The state of knowledge of the lobster resource in Miramichi Bay and adjacent waters; some suggestions for conflict resolution over fishing seasons, and ideas for fisheries research in support of lobster management

J.F. Caddy PhD

Research Fellow, T.H. Huxley School of Environment,
Earth Sciences and Engineering, University of London, England.

Postal Address: Via Cervialto 3,
Aprilia 04011, Latina, Italy

O' Great Spirit
Whose voice
I hear in the winds
and Whose breath
gives life to all the world, Hear Me!
I am small and weak
I need Your strength and wisdom

-(Exerpts from an Indian Prayer)

CONTENTS

1) Executive summary

This section of the report is intended to stand alone, and includes ideas on conflict resolution that are specific to the 2001 situation and are not found in the main body of the report.

A/ The fall fishery and following spring fishery are both catching the same population of lobsters.

1) Aspects of lobster biology and dynamics derived from the literature are used together with relevant data to predict the effects of a fall season in Miramichi Bay. The analysis accepts current estimates of degree of exploitation in the spring fishery which results in 75-85%% captures and corresponding mortality rates annually, and asks what will happen if a fall season opens in the same district harvesting the same stock? The context is that by summer moulting into the legal size category, a high proportion of the catch enters the fall fishery, meaning that the fall season is an interception fishery prior to the spring fishery. The spring fishery depends on the same newly-recruiting lobsters passing through the fall fishery the previous year. In the presence of an intensive fall fishery, the survivors of the fall fishery entering the following spring fishery will be few and spring catch will be down. There is already evidence from non-native fishermen of a shortfall of their catches in the spring of this year. Experience elsewhere and some simple calculations suggest that under the circumstances of an uncontrolled fall fishery, the whole fishery will convert to a fall harvest, since spring season fishermen cannot compete. The evidence from the USA where lobster closed seasons are not used, confirms this, with most landings there coming in the summer-fall months.
2) The reason for the spring season is that lobsters caught in spring are in better condition and get a higher price. This is also a period of the year when no other fishing activities are really feasible, while the fall lobster fishery conflicts with summer-fall fisheries for crab, herring and trawl fisheries, with the possibility of gear conflicts and interruption of operations for a multi-targeted fishery. most important, the fall fishery is so efficient, it risks catch overshoot and stock decline.

B/ Catch rates and trap efficiency are higher in fall

3) Scientific evidence backed up by DFO trap observations in the fall season point to much higher lobster catch rates in the early fall fishery than in spring. This is a long established and studied phenomenon and various scientific studies explain the reason for this. Lobster crawl faster and are more attracted to the baited trap at warm temperatures. Also in early fall, they are more dense in Miramichi Bay than in spring, when they are scattered more widely further offshore in colder water. Summer-fall, lobsters are also feeding actively after moulting.
4) Estimates of the ratio of vulnerability to capture, or 'catchability' in the spring and fall suggest lobsters range from 2.5 to 9 times more catchable in fall than in spring, with the best supported estimate being around 5-6 times. This increase is due both to higher activity in warmer temperatures, the need to feed to replenish reserves lost in moulting and egg laying, and due to the higher density of animals on the inshore grounds in fall.
5) Taking this increased vulnerability to capture into account, means that a given number of traps catch the same number of lobsters in fall as a much larger number of traps fished in

spring. 5600 traps are proposed to be fished in the fall of 2001 in the Burnt Church lobster management plan. If fished throughout statistical areas 70, 71 and 73, this would be equivalent in fishing power to a sizeable fraction of the total number of traps (60,000) fished by all licensed fishers in spring. Given points 1 and 2, a significant shortfall would be expected in catches from the following spring season if the fall fishery operated throughout statistical areas 70, 71 and 73.

6) In fact the Burnt Church fishery did not operate throughout all areas of the Bay so the impact so far would be less than mentioned in 7). It is estimated that between a third and a quarter of the lobsters entering inshore waters are in the areas which DFO allowed Burnt Church fishers to fish. Establishing in the next fall season precisely what proportion of the stock enters the triangle where Burnt Church fished, is a priority for the next fall season, since this controls the impact of the fall fishery on that of the next spring. Assuming that either a third or a quarter of the stock in areas 70,71 and 73 enters the zone where Burnt Church fished, the likely order of magnitude of the reduction in catch in the following spring will be between 30-33% and 22-25% respectively (see later table).
7) You can see that if the whole stock in 70, 71 and 73 migrated into the triangle fished by Burnt Church in the fall of 2000 (Fig 6B), since the catchability ratio is about 5 – 6 : 1 as DFO trap surveys in fall and biological information suggest, the effect would be close to a shut out of the following spring fishery. It seems obvious that the allocation of 300 traps per license allowed by DFO was to be fished in the spring season. If the number of licenses allocated to Burnt Church were to have any meaning in comparison with the spring fishery, an equivalent number of traps per license for fishing in the fall season would be much smaller – i.e. 50-60 traps per license for q ratios of 6:1 to 5:1 respectively.

   For 13 licenses this would make a total of 650-780 traps for these licenses to have the same effect as they would if fished in spring.
8) As can be seen, the impact of the fall fishery depends mostly on knowing the degree of spatial overlap of the fishery with the whole inshore movement of lobsters in summer, which is not established. It does not depend so much the catchability ratio which only affects those lobster fished in the catch triangle. From available information, < 34% of potential lobster bottom in the Bay is inside the triangle fished by Burnt Church in 2000, and some very favourable areas such as the horseshoe are included in it. In conclusion, I am obliged to conclude that the net spring shortfall is unlikely to be less than 25%.

C/ Protecting berried lobsters is essential to population renewal

9) The consultant believes that the current accent placed on protecting the spawners and aiming for a target in terms of egg production as suggested by the FRCC is correct. Where there is room for further elaboration however, relates to one main issue: should we be aiming to harvest mature females after they have spawned once or conserving the small population of large lobsters that escape through the fishery? The second approach seems better, and approaches such as closed areas, tail notching of berried lobsters or a 5- 5½`` hoop regulation that protect large lobsters, seems the way to go. Reasons are the apparently higher viability and number of eggs of larger lobsters, but also their lower value per pound, and problems reported in selling `selects` at higher market prices. I believe fishermen should seek to conserve this valuable `safety margin` for a fishery where catch and effort limits are only

loosely controlled, but a decision on this should follow from a bioeconomic analysis and not from simply maximizing tonnage.

10) For unberried, mature females (those without eggs), mating or (usually in alternate years) egg laying occurs and the female becomes 'berried', attaching the eggs under her tail. Eggs may be laid, fertilized by sperm stored since the last mating up to a year ago, and attached by glue to the tail. The sperm has been stored by the female in packets or spermatophores, even from the previous year. There is no evidence from the outside that a female caught with no eggs has been fertilized, so these future mothers are vulnerable to capture for up to a year before eggs are laid and attached under the tail. This converts them to protected mature females that must be returned on capture.

11) The implication is that though berried females are put back, there is a period, often one season after fertilization, when unberried females have a 75% chance capture before egg laying. This is the reason for tail notching 50% of berried females, a voluntary management measure. Larger market females with clipped tails, even without eggs, are generally fertile, and are to be returned to the sea. This measure takes account of the much higher egg production of larger females and the higher viability of their eggs.

D/ Lobsters migrate inshore in late spring and summer and offshore in fall

12) Because in the past, most DFO lobster research has had to be done within the fishing season to avoid complaints from fishermen, little information has been obtained on lobster biology in the summer-fall, for example on life history and migrations. Classical studies tagging in one season and capturing tagged animals the same period next year show limited (about 7 miles) movements from year to year.

13) Fishermen know that lobsters migrate inshore-offshore further than this since they follow the peaks of abundance inshore during the season. In fact they move inshore in the spring to benefit from warmer shallow water to hasten egg development, and then offshore as winter approaches. This is important, since evidence suggests that in populations close to their northern limit (as is the Gulf of St Lawrence), early hatched larvae have the best chance of completing a long life history in the plankton. Suggestions for research on aspects of this problem are mentioned in the report.

E/ Lobsters are inshore in summer to moult, mate, and release their eggs as larvae into the plankton

14) Bays and other nearshore areas are often aggregating points for mature female lobsters, and Miramichi Bay seems an important moulting, mating and larval release area. Further tagging studies in the fall are needed to clarify this, supported by DFO, and it is suggested that with some technical advice, these field operations could be carried out by Burnt Church Nation under some sort of contract arrangement. At present however, I judge there to be a significant likelihood that the Bay is a congregational centre for lobsters normally found in surrounding areas outside the Bay in winter and spring.

From what I have been told by those interviewed in the commercial fishing sector, fishing in the fall other than limited needs for food and ceremonial requirements, will lead to further social tensions with non-native commercial fishermen. These have long-standing investments in this fishery and have developed it by accepting more restrictive regulations.

15) In my opinion, delaying the fall season for 2 weeks would be a desirable measure to reduce the impact of high catches in the warmest period of the fall fishery since temperatures are likely to drop in September reducing the major impact of fishing then.

F/ Reasons given for a fall fishery

16) Currently, the motives for fishing in the Fall mentioned by Burnt Church are because of lack of interference from non-native fishers, the need for summer employment, and the high catch rates close to shore in fall. The fall fishery does not require large boats which are not currently available, and a significant number of band members are on welfare due to lack of employment opportunities locally. They are only able to participate in fall, or have the traps allocated to all band members fished on their behalf by those with boats.

G/ Are there good reasons for an agreement between Burnt Church and DFO?

17) A fishing agreement with DFO has been rejected by Burnt Church Nation to date, but evidence from agreements between DFO and other First Nations indicates that this would be accompanied by a large amount of funding for creation of employment opportunities for less fortunate band members and for purchase of extra licenses in the fishery. The quid pro quo mentioned by DFO would be a requirement to move the licenses to the spring fishery and phase down the fall fishery to low levels for food and ceremonial purposes, perhaps over a three year period. Further fishing licenses would also be provided if the Burnt Church band members were they to agree to concentrate their fishery in the spring, and adjust their fishing plan to make it compatible with others operating in the spring fishery under DFO regulations. Apart from the question of the fall fishery, the current Burnt Church Plan has very similar provisions to that of DFO, making harmonization of other factors in the plan a simple exercise.

18) Any kind of fishery management is absolutely dependent on good data. At the moment, adequate data is only provided by the sentinel fishery. This must be continued, but accurate data on catches and their biological size composition, and on number of traps fished by whom, and when are absolutely essential to protect the resource from accidental overfishing, even if interpretation of the data may be approached on an independent basis. Neither Burnt Church nor non-native fishers are providing catch and biological data needed to keep the resource in a safe condition.

H/ Historical roots of the Burnt Church lobster fishery

19) Mi'Kmaq peoples have probably been taking some lobsters inshore for food for millenia, but historically, with respect to modern commercial fishing with traps, it was mentioned that some 40 lobster fishermen operated part-time out of Burnt Church prior to license limitation being introduced in the 1960's, but did not see why they had to purchase licences when the fishery was limited in the 1960s. Later when licenses were transferred from the license holder to the boat. In fact loan requirements at that time in New Brunswick did not encourage native peoples to seek loans for boat or license purchase. If the total number of Burnt Church lobster licenses in the spring season approached this number, employment would be provided

for some 120 people in the lobster fishery, plus more on shore working on boat maintenance and trap construction.

I/ Territorial aspects of the lobster fishery are stronger than for offshore fisheries

20) Lobster fisheries differ from other more mobile fisheries by being more territorial, with TURFs (Territorial User Rights for Fishermen) operating formally or informally in most inshore lobster fisheries. This means that operating traps within the habitual fishing areas of other fishermen is socially inflammatory. It is important therefore that harmonization of fishing activities should not only be between Burnt Church and DFO, but with adjacent fishing communities.

J/ The perspective of non-native fishers

21) Non-native fishers feel strongly there should be only one season, since problems of ensuring compliance with regulations must be controlled fairly for all participants, and they feel this will not be achieved for a fall fishery unless DFO has an active surveillance of catches. This consultant is generally of the opinion that one fishing season should be decided on, since he is unaware of fisheries around the world that successfully regulate two open seasons in the year with the logistic complications this involves. However, accepting the points of view of the parties, two seasons might be workable, but only with good surveillance and under a catch allocation by season or fisherman that is properly supervised.
22) In meetings of this consultant with commercial fishermen from adjacent fishing communities to Burnt Church, it was stated that they will be willing to accommodate native fishermen on the spring fishing grounds without friction. They indicated they will even be prepared to move out further from the prime inshore grounds in order to allow Burnt Church License holders to fish closer to shore in spring. They are strongly opposed however to any exclusive fishing area boundaries in the spring season, and do not accept that Burnt Church has exclusive access to Miramichi Bay, and say that most of them have avoided fishing there in recent years.
23) They indicated however, that if the fall season begins again this year in force, in absence of action by the DFO, they will be obliged in self defence, to fish the same season in the same area. This despite knowing that this is likely to have serious impacts on the local lobster stock. The reason being their perception, correct in my view, that an uncontrolled and excessive fall fishery will impact their livelihood and nullify their past efforts towards conservation.

K/ Likely consequences of a continued lack of resolution of the current dispute

24) If this local wholesale change over from a spring fishery to a fall fishery with an unregulated number of traps occurs, we can then expect the fishery yields and economic returns to drop to low levels, and only the more skilled fishermen will then make a reasonable income in such a fishery. A slow recovery will only follow establishment of lower levels of fishing, and harmonized fishing plans.

25) If a large number of traps will be fished in the fall fishery in 2001 by Burnt Church Nation, I am assured by non-native fishermen that they will also participate in the fall fishery in the Bay.
26) Under these circumstances DFO will be obliged to take management action given the responsibility to guarantee conservation assigned them by the Supreme Court subsequent to the Marshall decision. Conservation in these circumstances will be seriously compromised without management control.

L/ Some ideas for conflict resolution

27) For completeness it is mentioned that one option is for DFO to buy out the fishing licenses and equipment at fair price of those commercial fishermen who wish to leave the fishery. This option is not discarded, but is not considered further in this report, since it would probably have to come from funding provided under an agreement with Burnt Church.
28) One option for Burnt Church Nation is to accept an agreement with DFO, in which case presumably more fishing licenses will be assigned them to be exclusively used in the spring season. In these circumstances I would suppose that these extra licenses will not be activated and boats provided, crews trained etc, before the proposed starting date of the 2001 Burnt Church fall season. If there is an agreement with DFO, it will therefore be necessary for them to fish a limited number of traps in the 2001 fall fishery, phasing down to the smaller number needed for food and ceremonial purposes once the new spring licenses are activated.
29) I would see as one possibility here. In order to reach an agreement that satisfies all parties, assign Burnt Church Nation a community allocation of what could be called a TAC. Logically, this TAC should be considered as the average annual catch taken recently in areas 70,71 and 73 of 1,219 tonnes (approximately 2.688 million lbs). Whatever the proportion of this 1,219 tonnes is going to Burnt Church, presumably this could be referred to as a community share for 2001 from this shared stock, to be divided up by Burnt Church as they see fit amongst their members.

M/ In absence of a fishing agreement with DFO?

30) If on the other hand, Burnt Church Nation rejects the idea of a fishing agreement with DFO, and intends to operate as in 2000 with more than 2000 traps fished, the DFO is faced with a difficult dilemma if counter action by the non-native fishers and collapse of the fishery are to be avoided. Other than enforcing a postponement of all fishing until agreement can be reached between the parties on a common approach to conservation of the stock they share, DFO indicates they may be obliged to impose some form of quota system with the same TAC as above and would have to make some decision on allocations. All of this assumes that both Burnt Church and the commercial non-native fishers intend to fish in both seasons.
31) In the case that DFO goes for a quota system to ensure fairness in a situation where two fishing seasons are allowed in the same year, areas 70, 71 and 73 presumably become an emergency lobster management area for an unspecified but hopefully limited period. Under such a regime it seems logical that catches by all parties can be taken either in the spring or fall seasons until some form of agreement is reached. All catches by all fishers from all parties would have to be registered at wharf side. These would be subtracted from a community share in the case of native fisheries, this time presumably based on the proportion

of commercial licenses and trap allocations they currently hold, as a percentage of the total number of commercial lobster licenses operating in these statistical areas.

32) Catches by non-native fishers would be subtracted from individual boat quotas in the case of the commercial fishermen, these would be obtained by dividing up the remaining TAC after subtracting the Burnt Church share, by the number of non-native licenses. The total catch must not exceed the TAC mentioned earlier.

33) Such an emergency management system is unsatisfactory for all parties, but it is not obvious what other options will guarantee conservation in these circumstances. This emergency management regime can revert to the previous one without quotas, under the circumstances that a spring fishery with full participation of Burnt Church Nation fishers, can be agreed to under a harmonized fishing agreement, in which fall catches can be phased down over several years to those levels required domestically by Burnt Church.

N/ Improved management of the lobster fishery in the future, and needs for research

34) Although there is no interest on the part of non-native fishermen in discussing new regulations until the current dispute is settled, they are interested in the future to consider the implications of a range of issues discussed in this report. These include studies on artificial reefs, closed areas, maximum hoop sizes on traps, and several possible lobster enhancement approaches mentioned in this report.

35) Burnt Church is also extremely interested in research on lobsters, and some experimental procedures are mentioned which will provide employment for some of the band members displaced from the fishery. DFO has indicated that if the fall season is regulated, they may be prepared to buy a certain number of lobsters caught in fall to be tagged and released after biological data gathering, to see where they are recaught in spring. Some of the trained divers in the band can also be employed in underwater observations and studies of trap performance and in diving surveys for juveniles.

O/ A research facility at Burnt Church as part of a fisheries agreement package

36) As part of an overall fisheries agreement with DFO, it is suggested that a small public aquarium and field research facility be constructed, to profit from the local availability of lobsters to study in the summer months. Any facilities provided will also produce some employment in Burnt Church and will be a local tourist attraction. Tourists could see aspects of lobster biology in the aquarium and be taken out to observe lobster traps being pulled. This kind of activity could be integrated with sale of local handicrafts, a small diner and displays of Mi`Kmaq culture, dancing, drumming etc.

37) This facility could also serve as headquarters for a small ecological reserve preserving Miramichi estuarine environments, requiring wardens trained from band members. Assistance in setting up this facility can be requested from universities in the Maritimes and elsewhere and from NGO's.

38) Contacts were made by this consultant with the Huntsman Marine Laboratory in St Andrews that has a large facility and aquarium, and a letter from the curator indicates that they have prepared similar courses in marine biology for native peoples and could be prepared to assist. Courses in marine biology for young members of First Nation communities, and also to the

children of local lobster fishermen as a measure to promote social harmony, would help install a sense of responsibility and conservation to all concerned.

39) A web site for the Burnt Church Nation should be established, and will be an advantage in learning what other native groups are doing to improve livelihood, and to advertise any new facilities available such as the aquarium, ecological visits and research opportunities on lobsters.

2. Introduction

The dispute over the lobster fishery between the Burnt Church Nation and non-native commercial fishermen came shortly after the decision of the Supreme Court of Canada in the Marshall case on September 17 1999. This affirmed the continuing validity of Treaties signed with the Crown in 1760 and 1761 by Mi'Kmaq and Maliseet communities. The provisions of these included the right to hunt, fish and gather in pursuit of a 'moderate livelihood', subject to regulation, if this regulation were:

- for the purposes of conservation
- for other compelling and substantial public objectives, including economic and regional fairness, or recognition of the historical reliance on the fishery by non-Aboriginal groups.

(Details from 'Government of Canada Backgrounder').

The Court's subsequent decision to reject a motion to have the case re-heard by the West Nova Fishermen's Coalition confirmed this as the basis for regulation of fisheries such as the lobster fishery from now on, by Fisheries and Oceans Canada. The civil disturbances in September and October 1999 which involved destruction of CAN $210,000 of traps set by Mi'Kmaq fishermen and injuries to a number of persons on both sides, led to an atmosphere of fear and anger and general social unrest. While this has subsided somewhat, the issue has not been resolved, nor has social harmony been fully restored between the communities involved. According to the web site 'Disparities in Law and Power', subsequent to these disturbances comments were made by the Supreme Court about fisheries regulation that 'appeared to shift the balance of power away from the native people and towards the government'. They appeared to give federal and provincial governments the authority to 'regulate the exercise of a treaty right where justified on conservation or other grounds'. Further, the statement included the following paragraph:

"The paramount regulatory objective is conservation and responsibility for it is placed squarely on the minister responsible and not on the aboriginal or non-aboriginal users of the resource. The regulatory authority extends to other compelling and substantial public objectives which may include economic and regional fairness, and recognition of the historical reliance upon, and participation in, the fishery by non-aboriginal groups".

The web site quoted above (http://www.rism.org/isg/dlp/bc/introduction/index.htm) notes that following this ruling, the DFO limited Burnt Church to 600 traps and began to confiscate those in excess of this figure, but noted that a detailed justification for this limit was never provided by DFO. In the spring of 2000, DFO offered fishery agreements granting communal licenses to First Nation fishing in New Brunswick. Such agreements were signed by 29 of the 34 bands and

gave DFO regulatory power outside of treaty rights 'in exchange for cash, boats, equipment and training'. These agreements were reported as being found unsatisfactory by the Atlantic Policy Congress of First Nations Chiefs, and no such an agreement was signed by Burnt Church Nation which developed its own fishery policy and management plan. This has the stated aim of protecting treaty rights, the fishery and ecosystem, and assuring collective benefits to all members of the community. Since few members of the community had, or have, large enough boats to venture outside the Bay, it was inevitable that these rights were mainly exercised in summer when lobsters are close to shore and easy to catch.

The plan sets limits for 15,000 traps to be fished in the spring fishery, and 5,600 in the fall fishery, with the intention to address the conservation issues mentioned in the Marshall clarification. DFO has not recognized the Burnt Church lobster management plan nor the trap tags issued by Burnt Church under it. Arrest of native fishermen and confiscation of their gear occurred in the fall fishery of last year, shots were fired, and personal injuries sustained by both sides. Some tens of millions of dollars were spent on enforcement in an atmosphere that was described to this consultant as resembling certain police state operations. The web site concludes with the statement:

'At the close of the fall fishery in October…an unreal calm settled over troubled waters. But there is no end in sight to the conflict created by the shifting disparities in the interpretation of law and distribution of power'.

Although the questions of treaty rights and who decides access right allocation to the lobster resource are central to this issue, this crisis goes beyond the question of rights to harvest the lobster resource. It also has biological dimensions stemming from the life history of the American lobster, and socio-economic dimensions in that the fall fishery in Miramichi Bay results from band members exercising their treaty rights under the Marshall decision, largely due to a lack of other economic alternatives for members of this First Nation community where many are on welfare. One example was cited of the need for some members of the community to fish a few traps from a small boat in August, in order accumulate some $500-$1000 to pay for clothes for their children prior to starting school. If there were alternative employment during this period there might be a readiness by some community members to moderate fishing pressure on the lobster resource in the fall. One suggestion this report makes is anticipated here, and that is to take into account the keen interest of the Mi'Kmaq people in resource biology. Involving native people in lobster research follows from what the anthropologist Fikret Berkes calls 'Sacred Ecology', which pursues the sentiment expressed in the extract of a prayer of the Mi'Kmaq peoples quoted at the start of this document.

Effectively, involving the Nation in biological studies of the resource and in exploring possible lobster enhancement measures in the Bay under the provisions of a local management plan, is one possibility which will be discussed later in the report.

One of the avenues explored by DFO for resolving the biological impact of a fall season, and the more general question of the optimal management of the lobster population of Miramichi Bay and adjacent waters, was to search for an independent expert operating under the terms of

reference given in the annex I. This is the report, which has been prepared free of pressure by all parties involved.

From 19 June to 13 July the consultant met with the native and non-native fishermen, DFO and other experts, and reviewed available data and the scientific literature on the lobster fishery in the southern Gulf, and presented this report in draft to the Burnt Church Nation and to DFO on the 12 July 2001. Obviously the time and information available for in-depth study was limited, but hopefully the present document is wide enough in scope to provide a focus for a dialogue, even if not all of its recommendations are agreed to by either the Mi'Kmaq Burnt Church Nation, the non-native fishermen, or DFO.

3. A short history of access to the lobster fishery

In the 1960's, the Federal Government created a class of full-time fishermen from inshore fishermen who were formerly pluralist in employment and moved between different tasks onshore and offshore on a seasonal basis. Ironically this has placed non-native commercial fishermen in this district in a condition of being largely dependent on a few resources.

