it available, is a projection of $F_{0.1}$ catch through 1998. Even better, a number of such projections under different assumptions about partial recruitment to the fishing gear. Presumably catch in the management unit—what are relevant growth increments and are they what is measured? Even better, a number of such projections under different parameter values consistent with what we have observed (construed as broadly as possible): risk analysis. Push the random resampling of risky elements as early in the process (as close to the data) as possible.

3.5 How might human action affect them?

$F_{0.1}$ at the time of closure was 7,000 t.

Projections based on SPA showed stock decreasing at $F_{0.1}$. But $F_{0.1}$ is a concept predicated on a stable age structure and need not be recommended for a stock with only one strong year-class in it.

There is no reason to advocate an offshore fishery or relaxing bycatch regulations.

Any reopening inshore must be conducted in a way that yields more information about the stock. For example, precede it by tagging lots of fish. Require fishers to provide more effort and biological information. People will be more likely to comply willingly with requests for information if we show them how it will make a difference and convince them that it is worthwhile.

Regardless of any increased signs of abundance inshore, we know that the 1989 year-class *must* be getting less abundant as time goes on. Therefore its continued appearance as the main year-class

present has to be worrying. There will be no 1996 fishery; a 1997 fishery can be timed to give the 1989 year-class chance to spawn as 8-year-olds. By then they will have spawned in 3 years.

Want methods for looking for juvenile fish, signs of good recruitment. But remember how early encouraging signs in 2J3KL were not borne out in the most recent year's work.

4 Non-traditional species

There is currently no work on estimating the production of any of these stocks and thence the size of fishery they can sustain. Analyses are typically restricted to changes over time in abundance in research surveys. So-called 'growth' information is in fact only information about different lengths and weights at different ages. A separate issue is where the growth occurs, and if the so-called production occurs in the area or is a spillover of production in more southern, warmer, more productive water.

4.1 Skates

[39,40] It is possible that skates come onto the Grand Bank only in July and August, so that they would not be detected in either the spring or the autumn survey. It is not clear if the whole of 3LNOPs is occupied by just one stock or more. If we take the survey abundances and the reported catches at face value, then the total catch is less than twice the decrease in biomass, suggesting only minimal production. If much of the reported catch was actually other species (recorded as skate because there was no quota for that) then the catch will have been smaller, even closer to the decrease in biomass, implying even smaller production.

4.2 Lumpfish

In 'good' times this fish would attract less effort than it does at present. The moratorium transferred fishing pressure to lumpfish, probably more than the stock can sustain. This has in turn increased the interest in having the stock assessed. There are no scientific data to support any particular level of quota, and so other management tools (closed seasons and regions) are indicated.

The catch rate is reported as average in Placentia and Fortune Bays; it had decreased along the northeast coast. There are reports of abundant baby lumpfish in Burgeo: stuck to the haulup rope of lobster traps for example. They mature at about age 5, although not much work is done on their biology or aging. The otoliths are tiny; perhaps a specialist in young fish would be able to read them. Lumpfish are often observed near the surface (for example stuck to the acoustic towed body) so perhaps they are not really groundfish.

4.3 Wolffish, white hake, monkfish, blackback flounder

Assessments of these species, attempted for the first time this year, are presented in working paper [41].

Participants

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Attended only the May meetings unless marked with * (both meetings) or # (August meetings only). DFO Science unless otherwise specified.

Working papers

May meeting

[1] Northern Cod stock assessment: what can be learned from interviewing resource users? B. Neis, L. Felt, D.C. Scnheider, R. Haedrich, J. Fisher. Also DFO Atl. Fish. Res. Doc. 96/45.

[2] Biological characteristics of Atlantic cod from three inshore areas of western Trinity Bay. J. Brattey. Also DFO Atl. Fish. Res. Doc. 96/50.

[3] Cross-shelf distributions of cod in NAFO divisions 2J3KL in May and June 1995: some preliminary findings of a longer term study. G.A. Rose. Also NAFO SCR Doc. 96/57.

[4] Microsatellite polymorphism and the population structure of Atlantic cod in the northwest Atlantic. P. Bentzen, C.T. Taggart, D.E. Ruzzante, D. Cook. Also DFO Atl. Fish. Res. Doc. 96/44.

[5] Bank-scale migration patterns in northern cod. C.T. Taggart. Also NAFO SCR Doc. 96/42.

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