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FISH STOCK CONSERVATION MEASURES AND THE IRISH FISHING INDUSTRY

JOHN A. CURTIS
Economic and Social Research Institute

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Abstract: The decline in fish stocks is well documented and numerous efforts are in place to preserve and rebuild stocks. While conservation programmes have the potential to improve profitability, this usually will not occur before contraction in the fishery (in landings, incomes, employment, etc.). Conservation programmes are therefore risky ventures for fishermen, because they may not financially survive until profitability improves and because the programme itself might not deliver its promises. One crucial element in commercial stock replenishment measures is the co-operation and support of fishermen. Using recent survey data fishermen's opinions on the current state of fish stocks and on the viability of conservation programs are investigated. The paper also examines fishermen's attitudes to risk and estimates their subjective risk premium on stock conservation programmes. The results suggest that fishermen support the need for stock replenishment measures but evidence of high discount premiums required for acceptance of risky stock replenishment programs indicates that voluntary participation without compensation cannot be assumed.

Keywords: Fish Stocks, Replenishment, Conservation Programmes.
JEL Classifications: Q220.

1. INTRODUCTION

In public discussion of the Irish fishing industry we constantly hear of calls for conservation measures and the possibility of stock collapses. Such utterances are now annual affairs coinciding with such events as EU council of ministers deciding quotas but there is little obvious improvement occurring from year to year. Movements to redress imbalance and over-exploitation are primarily awaited from government, though there have been some unilateral initiatives by concerned fishermen, for example, the V-notch program for lobster. Though there may be a myriad of reasons for declining stocks, the leading detrimental cause of stock decline in most circumstances is over-exploitation, that is, harvesting at levels that are not sustainable. To what seems a very simple cause of decline there is an equally obvious solution; reduce harvests to allow fish stocks to recover and thereafter resume harvesting at sustainable levels. But the solution is not that simple and reform is faced with considerable inertia from all stakeholders and the consequence is a gradual deterioration with time.

The reasons for the inertia in tackling the difficulties faced by the industry are numerous and complex. The bottom line is that decisions are required that will detrimentally affect incomes and employment in the fish catching sector. After initial adjustment, a fishing sector based on a sustainable harvest level is envisaged but the difficulty lies in the transition period. Substantial downsizing is probably required in many fisheries but few apparent viable alternatives are available to the semi-skilled crew of fishing vessels.

This paper examines some of the issues involved in stock conservation with particular focus on the perspective of commercial fishing vessels. The paper utilises new data, the novel component of which is information on fishermen's opinions about conservation, whether they believe such programs are feasible and their views on the associated risks of such programs. The data contains observations on vessels operating in the Irish Sea and consequently the paper concentrates on the state of stocks and need for conservation in the Irish Sea.

2. FISH STOCKS IN THE IRISH SEA

The International Council for Exploration of the Seas (ICES) designates the Irish Sea as area VIIa, specifically the seas between latitudes 52° and 55° north. ICES stock estimates of several Irish Sea species are presented in Table 1. Estimates are based on a variety of data sources including scientific surveys. For each of the species shown in Table 1 there is a general downward trend in spawning stock biomass over the 1985-1999 time period. The most significant decline occurs for whiting, where the estimated spawning biomass of whiting in 1999 was only 35 percent of its estimated 1985 level. Though frequent large fluctuations in the spawning stock biomass occur and depend on items such as habitat conditions and year class recruitment, the significant and lengthy downward trends in these figures are clear indication of the threat to the viability of commercial fisheries for these species in the Irish Sea. Also contained in Table 1 is yearly catch as a percentage of the spawning stock biomass. Caution is required in interpreting this statistic without referring to the biological literature on species' life cycle, nonetheless, constant high catches as a percentage of spawning stock biomass are a serious threat to the viability of a species. In the case of cod, catches have exceeded 75 percent of the spawning stock in every year between 1985 and 1999 and for four years exceeded 100 percent. The latter occurrence is possible because catch includes juvenile fish. The dramatic 65 percent decline in whiting spawning stock biomass is no doubt a reflection that catch exceeded spawning stock biomass in eight of the fourteen years presented.