As far as established rights to participate in the lobster fishery are concerned, Burnt Church Nation representatives claim that 40 fishermen from the community formerly participated part time in the lobster fishery before limited entry was introduced into the lobster fishery after 1967, but at that time they were unwilling or unable to obtain licenses, presumably since from time immemorial they had exercised the right to collect lobsters from below the tide marks for their personal need by various artisanal methods. The replacement of licensed fishermen by licenses by boat in 1969 also helped eliminated small-scale temporary operators from the fishery. The subsequent setting of trap limits per license, as noted by De Wolf in 1974, seems to have 'averaged up' the number of traps fished to close to the upper limit and in fact increased the fishing effort in some districts: a tendancy subsequently added to by larger and more efficient boats and larger traps. All of these legislative moves discriminated against multi-activity 'moonlighters' as these part time fishers were subsequently referred to, which included those native peoples formerly occasionally fishing lobsters, who were apparently unable at that time to obtain loans to purchase lobster boats through New Brunswick loan outlets.

Parsons (1993) noted that formerly "movement of fishermen into and out of the lobster fishery was determined by the availability and attractiveness of alternative employment opportunities". However, following a DFO lobster task force on economics in 1974, the objective of management of lobster fisheries was agreed to by DFO as optimum economic yield, and an attempt was made to reduce the number of fishermen, largely by attrition. Those remaining were to be converted to 'professional' fishermen, and their activities spread over a number of resources. In fact the value of a licensed boat for those in the fishery increased significantly in consequence, and as Parsons put it, "the best able to afford licenses purchased them". Those left in the lobster fishery in the 1980's, entered a boom period with doubling catches, but according to Parsons, (and most lobster biologists would agree I guess), "this resurgence in lobster stocks was not a result of any effort reduction resulting from the buy-back program but rather a general Atlantic-wide lobster recruitment pulse".

Nonetheless, to be fair, Parsons points out that the net return to those in the fishery, without license withdrawals, would have been much lower (but the total landings about the same). Hence the introduction of limited licensing to the lobster fishery has been a success judging from the economic criteria that were pursued for the fishery but necessarily restricted access to the resource, and increased the incentives for full time fishermen to fish more traps per boat. At first, the total effort in the fishery probably increased in the fishery, since part-time lobster fishermen probably left the fishery when catches were poor for other occupations.

The above section has been entered into in some detail to illustrate why part-time local fishermen were eliminated from the fishery. These included part-time native fishermen which formerly were given no assistance or encouragement to continue participation in this increasingly restricted and lucrative activity.

4) Getting to know the beast

The lobster has a curious and fascinating life history, but one that is not widely known outside of scientific circles, and hence the consequences of certain management actions on the stock are not readily evident. A first conclusion from talking to those most involved in the present crisis is that there is an urgent need to raise the level of public understanding of lobster biology as an important issue in coastal communities in the Maritimes. I may say this probably applies also to the commercial non-native fisherfolk as well as the native fishers. Providing training material that is readily understandable showing how lobster regulations interract with the biology of the animal, could be used in schools and translated into Mi'Kmaq. It is clear from their long history of custody of natural resources, that First Nations in general, care what happens to species and environments they depend on, and I am assured they would be upset if this dispute led to a serious decline in lobster populations. In fact it is from the common perspective that all concerned want to guarantee the wellbeing and continued productivity of an important Maritime resource, that a solution can be found. Creating a sense of good stewardship by all those who have the privilege to harvest this resource belonging to mother nature, should be the objective of all resource users, native or non-native. Where exerting a harvest right runs the risk of destroying the resource supporting this right (as has unfortunately happened for other resources in Canada and elsewhere), negotiation in good faith to keep the harvest under control is essential and urgently needed before the Mi'Kmaq fall season commences in August 2001.

5) Setting objectives for fishery management

The Technical Guidelines for the Code of Conduct for Responsible Fisheries of FAO (FAO 1997) note that the formulation of management guidelines requires prior agreement from all involved. "Not only on the technical details by local experts on resources, economics and sociology, but also on common paradigms and objectives.... To a significant extent, this process must be accomplished in the local context and cannot be provided in the form of a 'recipe' ". All of this obviously applies here, and the consultant will shortly look at the management plan of DFO and compare it with that developed by the Burnt Church Nation, to see if there is a possibility of making them compatible.

The FAO Guidelines go on to note that "the current period is one of considerable experimentation with new approaches to fisheries management, including, inter alia, technical measures, economic and social tools for ensuring intergenerational equity....and management frameworks involving partnership between the State and fishers and their communities...Searches for (new) combinations of established management tools may well be fruitful in many cases". These statements also apply to the lobster fishery, and suggest we should be allowing local coastal communities, and not only the Mi'Kmaq Nation, to experiment with new approaches to management, as long as these do not, as the Marshall clarification says, "Affect the historical reliance on the fishery by non-Aboriginal groups".

The FAO Guidelines also note that "in small-scale fisheries, contacts between user group, political leaders and administrations tend to rely mainly on social processes and institutions"... "Where there are conflicting views, or where the current institutions are not accepted by all parties, this failure to reach a minimum agreed level of compatibility will directly affect the acceptability of a management plan, not to mention its likelihood of implementation. Conflicts between different users of the same aquatic resources are common...and an important task of the relevant authorities is to evaluate current and potential conflicts with a view to minimizing them."

All this is easier said than done. The current situation faces one main problem in that the 'relevant authority' considered by Government to be the DFO, is not fully accepted as such by one party to the dispute, which has invoked national status within Canada. An article in Time Canada in Oct 9 2000 (Vol 156 No.15) quotes a 1996 Report of the Royal Commission on Aboriginal Peoples, which the article contends, asserts that "the future relationship between Indian peoples and the state should be nation to nation". This is the position held by one party to the dispute, the Burnt Church Nation. Not being a constitutional lawyer, I am nevertheless aware of some of the provisions of international agreements on fisheries through my twenty years work for the FAO. In general, the provisions of national fisheries legislation within Exclusive Economic Zones are usually harmonized with such international agreements on conservation signed by the parties, such as the non-binding Code of Conduct for Responsible Fisheries. Some articles of the Code have a relevance in this case whether or not some other social category is substituted for the word 'state'. In fact, many countries around the world, and I think it is fair to include Canada here, recognize that the principles of the Code also apply to fisheries within national jurisdiction.

For example, consider the following:

Article 6.4 of the Code says: "Conservation and management decisions for fisheries should be based on the best scientific evidence available, also taking into account traditional knowledge of the resources and their habitat, as well as relevant environmental, economic and social factors. States should assign priority to undertake research and data collection in order to improve scientific and technical knowledge of fisheries including their interaction with the ecosystem".

The themes that seem immediately relevant in the above quotation are the need to respect traditional knowledge, but for a successful resource sharing arrangement, both parties involved should cooperate in fisheries research and data collection, and that has got to be the basis for any

future co-management of the lobster resource. It has to be said that the Mi'Kmaq nation of Burnt Church has not kept adequate records of its fishing operations, and has been sceptical of observations by fishery officers. This places the consultant in the position of having to argue from biological principles and the life history of the fishery. A proper data collection system and the use of Sentinel fishing will be necessary if more detailed analyses are to be possible.

After recommending the adoption of appropriate management measures based on the best data available, Article 7.2.1 says, inter alia, that 'the interests of fishers, including those engaged in subsistence, small-scale and artisanal fisheries should be taken into account'. I think in all fairness, this statement applies to both the native and non-native fishers in this dispute.

Article 7.6.5 says that: 'States and fisheries management organizations and arrangements should regulate fishing in such a way as to avoid the risk of conflict among fishers using different vessels, gear and fishing methods'. This is especially relevant in the current context, and restraint is needed from all sides if we are to hope to find a solution to this problem.

With reference to the need to prepare a management plan, the management guidelines for the Code say: "The fishery on any given stock may be complex, consisting of several different fleet types. A management plan needs to consider each of these fleets in terms of their impact on the resources and in turn, the impact of a management plan on them". This question of reciprocal impacts is what I will try to address in the following, using what data is available.

A final quote from the management guidelines of the Code is given in the box below, and makes it clear that there can be only one management plan for a stock, or if there are two or more, they have to be made compatible.

> Fisheries management entails a complex and wide-embracing set of tasks, including the following:
>
> - Identifying (common) objectives to work towards in consultation with all interest groups
> - Analysing available data to determine the overall situation and directions for further research in support of management measures needed to meet the objectives
> - Developing and implementing a common management plan based on the best available data
> - Ensuring that the stock and its habitat and environment remains in a productive state
>
> (The FAO Guidelines for Responsible Fisheries Management).

6) The precautionary principle

One perspective that FAO has been promoting over recent years is the 'Precautionary Principle', and it can reasonably be argued that ignoring this principle has been responsible for the collapse of many fisheries.

The Code and its Guidelines define the precautionary principle 'as the application of prudent foresight', which requires, among other factors:

1) Consideration of the needs of future generations and avoidance of changes that are not potentially reversible
2) Prior identification of undesirable outcomes and of measures to avoid them or correct them promptly
3) Corrective measures should be initiated without delay
4) Where there are uncertainties as to the impact of the plan on the resource priority should be given to conserving the productive capacity of the resource.
5) All fishing activities must have prior management authorization and be subject to periodic review
6) An established legal and institutional framework for fisheries management must exist within which management plans are instituted.

If we look at the current dispute in light of points 1-7, I suppose nobody would seriously disagree with points 1) to 3) incl? Point 4) has been established as a priority by the Marshall judgement, and only points 5) and 6) seem to be in contention, since we have two management plans which need to be reconciled.

Perhaps the problem for Burnt Church in signing a fishing agreement with the Federal Government is their perception of a lack of reciprocal respect shown in the form of the proposed 3 year agreement, rather than its content? The agreement should perhaps make note of the claims of both parties, and rigorously avoid suggesting that a right is 'conceded' by one party to the other. Rather, the agreement should be preceded by phraseology something like the following: 'Taking into account the claims of both parties to jurisdiction over and access to the lobster resource in Lobster management area 23 of the Gulf of St Lawrence, the following agreement is signed for the following 3 years to harmonize measures in the Mi'Kmaq lobster management plan and that of DFO. The Mi'Kmaq Burnt Church Nation will fish N licenses and 300 traps per license in the spring fishery in area 21. It will also make its regulations compatible with those applicable to non-native fishermen and will collect adequate data on the catch and fishing effort and support a research programme to collect more detailed information on the catch. The Burnt Church Nation agrees that it will limit its take (or number of traps) in the fall season to (specify agreed figures)".

7) Comparing the federal governments view with the Burnt Church Plan

While there seems to remain disagreement between parties over the full exercise of treaty rights, there presumably is room for agreements over a limited time span. Thus the 3-year period of DFO agreements with native peoples should be aimed at ensuring them a reasonable share from the lobster resource consistent with making a moderate livelihood from local lobster resources without compromising the ability of local non-native peoples to do so. As noted by a Government of Canada Flier entitled 'Marshall Myths and Realities', 'Fisheries agreements will be "without prejudice" to the positions of the government or First Nations'. In other words, agreements do not imply renouncing the differing global views on this issue of the participants. I

see no reason to doubt this statement, and without accepting it tacitly or overtly, no agreement is possible.

No comments in this report should be construed as suggesting that the author has any preconceptions as to the appropriate level of resource sharing. My main concern is with the proper management and conservation of the resource, so that whoever captures lobsters in Miramichi Bay and environs, must regulate for a sustainable shared resource. Even in the international arena, nations need to take part in co-management of shared stocks, and cannot do this independently! In fact the Law of The Sea requires them to get together and establish a mechanism for managing the shared stock. I may note that it is not unusual for two political entities (within or between countries) to have different views on resource ownership or access rights. A basic requirement is that they be prepared to sit down to negotiate a periodically-renewable agreement over a fixed time period. This agreement will almost certainly be slightly sub-optimal for both parties, (as almost all agreement are) but should involve an 'equitable share of the pain' between both parties.

It is not intended to go further into detail on past political decisions that affect the management of lobsters and their allocation. I would note however that the 1990 Sparrow decision on the right of native peoples to fish for food and ceremonial purposes first recognized the justification for such a fall fishery off Burnt Church. Its modification by the Marshall decision, (which in the Burnt Church view made it obsolete) recognized the right of the community to also participate in the commercial fishery. Presumably however, the intention from the side of the DFO in providing 17 lobster licenses, was that these should be used in the Spring season. There are at least three reasons however why Burnt Church fishing effort continues to be concentrated in the fall season, and is likely to continue this way unless there are significant changes:

- Ceremonial activities require some limited lobsters for consumption in summer
- Poorer members of the community are only able to participate with small boats in the fall fishery close to shore.
- There is concern with aggression should fishing be extended beyond the Bay as would be needed in a spring season.

A different 'world view' to that espoused by DFO emerges from the preamble and contents of the draft fisheries management plan prepared by the Burnt Church Nation of the Mi'Kmaq peoples, but most technical details are the same. The main problem as I see it is with the level of fishing proposed in fall by the Burnt Church plan, and the long fall season.

When we focus on the technical elements of the Burnt Church plan, which are the immediate concern of this report, despite the differences in management objectives, the approaches are very similar, as can be seen from the summary table below. A summary of some of its main features are given in the following table alongside those spelled out in the report of the Fisheries Resource Conservation Council entitled: 'A Conservation Framework for Atlantic Lobster'.

	Burnt Church Plan	Government of Canada framework
Objective	Precautionary principle to maximize conservation of species and their ecosystems. Restore to native peoples, whether or not in reserve areas, access to the natural resources inside and outside reserve areas, that were theirs prior to arrival of non-native peoples.	Under the new conservation framework, the Minister is mainly concerned with conservation principles, objectives and targets. Further definition of objectives required but a more precautionary approach is needed. Effort is too high and spawning escapement and egg production too low. Key elements for management are good egg production, reasonable values of fishing mortality and several (fishable) year classes in the population. Egg production should be increased with 5% of unfished population as target. Significant reductions in fishing effort recommended over a 'reasonable period of time'
Habitat	Inter alia, EFN will provide for protection of marine habitat, and promote habitat restoration in accord with traditional philosophy	No specific mention of habitat
Access rights	All members of the EFN have an equal share in the resources and EFN must promote collective benefit	Access limited to license holders and 'A fair and reasonable level of fishing' for native peoples. Illegal fishing and improved enforcement are major concerns.
Deciding on Current level of effort?	- Equitable access to all Mi'kmaq wishing to – exercise treaty rights, but maximum 15,000 traps in spring and 5,600 in fall, with max of 300 traps and 4 for each man, woman and child of EFN - Any effort reduction must come from non-natives unless EFN-funded Aboriginal biologist agrees that these extend to Mi'kmaq. -Natural Resource Management Division of NRPA will issue, withdraw, limit or suspend fishing tags and permits - EFN management plan will decide who, where when fishing occurs - Use DFO funds proposed for purchasing boats and wharf to purchase additional licenses <u>not</u> to be used – i.e. to retire them and build down effort. Seizure of gear on violations.	248 license packages retired of the 7,850 that existed in the Maritimes and Quebec to 'make room' for such a level of native fishing. Fishermen work in partnership with DFO on Lobster Advisory Committees to work out detailed measures consistent with principles and objectives approved by DFO.
Relations with other resource users	EFN recognizes that 1760 treaty does not apply to non-native fishermen A mutually beneficial relationship can be developed between native and non-native fishermen	DFO committed to promoting access of native peoples to the commercial fishery.
Lobster season	29 April- 30 June (61 days) then 3rd week Aug to Oct 31 (78 days). Closure for moulting July and 1,2n weeks Aug.	Season currently 1 May to 30 June (61 days)
Lobster districts and other geographical regulatory units	'reject oppressive confines of reserve boundaries and limited water zones associated with them, since treaty rights do not cease at the boundaries of the reserve, <u>but EFN will reassert control particularly in its traditional district.</u>	Need to keep the regional basis for lobster management that reflects characteristics of local populations but uncertainty as to appropriate spatial framework that reflects the geographical characteristics of local populations. 7 Lobster Production Areas (LPAs) recommended each with 'homogenous' lobster populations. LPA's are not necessarily operational units, nor need management measures be standardized within them.
Management authority	A community-based judiciary provided for by Natural Resource Tribunal	The Department of Fisheries and Oceans
Other regulations	Escape+biodegradable panels, traps tagged, trap size limited, return females with a notched tail	Escape+biodegradable panels, traps tagged, trap size limited, notch 50% berried females and return females with a notched tail

At this point it may be useful to suggest that the management approach should not be aimed specifically at maximizing the yield or necessarily at optimizing economic return. It has been specified that in implementation of the Marshall decisions a priority is ensuring that impacts on other users are not excessive, and exercising treaty rights is subject to the overriding requirement that the potential for future reproduction of the lobster population is maintained. The criteria proposed by the FRCC with respect to increasing egg production also give the same top priority to conservation. As the consultant was partly instrumental for promoting egg/recruit calculations for lobsters in Canada, (Caddy 1979a), I could hardly disagree with this, since criteria based on sustainable yield without taking account of stock replenishment, have obviously led to depleted fisheries round the world. At the same time, as I will discuss, there are different opinions current as to how reproductive replacement is best enhanced.

In this context it is remarkable to note the way that lobster landings in Eastern Canada, but also in the US, rose to almost unprecedentedly high levels in the 1990's after close to a hundred years of the commercial fishery. The early decline in the 1930's after the first peak, paralleled events in fisheries for other resources such as cod, where this decline has not been substantially reversed. In the 1960's, this decline also looked irreversible for the lobster fisheries of the Atlantic Seaboard as a whole. This makes the rise in lobster landings to new peaks in the 1990s still more surprising. Two things are noteworthy here: the first is that for most fisheries in both the US and Canada, managed in completely different ways, and including those where conservation controls are regarded as inadequate, landings rose in the 1990's despite this. There was and is, a considerable degree of overcapitalization in all lobster fisheries, especially with regard to the number of traps fished. The evidence suggests however that something else has been going on that is common to lobster fisheries throughout their whole geographical range.

This doesn't mean that regulatory changes in recent years have been ineffective; on the contrary, they were needed, and without them landings would certainly be much lower. In fact, non-native fishermen point with justifiable pride to their role in ensuring a productive fishery. They point to the reduction in poaching, smaller numbers of traps and illegal fishermen, introduction of escape gaps and slightly higher legal size limits as the causes for higher landings. These certainly are considerable achievements that they should be given credit for implementing, and involved sacrifices on their part for which they wish to see the benefits. Their concern is increased when they see the gains realized in danger of slipping away due to events beyond their control.

I do not pretend to know what proportion of the landing increases in the 1990's are due to better regulations, and what due to biological and environmental changes, and the relative contribution of different factors to the recent highs cannot be resolved here. In addition to the positive effects of fishery regulations, environmental changes and the significant reduction in predation on small lobsters, and hence natural mortality of small lobsters resulting from the groundfish stock decline since the 1970's, may have played a part. These are popular reasons with lobster biologists for explaining increases in abundance. In fact, it is going to be interesting to see how lobster landings hold up if groundfish stocks recover. The reason for insisting that the recovery is not all due to improved regulations, is that from a scientific perspective, expectations for further increases should at this point should be moderate. They could be balanced by an equal

probability on the down side due to a number of factors, of which civil disturbance is only one of them.

More immediately to the point, it should not be assumed that catch declines anywhere in the Gulf are necessarily due to the fall fishery in lobster districts 70, 71 and 73. Certainly however a significant increase in fall landings is likely to cut into the spring fishery in adjacent lobster fishing areas, but we do not know what proportion of the stock outside the Bay is seasonally available to the Mi'Kmaq fall fishery. Despite their other differences, a key objective of all stakeholders should be to ensure that population replenishment is maintained to the extent possible, in order to avoid the fishery as a whole returning to the low levels of harvest experienced in the 1920's – 1970's.

The adoption by DFO of a minimum criterion for doubling egg production by lobster populations seems appropriate, even though the objective seems a modest one, and does not take into account specifically the higher viability of eggs produced by larger spawners. Later in the report I will suggest some supplementary ideas that could be considered for maintaining or enhancing annual recruitment. For the moment however, I will comment that recent uncertainties in Areas 70, 71 and 73 do not give much cause for optimism for future levels of stock replenishment since they undoubtedly affect the spawning potential of the stock.

8) A brief summary of the lobster life cycle

This account of features of lobster life histories necessarily condenses a complex series of physiological processes into a few paragraphs, and places less emphasis on the structural and physiological details, and most emphasis on the timing and sizes of the processes involved. It draws heavily on reports by Aiken and Waddy (1980) and Chaikelis (1953).

Generally, lobster populations recruit into the fishery at ages between 6 and 9 years; spending their early benthic stages as crevice dwelling organisms. (See e.g. Wahle 1992, Lawton et.al. 2001 and earlier studies by British authors on European lobsters in the southern North Sea – another area dominated like the southern Gulf by finesediment bottoms). Although new research in Europe allow the age of lobsters to be approximately determined based on lipofuschin, a material that accumulates in certain organs through moults, determining the age of individual lobsters is problematic. What seems to be the case is that there is a rather sharp 'threshold' of sizes when the individual lobster moults from a size below the legal limit to become a canner that can be legally retained.

At this point it is practical and relevant to consider 'relative age', or even more practically, to divide the population into groups based on 'the number of moults since entering the fishery'. These 'moult groups' are not homogenous by age, but their age and size since entering the fishery becomes the control variables. This approach in fact makes calculations using 'number of moults since entering the fishery' the most practical and biologically relevant approach to measuring time when modelling the population dynamics of lobster (Caddy 1979a), and will be the one used here. On this point it can be remarked that increasing size limits by intervals of millimetres instead of by a whole moult interval of about 10% in length, makes calculation of quantitative benefits of such increases highly problematical. Since intermoult intervals are

relatively well known, these can be converted to mortality rates as shown in the appendix table 1 as long as you have some idea of the time between moults. While it is true as stated by the 1995 Fisheries Resource Conservation Council report, that 'models of population dynamics such as those currently used for groundfish cannot be used', it is not true that models cannot and have not been used to manage lobster fisheries round the world. There are alternative approaches to modelling crustacean fisheries that have not been fully explored for Canadian lobsters, and need to be tailored to the life history of the animal concerned.

Mature females are distinguished from males and immature females by a wider abdomen, and while female maturity might start from 59 mm CL in the Southern Gulf, but even when they average 70-75 mm CL, only 50% of them have reached sexual maturity (Lanteigne et.al. 1998). Hence a significant proportion of legal-sized lobsters in lobster district 23 enter the spring fishery as immature animals (canners) and are caught before they have a chance to mature and reproduce. The situation is even more of concern for a fishery starting in the early fall for reasons we will discuss.

Mating occurs shortly after the female moults. In anticipation the female leaves her burrow, and seeks out and pairs with the dominant male in the area. Males mature at a smaller size than females, and at 40-45 mm CL already produce sperm. It seems likely however that functional maturity, defined as the ability to turn the female on her back for mating, requires the male to be larger than, or fairly close in size to the female, and this is rarely possible if the male is less than 65 mm CL. A package or spermatophore containing sperm is transferred in mating to, and stored by, the female, and can be used to fertilize eggs immediately, or after a considerable length of time; often up to a year.

Fertilization may not occur immediately but can be delayed even until after the next moult or the following summer after fertilization. The chances of a fertilized female arriving at egg laying is probably not very high for market lobsters in heavily exploited populations. Female survival to maturity is rare, as is (more so) their survival to lay eggs a second time. (Remember, females can lay eggs every second year or so for many years if not fished, with progressively larger number of more viable eggs released as they grow). Egg laying can occurs from a month or so after fertilization in the same season, but probably in the Gulf is more typically postponed to the following year. Chaikelis says that egg laying occurs in August, and he is presumably talking about lobsters off New York, but apparently egg laying mainly occurs in the Maritimes from June-Sept. As a result of this, a significant proportion of female lobsters caught and legally retained, being without eggs, may be fertilized but not yet have extruded their eggs and attached them under the abdomen. In fact a high proportion of mature females are likely to be found to contain spermatophores when dissected, but this cannot be seen without damaging the animals. We may note the major inconvenience of lobster biology from the perspective of management is that it typically takes an American lobster two years to produce a brood! However inconvenient this may be, it is essential that the management system accommodate this situation.

At this point it can be mentioned that the practice of scrubbing the eggs from the abdomen practiced by some unscrupulous fishermen is detectable by a chemical test for the cement left on the underside of the abdomen. Of interest, newly laid eggs are green in colour while those on the abdomen which are close to hatching are 'eyed' and brown in colour. Soon after hatching of the

last brood, a female will typically moult again, but the long period when moulting has been inhibited while carrying external eggs, makes female growth somewhat slower than for males.

Larvae released into the plankton stay mainly in the surface waters and go through 4 larval stages each separated by moults, for about 3-10 weeks, before moving to the bottom in the middle of stage IV. The general philosophy about larval production has often been to assume that larvae do not home on their areas of hatching, but this seems not to have been confirmed scientifically, and different size groups of larvae are mentioned as being geographically differentiated in Gulf of Maine waters. Some recent studies seem to show that lobster larvae may be able to use vertical migration and prevailing currents to remain more or less in the area of the lobster grounds. Therefore, the above 'conclusion' which was used in the past as a reason for not considering the recruitment contribution of local populations, is suspect. Larvae once were often assumed to 'come from somewhere else', mainly because it was convenient not to consider survival of mature animals. Whether true or not, this is not what you would call a precautionary approach! It would be wise for local management regimes in a large area such as the Gulf that probably consists of a mosaic of 'metapopulations', if each management area were to independently ensure a significant proportion survives to make a contribution to the next generation. i.e. avoid the conclusion that it doesn't matter if local berried females and large females are fished out or not, because good management 'somewhere else' will save our bacon!

9) The age of the parental population

Concerns have been expressed for heavily exploited fish and invertebrate populations about the high proportion of progeny that come from first maturing females with current regulatory approaches. For lobsters, this is not just because the season of egg release of first spawners differs somewhat from older lobsters but younger lobsters are much less fecund, and produce eggs that may be less viable. Through fishery-induced natural selection, depending on 'post-virgin' small lobsters is a fishing strategy that could lead to selection for early maturing organisms, and for other organisms is associated with a tendency to stunting. Larger females are much more fecund than small ones, thus a female of 72 mm CL produces some 5,500-6,000 eggs, while one of 100 mm CL produces typically 16,000 – 19,000 eggs – in fact a doubling of carapace length is reported to increase brood size by 8 - 9 times.

Egg laying and fertilization may occur from as early as a month or so after mating, to being delayed till the next year. Then eggs are held under the abdomen of the females for around 1 year, making the whole parental cycle about two years long, with the female vulnerable to legal fishing for roughly one season in two. A few individuals (said to be rare the Gulf) may lay eggs twice between moults but these seem to be rare and would be very large females moulting every two years or more. The situation for berried females is more favourable if the berried female ban is respected and they are returned to the water, but as noted, this is only the case for most animals on alternate years.

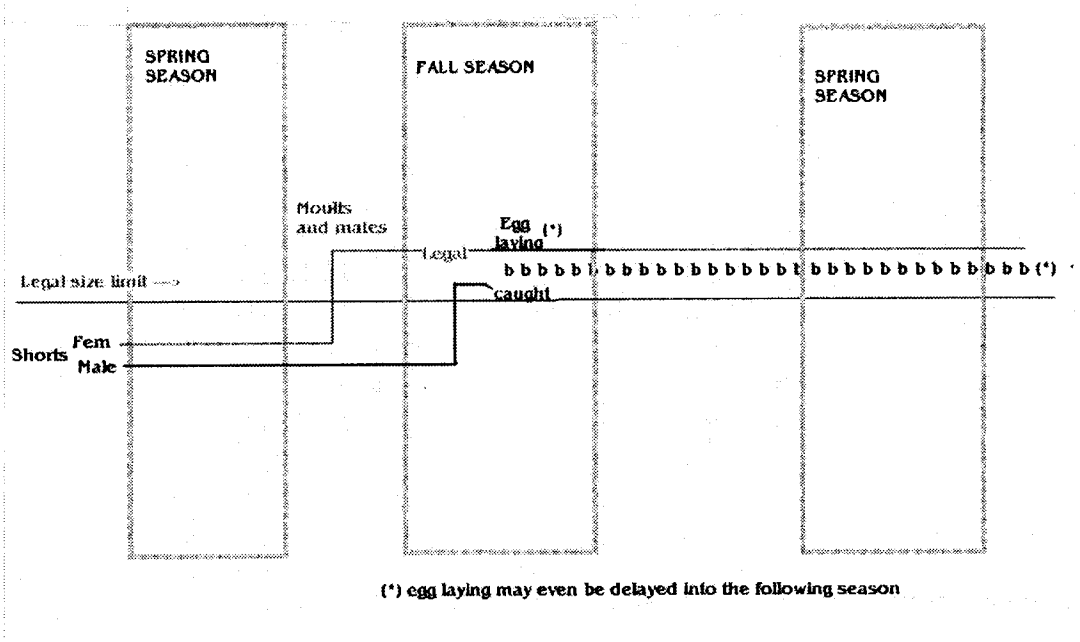


Fig 1: Showing the entry of newly moulted lobsters into the fishable population in summer. Since most lobsters that recruited (75-85%) last year have been captured, these new recruits are the bulk of the fishery. No further moulting occurs between the fall fishery and that in spring, so the fall fishery acts as an `interception` fishery determining how many lobsters reach the spring fishery.

A summary of the main events as seen seasonally is given below in a very schematic way in Fig 1. X represents 2 sublegal sized lobsters, the female entering the spring season prior to its first mating and later, egg laying. (This may occur in many lobsters the following summer to mating, and not in the same summer as is shown in the figure). Since approximately 75-85% of male and not egg-bearing female lobsters are captured prior to the end of the first lobster season, only a few lobsters survive to spawn. Of those that survive the first year as mature animals, a very small percent survive the fishery a second time. There are indications though from bottom gill/trammel netting (Lanteigne and Tremblay 2001) that a few larger animals that escape the fishery reach a size when they cannot enter most lobster traps due to the hoop size of 5 ½" or so used in most areas. They may accumulate in the area over time since the maximum age of lobsters may be 10 years and over, and a large female will produce many more eggs than a small one. Thus these larger animals may play an important role in egg production and are a form of insurance in a fishery without either catch or very effective effort control. I believe special efforts should be made to conserve them and add to their population.

The survivors of the spring season, plus the sub-legals that were too small to be retained in the spring, migrate inshore, and mature females moult. While the shell is soft, they mate. Those that mated and probably before the end of the fall season, a good proportion of them extrude eggs and become berried lobsters. Current regulations require berried females to be returned to the water, and that 50% of them should be tail clipped. Since a lobster with a clipped tail should be returned to the water, berried or not, this measure allows in theory a small proportion of larger females to reproduce more than once. This is important, since though a female lobster may be fertilized,

until it lays its eggs and attaches them under its tail, a larger female that has spawned at least once before could be legally captured it if it did not have a clipped tail.

Making sure that a small but significant proportion of large spawners are left in the population (and here we need some large males, since small mature males are physically incapable of mating with large females), provides a measure of security for the future of the population. Spawning is spread in time, probably occurring earlier for the larger females, and hence the whole population is going to be more resistant to environmental changes such as low spring temperatures which are especially likely to delay maturity, mating and egg release of first spawning females. For example, the effects of a cold spring or of early fall storms that reduce the water temperature is likely to reduce the probability of survival of larvae produced later in the summer, which by some accounts, mostly come from first maturing females. As just described, a regulation that conserves a good proportion of older mature animals is a measure that also reduces genetic selectivity by an intensive fishery for small, early maturing lobsters. In addition, due to the greater number of eggs, and perhaps their greater size and yolk content according to some authors, it makes for a more even reproductive contribution since small and larger lobsters have slightly different breeding strategies.

10) The spring and proposed fall fisheries in statistical areas 70, 71 and 73

As seen from Fig 1 and from other considerations, the spring season serves a number of purposes that favour conservation in a situation where there is little flexible control of fishing effort (which is agreed by all lobster biologists to be excessive), and where quota control is not used. The spring fishery restricts exploitation of lobsters to cooler periods of the year when no moulting occurs, hence shells are firm, catchability is fairly low, and the animals are more widely dispersed over a larger area of deeper water. As such, it is a 'passive' form of regulation that despite excessive levels of effort, has maintained the stock for many years without so far the fishery collapsing. In fact, landings have increased significantly since the 1970's and now consist of a larger proportion of market sizes than formerly.

Although the current fishery regulations could undoubtedly be improved and made less risk prone by reducing the number of traps fished, the spring season avoids fishing lobsters in the sensitive periods during mating and moulting. It also protects soft-shell animals from being damaged by handling and shipment, and in most cases, has allowed a higher price to be attained, on markets distant from the point of capture.

There are other reasons why the spring lobster season has been favoured in many areas, and some of these were mentioned by non-native commercial fishermen. Inshore fishermen often target different resources at different periods of the year: groundfish and herring for example tend to be available in shallower water in the summer and fall, and a lot of traps fished in a summer fall lobster fishery would interfere with these operations. A fall season would also leave a long period of inactivity in spring and early summer when no major fishery was available. If you examine the sea temperature range in the spring and fall seasons, they are different: but the main difference is that early in the spring season, lobsters are relatively abundant but less catchable, while at the start of the fall season they are locally very abundant and very catchable.

The fact that they become less easy to catch later in the fall season as the temperature starts to drop doesn't have much

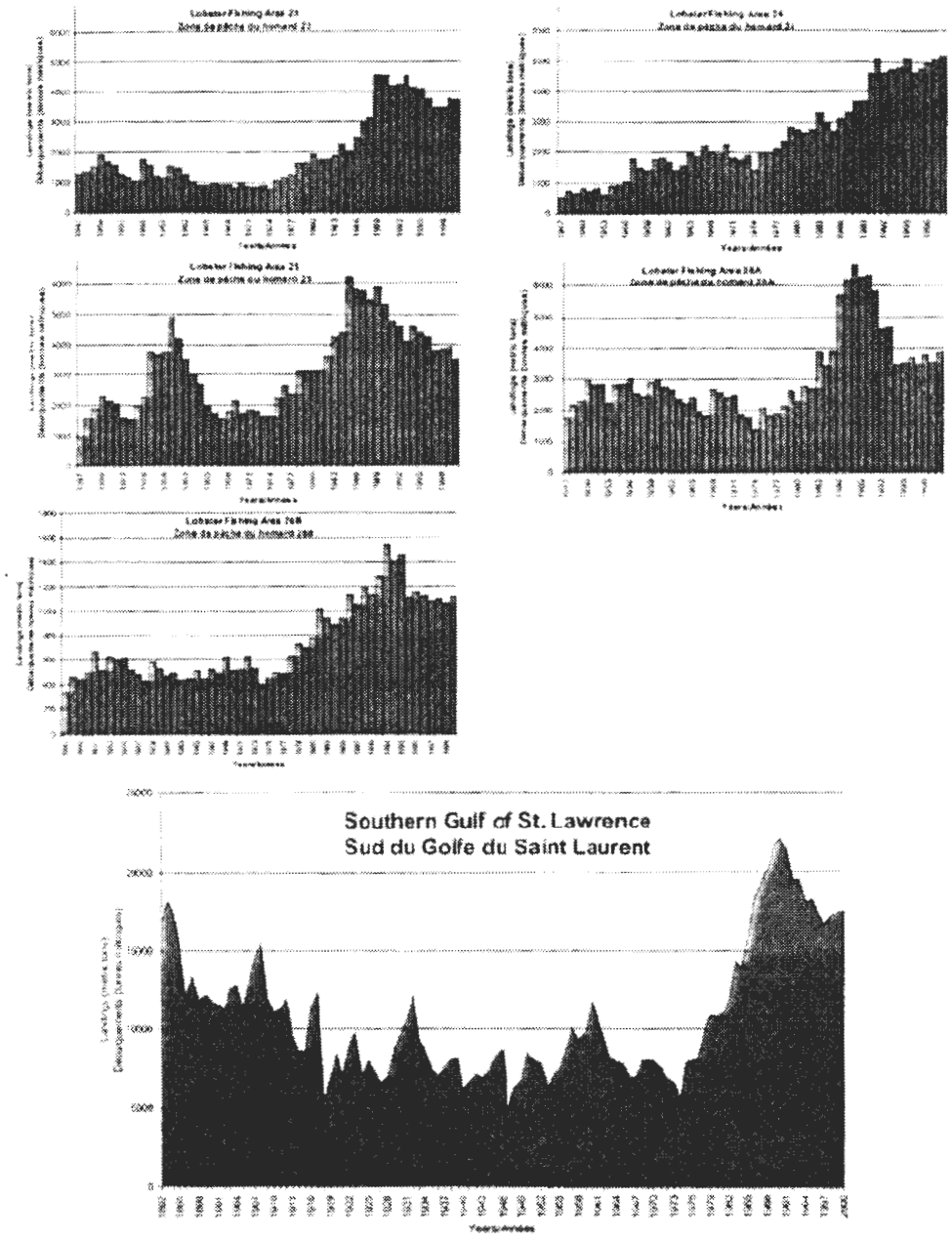


Fig 2 a) Historical catch trends for Northumberland Strait and Area 23

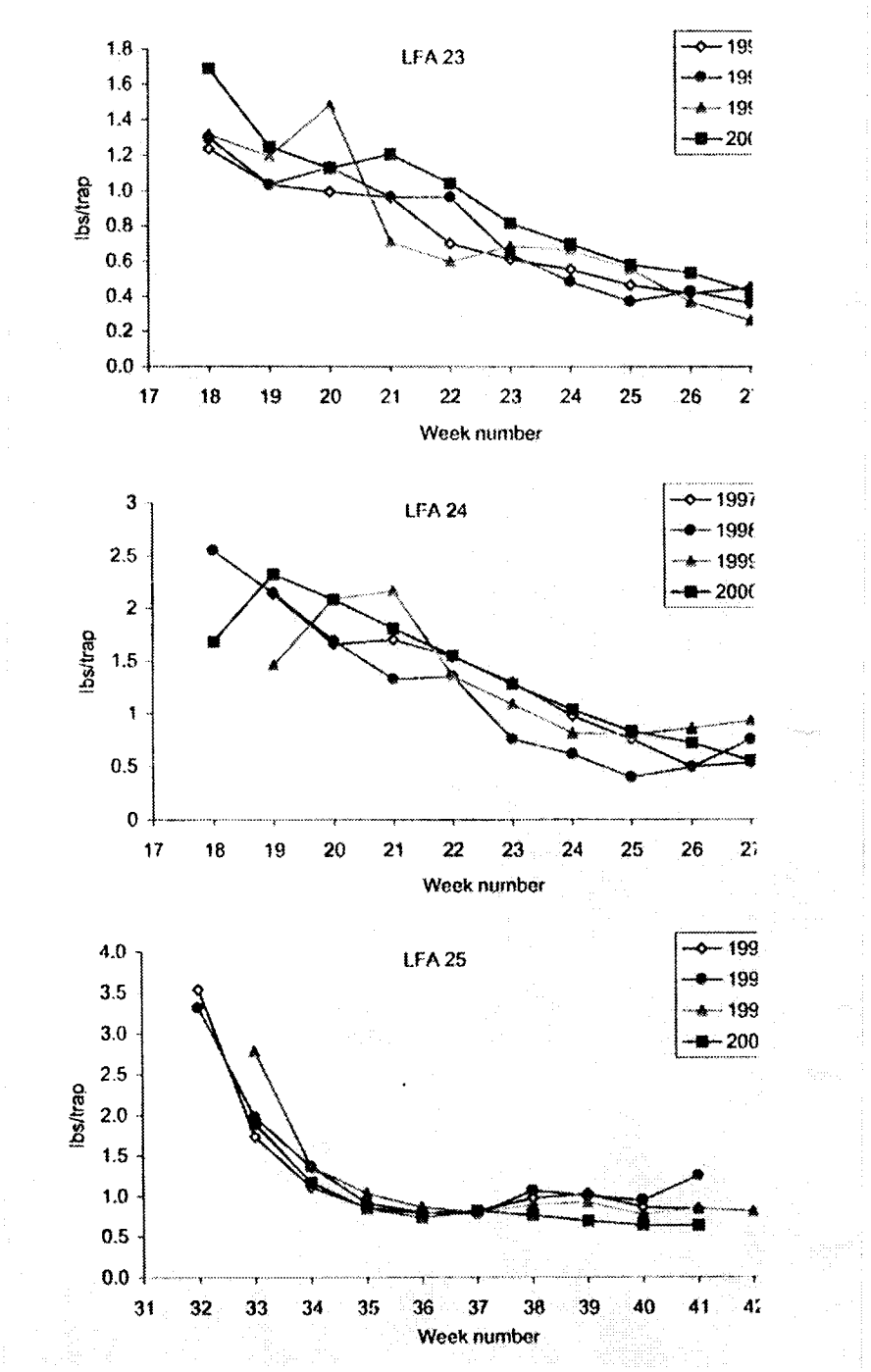


Fig 2 b) Trends during the season for a fall fishery (LFA 25) compared with spring fisheries

influence, since most will already have been caught by then as seen in Fig 2 for the Northumberland Strait fishery in Lobster Fishing Area 25, where catch drops to low levels after the first two weeks of the season due to very high initial exploitation levels.

For Statistical areas 70,71 and 73, the current best estimate of the rate of fishing is that for LFA 23 as a whole in the spring season, namely a harvest of between 75 and 85% of the stock in a season of 61 days. This is achieved in statistical areas 70, 71 and 73 by 203 license holders (including the 17 from Burnt Church), each potentially hauling 300 traps daily. Given that about 20% of exploitable sized lobsters survive the previous year's fishery, the bulk of the fishery each year consists of newly recruiting lobsters that entered the fishery during the summer.

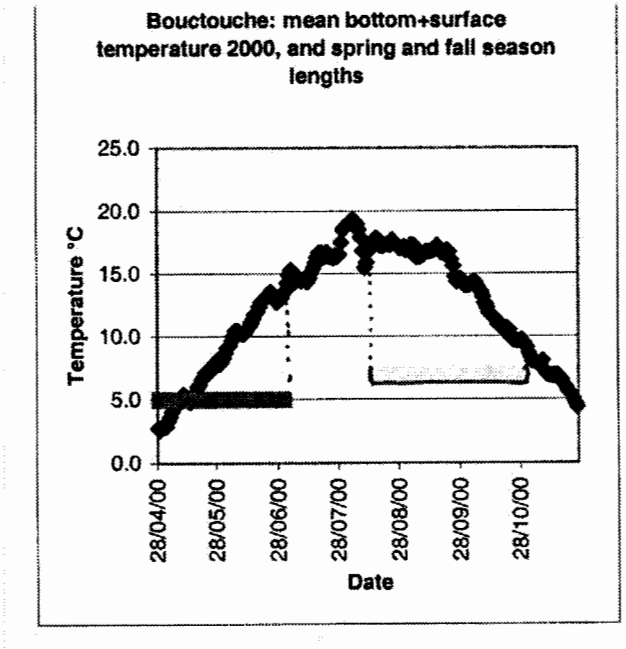


Fig 3: Showing the typical seasonal temperature cycle in the Southern Gulf and the two seasons being discussed.

Several factors determine the level of fishing mortality and its variation with season, and some further ideas on this are given in Annex II . As we can see from Fig 3, lobsters will be very vulnerable to over-harvesting, due to warm water conditions that promote feeding activity, with aggregation of the bulk of the stock at high densities in easily accessible inshore waters. These animals will be feeding actively to make up energy reserves used in the previous period of moulting and egg production, and their eagerness to enter the trap is clear from Fishery Officers inspections of lobster catch per trap early in the fall season. As noted in Annex I, trap catch averaged about 6 – 9 times that at the start of the spring season. Such a high ratio as 9: 1 probably does not apply throughout the whole season, and Tremblay (2001) in fact found a higher catchability in late spring for females than in September, and in general catchability was higher for female market lobsters than smaller ones.

Earlier work on lobster behaviour by McLeese and Wilder (1958) (see figure 4) found both lobster walking speed and trap catchability rise linearly with temperature, a conclusion confirmed by field experiments by Paloheimo (1963). In theory, the catchability coefficient can be broken down into seasonal values depending on a number of factors determining the vulnerability to capture of lobsters, and Annex I suggests an approach to this which yields a value for the q ratio of 5 : 1. Taking all the estimates of relative catchability together, the most likely ratio for fall and spring catchability falls somewhere around 5:1 to 6: 1. I prefer to do calculations with a range of ratios from 2.5:1 to 9:1 to show the effect of this factor, but give most weight to values in the area around 5 or 6 to 1.

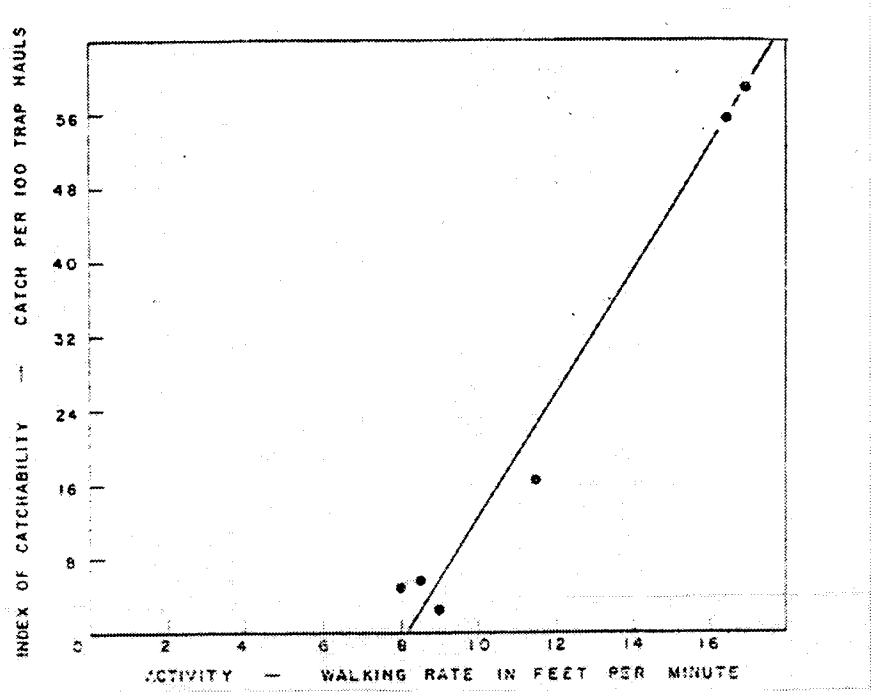


Fig 4: Showing how activity and catchability both rise with temperature in lobsters (From McLeese and Wilder 1958)

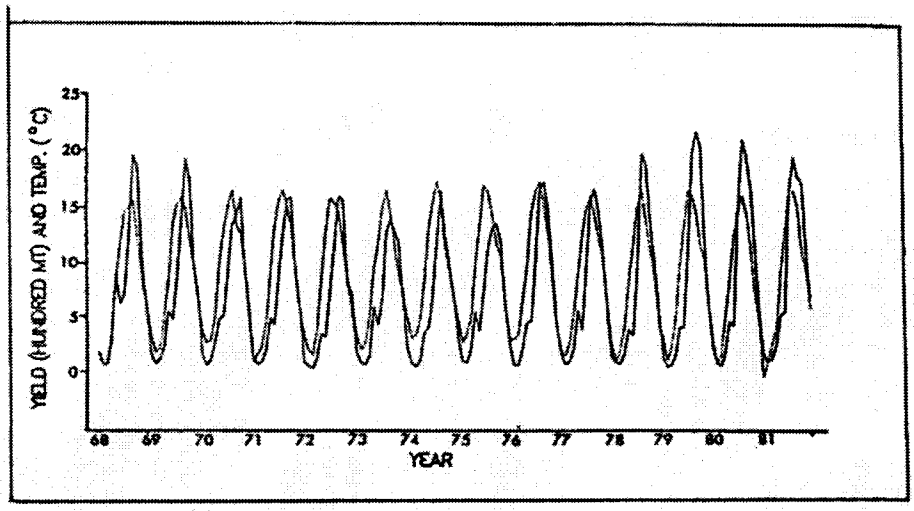


Figure 5. Monthly Maine lobster yield (mt x 10^2) and mean monthly water temperature at Boothbay Harbor for the period 1968-81.

Fig 5. From Fogarty (1984), showing how in the US where no lobster closed seasons exist, landings go up and down with the water temperature: most animals being taken in the summer-fall when they are more vulnerable.

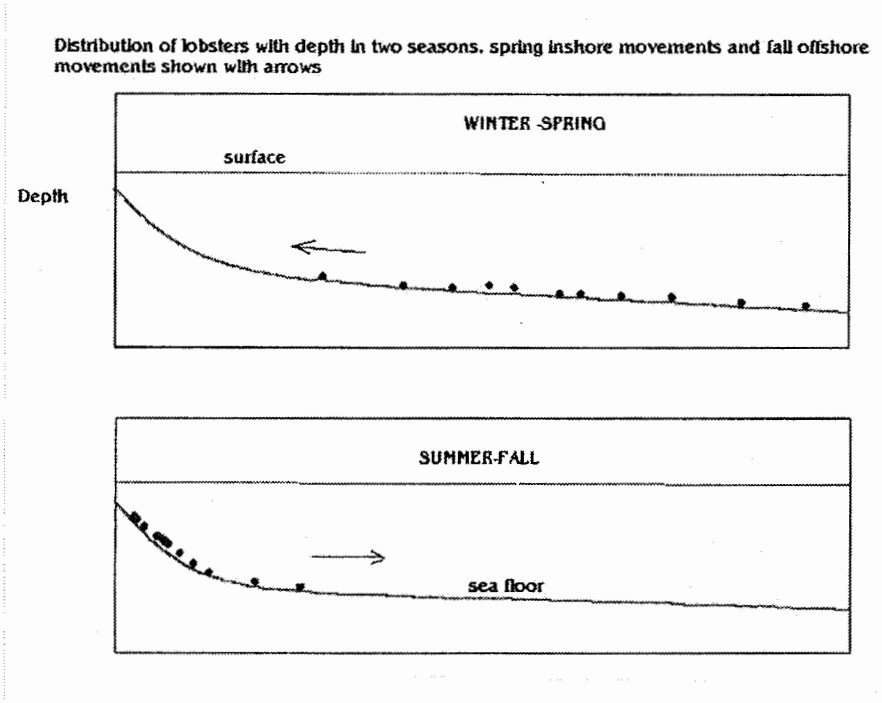


Fig 6: Illustrating aggregation of lobsters in summer fall as they move into warmer waters inshore. This higher density makes them easier to catch.

11) Projections for sequential fisheries

With two seasons in the same year, and new recruits moulting in before the fall fishery but not before that in spring, it can be readily shown that from the perspective of yield, that with the same number of traps fishing in fall as in spring (i.e. not the current situation), more than 80% of the total annual catch of lobsters will be captured in the fall season. This seems the case even assuming a fairly conservative ratio of catchabilities of 2.5 between fall and spring, Figure 5 from Fogarty (1984) for the US fishery where there is no closed season, illustrates how the landings and the temperature both peak together in the summer-early fall. It is clear from this that if there were no lobster seasons, the majority of the catch in this area would be made in the mid-late summer and fall. Catches would consist of a significant proportion of soft-shelled animals in poorer condition than in the spring season (although Fogarty suggests that catch rate is lower during the moulting season). The other danger of a fall season, is that because the animals are concentrated in a smaller area at higher densities and are more catchable, the stock can be seriously depleted if the number of traps is, accidentally or deliberately, set too high.

Table 1 : A simulation follows a group of animals entering the fall the fishery for the first time, through 3 years of a double season fishery. This supposes the same trap numbers operate in both fall and spring seasons (for districts 70,71 and 73) as proposed by the Burnt Church Management plan. This assumes catchability in the fall is 2.5 times that in spring. (See annex 2 for details of assumptions).

	INTERVAL DURATION	INITIAL NUMBER	FINAL NUMBER	CATCH NUMBER	RATIO CATCH IN FALL/FOLLOWING SPRING:	
FALL SEASON (1)	0.214	100000	27935	71803		
WINTER CLOSURE	0.496	27935	26584			3.58
SPRING SEASON (2)	0.167	26584	6512	20032		
SUMMER CLOSURE	0.126	6512	6430			
FALL SEASON (2)	0.214	6430	1796	4617		
WINTER CLOSURE	0.496	1796	1709			3.58
SPRING SEASON (3)	0.167	1709	419	1288		
SUMMER CLOSURE	0.126	419	413			
FALL SEASON (3)	0.214	413	116	297		

If the same level of fishing effort and number of trap hauls were applied both in a spring and in a fall fishery, the percent of annual catch taken in the fall season would be about 80 %. This simply confirms what has been said before by lobster experts, that spring and fall seasons fished in an area with the same number of traps, will effectively become a fall season. This is because the fall fishery is very efficient and 'intercepts' a high percent of newly-moulting lobsters before they reach the next year's spring fishery. Of course it would be possible to reduce the fall exploitation rate by reducing the number of trap hauls in the fall season. In fact, the number of traps fished per license was established for the spring season, and as we noted, should be reduced to 50-60/license in a fall fishery to achieve equivalent catch shares per license fished in the two seasons.

12) Projections for the 2002 spring lobster season

It must be clear from the earlier sections that a full-scale commercial lobster fishery in the fall is not compatible with a similar fishery in the spring. The figure of 5,600 lobster traps if fished daily (which probably will not be fully the case) during the proposed fall season, would undoubtedly lead to a decline in the next spring season. Evidently the non-native fisherfolk who have shown good stewardship of the fishery by measures such as installation of escape gaps, voluntary reductions in total traps fished to 300, etc, will have legitimate reasons for concern if such values are exceeded, since their lobster licenses (not to mention investment in boats) which constitute at least quasi-property rights, will have decreased in effective value over the course of a few seasons.

Fishing mortality has been estimated by Lanteigne et. al. (1998) to be at an equivalent annual rate of between 70 – 85% under the current spring season conditions of 61 days fishing. I see no reason to doubt these estimates that are not much different from those I found in the 1970's. This corresponds to an estimated 300 traps fished in Miramichi Bay by each of 203 license holders in the spring season, or 60,900 traps and a maximum 3.776 million trap hauls. Burnt Church Nation

proposes to fish 15,000 traps in the spring season and 5600 traps in a 78 day season from the 3rd week of August to the end of October. The First Nation spring trap total is not of concern, since their licenses replace those retired from the non-native fishery. The concern is with the number of traps fished in the fall. As indicated above, in the fall an imprecisely known proportion of new recruits to the population and the relatively smaller proportion of market-sized individuals left from the previous spring season will be taken. Thus, we need to look at the effect of their fall season on the number of newly moulted lobsters, and estimate the proportion of survivors that will later enter the next spring fishery.

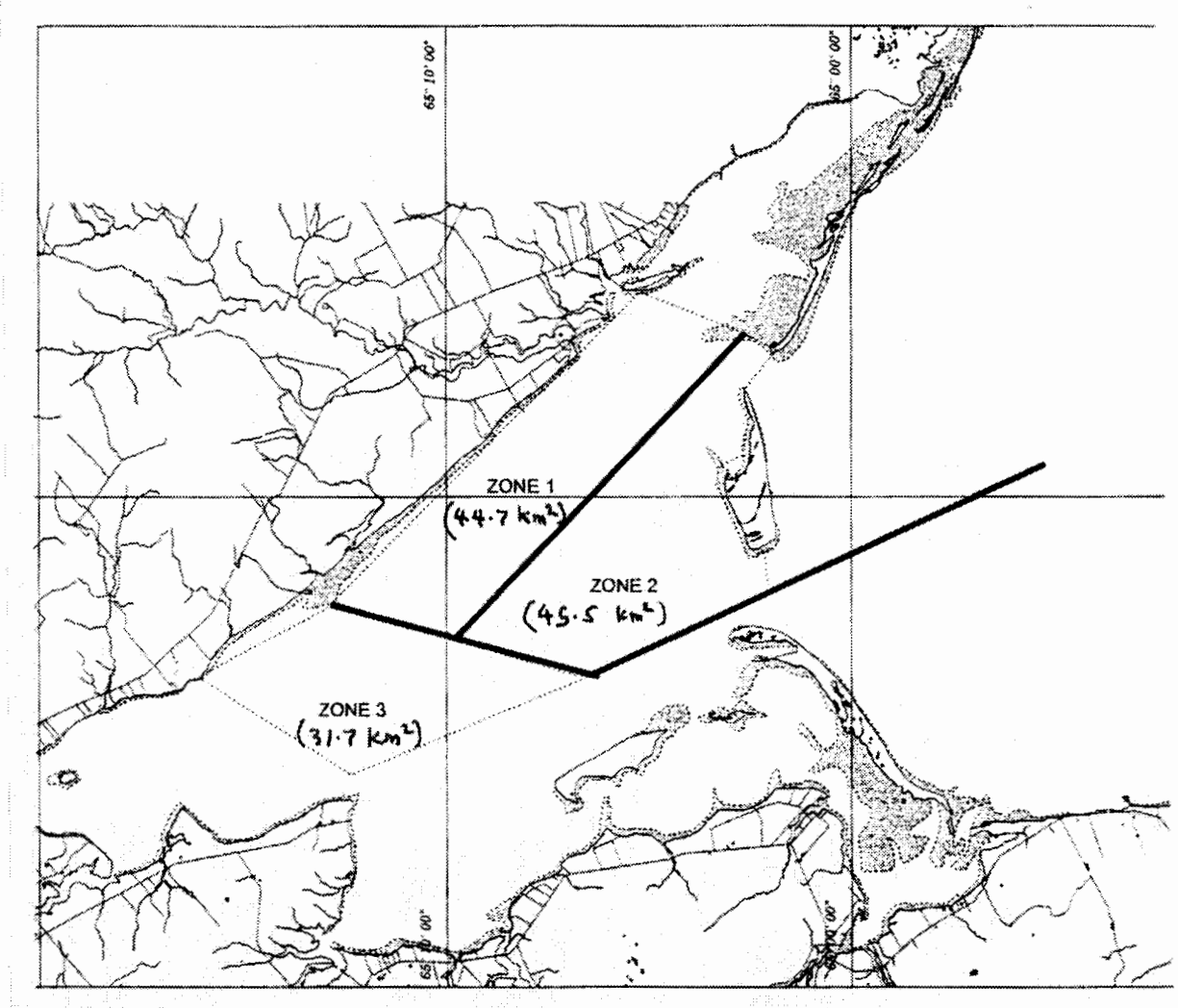
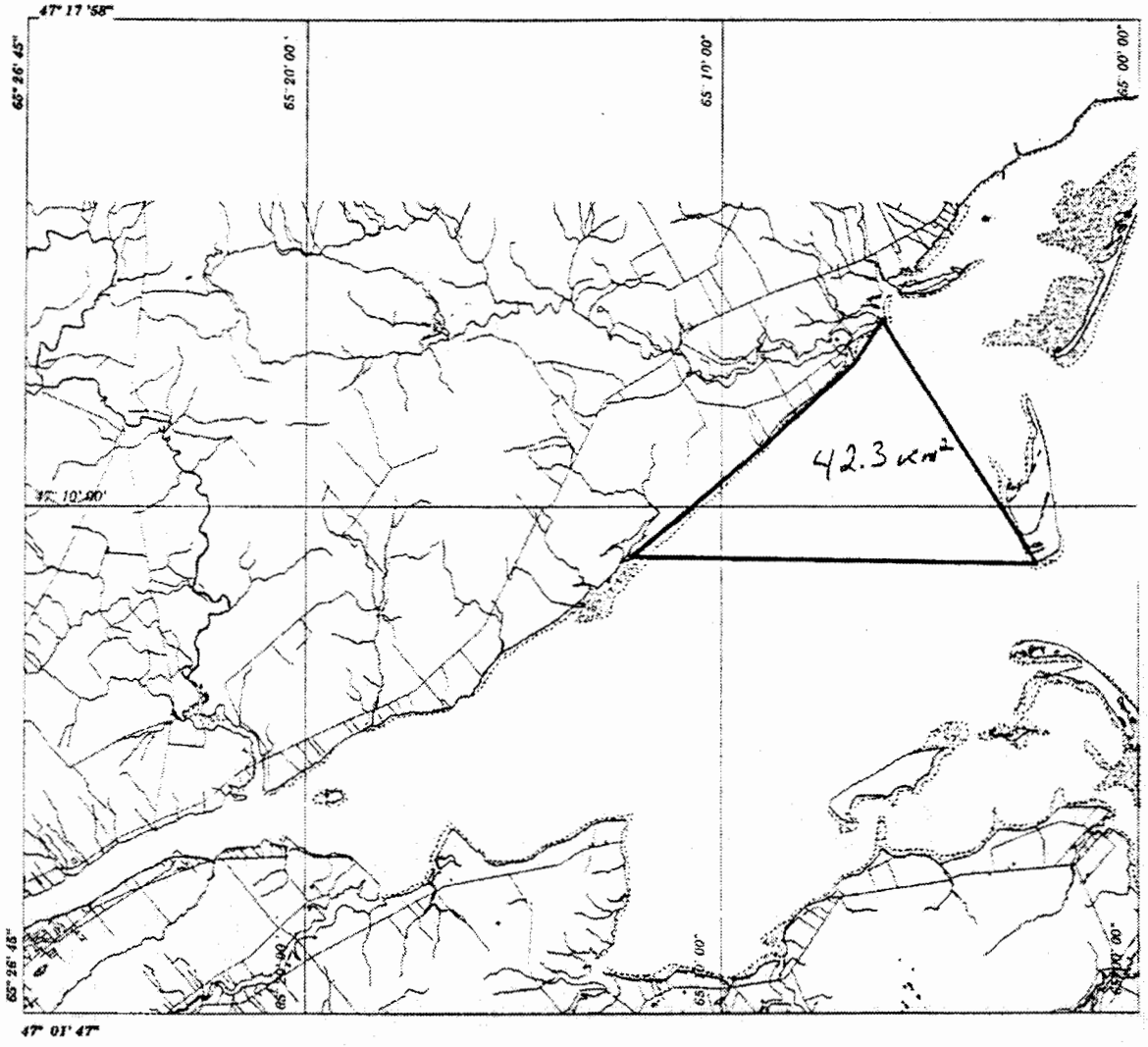


Fig 7 a): Showing the main areas inside Miramichi Bay, and (7 b) the triangle where Burnt Church effort was concentrated in 2001.

A rough calculation was made on the basis of the 5,600 traps proposed in the Burnt Church Management Plan to be fished exclusively in the fall season, assuming they will be fished anywhere in areas 70, 71 and 73, and the results are shown below. Remember however that it is unlikely that the Burnt Church Nation


47° 17' 58"
65° 26' 45"
65° 20' 00"
65° 10' 00"
65° 00' 00"
42.3 km²
47° 10' 00"
65° 26' 45"
47° 01' 47"

fall fishers will exploit inshore areas throughout all of statistical districts 70,71 and 73 and beyond, and in fact, their fall fishery has been largely confined to areas 1 and 2 inside the Bay (Fig 7a), and it likely will be impossible to fish anything like that many traps in the triangle proposed by DFO last year (Fig 7b). Hence the actual impact of their fishery can be reduced in proportion to the area of grounds (and supposedly the area of stock) that they are fishing as a proportion of the whole inshore area in statistical areas 70,71 and 73. In fact, not much fall fishing was observed by fishery officers on the other side of the channel from Burnt Church, nor further up the coast outside the Bay.

Table 2: Tentative calculation of spring shortfalls assuming different catchability ratios between trap fishing power in fall and in spring, and different proportions of the stock vulnerable to Burnt Church fishing.

Q ratio:	All stock enters Burnt Church area in fall	One third of stock enters Burnt Church area	One quarter of stock enters Burnt Church area
2.5 : 1	40.7%	30.3%	22.7%
6 : 1	71.5%	33.2%	24.8%
9 : 1	84.8%	33.3%	24.9%

As shown by table 2, depending on the q-augmentation factor, this calculation initially makes the probably incorrect assumption that all area 70, 71 and 73 lobsters move onto the inshore area off Burnt Church, and then attempts to correct for this afterwards. The incorrect assumption that all spring season lobsters in statistical districts 70, 71 and 73 enter the area fished in fall by Burnt Church, would mean that the combined catch in the next spring season in these statistical districts would be expected to drop by 41% if the q ratio is 2.5. It would drop by an order of about 72% if the q ratio should be 6 or more. As noted, this assumes the improbable event that all spring lobsters are available to Burnt Church fishing effort, which at present is mainly concentrated within a small area northern Miramichi Bay. In fact, the fishery there is not impacting all the lobsters fished in the spring season in statistical districts 70,71 and 73, so the shortfall will be smaller. It is probably to be expected a spring shortfall of a quarter to a third of the spring season catch without a fall fishery: the data are not good enough to be more precise. As noted, this impact depends largely on guesses as to what proportion of spring fishery lobsters enter the Mi'Kmaq fall fishery. Care must also be used not to pick one or other of the q ratios shown that helps to prove your point: ratios of 5 or 6 to 1 seem most likely.
A number of correspondents mentioned that lobster stocks may be in a declining phase. This certainly occurred in the mid 1990s (Fig. 2a) and could conceivably be continuing. If so, any shortfall due to fall fishing could be higher than predicted here, or vice versa, if the stock is increasing due to climatic improvements, it could be less. It must be understood that this type of calculation is of the 'if everything else remains constant' variety, but its relevance in my opinion is not invalidated by this. Similarly the storms that threw ashore lobsters in PEI was suggested as a possible alternative cause of a shortfall in 2001. Here we have to ask if events in PEI affect catches in areas 70, 71 and 73 (if so we'd have to admit the stock areas is bigger than just on the NB side). but the answer here I believe is basically the same as for the comment on the long term

trends. We have to be careful when basically explaining short term changes in the fishery by changes in management practice.

13) Effect of the fall fishery on population fecundity

If fishing is carried out throughout inshore waters in all of districts 70,71 and 73, there will obviously be a serious impact of the fall fishery on the population fecundity should the Burnt Church plan be followed. This will be in part due to the extra fishing mortality shown in the above table, in that the number entering the spring fishery will have been reduced approximately in the ratio shown in the 4th column of numbers in the above table. The impact on population fecundity in terms of the relative number of females surviving (not their egg production which is not calculated) will therefore be roughly in the same ratio as above.

14) A comparison of possible size-based fishery strategies with those in other fisheries

I would like to pause here and discuss the question of size and age-based regulations in a broad context, since it is my impression that species specialists often are unaware of the relevance of experiences in fisheries for other species and areas. In general, most fisheries regulatory measures in the North Atlantic follow the Beverton and Holt (1956) approach for size-based regulations, where the aim is to increase the minimum size limit, hence increasing yield per recruit, and assumes it is acceptable to harvest a fish after its first spawning. Larger adult fish or invertebrates are the target for exploitation. The experience in North Atlantic groundfish fisheries under this paradigm has generally been dismal despite indirect effort regulation by quotas, and by license limitation. In contrast, some fisheries for juveniles of a species have persisted and appear robust even in the absence of catch or output control as long as the adults are not the target of a fishery. Most lobster fisheries are in fact fisheries for juveniles, and according to the Beverton and Holt paradigm should already have collapsed. The juvenile fishery I have studied recently is the Mediterranean hake fishery (Caddy and Seijo, in press) and I will mention this briefly for illustration of an alternative paradigm more suited to fisheries for juveniles.

The principle we used in modelling the bioeconomics of the Mediterranean hake fishery was to suggest that when a decision is made to fish an age class of female hake, it supposes that the future reproductive contribution of individuals of this age have a lower economic value than their current landed value. If this is not the case, logically it would be better to leave most of the 'mothers' in the water to reproduce and catch the 'teenagers'. One reason for considering this approach is that more recent work based on examining stomach contents of fish in the North Sea shows that death by predation of young fish by older fish and other predators, is much higher than for adults, so not many small juvenile fish make it to marketable size. The approach we took to getting a value for the lifetime reproductive contribution of a cohort was to sum the egg production over a lifetime with a known fishing and natural mortality vector for each age group. We then estimated what proportion an age group of spawners contributed to the total lifetime egg production from that age onwards as a proportion of the total egg production of all age groups in the fishery.

Under assumptions of population stability, a proportional contribution of eggs to the total reproductive output by any age group can be converted to an economic value by dividing up the total landed value of the stock in the ratio of eggs produced, and likely to be produced in the future, by each age group. The proportional reproductive value of an individual female in the cohort value can then be obtained by dividing the cohort value by the number of individuals in it, and comparing the resulting reproductive value of one spawning female with its landed value. If the reproductive value is higher, it would be logical to conserve a good part of this age class. We found a break-even at ages 4-5 for hake, suggesting that fishing individual females just below this age cut-off was acceptable, but a directed fishery for larger females would lead to a loss of spawning potential not compensated for by the increased landed value. I realize that this line of argument will be objected to as not consistent with stock recruit theory by some theorists. I assume however there is agreement that egg production is sufficiently low for Maritime lobster stocks, that any increase in egg production will result in a close to linear increase in recruitment, all other factors equal? That seems to me in the circumstances to be a precautionary point of view.

I have not carried out the above calculation for lobster populations since it would require more detail on life histories and time than is available, but this exercise seems worthwhile for someone else to do. From a preliminary view of the size compositions, it seems intuitively certain that after a third moult into the fishery, and perhaps earlier, at current low levels of survival to reproduction, that these older females are worth more as reproducers than when caught. I.e. they probably have more value as insurance against future stock declines than their individual landed value, and probably also have played a significant maternal role in supporting recent good recruitment.

15) Top-down or bottom-up management approaches? alternatives to managing local lobster fisheries

In deciding on the objectives for management, conventional fisheries management theory has given the greatest emphasis to maximizing the extraction of the resource, with objectives such as Maximum sustainable Yield or Maximum Economic Yield. These objectives have usually been associated with the 'top-down' approach to management, whereby governments in a paternalistic mode decide on the appropriate regulations, and supervise the division of benefits from the fishery. This approach has been relatively unsuccessful, not least since it puts fisherfolk and government into adversarial positions, and removes the incentives for conservation-orientated behaviour by fisherfolk. As such a 'ratchet' operates which ensures that effective fishing effort will continue to increase as potential stake-holders seek to evade the regulations, since effort is not easily controlled through top-down approaches.

Nowadays, the perspective for inshore fisheries is changing towards bottom-up approaches, where fisherfolk have a major say in how the resource is exploited. At the same time, when taking on this role, they should remind themselves of the idea of intergenerational equity..... which has been well expressed by a quote from Berkes (1999) referring to Menominee forest conservation principles. These provide a motto that could be usefully applied to the lobster fishery: 'Remember that we are borrowing the forest (in this case, the lobster resource) from our

grandchildren'. We should ask ourselves: Is the management plan under a co-management scenario, leaving the resource in a productive condition for future generations?

What other objectives then seem suitable for management of the lobster fishery? One of these that must be given high priority is the maintenance of productive employment in coastal communities. In New Brunswick the lobster fishery has always been an important contributor to employment in coastal communities within the core resource-based industries.

Another possible objective of fisheries management that is currently in danger of being forgotten is that of social harmony: this objective is always at risk if two or more separate groups share the same resource, and the current conflict is a good example. From my discussions with both parties, I detect that many are tired of the conflictual situation, and are ready to make some reasonable concessions, if not to each other, certainly to ensure the well-being of the resource. One can ask the question for example whether it is possible for the fishery to be exploited harmoniously by two or more groups that are following different seasonal patterns of exploitation, or observing regulations that differ from those of adjacent groups fishing the same resource? The requirements of the Marshall decision for increased commercial participation by First Nation peoples in the lobster fishery should, I believe, be largely achieved by increased access to the current spring fishery. Appropriate alternatives will presumably be provided to stakeholders displaced from this livelihood, in recognition of their existing access rights.

Thus, my conclusion is that a major fall fishery for lobsters will clearly have widespread social and economic repercussions and promote social unrest. In the interests of social harmony I believe the fall fishery should be kept to limited levels, plus I would suggest some limited use of the processed product where this will increase employment to the Burnt Church community. This might include for example, an outlet for tourist consumption of lobster in a diner set up on the reserve (see later). The agreement of the Burnt Church Nation for the statutory period of 3 years to progressively reduce the fall fishery would have to be compensated for by other sources of employment until the extra licenses provided under the agreement become operational in the spring fishery. This could be by achieved by creating other gainful employment from the resources in the Miramichi Bay area, of which more later.

The question of what are access rights in a limited license fishery will of course need to be considered when discussing these types of issues, and to the extent that access rights are individual or belong to a community is a key issue I believe.

16) Access rights, co-management, and community-based management

Resource access rights have de facto existed in the Maritime lobster fishery as a result of about l00 years or so of fishing by non-native peoples and a much longer period of small scale harvests by First Nations. Commercial fishing rights have already been exercised in cooperation with government through lobster management committees in what has come to be known as a co-management approach. Geographically-delimited access rights also exist at least at the level of Lobster Fishing Districts for those fisherfolk holding a license to fish lobsters in that district, but are not differentiated at the level of statistical district. The question arises however if there is a logical basis for considering smaller and more coherent area-based rights where the local

community itself could have more of a role in deciding on how the fishery local to the port is carried out. If such an approach were feasible it would help break the inertia that makes it difficult for the more active communities to make progress, free from the 'tyranny of the masses' that makes it so difficult to move forward in managing a common access resources. Should a community wish to invest in enhancing the productivity of their local resources they should be encouraged to do so within reason, as long as it can be shown that they are not adversely affecting adjacent communities by doing so. This would open the door to a number of activities in the field of resource and/or habitat enhancement, and some of these potential benefits are described later in the report.

The argument against enhancement is that lobsters migrate, so that there is little local benefit in increasing local production, or enhancing local larval production etc. Despite occasional longer migrations by larger lobsters, seasonal inshore-offshore movements probably do not displace the local stock unduly, especially if there is cover provided locally. Such exchanges as occur with adjacent communities are largely two-way. As long as all move forward fairly much in step, there seem strong arguments for local jurisdiction over most shallow water resources under government overview and advice. This does not apply only to the Burnt Church community, though it is the main objective of this report.

17) The appropriate scale of management units

Dick Wilder who did most in the 1950's to 1970's to collect and analyse lobster data in the Maritimes, carried out extensive tagging in the spring season and found that there was relatively limited migration of animals recaptured in the same or following season. (Wilder 1963). Average movements were 7 miles or so over the course of a year. Other information such as the difference in growth rates shown by lobsters inside and outside of Northumberland Strait support the contention that once settlement to the bottom has occurred, long-distance movement is relatively limited for the sizes in the fishery. This experiment has a serious drawback however in that movements outside the spring season cannot be detected. More recent tagging experiments seem to confirm these earlier results showing very limited movements in the Gulf area, but with movement inshore and offshore seasonally.

From indirect evidence, now confirmed by the Burnt Church fall fishery, it is clear that there is a seasonal migration of lobsters into deeper water at the end of summer and a return migration to shallower areas in late spring. It is worth considering why this occurs. In deeper water within the Strait, movements may be more pronounced, which could be in part a function of the largely fine sediment bottoms in many areas of the Strait. These provide little cover for animals, hence making for more movement. Winter ice conditions in the Strait presumably lead lobsters there to exit shallow areas into deeper water at either end of the Strait in the winter. We have very little information however on lobster distribution and activities during winter in Gulf, or where the Strait lobsters go for egg hatching.

Despite these mysteries, as long as the fishery is mainly carried out in the spring season, lobsters apparently will tend to remain or return to the same areas in successive years. As a result, despite the fact that no genetically separate stocks have yet been identified in the Gulf, there is no radical reason why lobster fishing access areas should not be based around local communities. With

regard to co-management. Berkes (1999) refers to the 'subsidiarity principle' which he states as: "Use as much local-level management as possible: only so much government regulation as necessary". Under this approach to community-based management, the allocation of benefits would be decided by the local community, under the technical guidance of DFO. Such advice could be channeled by government through one of the regional lobster committees suggested by the FRCC, but development of independent sources of expertise is to be actively encouraged. A Community-based management approach like this will differ from the system described in the FRCC report, which can be summarized as follows in three steps:

1) Lobster Advisory Committee (with fisherman input) recommends measures for the LFA
2) Regional Resources Manager (DFO) drafts lobster management plan
3) Regional Director-General (DFO) approves the plan

Under community-based management a wide variety of approaches are used, some of which have been spelled out in a recent FAO Fisheries Technical Reports 404 entitled 'Use of property rights in fisheries management', edited by Ross Shotton. They have in common the feature that decision-making and planning is initiated from the local level, even if it benefits from overall advice from government, and works within a framework ensuring it does not adversely affect other communities.

Much more effort will be needed at a local level if communities or other groups are to take this step to effective self-management (See e.g. Harvey and Coon (1997)'s study on this in New Brunswick). Referring to the New Zealand situation where this process has already occurred, with a restoration of a sizeable proportion of fishing rights to the Maori People, Harte (2000) points out that rights holders associations or other local management groups, must:

- Set management objectives and performance measures
- Specify rules for management and governance
- Define necessary services such as research, administration, monitoring and compliance and establish funding arrangements

After developing a management plan, rights holders groups must:

- Manage decision-making processes
- Purchase research services
- Administer access
- Monitor fishing activity
- Provide information and education services
- Enforce non-criminal rules
- Collect levies to fund management.

Obviously this is a tall order for small local communities, and a mixed management approach where DFO provides many of these services to the local management areas is probably the way to go, if this is administratively feasible.

18) Lobster enhancement measures

1) Are there advantages in establishing inshore refugia for berried lobsters?

We have already noted that environmental variability may be one cause of possible future declines in recruitment of lobsters, and it is significant that lobsters in lobster district 23 are near the northern limit for the species. As usually occurs for most species in these conditions, low water temperatures (already found further south by Fogarty (1984) to be a constraint on lobster production) are likely to be especially important here. Lobsters pass through 4 stages during their life in the plankton, and settle to the bottom some time during stage IV. In the Northumberland Strait area, data collected by Scarratt (1964) revealed a wide variation in times of release of stage I larvae into the plankton, but the dates of occurrence of Stage IV larvae tended to be shifted towards the end of the warm water period as one might expect. My analysis in the 1970's of Scarratt's data using the laboratory results from one of the earliest Canadian fishery biologists (Templeman 1936) looked at larval development in terms of the seasonal temperature cycle and the number of degree-days required to survive from stages I to IV. Degree-days are a rough measure of the thermal requirements to pass through a particular development stage, and are obtained by multiplying temperature x number of days. This study (Caddy 1979b) confirmed that in many stage I larvae released later in the summer would need more degree-days to reach metamorphosis to bottom-dwelling mid-way through stage IV, due to the declining temperatures at the end of the summer, than are available. The fact that larvae released later in the summer were unlikely to reach stage IV before the end of summer was due to the rapidly declining surface temperatures after July-August and would fail to add to the population.

The cool surface waters in some years may also reduce the survival of stage I larvae produced after June. In fact, Scarratt showed that larval survival seemed very variable, and to be highest in years of high larval production. In part also, the strong thermocline that develops in warmer years between cold bottom water and warm surface waters, plays a part. It may mean that females in cold water below the thermocline have no way of assessing whether surface water conditions are optimal for larval development, and development of eggs and release of larvae could be delayed, even if conditions in the plankton are favourable to them. We can tentatively conclude from this that the long period of release of larvae throughout the summer is a safety device in situations where there is poor predictability of optimal time of larval release. It is achieved at the cost of a high loss of larvae released later in the season.

We already suspect that larger lobsters may release more viable larvae than first spawners, and this seems to emphasize their importance in years when summer temperatures are below average or onset of spring delayed. In general, in the Gulf there seems an advantage in hastening egg and larval development, and this is presumably why egg-bearing animals surviving the spring fishery move to warm shallow water early in the year. Taking this argument further, it suggests a potential advantage when returning berried females to the sea, of bringing them to shallow water for release early in the season, if doing so is compatible with proper handling of adults and does not damage their attached eggs or expose them to low salinity water. One possible enhancement strategy is that each fishing port establish a reserve or refugia in shallow water, (Fig 7) preferably close to the harbour for ease of supervision. Once water temperatures inshore begin to warm up in the spring season, a proportion of tail-clipped berried females caught late in a trip could be dropped off there when returning to port, if this can be done without their prolonged exposure to air and high temperatures. Such local refugia can be easily supervised to avoid illegal fishing, and their holding capacity enhanced by placing cement or 'breeze block' structures within them with crevice sizes suitable for larger females.

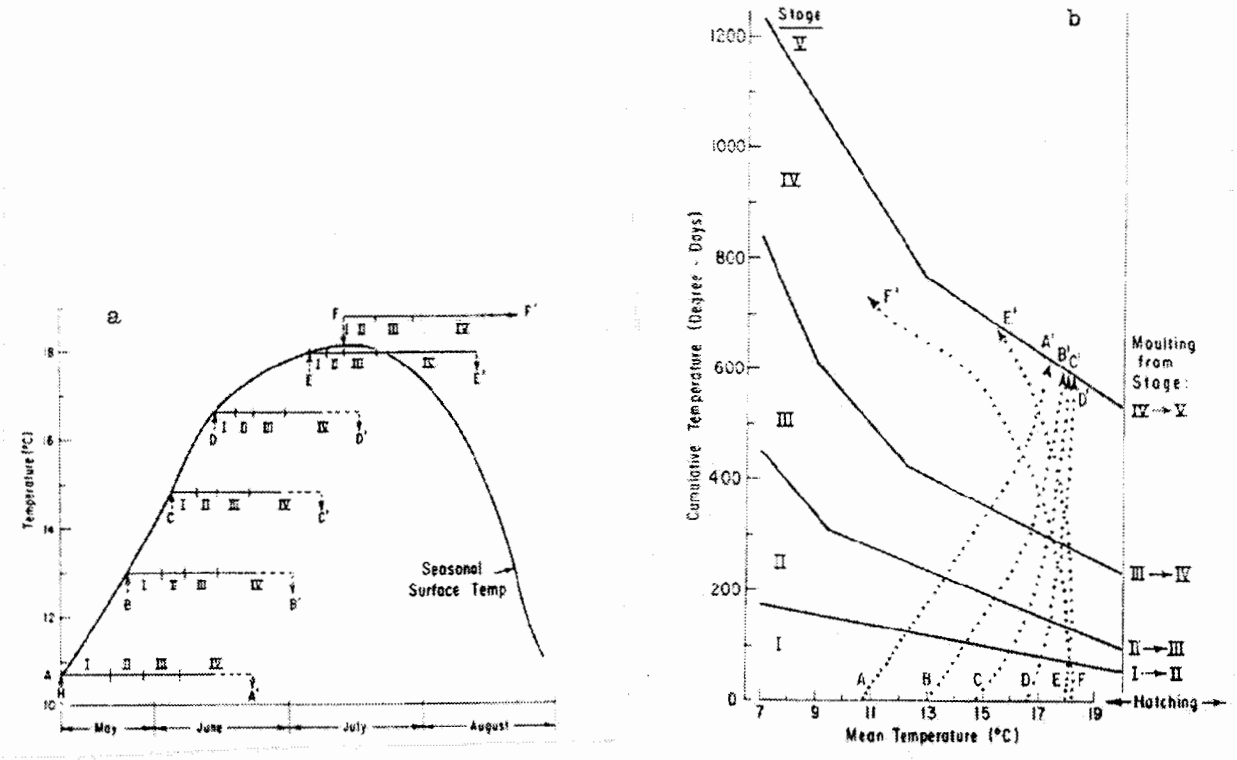


Fig 8. Illustrating how larval survival is likely to fall off later in the season due to the need to achieve a certain temperature sum to reach stage IV and metamorphosis. This suggests that releasing larvae earlier in the season will lead to a greater survival rate (From Caddy 1979 b).

It is virtually impossible to calculate the net benefit in terms of larval production through such a measure, which for the moment needs experimental study before major application. The aim would be to ensure an early start to larval life as well as providing a logical extension of berried lobster conservation. Hopefully placing these animals in a refugium would also reduce multiple recaptures and release of larger tail-punched individuals which exposes them to incidental fishing deaths. Such a reserve could also be a logical focus for summer-fall tagging experiments to compare mortality, recapture and migration rates of these individuals with those from fished areas. The ideal place for such experiments is off Burnt Church, with the involvement of the local people in carrying out these experiments under DFO supervision.

As mentioned, such a possible 'larval enhancement' strategy will require to be carefully examined by appropriate field experiments before application. We need to look at the survival and hatching time of eggs on berried females returned to the bottom near shore after capture, after they have been kept inshore for different periods of time under different temperature conditions. We also need to compare the stage of egg development with depth and size of female lobsters.

The FRCC conservation framework also emphasizes the need to have several year classes in the fishery, and specifically planning for this seems an objective in itself. An example is given by Berkes for another native fishery of the use of two sizes of gill nets by indigenous fishers in a lake trout fishery to avoid depleting the larger fish. He noted that 'the collapse of such a fishery was related to a combination of two things: a) because of the selective removal of large fish the population came to depend on a small number of reproductive year classes, and b) poor spawning for two or more years in a row'. Such a sequence of poor recruitment years has not occurred recently in many lobster fisheries, but it is arguable that there is a relatively small safety net of reproducers should such a series of poor recruitment years occur for whatever reason.

The mechanisms of clipping and returning large females, the possible use of maximum size limits to protect larger spawners, the use of closure areas, refugia and buffer zones between the grounds of adjacent ports, are all ideas in my opinion that are worth exploring. The point is that they can be explored on a local basis with the willing participation and agreement of local communities that have established exclusive access to their local commons that justifies such expenses and/or sacrifices. The usual argument against such activities is that their effectiveness is impossible to establish, and their cost effectiveness negligible. In my opinion it would be better to establish first that they are feasible first before dismissing a possibly good idea in advance. This is another reason for suggesting local lobster management areas, some of which may be interested in testing one or other idea, which can subsequently looked at by other communities and adopted if they are convinced as to its effectiveness.

19) Do recruitment 'bottlenecks' exist?

Studies on European lobsters involving microtagging of very small lobsters showed that juveniles pass a significant phase in their prerecruitment life in crevices in cobble bottom where they are protected from predation. Such cobble bottom areas are rare below tide marks and rather limited in extent. If so, their limited area could be a 'bottleneck' for the production of prerecruits,

especially since their aggressive behaviour does not permit them to occur at high densities as for spiny lobster juveniles (Arce et.al.1997). It may be questioned whether the placing of wire mesh cages containing materials creating small crevices such as clam shells, on the bottom at appropriate depths could provide such enhancement. This idea would need to be studied in an experimental format. In areas such as Miramichi Bay, the limiting factor governing juvenile abundance is unlikely to be food, given that the Miramichi is considered a system providing a high rate of supply of organics and sediments (Buckley 1995). As noted, the limit to recruitment could be the absence of crevices of suitable size.

Some theoretical considerations on this are discussed by Caddy and Stamatopoulos (1990) who suggest fractal characteristics will differ between ideal juvenile and adult habitats. They proposed an experimental approach to detecting post-settlement habitat bottlenecks, involving a 'crevice sampler'. This is a structure of concrete or pvc pipes of different diameters held in a frame, with a known proportion of crevices of known size. It is examined periodically to determine the occupancy frequency of each size of crevice. Those crevice sizes with the highest occupancy rate presumably correspond to the sizes of lobsters suffering from a lack of natural crevices of the same size in the natural environment. Presumably this size coincides with a natural 'bottleneck' to production of lobsters. Such a concept was found to provide practical results by Beck (1995) for studies of stone crab ecology in Florida, and could be adapted for experimental study with lobsters. In fact Lawton et. al. (2001) distinguish for the Bay of Fundy two types of critical habitat for lobsters: nursery areas where small lobsters settle and spend their first seasons on the bottom, and shallow spawning areas where adult lobsters move in to complete reproductive functions. The high density of animals occurring in Miramichi Bay makes this an ideal place to study shelter and food requirements of lobsters and also the possible predation on juveniles, and these features could make it attractive to research workers if some facilities were provided.

On the subject of predation, the studies of Hanson and Lanteigne (2000) seem to show that cod do not prey much on lobsters, but I believe we should be looking more at inshore predators such as sculpin as possible predators on young lobsters. Despite this, the number of large predators in the Gulf is currently very low for larger fish such as white hake, flatfish and cod due to stock depletion. This may be an important reason why lobster recruitment has been good in recent years. Given that rocky areas where shelter from predation are not abundant in many areas, is it possible that those juveniles displaced from crevices by the fierce competition that goes on between juveniles are surviving which would have been eaten in earlier years when groundfish were more abundant? This type of hypothesis need more confirmation, but it would be worth studying the stomach contents of inshore predators caught by long line fishing with juvenile lobster (or more practically, shrimp?) for bait over juvenile habitat, to see if it is possible to quantify predation of juvenile lobsters. Another hypothesis that seems to fit the facts considers herring as a potential predator of lobsters! Here we are talking about lobster larvae of course. Herring feed in the top 5 metres at night which is where lobster larvae are found, and herring stock size has also been low in the 1990`s when lobster recruitment was high. Examination of stomach contents for lobster larvae might be interesting.

20) First Nation experience in resource management

Fikret Berkes in 'Sacred Ecology' summarized a number of principles and traditional approaches followed, often successfully, by native peoples in managing their resources especially in fresh water. Although he finds that a clear demarcation between indigenous practice and Western science does not exist, the latter proceeds mainly by reductionist analysis, dividing phenomena into smaller units to describe them exactly, often with less attention paid to the whole ecological situation. Often, he says 'scientists tend to dismiss understandings that do not fit their own; this includes understandings of other scientists using different paradigms' (see Caddy 1999 on this). At the same time he notes that exaggerated claims of indigenous wisdom have hurt the study of traditional ecological knowledge. At least in the past, and in some cases today, he points to the Indian economy as fitting what we would now call an ecosystem approach. This treats the environment 'as a portfolio of resources and services that supported livelihoods'. In contrast he says that the colonists 'turned the environment into commodities, exploited sequentially one resource after another following market demands, and caused depletion and environmental degradation in the process'. The history of fisheries development along the east coast of North America seems to have reflected this latter situation. For example, deleterious changes in exploitation of cod fisheries towards industrial exploitation from traditional fishing practices was felt by Hutchings (1998) to have been obvious predictors of future stock collapse. Perhaps for this reason the conservatism of lobster fishers is one aspect that needs to be conserved if the resource is to remain productive, and their opinion respected, since not only native peoples show a concern for respecting ecosystem integrity.

21) TURF's

Tenure systems for the use of local renewable resources are widely distributed amongst rural communities, and in the marine environment, Christy (1982) proposed that governments should more explicitly recognize local territorial use rights in fisheries (TURFs) in improving management systems, and this seems applicable both at the individual level where some fisheries for lobsters traditionally operate this way, and at the community level. The rationale of course is that this way the resources can be matched to the numbers of exploiters. This approach is in effect in the natural world and man is no exception to this situation.

Adaptive management (e.g. Holling 1978) is one approach to natural resources that recognizes that ecosystems are changing, and the need for resilience to avoid the system breaking down or degrading to a less productive state. One advantage that multiple local management areas provides is to test a variety of different approaches, and select that which proves to be the most stable and/or productive. Taken together with local tenure systems, the adaptive management approach may allow different approaches to be compared. It may be important and relevant to the lobster fishery that there may not need to be a precise capability to predict yields quantitatively (there is no such capacity for most fisheries), but rather to identify ecosystem processes and adapt to them. Thus, knowing that egg production is the key limiting factor should allow one or more innovative approaches to be used such as reef refugia, maximum size limits, clipping and returning large females, rotating harvest schemes etc.

22) Some possible management initiatives

Some other options to consider for lobster management here or elsewhere in the future, are mentioned below: not many of them have an immediate bearing on resolution of the Miramichi Bay contention, but may be of general interest.

A/ Increasing the size limit by one moult increment

Increasing the minimum size limit is the classical response in the Beverton and Holt tradition, and almost certainly would increase yield and eggs per recruit for the first maturing moult group. I suspect that this measure will however be unacceptable to fishers at this time, and although it would increase the yield as explained by many studies, it will indirectly place pressure on the older females that I believe are important for stock replenishment. At least for the Magdalen Islands, Gendron and Gagnon (2001) seem to find that a substantial increase in minimum size will be needed to double eggs produced per recruit, but measures to protect large females (e.g. over 127 mm CL show less risk of not achieving the management target of increased egg production.

The only suggestion I could make here that if it is decided to implement a significant minimum size increase in a spring fishery, instead of increasing sizes by a few millimetres at a time over a series of years, a more substantial increase should be aimed for, using a strategy such as the following. Given the high exploitation rate, a significant increase of up to one moult interval can be achieved by allowing a short spring season in the year of change over at the old size limit. This would be followed by a short fall season at the new size limit in the same year of moulting, and then a normal season the following year, again with the new size limit. Undoubtedly earnings will be lower in the double season year and the in following spring, but will rapidly be made up for in the following year. I am not convinced however that this is the immediate priority though it could be a useful measure to consider in the future.

B/ Close a proportion of the stock area to form a refugium

Under this option, at least a proportion of older lobsters in the refugium escape the fishery. This approach is effective in reducing exploitation rate slightly without much of a drop in yield, but should have a much more positive effect on egg production, even if the number of traps fished outside the refugium is unchanged. Of course, we need to know the dispersion rate of lobsters from inside a refuge onto the fishing grounds. Since it is likely that at least 10-20% exchanges occur with surrounding areas, eventually many lobsters in a refuge will be captured, but probably at somewhat larger sizes and higher individual yields than in the surrounding open areas. Hence it is likely that any short term yield lost in closing (say) 10-20% of the grounds, will be made up for by a higher proportion of markets in the catch. More importantly, it will improve recruitment, and as is shown by a simple simulation, will increase egg production, and perhaps equally importantly, the mean parental age.

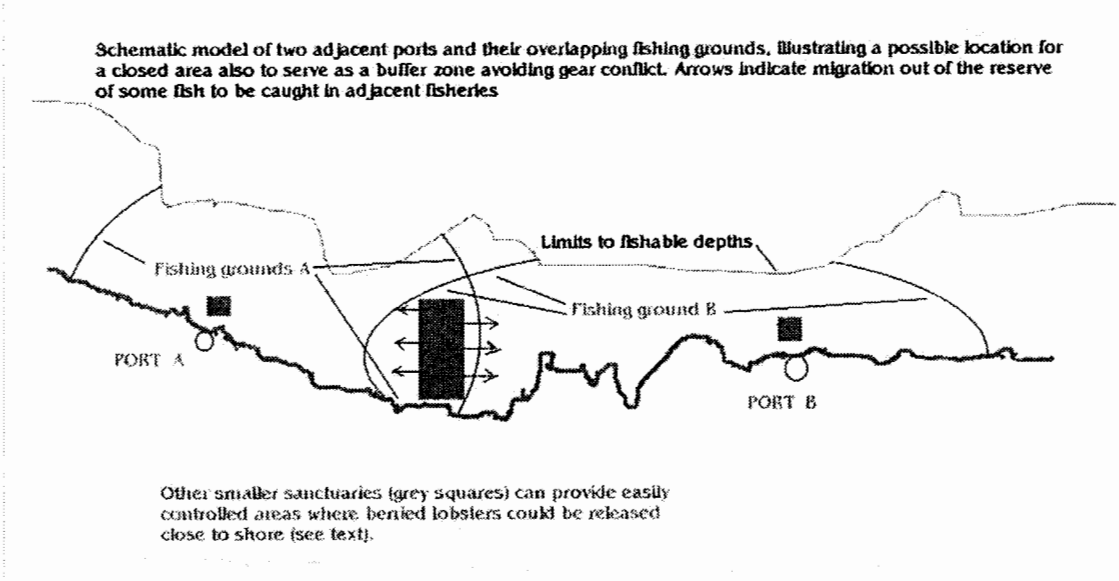


Fig 9: Overlapping areas fished by adjacent ports could be the ideal location for a closed areas functioning also as a buffer zone. Other easily-supervised closed areas could be close to port inshore for placing berried lobsters and contain artificial reefs.

It is my opinion that closed areas for fisheries purposes have been less than fully effective for three reasons: their small size, illegal fishing in them, and a low holding capacity per area (Caddy 2000). Increasing holding capacity for large lobsters by installing artificial reefs in refuges is one approach that shows promise. Such refugia can serve a double purpose, conserving a small population of larger spawners, but also acting as 'buffers' between fishing areas of adjacent ports, as suggested by Caddy and Carocci (1999). Implicit here is the idea that if a move is made to community-based management, such closed areas would be partly self-managed by local fishermen's communities, with overall consultation and coordination with a management committee for the lobster district as a whole. Such an approach has been criticised since the sub-area managed locally does not correspond to a unit stock: unfortunately, this comment applies to most inshore resources, and requires local coordination between adjacent areas. As noted, it does allow the flexibility for experimentation in different approaches to management, and would encourage enhancement activities.

The objective of management by refugium is to try to increase the proportion of larger lobsters (not just females since a proportion of larger males are also needed for mating) in the population. As suggested earlier, the closed areas can be in the form of 'buffer zones' separating the fishing grounds of adjacent ports or communities, who will be expected to assume some of the responsibility for their continued integrity, or can be proprietary zones close to port where they can be easily supervised (Fig 9). No attempt can be made with existing data to fully quantify the effects of this option, but under this option it can be shown that the reproductive potential can be increased significantly with closure of as little as 10-20 % of the stock area.

C/ Maximum size regulations

I believe that some variation on this type of measure is going to be the most effective for ensuring a high and viable egg production. Recent studies with trammel nets (Lanteigne and Tremblay 2001) show that there are even animals up to 150 mm present which are too large to enter traps. The current approach of returning berried females is a good one, and the use of tail notching 50% of berried females will help ensure that older female lobsters are returned even if they are not carrying eggs. As suggested by Aiken and Waddy (1980), small males may be mature, but are not functional in mating with larger females. A much simpler approach to a maximum size regulation seems possible, as follows.

D/ Maximum trap hoop size regulations

The most easily enforced and fair approach, and one that reduces potentially damaging handling of animals even if they are returned to the water, would be to focus the fishery on the first three moult groups into legal sizes sizes, i.e. to catch animals between 67.5 mm CL up to those having made three moults into the fishery, i.e. less than or equal to 106 mm CL or so, which should have a 50% chance of being unable to enter the trap. Some studies on this have been made by Lanteigne and Tremblay (2001). No suggestion as to the precise hoop diameter is made here, which would require some experiments which could be carried out offshore from Burnt Church in summer. No suggestion is made that this does not require the berried law and tail notching approaches as a back up.

E/Artificial reefs

The theme of artificial reefs is one that interests many fishermen, but there has to be a differentiation between habitat for adults and that for post-settlement stages. In general, soft sediments predominate in the southern Gulf, and although lobsters can make holes in the bottom, they prefer to do this under rocks, presumably for protection from predation. The question that can be addressed by a tagging study is to what extent dispersal is a reaction to lack of cover. Do lobsters tagged over flat mud-sand bottom move more than those over rocky bottom? Logically this seems likely but to my knowledge has not been tested. It would have practical implications if a community wished to retain its own lobster population to the extent possible.

Would reefs placed offshore from each port (and hopefully not all fished, but used as refugia as described earlier), retain lobsters in the local area? Tag and release over different types of bottom would help resolve this question. For adult lobsters, using natural rocks for this purpose on flat sand or muddy sand bottoms is not especially efficient, and some sort of artificial crevice design of a similar or slightly higher density to lobster traps would seem more efficient. Some preliminary tests of different designs to establish cost effectiveness and feasibility seems required here. Since one source of attraction of a lobster pot is as cover, it would be interesting to fish some unbaited traps alongside baited ones to see what proportion of the catchability is due to bait, and do this comparatively on rocky bottom and bottoms without other sources of cover.

There seem to be some surprises in store from recent studies of lobster post-larval stages. The existence of bottlenecks in the post-settlement stage seems likely to be the case in the southern Gulf, due to the rarity of cobble crevice-rich bottoms such as have been described as juvenile

lobster habitat elsewhere. Experiments with wire baskets filled with clam shells and other aggregate material placed down in the sub-tidal region to attract early post-settlement stages may help establish whether there is an enhancement potential for avoiding a possible recruitment bottleneck. The study of the topography of lobster grounds in the Bay of Fundy seems a good approach to take here. For crustaceans in general, the absence of shelter may lead to delays in moulting and egg production (Beck 1995).

The other surprise seems to be the aggressive territorial behaviour of young lobsters, (Paille and Sainte-Marie 2001) which makes the idea of placing down large multi-crevice habitats to enhance juvenile density likely to be less effective. One small lobster may aggressively drive out others in multiple holes under such a device even if it is up to half a metre or so in size. This kind of shelter size for more gregarious young spiny lobsters (Arce et al. 1997) in the Caribbean would support many juveniles. This aggressive behaviour of young American lobsters could in fact lead to a bottleneck by itself, since as a result of territorial behaviour, the density of juveniles would become low and self-regulating. If enhancement is possible, one approach would seem to be to distribute smaller individual tile-shaped 'casetas', or aggregations of clam shells or oyster cultch, over sandy or otherwise unproductive areas to help improve lobster recruitment– again the objective at first is to test an idea as a research initiative. It is not being suggested to do this commercially until some practical and bioeconomic studies have been carried out, but again, this is the kind of experiment that could be done at Burnt Church. At the same time, Sainte-Marie and Chabot (2001) showed that small lobsters may occupy small crevices in adult burrows, and may feed on the debris from their meals, but it is not clear if this is always the case or whether cannibalism occurs.

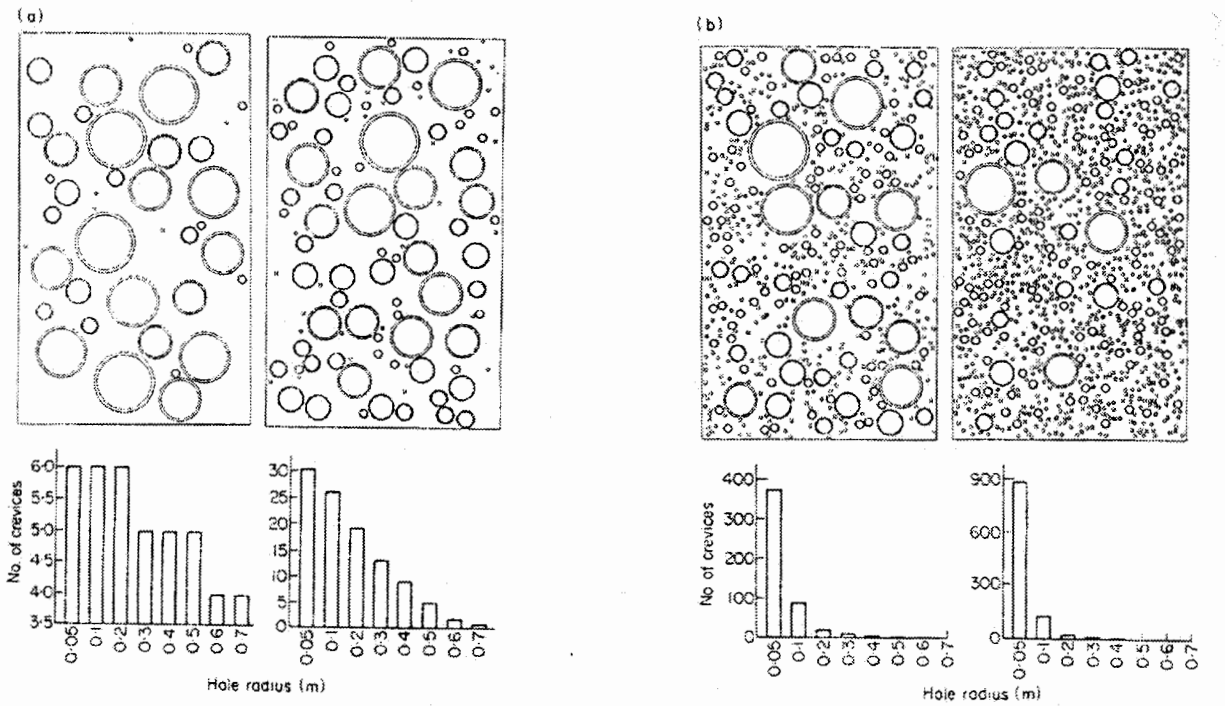


Figure 3(a). Frequency distribution of hole radii predicted (lower panels) from two combinations of growth and natural mortality rates, and their random distribution (upper panels) over a plane surface, 5·0 × 10 m in area. [Left: $K = 1·0$; Right: $K = 0·1$; with, for both, $t_0 = 0·05$, $L_\infty = 0·9$ m, $M = 0·2$]. (b). Frequency distribution of hole radii predicted from fractal assumptions, with left $D = 1·1$; right $D = 1·9$; and their random mapping over a surface. N.B. The relatively small area of surface ($\sqrt{\text{area}} < 10\,L_\infty$) illustrated, plus the integer values which truncate the predicted frequencies, are responsible for the apparent 'step function' in crevice frequency.

Fig 10: Showing the difference between low fractal coefficient habitats suitable for adult grow out (left) and high fractal coefficient habitats (right) more suitable for juvenile nursery areas (from Caddy and Stamatopoulos 1990)

F/ Other fishery enhancement possibilities

The potential carrying capacity of lobster habitat has usually been considered not to be a constraint on production, although the existence of such constraints for crevice-dwelling species seems inevitable from theoretical considerations as mentioned in Caddy (1986) and described in Caddy and Stamatopoulos (1990) – (see fig 9). For other lobster fisheries, considerable field research has been focussed on the possibility of recruitment bottlenecks, and there is growing evidence that these exist, and practical steps have been taken to enhance the fishery by increasing the abundance of appropriate size of crevices. An example is the Cuban fishery for spiny lobsters where some half million 'casetas' (lobster 'houses' consisting of a flat sheet of concrete some 1 m^2 in area held some 5-10 cm above the bottom by concrete flanges (see Arce et.al. 1999 for references on this), and the spiny lobsters (=$'s) shelter below it:

----------1 $ $ $ 1----------

The net result has been a lobster fishery that by the early 1990's had reached (by memory) some 10,000 t from a figure of around 3,000 t earlier. It is not suggested that this approach is

directly applicable to *Homarus americanus*, a species that is able to make burrows even in fine sediment bottoms (but prefers to do so under ledges or boulders). At the same time, evidence is accumulating from new experimental and field observations, of a potential bottleneck shortly after recruitment to the bottom. European studies in the southern North Sea where rocky outcrops are rare, have found juvenile lobsters more abundant in cobble bottoms with suitable sized crevices: a rather rare type of sediment. Wahle (1992), Rangeley and Lawton (2001) and others have documented that patterns of sediment distribution in the subtidal zone seem to have a relevance to juvenile densities, and rock size distribution was used by them as a proxy for shelter size. Particularly interesting were the conclusions of the last cited authors that:

1) availability of suitable habitat for juvenile lobsters is distributed across a large range of spatial scales
2) existing gravel substrates would support high densities of small post-settlement lobsters
3) availability of cobble and boulder shelters declines rapidly with increased lobster size
4) Gravel substrates could support relatively high densities of small juveniles.

Their conclusion is that it is wrong to assume all types of habitats have the same carrying capacity for young lobsters, and makes me wonder whether it would be a) feasible and b) cost effective to enhance carrying capacity in areas such as Miramichi Bay where fine sediments predominate.

23) Some precautions and research priorities

One issue that was brought up by the non-native fishers that concerns me, is one where there is not much data to confirm or deny it. This relates to the possibility that lobster stocks are replenished in part by aggregations of berried females to bays or other areas of warm water in spring where larvae have a better chance of surviving and staying in the same area after release. Evidence of aggregations of females have been provided for the Bay of Fundy, and here some fishing is targeted on the larger mature animals with exploitation rates that must be high, given that apparently a high proportion of larger lobsters are females. (Incidentally, this suggests that the proportion of larger lobsters that are females in the catch may provide an index of exploitation, and /or compliance with the notching regulation as a possible limit reference point for the fishery). Coming back to the Southern Gulf, some evidence for congregations of female lobsters in summer-fall was reported from northern PEI by Lanteigne (pers com).

Concern has been expressed by fishers that Miramichi Bay may be such a larval release area for lobsters from a much wider area than statistical district 70, 71 and 73. Declines in recent spring catches further north of Miramichi Bay towards Chaleur Bay in the last two years have been suggested as related to the fall fishery in 1999 and 2000 in Miramichi Bay. No confirmation of this is possible which would require summer tagging in Miramichi Bay late in the fall season. This I believe should be an activity carried out by the Burnt Church community, supported by DFO. In fact I would suggest that during the last two weeks of the proposed fishing period, a large proportion of lobsters captured should be purchased by DFO, should be tagged and released after recording their condition, sex and size.

As noted, relatively minor movements of lobsters have been shown so far in the Gulf, but one comment should be made: most previous taggings have been carried out in the same season as the fishery and recaptures evidently came from the release area the same or previous years. There seems an urgent priority to tag lobsters during the spawning season following a moult to determine their dispersion during the following spring season. Not having this data present a serious obstacle to going into more detail on the effect of the fall season. We look to the Burnt Church community to help fill this gap, and for the DFO to coordinate collection of tagged data and payment of rewards for tags recovered.

24) Information gaps and needed research on the lobster fishery in Miramichi Bay.

The most obvious gap in information relates to the fishing effort, catch per trap and size and sex composition of the catch, and this also applies to non-native commercial fisheries outside Miramichi Bay. Native and non-native fisherfolk may have had their reasons for caution in providing information to government in the past, but there is little chance of improving the management regime, or even mediating between different groups, if uniform information is not provided relevant to these issues.

Computer modelling of Canadian lobster populations currently employs a model developed for the American fishery by Fogarty and Idione (1999). This is useful, but models developed for situations where there are no fishing seasons are not likely to provide detailed management inputs. There also seems considerable potential for modelling crustacean populations by moult group, and some approaches to this were initiated but not completed in this consultancy for lack of time. Using moult groups instead of size classes it seems possible to obtain estimates of population density by retrospective analysis comparable with size-based VPA, and this is an approach that I believe should be followed up on. Current egg per recruit models in my view have a serious deficiency in that they do not evaluate the quality of the eggs produced, which principally seems related to maternal age.

One general comment about the past research strategy of DFO in those lobster districts with a spring fishery, is the serious lack of detailed life history information during the closed fishery season. This lack of information after some 60 years or more of research is a cause of the problem of analysing how to deal with the current emergency. Perhaps in part it was due to the reluctance of fishing communities in spring season areas to see government engaged in experimental fishing for lobsters out of season. However, the major gap in data it led to comes back to haunt us when we are faced with a totally new fishery situation such as that we are dealing with now. An example is the regularly repeated tagging surveys in the early years, and their conclusion that there is no migration of lobsters. Although this general sedentary behaviour seems the rule, it would have been very useful to have seen the dispersal pattern of lobsters (and particularly berried females) tagged and released from summer near shore sites. As noted above, such experiments should be part of a research protocol to be carried out under technical advice by the Burnt Church Community, with tags and advice on tagging provided by DFO, and payment provided for work carried out.

If this view of Gulf lobster populations involving aggregation of egg-bearing females in warmer water in spring-summer is borne out by further research, it may counter the suggestion in the

FRCC report that there are no obvious reasons for dividing up Gulf lobster stocks. In the long run it may suggest other management divisions. Certainly, for many other species, aggregations at spawning (or egg hatching in this case), often provide a clue as to stock structure. Testing whether there may be distinct larval release areas, even if prior to maturity the stocks from the spawnings in the Gulf are mixed in the spring fishery, is at least a clear research hypothesis with important practical implications that merits further investigation.

One further comment that to my mind makes this hypothesis more likely (and would make it less than precautionary to ignore it!) is where temperature may be limiting for species near the northern end of their range. By releasing larvae inshore, as noted, this will speed up the development rate hopefully increasing the probaability of settlement of juveniles before the end of the summer. Even more so, the fact that lobsters seem to naturally congregate to release larvae in bays or enclosed areas is perhaps an adaptation to prevent excessive dispersal during the larval stages, to speed larval development, and to provide good feeding conditions since plankton density is likely more abundant in these areas. (Incidentally, the concern expressed earlier about the effect of lower salinity in shallow water due (e.g.) to river runoff, may be less important for lobster larvae which often tend to be in surface waters where freshwater impacts are generally greater). Tank experiments on development rate of eggs in berried females kept at different temperatures would also be useful.

The question has been raised by non-native commercial fishers that Miramichi Bay may be one such aggregating site for larval release, and some fishermen-correspondents see declines of catches in the spring season further north along the coast, to last summer's fishery in the Bay. This is only a supposition at this point, but the mechanism suggested needs looking into carefully. The high catch rates in the summer fishery reported by fishery officers in Miramichi Bay may support this contention, and a rough idea of possible population sizes in the northern part of the Bay could be established by a carefully planned depletion experiment which could be carried out by Burnt Church fisherfolk under supervision. In conjunction with trapping observations, it seems urgent to carry out a diving survey inside and outside of the Bay in 5 –10 metres, preferably starting in late July to August, in order to get an independent estimate of densities, size frequencies and sex ratios on the bottom to compare with trap catches, and to help predict the population impact of the Burnt Church fishery.

A general conclusion I am coming to, is that Burnt Church and Miramichi Bay are ideally placed to be a centre for studies on a high density summer lobster population, and a research programme inviting visiting university investigators to participate and carry out training of local technicians seems feasible, and will be discussed later in the report.

25) Occupational enhancement and participation in conservation by Burnt Church Nation

In their management plan, Burnt Church has placed strong emphasis on the need to conserve the habitat and the ecosystem of the lobster, and this seems consistent with First Nations beliefs in the importance of living in harmony with nature. The reality however is that there is significant unemployment, and a need for job creation that goes beyond the issue of lobster management. The following scenario is suggested and despite its ambitious nature, seems to provide some possible goals for First Nations in the area of marine research, as well as providing a possible

contribution to educational and tourist goals in Northern New Brunswick. These ideas can only be sketched out quickly, and should be discussed for feasibility by those most concerned.

26) Enhance First nation knowledge of marine science

It is highly desirable for First Nations to have more expert knowledge of their own marine resources, and they have expressed a wish for this in their management plan. I suppose that scholarships can be provided for those finishing high school, but this will help only a few, and such knowledge can be gained outside of the academic mainstream. It is suggested that a small field station with a teaching laboratory for 10-15 students be constructed at Burnt Church and maintained by the community. Given the lack of a trained biologist currently at Burnt Church, this concept will only work of course, if a university, or university consortium. Two possibilities emerge: Distance education is offered by St Francis Xavier University whose Institute for Studies in Aquatic Resources are available to First Nations over the Internet. Mr Ian Austin (aiaustin@stfx.ca) can provide more details. Alternatively, or in addition, the Huntsman Marine Laboratory (HML) in St Andrews run course and maintain an aquarium complex, and may be persuaded to advise on this. In fact the letter in Annex IV suggests that such cooperation is possible. Initially an outside manager/biologist will need to be provided, hopefully by the Government or hired from funds available to Burnt Church.

If this idea is considered seriously, Maritime universities may be asked to carry out regular field programmes there, and provide training in the identification, biology, and ecology of lobster and other marine resources. Native peoples, as well I suggest, as the children of local non-native fisherfolk could use this opportunity to learn about wildlife and the traditions of First Nations. Again, in comparison with the Huntsman Marine Laboratory, it would be ideal if a small public aquarium could be constructed and maintained to allow visitors to see lobsters and other marine life, and community members would have to be trained to maintain such a facility. Providing such a facility to allow people to see lobsters and other underwater wildlife could enhance local tourism and the general public, since as noted by Mr Costello of HML, the lobster is a charismatic species of great interest to the general public. This idea also suggests a limited outlet for some of the fall lobster catch: there may be some advantage in opening a gift shop for artisanal crafts, and a small cafe as part of a complex including the public aquarium, and some cabins for visitors, selling amongst other sea food items, lobster rolls! This could be a complement to the public aquarium, enhancing a pleasant and educational experience for tourists and local residents. In the experience of HML, the café and gift shop each cover a third of the costs of running the complex.

Other employment opportunities could be associated with a small biological field post such as described. There is probably a role also for a Centre for local conservation of birds and wildlife of the Miramichi Estuary, and this might eventually be seen in the context of a biosphere reserve with an agreed but limited local harvest of certain resources. The community would then have to provide staff to be trained as wardens, for supervising activities affecting the inshore marine ecosystem and wetlands in this area. Conservation groups in the Maritimes might be approached for their interest in contributing to the running of such a centre, but some initial financial support from government, at least during the first three years of operation, should be considered.

Extra options available to the community will have to be sought outside the fisheries sector, and as always, identifying these depends on better information and initially, on the advice of outside experts. It is recommended that the Council of the Burnt Church Nation make arrangements to look on the internet to see what other First Nations have done to promote their wellbeing. Another option is illustrated from events such as the Ànnual Big Tex trout Derby being held by Red Bank First Nation, and the tours organized by Èel ground community development Centre inc, advertised in the official Touring Guide of New Brunswick for 2001. It seems that something similar focussed on lobster fishing could be well appreciated?

If accomodation and laboratory facilities were available, they might eventually wish to establish their own website describing the research opportunities that exist at Burnt Church, and invite research workers and other interested persons through their web page to come and help them study the local resources.

27) Some conclusions and management recommendations

It became obvious early on to the consultant that whatever an independent adjudicator came up with, there is considerable potential for unpopularity with both native and non-native fishermen. Any kind of ' judgement of Solomon' which will be readily acceptable to all is unlikely to be found and would be presumptuous on such short notice. As in all negotiations, both sides should look for a solution they can live with over the short-medium term, but be aware of the long-term losses to all sides if a solution is not found quickly. Neither apparently is DFO in a position to easily arbitrate here, for at least one reason: the Marshall judgement assuring a 'moderate livelihood' in commercial fishing to native peoples is not easily convertible into an unambiguous operational target that everyone will agree to. How big a share of the lobster resources of the Gulf will be needed to make up a 'moderate livelihood' for the Burnt Church Nation given the attempt now underway to give them access rights to other commercial fishery resources? What will be the impact on non-native fishermen already established in the fishery of an expansion of the Burnt Church fall fishery? This study cannot place a firm figure on this, but suggests it could be significant.

The movement to action by Burnt Church in setting a fairly large number of traps in the fall following the Marshall decision led to a non-pacific reaction by non-commercial fishermen. While perhaps understandable by a group that sees themselves as no longer having their rights protected by government, and where their livelihoods are at risk, these events haven't led to a climate making resolution of the crisis easier. It must be clear to all nonetheless, that the intent of the Marshall decision is to pursue the objective of increased self-reliance for First Nations, and the commercial fishery is the most obvious source of wealth to coastal communities in the region. Their access rights must be accomodated, since it is unreasonable that to date they have had only a small share in the main natural resources in the region. The question is, what share and at whose expense? DFO have been given the responsibility of providing for a phased entry of Burnt Church into the commercial fishery, and should seek to clarify this situation since uncertainties as to livelihoods and prospects are what leads to this climate of confrontation.

Admittedly, the greater participation of First Nations into the fishery takes time, and there is a need to train the fishermen and adjust fishery management plans to the new reality created by the

Marshall decision. To date the DFO has not infringed on stakeholders in the fishery in providing retired licenses to Burnt Church, but these licenses were presumably intended mainly for use in the spring fishery. Certainly, making some provision to compensate for the loss of any access rights that are implied by holding a commercial fishing license as a result of such decisions, seems essential for a smooth transition.

Whatever the origins of the problem, all sides in the dispute now need to sacrifice some part of their expectations, and begin a realistic dialogue on how to manage the fishery. Two different management plans are not a practical solution for managing the same resource, and clearly an unlimited summer-fall fishery is not compatible with the current spring fishery, and it will be the spring fishery which will lose out in such a contest for reasons mentioned in this report. Nonetheless, a limited fall fishery in Miramichi Bay seems inevitable, but in this consultant's opinion should be voluntarily limited by the Mi'Kmaq in exchange for access without interference by their licensed lobster fishermen to the spring fishery immediately outside the Bay.

The Mi'Kmaq claims for jurisdiction over much of the natural resources of the Maritimes and 'the right to exploit them where they occur', going back to treaty rights is on one side of the dispute. The right of non-native citizens of Canada from local communities who have been in the fishery for several generations, to complain if their livelihoods in the spring lobster fishery are reduced in value by what they see as an inappropriate and dangerous and uncontrolled summer-fall fishery. The search for a formula for agreeing on principles for managing the lobster fishery has, I believe, to take into account the following realities over the short term:

1) A fishery of 5,600 traps in the fall season proposed by the Mi'Kmaq plan will result in a shortfall in the following spring fishery that could range from a modest decline to a serious drop in landings. From the scientific evidence available this drop would be from 25 to 30 % , but could be more or less depending on the proportion of the stock in area 23 fished by Burnt Church in fall.

1) There are reasons why the Mi'Kmaq fishery is likely to be confined in some way to the Bay and this results from the risk faced by Burnt Church fishers operating outside the Bay in what is seen as `out of season` by fishers of neighbouring communities. The risk is of at the least, losing the traps placed on fishing grounds usually occupied in spring by non-native fishers. Unless DFO were instructed to supervise and protect these traps on a 24 hour basis for the proposed 78 day season, which would cost much more than the fishery is worth, we probably are dealing with a de facto example of a TURF (Territorial User Right for Fishermen). This is typical of lobster fisheries elsewhere, which show a high degree of territoriality in the fishing grounds used by participants.

2) In the Punta Allen fishery in the Gulf of Mexico for spiny lobsters for example, repeatedly interfering with the fishing gear set within the specific TURF of another fisherman can lead to 'shunning' of the culprit by the community. Fishing rights for lobsters are not only determined by license number but by geography. Although Native peoples could in theory take over the whole of an offshore fishery, it would be impractical to allocate a large proportion of existing fishing rights in the Gulf of St Lawrence to First Nations distant from

their area of residence, since lobster fishing is a geographically constrained activity. Unlike fisheries with towed gear, setting traps offshore from another community is not a wise fishing strategy when relationships are strained, due to the existence of TURF's.

3) From the opposite perspective, the fishery inside the Bay can be regarded as corresponding to the exercising of a TURF by the Burnt Church Nation. It is hard to see how they can be constrained to renounce this right which has been given them by the Marshall decision, even if it has negative repercussions on the spring fishery, unless they are provided with some alternative benefits for doing so. The existence within Miramichi Bay of a large aggregation of lobsters in summer-fall that by offshore migration outwards of the survivors to the offshore fishery the following spring, places them in a position of 'first come first served'. Their control over the supply of newly moulted lobsters to the spring fishery may be only partial if the lobsters in the Bay come from only immediately offshore. However, if Miramichi Bay is a aggregation point for a biological stock unit extending between the north end of Northumberland Strait to the south of Chaleur Bay the impact of an uncontrolled fall fishery becomes more serious. I mention this since reasonable fears have been expressed on this point by non-native fishermen.

4) Despite the foregoing, I believe that the concern for the welfare of the lobster population shown by the Mi'Kmaq I have met, will lead them to cooperate in controlling the inshore fishery to modest levels. This however is only going to be possible as long as it is recognized it does not compromise their treaty rights which extend beyond the local area. It will also have to be compatible with them achieving a moderate livelihood from the fishery, which hopefully will be mainly exercised during the spring fishing season.

5) If there is agreement more or less along the lines suggested, a joint fishing agreement will have to be arrived at. Included in such an agreement should ideally be provisions that the Burnt Church Nation research and fishing activities will maintain data on the number of traps fished daily, keep copies of purchase slips for lobsters sold, and be ready to discuss with DFO officers problems both of research and compliance.
6) Specific management suggestions are transferred to the Executive Summary to avoid repetition.

28) References

Abella, A.J., J.F.Caddy and F. Serena. (1997). Do natural mortality and availability decline with age? An alternative yield paradigm for juvenile fisheries, illustrated by the hake Merluccius merluccius fishery in the Mediterranean. Aquat. Living Resources, 10: p 257-269.

Aiken, D.E., and S.L. Waddy. (1980). Reproductive biology of lobsters. P 215-276. In: J.S. Cobb and B.F. Phillips (ed.), Biology and Management of lobsters, Vol 1. Academic Press, New York, N.Y. 463 pp.

Anthony, V.C. and J.F. Caddy (1980). Proceedings of the Canada-US worrkshop on status of assessment science for N.W: Atlantic lobster (Homarus americanus) stocks, St Andrews, N.B. Oct 1978. Can. Fish. Aquat. Sci. Tech. Rep. 923, 186p.

Arce, A.M., W. Aguilar-Dávila, E. Sosa-Cordero and J.F. Caddy (1997). Artificial shelters (casitas) as habitats for juvenile spiny lobsters *Panulirus argus* in the Mexican Caribbean. *Marine Ecology Progr.Ser.*, 158:217-24

Beck, M.W. (1995). Size-specific shelter limitation in stone crabs: a test of the demographic bottleneck hypothesis. Ecology 76: pp 968-980.

Berkes, F. (1999). Sacred ecology: Traditional ecological knowledge and resource management. Taylor and Francis. 209 p.

Beverton, R.G.H. and S.J. Holt. (1957). On the dynamics of exploited fish populations. Fish. Invest. Lond. Ser 2, Vol 19, London HMSO, 533p.

Buckley, D.E. (1995). Sediments and environmental quality of the Miramichi estuary: new perspectives. P 179-190 in: Chadwick M. (ed). Can.Spec. Publ. Fish. Aquat. Sci. 123.

Caddy, J.F. (1979a). Notes on a more generalized yield per recruit analysis for crustaceans using size-specific inputs. Dept. Fisheries and Oceans, MS Report 1525.

Caddy, J.F. (1979b). The influence of variations in the seasonal temperature regime on survival of larval stages of the American lobster (Homarus americanus) in the southern Gulf of St Lawrence. Rapp. P.-V. Reun. Cons. Int. Explor. Mer, 175: p 204-216.

Caddy, J.F. (1999). Fisheries management in the 21st Century: will new paradigms apply? Revs. Fish Biol. and Fisheries, 9, p 1-43.

Caddy, J.F.(2000) A fisheries management perspective on marine protected areas in the Mediterranean . Environmental Conservation, 27(2) : p 98-103.

Caddy, J.F. (1998). Establishing a consultative mechanism or arrangement for managing shared stocks within the jurisdiction of contiguous states. In: Proceedings of the Joint Workshop on Taking Stock: defining and managing shared resources, Darwin, Australia, 15-16 July 1997, pp 81-124.

Caddy, J.F. and F. Carocci. (1999). The spatial allocation of fishing intensity by port-based fleets: a GIS application. ICES J. Mar. Sci. 56: p 388-403.

Caddy, J.F. and C. Stamatopoulos. (1990). Mapping growth and mortality rates of crevice-dwelling organisms onto a perforated surface: the relevance of 'cover' to the carrying capacity of natural and artificial reefs. Estuarine, Coastal and Shelf Science, 31, p 87-106.

Caddy, J.F. and J-C Seijo. (submitted). Reproductive contributions foregone with harvesting: a conceptual framework. Submitted to Fisheries Research.

Campbell, A. (1985). Application of a yield and egg-per-recruit model to the lobster fishery in the Bay of Fundy. N. Am. J. Fish. Management, 5: p 91-104.

Campbell, A. (1986). Migratory movements of ovigerous female lobster, Homarus americanus, tagged off Grand Manan, Eastern Canada. Can. J. Fish. Aquat. Sci. Vol 43, p 2197-2210.

Chaikelis, A.S. (1953). Homarus americanus, the American lobster: A handbook of embryology and physiology of the lobster. The City College Press, New York, 63p.

Fisheries Resource Conservation Council (1995). A conservation framework for Atlantic lobster. 49p + appendices.

Fogarty, M.J. (1984). Temperature-yield relationships for the Maine American lobster (Homarus Americanus) Fishery: A time series analysis approach. NAFO SCR doc. 84/VI/57.

Fogarty, M.J. and J.S. Idoine. (1988). Application of a yield and egg per recruit model based on size to an offshore American lobster population. Trans. Amer. Fish. Soc. 117: p 350-362.

Gendron, L. and P. Gagnon (2001). Lobster egg per recruit calculations: inclusion of uncertainty and evaluation of the risk of not achieving a management goal.

Hanson, J.M. and M. Lanteigne. (2000). Evaluation of Atlantic cod predation on American lobster in the Southwestern Gulf of St Lawrence, with comments on other potential fish predators. Trans. Amer. Fish. Soc. 129: p 13-39.

Harte, M. (2000). Industry perspectives: taking the initiative for the management of New Zealand's commercial fisheries. P 270- 273 in FAO Tech Pap. 404/1, 342pp.

Harvey, J. and D. Coon. (1997). Beyond crisis in the fisheries. Conservation Council of New Brunswick, 59pp.

Holling, C.S, (ed), (1973). Adaptive environmental assessment and management. London, Wiley Press.

Lanteigne, M., M. Comeau, M. Mallet, G. Robichaud, and F. Savoie. The American lobster, Homarus americanus, in the southern Gulf of St Lawrence (Lobster Fishing Areas 23,24,25,26A, and 26B). Canadian Stock Assessment Secretariat, Research Document 98/123, 29p.

Lawton, P., D.A. Robichaud, R.W. Rangeley and M.B. Strong. (2001). Long-term monitoring of lobster spawning and nursery areas in the Bay of Fundy, 1989-1999.
P 92-97, In: In: Canadian Tech. Rep. Fish. Aquat. Sci. No 2328.

Lochhead, J.H. (1961). In: Waterman, T.H. (1961). The physiology of crustacea Vol 2. Academic Press.

McLeese, D. and D.G. Wilder (1958). Theactivity and catchability of the lobster (Homarus americanus) in relation to temperature. J. Fish. Res. Bd. Canada 15, p 1345-1354.

Ouellet, P., D. Lefaivre and J.-P- Allard. (2001). Lobster (Homarus americanus) larvae abundance and post-larvae availability to settlement at the Magdalen Islands, Southern Gulf of St Lawrence (Quebec). P 14-18. In: Canadian Tech. Rep. Fish. Aquat. Sci. No 2328.

Paille, N. and B. Sainte-Marie (2001). Effects of crowding and shelter limitation on the behaviour and survival of the first benthic stage of lobster. P 30-32, In: Canadian Tech. Rep. Fish. Aquat. Sci. No 2328.

Paloheimo, J.E. (1963). Estimation of catchabilities and population sizes of lobsters. J. Fish. Res. Bd. Can. 20: pp 59-88.

Parsons, L.S. (1993). Management of marine fisheries in Canada. Can. Bull. Fish.Aquat. Sci 225.

Plante, F., P.Ouellet, and J-C. Brethes. Maternal size influence on larvae size and growth performance in lobster (Homarus americanus). P 101, In: Canadian Tech. Rep. Fish. Aquat. Sci. No 2328.

Powles, H. (2001). Biological reference points for lobster. A discussion paper – claws symposium. P 72-74 In: Canadian Tech. Rep. Fish. Aquat. Sci. No 2328.

Rangeley, R. and P. Lawton. (2001). Spatial scaling in coastal landscape structure and the distribution of juveniles. P 21-24 In: Canadian Tech. Rep. Fish. Aquat. Sci. No 2328.

Scarratt, D.J. (1964). Abundance and distribution of lobster larvae (Homarus americanus) in Northumberland Strait. J. Fish. Res. Bd. Can. 21: pp 661-680.
Sainte-Marie, B. and D. Chabot. (2001). Ontogenic shifts in diet of lobster in the Magdalen Islands. P 34-42 In: In: Canadian Tech. Rep. Fish. Aquat. Sci. No 2328.

Templeman, W. (1936). The influence of temperature, salinity, light and food conditions on the survival and growth of the larvae of the lobster (*Homarus americanus*). J. Biol. Board. Can. 2: p 485-497.

Lanteigne, M. and M.J. Tremblay, (2001). Size composition of American lobster, Homarus americanus, catches using traps fitted with different entrance diameters and with trammel nets. P 45-46, In: Canadian Tech. Rep. Fish. Aquat. Sci. No 2328.

Wahle, R.A. (1992). Substratum constraints on body size and the behavioural scope of shelter use in the American lobster. J. Exp. Mar. Biol. Ecol. 159: p 59-75.

Wilder, D.G. (1963). Movements, growth and survival of marked and tagged lobsters liberated in Egmont Bay, Prince Edward Island. J.Fish. Res. Bd. Canada, 20(2), p 305-318.

ANNEX I : Catchability of lobsters

F = q.f is the classical formulation for the mortality rate due to fishing, where
is the fishing effort, estimated here as trap-lifts during the season or season length* number of traps fished.

Two approaches have been taken to estimating the relative values of q for the spring and fall seasons.

1) Estimates based on field observations.

A direct estimate of relative catchabilities is provided by typical catch rates/trap haul early in the summer season in area LFA 25 where the season is open in the warm months. If we can assume initial densities are relatively similar in the two areas at the start of the season (they probably are not later on after exploitation has occurred) this provides one ratio estimate. This is compared with the early season catch rates in the first week of the spring fishery in area LF 23. The relative catchabilities suggested by this method are of the order of 2.5 times as high in area LFA 25 at the start of the season.

3) Catch rates were determined directly by fishery officers within Miramichi Bay during the EFN Food and Ceremonial fishery, and for three zones ranged from 5.0 to 8.2 lbs/trap haul/day. The average catch per trap haul in the spring fishery is about 0.9 lbs/day, suggesting a range of q ratios for lobsters of 5.5 to 9.0 times more catchable in the fall fishery than in the spring. From these direct observations, relative catchability for the Fall season would seem to be in the range 2.5 : 1 to 9.0 : 1. The author would favour the value in the middle of the range since there seems some doubt on the part of Burnt Church whether all berried females and shorts were excluded from the fall catch estimates.

2) A breakdown of q into its elements:

- q can be defined as the fishing mortality exerted by a single trap, and q_s/q_a is the ratio between catchabilities in the spring and fall. We will be trying to estimate this here from first principles. One way that q can be broken down further into its elements is to define q as the fishing mortality rate resulting from 1 trap (i.e. when f in F = qf is unity). As such, q α (proportional to) v.a/A , where v is the vulnerability to the gear which in turn is a function of activity, A is the area within which the population is distributed, and a is the area of attraction around the trap, in other words the area around the trap within which a lobster can detect the bait. Thus $q_f/q_s = A_s v_f a_f / A_f v_s a_s$

Since there seems no reason why a lobster cannot detect the trap and reach it in a day between hauls from the same distance in spring even if it takes it longer to crawl there at lower temperatures (See McLeese and Wilder 1953), we probably can eliminate the a's from the above. The stock area A will be smaller in summer when the population moves inshore than when it is

dispersed in deeper water offshore, and with a smaller value of A, the density will be higher in summer making for higher catchability since we know that A_f/A_s is < 1.0.

- Therefore if v_s/v_f is a function of activity, which in turn is a function of mean temperatures in the two seasons, i.e. $v_s/v_f = T_s/T_f$. All that can be said at this point is that $q_f/q_s = A_s v_f/A_f v_s$ is given as the product of the ratios of mean temperatures times a value of A_f/A_s that is also greater than unity.

Availability: In the summer and fall months, the typical depth range occupied by lobsters is in the sub-tidal area while in the spring season they are in deeper water, down to 30m or more in the Gulf. This implies that the population is more concentrated later in the year, and although it is difficult to estimate this precisely, the relative areas were estimated for the area off the Bay down to 20 fathoms. The table below gives the following results based on estimates by GIS of the areas occupied by most of the stock in the two seasons.

Areas (km^2) occupied by the main bulk of the stock in the two seasons as judging from their preferred depth range.

Lobster stat. Area	Fall -> 5m	Spring 5 ->20 m	Ratio
71	175	425	2.43
73	197	646	3.28
		Mean (both areas)	2.9

i.e. for spring to summer-fall seasons the ratio $A_f : A_s$ is roughly 1 : 2.9. In other words, the same number of lobsters are going to be at higher densities in the summer-fall season when they are more concentrated in shallower water roughly in a ratio of 2. 9 : 1 for fall: spring seasons. These estimates are necessarily crude, but are easily refined by further study.

Temperature: Temperature plays an important part in regulating various aspects of the life history, such as moulting and reproduction, although photoperiod or day length is probably also important in determining timing of life history stages. The bottom water temperature occupied by lobsters in the spring and summer-fall seasons are given in the following table, calculated for the nearest port where they are available, Bouctouche. As to the significance of temperature, it is probably the single most important variable for a species close to its northern limit, and more specifically related to trap catchability, Lochhead says 'the rate of locomotion in crustaceans is proportional to temperature'. McLeese and Wilder (1958) and Paloheimo (1963) found relationships between catchability and temperature that confirm this. Looking at the temperature cycle in the Southern Gulf, as shown by temperatures in the ice-free seasons for Le Goulet (figure below), we can see the seasons proposed in the Burnt Church Plan as 2 horizontal lines, and also (above it) the season for LFA 25.

	Proposed Burnt Church Seasons	
	Spring	Summer-Fall
Degree-days	417.3	961.1
Season length (days)	59	77
Mean T°	7.07°	12.48°
Summer season (Area 25)		
Degree- days		870.3
Season length (days)		63
Mean T°		13.81°

Given that the rate of locomotion for lobsters is proportional to temperature, then we would expect this to directly affect catchability. Although a specific study would be desirable on this confirming the Wilder-Paloheimo results, the immediate conclusion suggested is that the influence of temperature on catchability in the spring and fall season is going to be roughly in the ratio of mean temperatures, i.e. a ratio of around 1 : 1.76 will apply in terms of activity levels, and that this ratio will be further increased due to the higher density in the fall inshore areas of Miramichi Bay.

Solving to take into account effects of density and temperature on q ratio we get:

$q_a/q_s = A_s v_a/A_a v_s = 5.1$. This tentative conclusion seems to fit the observed data, but should be followed up experimentally. It could be one of the studies I am suggesting should be carried out by Burnt Church during the summer-fall season and in spring; namely, establish the local density by diving at different water temperatures and compare it with catch rates in the same area.

ANNEX II: Some theory of fisheries yield

The following assumptions are used in a simple calculation over two seasons, starting in fall and continuing through until the end of the next spring season. We will be comparing the shortfall of lobsters by assuming in one case there is no fall fishery and in the other that there is. The difference in % is the shortfall to the spring fishery.

Maximum # trap hauls per season = No. active licenses*No. traps per license*season length

Effective # spring haul units in fall = $f_s = (q_f/q_s)$* No trap hauls fished in spring (f_f).

If the spring fishing rate $F_s = 8.32$

Fishing mortality rate in fall = F_s* (f_f /f_s)*(q_f/q_s)

In the following calculations we are considering the fate of N_0 lobsters that enter the fishery at the start of the fall season and we follow this group of cohorts through to the end of the next spring season. Since they do not grow in this period, having moulted prior to this season, we can perform these calculations in terms of numbers since we are dealing with the same number of animals and can reasonably assume that selectivity stays the same in the period.

Mortality rates are treated as instantaneous, thus the fishing mortality rate F over a period of Δ_t year (= about 61/365 days for the spring season) is the higher rate which over the short season produces the same population decline as a lower annual rate would do if exerted over one year. Thus, for example, if 75% of the stock is removed in a year round-fishery,

F (annual) = [In (Initial number)-In (Final number)]/ 1.

This is artificial however in our present situation, and not useful for calculations. It seems more reasonable to recognize the much higher instantaneous rate of fishing in the lobster fishery which is probably higher than that of any other Canadian sea fishery. The only thing that prevents this fishery from completely fishing out the stock in a single year is the short season duration. Hence for a season of $\Delta_s = 61/365$ yr,

N_1/N_0= exp (-F*Δ_t) =25/100 when solved (ignoring M) gives F = 8. The natural mortality rate M is much, much lower than F; and is assumed at about M = 0.1,
and could probably be effectively ignored in the fishing season, Although the natural death rate of large animals is negligible (lobsters are supposed to live for many years if unfished), for the first year in the fishery I keep the natural death rate at M = 0.1.

Initial number N_0 is set at 1 million lobsters entering the fall fishery (This number can be changed for the actual number if this can be estimated, e.g. by cohort analysis, but we are here looking at comparative numbers of animals of an assumed constant inter-seasonal size resulting from two different fishing strategies, hence for this calculation the actual number used is not important since we are looking at ratios for two different management possibilities).

In the following table, the instantaneous values of F and M are adjusted appropriately for period duration, e.g. M' = M*(x/365) where x = fraction of a year.

Seasonal catches and survivors	No fall fishing	Fall fishing
# entering fall fishery	N_0	N_0
Survivors by end fall Fishery (' =78 days)	$N_1=N_0*\exp(-M')$	$N_1=N_0*(F'/(F'+M'))*(1-\exp(-M'-F'))$
Catch in fall fishery	0	$C_f = N_1*(F'/(F'+M'))*(1-\exp(-M'-F'))$
Number entering spring Fishery ('' = 181 days)	$N_2 =N_1*\exp(-M'')$	$N_2 =N_1*\exp(-M'')$
(*) Catch in spring fishery (''' = 61 days)	$C_s = N_2*(F_s/(F_s+M'''))*(1-\exp(-M'''-F_s))$	$C_s = N_2*(F_s/(F_s+M'''))*(1-\exp(-M'''-F_s))$
Spring % shortfall	$= 100*(C_s - C_s)/C_s$	

Effect of area fished

In order to take into account the effect of fishing on (say) one third of the area of stock in fall, one third of the recruits to the fall season are fished (right column in above table) and 2/3 unfished (left column). However, on the fifth step of the calculations, the spring catch is calculated from the survivors of both series of calculations.

Annex III : What the correspondents say

1) Some Burnt Church views

The Band has 15 commercial lobster licences which are held by different people from those that fish in the summer-fall. It is agreed that a delay in the onset of the summer fishery will reduce catch rates somewhat: they are aware that lobsters are migrating out of the Bay towards the end of the season.

The small scale fishery in the fall season results from the need for some members of the community to accumulate some $500-$1000 to pay for costs such as clothes for children prior to starting school. If these people could be given alternative employment during this period they would be ready to moderate their pressure on the resource. One solution is to promote lobster and environmental enhancement measures in the Bay under the provisions of a local management plan. In my meetings, several examples of such plans were provided to them from other areas of the world.

It was suggested that a Burnt Church lobster research programme would be a good investment rather than spending 11 million on enforcement.

Financial problems are probably at the basis of the pressure to enhance the fishery yields, since an independent auditor was appointed by DIAN?? to run the accounts of the band due to a significant debt burden.

In general, Burnt Church prefer to fish the fall season for reasons mentioned. In the past, maybe 400-500 traps were fished through the whole fall season, many dropping out through the season. A few fishermen are interested in the spring season: they report fishing 10 traps in the spring of 2001 with treaty tags. The best catches at the start of this season were reported at around 100ft depth outside the Bay, the lobsters moving in during the season. In the fall, the larger boat fishermen claim good catches of larger lobsters at around 50-60 ft.

Although the total traps to be fished in the fall season in their plan is 5,600, they are prepared to discuss fishing fewer. One figure of 4,200 is equivalent to 4 traps for each of the 1,300 people on the reserve, but the number per band member could be reduced. Some who have no boat have their traps fished by relatives. Many on the reserve are on welfare and this provided needed income for fitting children out for school etc. The only equitable approach feasible would be to allocate a smaller number of traps per person, but this would have to be negotiated in return for other benefits such as some free and unfettered access outside Portage Island in the spring season and other compensation in terms of employment.

It is evident that there is a lack of confidence on all sides as far as the basic data are concerned which makes it difficult to establish the exact situation. Some examples of misconceptions of others were provided by Burnt Church:

- Some traps fished outside the island in the fall season were not from Burnt Church but set by poachers, hence DFO may be overestimating the number of traps fished by Burnt Church.

- The number of lobsters caught per trap may be overestimated by DFO, since DFO estimates according to a witness, included also catches of shorts and berried lobsters, hence they have doubts about the fall mean figure of 8.17 lb/trap recorded by DFO – it is too high.
- As far as Zone 1 is concerned there are not many lobsters there: about 2-3 average per trap haul and many are undersized. The 'horseshoe' in Zone 2 is best area. Here they have recorded many berried lobsters, mostly small and even some sublegal sizes – up to 32 in 12 traps was cited.

Little documentary information was provided by Burnt Church, some was lost in a fire in the band office two years ago. There was mention of an offer to DFO to come on the reserve and measure catches jointly with them, but this was not taken up. They are willing to collect better data in the fall as a systematic exercise, but as part of a lobster research project.

As far as persons capable of an underwater study of trapping efficiency, there are reported 12-20 trained divers on the reservation.

They are prepared to include v-notching berried animals in their fishing activities, noting this to be a voluntary measure, and to return notched lobsters to the water.

With respect to fishing zones, they mostly respected the 'buffer' zones established by DFO in previous seasons on the fall fishery, without agreeing to them, and feel they have the right to fish other areas of the Bay and outside.

It was noted that all buyers from Indian fishers last year are in court currently under DFO prosecution. Who is bringing the cases on what basis? The prosecution of buyers by DFO who bought lobsters from them in the fall season, is seen as an indirect way of infringing on their rights to engage in commercial activities under Marshall, but clearly the buyers could be boycotted by non-native fishermen in the spring season and are not prepared to risk further prosecutions and sabotage of plants by non-native fishermen.

2) Some non-native fishermen`s opinions

This spring fishermen were down an estimated 3000 lb of lobsters/fishermen, and net earnings were around $23,000/boat this year. The United Fishermen's group will act in concert in any management issue. They don't mind if the government buys everyone out at a reasonable price, but not at the price offered by DFO for a license. Alternatively, close the fall fishery. If they close the fall fishery all native fishers would be welcome in the spring fishery and would not suffer harrassment. In fact they report that of 8 non-native licenses fishing out of burnt Church wharf, only 1-2 stayed within the islands in spring.

Although they are willing to give a guarantee that their traps will not be touched there is complete disagreement with the idea of an exclusive zone for native fishers, whether in spring or fall season. The point of view expressed was that there needs to be some equitable organization within the native community since a large number of members in their view have expressed concern to them with the current position of the Nation on the lobster fishery.

The fisherman's union sees the potential for 100 jobs in the spring lobster fishery once Burnt Church fishermen receive the licenses now in DFO possession and have participated in training programmes. Other jobs will be generated around the commercial fishery. The point was made that the Burnt Church community is a small proportion of local populations compared to Big Cove which makes up half of the local population. This makes harmony between local communities, whether native or not, doubly important.

They recognize that Burnt Church is in need of a facilities that exist in other communities, and an agreement with DFO would be to everyone's advantage. They suggest that Burnt Cove ask what was received by other groups such as Big Cove. They had heard of figures of some 10-15 million for a period of 3 years for job creation. Apart from financial inputs, they presume such an agreement would result in Burnt Cove having some 30+ full time lobster licenses, including those 18 currently held by DFO, to fish in the spring season – the equivalent of some 90 jobs. They could then take pride in a professionally run fishery.

If it would help persuade Burnt Church to abandon the fall fishery, they would be prepared to move further offshore in early spring, and although they would expect to move inshore later on, there would be no harrasing of fishers or traps of native people. There would be no problem if they wished to extend along the coast towards off Bay St Annes for example.
The motto they support is 'One season for all!' They note that they would not have much to do in spring if there were a fall lobster season. Extensive numbers of traps set out would prevent dragging and finfish capture.

Experience was referred to in the 1982 season when a lot of poaching went on in the closed season in summer fall inside the Bay (not particularly by native peoples). Their experience at that time was that the spring fishery took several years to recover after this was cleaned up by FO's.

They are worried because they believe from long experience in the fishery that lobsters which move into the Bay are a melange of all stocks fished outside over a considerable area, and feel that a big percentage of lobsters go to the inner Bay from all outside fishing areas. In fact they consider Miramichi Bay as the main moulting and breeding ground for the whole area.Over the years they have tracked the lobster migration inshore to the main channel during the spring season. In fact they start far out and fish progressively towards the channels into the Bay, following the lobsters in. They suggest that seasonal migrations of up to 17 miles are not uncommon from evidence such as recaptures of claw-banded lobsters that escaped from holding crates and were recaptured later at sea some distance away. They suggested fishery last fall was responsible for diminished catches from Neguac to 50 miles up the shore. If a fall fishery begins in 2 months time and still DFO takes no action, all union fishermen will join in. They know full well this will ruin the fishery, but if it is going to be ruined anyway, they wish to get some final benefit from it.

DFO had suggested that last year 3000 traps were in the water and not all with buoys since trap strings could be found by grappling and satellite positioning equipment (GPS). Non-commercial fishermen estimate was that in the fall last year, there were 4,000 traps catching up to 80,000lb per day, but the price received was low as would be expected with poor condition lobsters at that time with little meat content. Another estimate estimated native catches in the fall of 1999 were

300,000 – 1 million lbs in the Bay. A number of fishermen from Big Cove came to fish in the Bay in the fall, and this was seen as one cause of the civil disturbances in 1999. Another estimate of the total catch was that 80,000 lb was removed per day or 560,000 lb/week – i.e. in a 2 month season given the high catch rates they have observed in the fall, this could easily arrive at 2 million lbs. If the exploitation rate is 75-85%, as the scientists say, they deduce that this means that the stock size in the fishery at the start of the fall season is about 2.35 million pounds? (This seems to me a quite reasonable deduction JFC). No fishery can withstand this type of pressure twice a year without declining.This year they say that non-native spring catches dropped to the north of the Bay but were maintained at Baie St Annes. If so, this is interesting since very little fishing was done by Burnt Church on the south side of the Bay.

Non-native fishermen strongly believe that the increase in landings in the 1990's was due to improved regulations such as reduced trap limits, escape gaps, reduced poaching, increased min size and freeze in licenses. Hoop size on traps is 5-5.5" but some in PEI use a 11" hoop. They would consider a regulation on maximum hoop size if it were studied scientifically. There will be no cooperation on new regulations or as Index fishermen until this crisis is resolved to their satisfaction. They expressed the view that the image of DFO has been damaged in some sectors. They note also that illegal fishing and illegal sales go up in times of civil unrest together with disregard for regulations by all parties.

DFO Science.

DFO Science is concerned that there is no information being gathered on the lobster fishery in Miramichi Bay. There is no data on effort (number of traps fished per day), catches and their size composition, the sex ratio of the catch and the percent berried females and shorts in the traps. As a result we are in difficulty to provide insights into the impact of the fishery in a given year, apart from the general considerations mentioned by Dr Caddy. Further biological studies in cooperation with Burnt Church should be discussed in the near future and would be assured of some support from the Department.

ANNEX IV : Communication from Huntsman Marine Laboratory

FACSIMILE COVER PAGE

Date: 07/05/01

Time: 16:39:00
Pages: 3

To: Caddy
Fax #: 915068512387

From: Mark Costello
Title: Executive Director
Company: Huntsman Marine Science Centre
Address: 1 Lower Campus Road
St. Andrews, NB E5B 2L7
Canada
Fax #: (506)529-1212
Voice #: (506)529-1224

Message:

Dear Dr Caddy
I attach the course program we offered to the Aboriginal Peoples Council of NB a few months ago. This is an example of what kind of training can be offered. HMSC would be happy to provide this training, most of which we can provide in house. In addition, we could advise on setting up aquaria from our own experience with both a public aquarium and aquaculture research and development. My first thought as we discussed was that a specialist aquarium that focuses on one charismatic species like lobsters (with shops and food outlets) could attract people from eastern Canada and USA.
best wishes,
Mark

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Dr Mark J. Costello,
Executive Director,
Huntsman Marine Science Centre,
1 Lower Campus Road,
St Andrews, New Brunswick,
Canada E5B 2L7.

Tel. +1-506-529 1224
Fax + 1-506-529 1212

www.huntsmanmarine.ca
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Training in Fisheries Ecology
For the
New Brunswick Peoples Aboriginal Council

Proposed course content and plan

Aim
To provide a practical understanding and knowledge of the marine environment to NBAPC members, with mixed educational backgrounds, to enable them to use marine resources with greater efficiency and sustainability. These uses may include current and new fisheries and aquaculture enterprises. An understanding of how the environment affects these resources is essential to protect the resources and prevent unsustainable exploitation.

Duration
- 10 days full-time, based at the Huntsman Marine Science Centre, St. Andrews, NB.
- The course would be intensive, often including evenings.

Dates
Dates must be flexible to accommodate changing NBAPC members' schedules, as well as those of the course instructors.

- First offering: late August 2001; if suitable to both parties, exact dates to be finalized
- Next offering: late November 2001?

Suggested course content (feedback desired)
- Introduction to the marine environment (2 ½ days)
  - Ecological habitats and associated organisms
  - Ecological factors and processes
    - Including water quality issues, nutrient cycles, role of algae and plankton
  - Basic biology and physiology of aquatic species
    - e.g. effects of temperature on activity, growth, and reproduction
  - Interrelationships of organisms in ecosystems
- Marine organisms – collecting and identification (2 ½ days)
  - Field trips:
    - 1-day boat trip – sampling ecological habitats and associated organisms
    - ½ day beach rtip – observing ecological habitats and associated organisms
  - Identification of marine life – fishes, invertebrates, plants
    - Awareness of what organisms cannot be identified accurately in the field, requiring laboratory examination or specialist skills
    - Resources – books, the Internet
- Human impacts on the marine environment – sewage, industrial wastes, dredging, trawling, aquaculture (2 days)
  - Recovery from disturbances
  - 1-day boat trip – comparison of seabed conditions at disturbed versus non-disturbed sites
- Introduction to aquaculture (2 days)

  - Current aquaculture practices and constraints
    - Atlantic salmon, mussels
    - Site visits
- Overview of research into new aquaculture enterprises
- Sturgeon, halibut, flounder, haddock, striped bass, char, sea urchins, scallops
- Introduction to fisheries (1 day)
- Fisheries management concepts
- Examples of local Fisheries
- Lobsters, scallops, herring, rockweed

Future courses
These would be more specialized and designed to meet NBAPC members' needs. Needs would dictate course content and manner of teaching preferred (proportions of lectures, labs, fieldwork, etc.).

Teaching staff
A course coordinator will lead course organization, and do some teaching. A full-time teaching assistant will work with the class for the duration. The following list of HMSC instructors should be available:

Dr. Mark Costello – Executive Director; over 10 years experience teaching environmental and marine sciences, including aquaculture-environment interactions, marine and freshwater ecology, ecotoxicology, and nature conservation.

Lou Van Guelpen, M.Sc. (Course Coordinator) – Atlantic Reference Centre Curator of Fishes and Collection Manager; ichthyologist

Dr. Mick Burt – Associate Director and Director of Academic Programs; parasitologist

Dr. Gerhard Pohle – Atlantic Reference Centre Curator of Invertebrates and Senior Applied Projects Scientist; crustacean systematist and benthic ecologist

Lynn Lush, M.Sc. – Aquaculture Technician

Dr. Brian Glebe – Atlantic Salmon Broodstock Development Program Manager; aquaculture specialist

Tracey Dean, M.Sc. – Public Education Program Coordinator; ornithologist

Dr. Derrick Iles – Emeritus Scientist; fisheries scientist

Tanya Leverette, B.Sc. – Research Assistant

Additional guest instructors from DFO and other organizations can be invited to participate as required.

ANNEX V : Description of Work

Description of Work

F4750-010010

John F. Caddy
VIA Cervialto 3,
Aprilia
Latina 04011
Italy

Contract Title:

State of knowledge of the lobster resource in Miramichi Bay and adjacent waters. Contractor must demonstrate a recognized expertise in marine resource assessment.

Work Required / Terms of Reference

1. Review existing data and scientific studies that pertain to the status of lobster stocks in Miramichi Bay and Lobster Fishing Area 23.

2. Discuss with fishers of the Burnt Church First Nation and other commercial fishers the impacts on catch rates, abundance and distribution in Miramichi Bay and adjoining areas of the spring fishery and explore the conservation impacts of a fall fishery.

3. Review the proposed lobster fishing plan of the Burnt Church First Nation for 2001 and assess the implications for conservation.

4. Identify any knowledge or information gaps in relation to the lobster fishery in Miramichi Bay and the studies that would be necessary to fill information gaps.

5. Prepare draft report with analysis and observations by July 13, 2001

Period of Contract:

From June 19, 2001 to July 13, 2001. Total period of 25 days.

ANNEX VI : Glossary

abdomen	The articulated tail of the lobster behind the carapace
berried female	A female lobster with eggs under the tail
bioeconomics	Analysis of the yield from a natural resources using the biological characteristics but expressing the outputs in monetary values.
bottleneck in recruitment	A feature of the habitat or environment required by the species to complete its life history which being in short supply, leads to a limited number of animals reaching maturity.
bottom-up/top-down management	Management initiated by local communities/Management dictated by government
carrying capacity	The amount or weight of lobsters that can be supported or produced by a given area of sea floor
caseta	An artificial 'lobster house' used in Cuba and Mexico for sheltering spiny lobsters and also for diver harvesting
catchability coefficient, q/ q-augmentation factor	The degree to which one unit of a fishing gear produces mortality/ the change (increase) in q that occurs in warmer seasons due to crowding, hunger and greater activity of lobsters at that time of year
co-management	The cooperation between different levels of government (e.g. the local village and federal government) in managing a resource
community-based management	A bottom-up approach to management where the local community initiates management measures.
crevices	Holes in or under rocks or in the bottom used by animals such as lobsters
degree-days	A measure of the warmth of the environment during the season or year, obtained by adding up the daily temperature in the environment over the period of time considered
depletion experiment	An experimental observation that studies how the catch declines with progressive removals of animals
enhancement	Actions intended to increase the capacity of the habitat to produce lobsters
fecundity	The number of eggs produced, or the reproductive capacity
fractal	A type of surface which has a similar appearance if seen at different degrees of magnification

habitat	The surroundings of an animal
harmonizing	Making two sets of regulations or fishing plans compatible with each other
homarus americanus	The American lobster's latin name
hoop size	The internal diameter of the circular opening at the entrance to the trap
intergenerational equity	A way of managing a fishery that ensures that future generations will have the same possibility of making a livelihood as today
maturity/functional maturity	An animal is mature if it is capable of breeding. In the case of a small male lobster it may be sexually mature, but incapable of successfully turning a female lobster on its back, hence it is not functionally mature.
metapopulation	A population of animals made up of smaller unit populations, but with some limited interchange between them
MEY (Maximum Economic Yield)	The maximum economic return obtained by fishing a population: occurs at a lower rate of fishing than MSY
modelling	The preparation of a mathematical analogue to the population
moonlighting	The pejorative term used when referring to a person having a part time job (e.g. fishing without a license)
moulting or molting/soft-shelled	Shedding the shell: the process required for animals with rigid outer armour if they are to grow in size
MSY (Maximum Sustainable Yield)	The level of fishing that gives the maximum tonnage: fishing harder or less hard gives a lower yield
natural mortality rate/fishing mortality rate (=M/F)	The rate of death due to natural causes such as predation/The rate due to fishing
natural selection	The process described by Darwin whereby natural causes (or over a long period of time activities such as size-selective fishing) leads to certain biological characteristics either becoming dominant in the population or less common
organics	Chemicals synthesised by living organisms
plankton	Those small animals that swim in the (surface) waters, including the 4 stages (I to IV) of lobster larvae
progeny	offspring

progeny	Offspring, the next generation
ratchet	The principle often seen in fisheries, that means that fishing effort goes up but rarely comes down again
recruiting/recruitment	The new animals entering the fishery in a year, in this case as a result of summer moulting and growth above the minimum legal sizes
refugium/refuge	That part of the lobsters range where they are less liable to be captured (or could be a feature of the fishing gear that lets some sizes escape)
reproductive value	The value a female lobster has to the fishery as a result of the eggs and new recruits she produces: can be higher than her market value
retrospective analysis	A way of analysing data in the fishery by calculating population numbers at some earlier date
shortfall	The future loss of benefits resulting from an action
soft-shelled	The state of a lobster after moulting
spatial scale	The scale over which events occur: e.g., statistical areas, provinces, countries, the world, galaxy etc, each have their specific dimension
spermatophore	The sperm packet passed to the female in lobster mating which she keeps until egg laying later
stock-recruit theory	The theory governing the number of recruits produced by the parental generation
stunting	A reduction in the growth rate and maximum size due to overcrowding or early maturity.
subsidiarity	The principle whereby a higher level of government delegates management authority to local government or a local community or other social grouping
tagging/microtagging	fixing a number to an animal so that it can be recognized on recapture / using a verysmall tag
tenure systems	Systems of habitat use near the community that recognize user rights
thermal	Relating to temperature and heat
vulnerability	The physiological condition of a lobster that makes it more or less liable to enter a trap

ANNEX VII : Burnt Church initial response to Dr. Caddy's report

Burnt Church First Nation
610 Bayview Drive
Burnt Church, New Brunswick
E9G 2A8
Telephone: (506) 776-1200 Fax (506) 776-1215

July 18, 2001

Initial Response of Chief Wilbur Dedam, Burnt Church First Nation to the July 10, 2001 Draft Report styled THE STATE OF KNOWLEDGE OF THE LOBSTER RESOURCE IN MIRAMICHI BAY AND ADJACENT WATERS; SOME SUGGESTIONS FOR CONFLICT RESOLUTION OVER FISHING SEASONS AND IDEAS FOR FISHERIES RESEARCH IN SUPPORT OF LOBSTER MANAGEMENT (submitted by J.F. Caddy phD, Research Fellow, University of London, UK)

It was with great interest that I and my support staff conducted an initial review of the Draft Report reference above. The Report's complexity dictates that a good deal of additional preliminary comments on the Draft Report, to be delivered during work week beginning July 16, 2001, and I have done so below. I found the Draft Report both enlightening and controversial. From my perspective I believe that the central lesson to be drawn from the Draft Report is the need for a Meaningful Dialogue on the Lobster Fishery between and among Equals (i.e. Canada and the First Nation);

> The themes that seem immediately relevant in the about quotation (from the Technical guidelines for the Code of Conduct for Responsible Fisheries of FAO, 1999) are the need to respect traditional knowledge, but for a successful resource sharing arrangement, both parties involved should cooperate in fisheries research and data collection and that has got to be at the basis for any future co-management of the lobster resources (Page 19).
>
> Even in the international arena, nations need to take part in co-management of shared stocks and cannot do this independently! In fact, the Law of the Sea requires them to get together and establish a mechanism for managing the shared stock. I may note that it is not usually for two political entities (within or between countries) to have different views on resource ownership or access rights. A basic requirement is that they be prepared to sit down to negotiate a periodically-reneweable agreement over a fixed time period. This agreement will almost certainly be slightly sub-optimal for both parties, (as almost all agreements) are) but should involved an equitable share of the pain between both parties (Page 22).

I firmly believe that one the main obstacles to the Burnt Church Government coming into a Resource-sharing Arrangement with Canada on the Fishery has been Canada's Lack of Respect for the First Nation's desire to become heavily involved in the future Management of the Fishery. The Draft Report notes this Lack of Respect.

> DFO has not recongnized that Burnt Church lobster management plan no the trap issued by Burnt Church under it. Arrest of native fishermen and confiscation of their gear occurred in the fall fishery last year, shots were fired, and personal injuries sustained by both sides. Some tens of million of dollars were spent on enforcement in an atmosphere that was described to this consultant as resembling certain police state operation (Page 14)

Yet Dr. Caddy the Draft Report's author, strongly indicates that First Nations local management of the Fishery is not unreasonable objectives and that the Burnt Church Management Plan should be respected and implementation in more aspects:

> Apart form the question of the fall fishery, the current Burnt Church Plan has very similar provisions to that of DFO, making harmonization of other factors in the plan of simple exercise (Page7)
> "...we have two management plans which need to be reconciled..." (Page 22)

> "When we focus on the technical elements of the Burnt Church plan, which are the immediate concern of this report, despite the difference in management objectives (with the DFO Policy and Plan), the approaches are very similar"...(Page 22)

In fact Dr. Caddy makes some excellent recommendations on Pages 46-48 of the Draft Report in terms of facilitating Burnt Church's management of the Resource which would include the ability of our Mi'kmaq Government to:

- "Management decision-making processe;
- Purchase research services;
- Administer access;
- Monitor fishing activity;
- Provide information and education services;
- Enforce non-criminal rules;
- Collect levies to fund management (Page 47-48)

These are issues, and an approach, which DFO has refused to discuss, seriously to date. In addition, Dr. Caddy, unlike DFO, refuses to rule out a Fall Fishery for Burnt Church:

> "...a limited fall fishery in Miramichi Bay seem inevitable..." (Page 68)
> "...However, accepting the points of view of the parties, two seasons might be workable, but only with good surveillance and under a catch allocation by season or fisherman that is properly supervised" (Page 8)

So given that Dr. Caddy recommends harmonization of Canada's and Burnt Church's Fishing Plans, favours a "bottom up" approach to Fisheries Management which we at Burnt Church have long advocated, and sees our Fall Fishery as both "inevitable" and "workable", what are the Doctor's main concerns and where does he agree with the First Nation's approach? He clearly indicates "The main problems as I see it is with the level of fishing proposed in fall by the Burnt Church plan, and the long fall season" (Page 22) Yet, if Canada was prepared to accommodate the First Nation in terms of its goal of planning for, and managing, the Fishery Resource with appropriate financial supports, and in consultation with others, a meaningful dialogue on the level and length of fishing could not be ruled out. From Day #1, the First Nations Position has been to develop and offer its own Management Plan, and to be open to a dialogue with DFO on how to Harmonize that Plan with DFO's Policy and Plan, making the two Compatible. Since Day #1, DFO has rejected that approach insisting instead, as Sole Regulator, that Burnt Church must accept the Federal scheme. We have resisted this "take it or leave it" approach Dr. Caddy's reasons for calling for a more limited Fall Fishery for Burnt Church are largely summed up on Page 3-5 of his Draft Report. He makes the case that and Indian Spring Fishery. Yet he concedes that the data is sketchy. The magnitude of the impact of the greater "fishing power" of the Fall Fishery on the subsequent Spring Fishery is highly dependent on just how much of the lobster stock in Area 70,71 and 75 migrate into the so-called "triangle" where Burnt Church has been fishing. The extent of this migration is not known, therefore Dr. Caddy makes various "assumptions" which Science has not confirmed. While he fears are very real, there is a definite gap in the data, which he recommends Burnt Church be resourced to fill.

Although Dr. Caddy makes several admirable suggestions as to how to use the First Nations interest in Lobster preservation and research to generate employment and shift pressures away from what he sees as an intensive Fall Fishery, he gives all to much credit to non-native fishers for maintaining and enhancing the lobster fishery to date: He also appears all too willing to portray the First Nations Fall Fishery as a disruptive activity that is just now

causing social divisions. I am afraid that the History is much more complex. Racism is no small factor to control the Fisheries agenda by forcing First Nations to conform to non-Indian models, like it or not.

As Chiefs and principal spokespersons for Burnt Church I am not insensitive to Dr. Caddy's concerns that an intensive Fall Fishery, coupled with a non-Indian decision to fish in the Fall, could spell disaster for Miramichi Lobster. Conversation (*sic*) must be first priority. However, Canada will not win Mi'kmaq cooperation on the Conservation front until the Rights and Status inherent in he Marshall ruling are respected by Canada. The Burnt Church Government is a Real Government – and we must be treated as such. We need a 'nation to nation' dialogue. Nations must cooperate in the interest of Conservation. If Canada continues to avoid real cooperation, harmonization and compatibility in favour of Imposed Solutions and Insensitive Enforcement practices then conservation will suffer. No management Plan is written in stone. Numbers and length of Season are legitimate topics; but so too are First Nations Planning, Administration, Management and Enforcement Everything must be on the Table. The parameters of a Fall Fishery must be negotiated not **imposed**. Unlike previous efforts and proposal I believe that Dr. Caddy's Draft Report can be a starting point for a new Dialogue, but cannot be used selectively to support the position of either DFO or the First Nation alone. It is a worthwhile first step. We need to deal with the issues raised but cannot simply jump to the conclusion that the author has come up with all the answers.

Yours in Brotherhood,

Chief Wilbur Dedam
For the Mi'kmaq First Nation at Burnt Church

August 9, 2001

ANNEX VIII : MFU's response to Dr. Caddy's report

The Maritime Fishermen's Union Inc.
L'Union des Pêcheurs des Maritimes Inc.

Tel 506.532.2485
Fax 506.532.2487
mfuupm@nbnet.nb.ca

408 rue Main St
Shédiac NB
E4P 2G1

August 1, 2001

J.F. Caddy
Via Cervialto 3
Aprilia 04011, Latina Italy

Dear Mr. Caddy,

We have had an opportunity to review your draft report, especially the Executive Summary and the comments below apply largely to the summary. In general, we found it to be a helpful report in so far as it allows all the interested parties to consider the issues within a framework. Furthermore the essential aspects of the framework validate the longstanding conclusions of fishermen i.e. that "under the circumstances of an uncontrolled fall fishery the whole fishery will convert to a fall harvest" and a "fall fishery is so efficient it risks catch overshoot and stock decline".

We believe you are right to stress that the 'catchability' of fall lobsters in the Bay are much higher than during the commercial spring fishery. The use of 5 to 6 times points in the right direction but the rate could be much higher depending on the catch period and the zonal definition.

In your Executive Summary point #6 you refer to the waters in "which DFO allowed Burnt Church fishers to fish". But, in reality most fishing in 1999 and 2000 was done in defiance of DFO and the restricted waters to which you refer were not as clearly defined. Nevertheless, you are right to state "the impact of the fall fishery depends mostly on knowing the degree of spatial overlap of the fishery with the whole inshore movement of lobster in summer".

In point #18 you stress the need for good data: from our experience over the past 30 years, effective management has not depended on the data that you suggest is absolutely essential. Commercial fishermen are overwhelmingly of one mind that what is essential is adherence to the complex of fishing practices evolved over time: e.g. minimum sizes, protection of berried females, escape mechanisms, season limitations. There is also growing recognition of the need to protect the large females.

In your point #21(still in the Executive Summary) when you state that "accepting the points of view of the parties, two seasons might be workable" you fail to note that two seasons is only the position of one of the parties i.e. Burnt Church. Earlier you note that the likely outcome of significant fall fishing would result in the end of a spring season. So, when you talk of "good surveillance" and "catch allocation" you must be talking of some kind of limited interim fall fishery that would be an allocation to Burnt Church, based on a 'fraction' of the expected commercial catch. We see in # 28 and 29 that this is what you are proposing for a transition period within the context of an agreement.

If such an agreement is to be roughly similar to other Bands (e.g. Big Cove) the number of commercial inshore operations that would accrue to the Band would be in the vicinity of twenty five to thirty. Given that in 2001 the Band fished thirteen lobster licenses in the spring season, and given the kind of "catchability"of fall lobsters, any interim fall fishery for 2001 that would be part of an agreement would have to be very limited indeed. Whether even such a limited fishery would meet with acceptance by commercial fishermen is wholly dependent on the

believability of the enforcement and monitoring provisions and on the assurance that such fishing effort is covered off by licenses bought from commercial fishermen in the impact area.

Re: your section " in the absence of a fishing agreement with DFO", we view this section as a kind of 'throw away' line. How could we possibly imagine this emergency management plan as being any more enforceable than last year's food fishery. Besides, you are well aware that lobster fishermen in the area do not believe in a boat quota system; your emergency suggestion would cause divisions among commercial fishermen who are fishing tuna, herring, rock crab etc. in the fall and therefore at a disadvantage to others not dependent on these fisheries to make their fishing year. Your emergency area would also run into problems with adjacent areas within the same LFA 23.

That there may be other approaches to an emergency plan is something we are all searching for and is really not for comment here.

In concluding, we should repeat that we find your work overall to be helpful and there are many positive things that we have not noted here. In the main report, there are various things that a person might take issue with; for instance, your effort to demonstrate the commonality between the Burnt Church plan and the DFO management plan is a bit of a stretch. It differs on fundamentals like seasons, management authority, delineation of zones, fishing effort and access and so on. In any case, we understand that you are simply looking for ways to break the logjam.

We trust that the basics in your report will serve to create better understandings among all parties in the days, months, and years to come.

Sincerely

Michael Belliveau
Executive Secretary