Table 1: ICES Estimates of Spawning Stock Biomass and Landings in Division VIIa (Irish Sea)

Year	Spawning Stock Biomass (SSB)	Catch as a % of SSB	Spawning Stock Biomass (SSB)	Catch as a % of SSB	Spawning Stock Biomass (SSB)	Catch as a % of SSB	Spawning Stock Biomass (SSB)	Catch as a % of SSB
	Cod		Plaice		Sole		Whiting	
	1000 tonnes	%	1000 tonnes	%	1000 tonnes	%	1000 tonnes	%
1985	12.7	82.5	6.6	76.9	5.3	21.6	16.4	111.2
1986	12.2	80.8	7.5	64.1	6.4	31.2	11.8	105.2
1987	13.3	96.9	7.2	86.4	7.0	40.1	11.3	127.6
1988	14.1	100.5	7.7	65.0	5.6	35.7	13.0	91.2
1989	15.3	83.3	7.2	60.7	4.8	38.2	10.8	124.1
1990	9.3	79.3	6.1	53.7	4.0	39.6	7.9	134.9
1991	7.0	101.4	5.1	50.1	3.6	33.7	8.3	119.8
1992	7.4	104.5	4.9	66.7	3.9	32.3	9.4	136.1
1993	6.5	116.2	4.1	48.7	3.7	27.6	12.4	74.4
1994	6.2	87.1	4.2	49.2	4.2	32.6	9.0	88.2
1995	4.9	93.6	3.7	50.6	4.0	31.7	7.6	92.7
1996	6.1	81.4	4.0	42.7	3.1	32.3	6.4	124.5
1997	6.0	97.7	3.9	48.0	3.1	32.4	4.3	97.8
1998	5.9	90.1	4.1	43.0	3.6	25.3	4.6	76.8
1999	8.1	n/a	4.5	n/a	4.1	n/a	5.8	n/a

Source: Marine Institute (1999)

Table 2 shows in absolute level how landings have fared over the same period for cod, haddock, plaice, sole and whiting. Plaice, whiting and cod landings have declined dramatically since 1985, all three by more than 50 percent. While for sole and haddock, landings have been less volatile though haddock have had a couple of years with significantly increased landings.

The estimates of spawning stock biomass indicate serious deterioration in the viability of Irish Sea stocks with a strong downward trend in each of the species presented. On causal observation it appears that the high levels of catch as a proportion of the spawning stock biomass is a major reason for the decline. Actual fish landings from the Irish Sea have also declined dramatically both by Irish and other vessels. Based on this elementary analysis there is evidence that fish stocks in the Irish Sea are threatened with collapse especially if current practices and trends continue. It is evident that there is urgent need for immediate additional conservation measures. Similar conclusions have been reached elsewhere both for the Irish Sea and other fisheries. For example, Bord Iascaigh Mhara (1999) made a series of recommendations with respect to development and conservation of inshore fisheries.

Table 2: Nominal Landings (tonnes) in ICES Division VIIa (Irish Sea) 1985–1997 as Officially Reported to ICES.

	1985	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Ireland – Cod	4,121	3,991	5,017	5,821	3,656	2,800	2,364	2,260	1,328	1,506	1,414	2,476	1,492	n/a
Total[1]	10,483	9,852	12,894	14,168	12,751	7,379	7,095	7,735	7,555	5,402	4,587	4,964	5,859	5,317
Ireland – Haddock	341	275	797	363	215	80	254	251	252	246	320	798	1,005	n/a
Total[1]	728	726	1,287	747	560	582	616	703	813	1,043	1,753	3,023	3,391	4,902
Ireland – Plaice	2,000	1,858	2,132	2,009	1,406	1,350	900	1,355	654	547	557	538	543	n/a
Total[1]	5,075	4,806	6,220	5,005	4,372	3,275	2,554	3,267	1,996	2,066	1,874	1,707	1,871	1,765
Ireland – Sole	180	235	312	366	155	170	198	164	98	226	176	133	130	n/a
Total[1]	1,146	1,995	2,808	1,999	1,833	1,583	1,214	1,259	1,023	1,369	1,266	1,002	1,003	910
Ireland – Whiting	5,521	3,101	4,067	4,394	3,871	2,000	2,200	2,100	1,440	1,418	1,840	1,773	1,119	n/a
Total[1]	18,236	12,415	14,418	11,856	13,408	10,656	9,946	12,791	9,230	7,936	7,044	7,966	4,205	3,533

1. Total catch figures used by the ICES Working Group for stock assessment and may include discards.

Over the same time period the number of vessels operating in the Irish Sea has declined. Ports in the southern part of the Irish Sea, such as Arklow, no longer have a strong fishing presence. For remaining vessels, stock conservation measures are likely to be quite important, though viewed with scepticism as such measures are liable to lead to lower incomes in the short term. Whatever the nature of proposed stock conservation measures their successful implementation will depend on the support of fishermen. One purpose of the survey of Irish Sea vessels was to elicit fishermen's views on the need for conservation and their willingness to accept preservation measures.

3. THE DATA

The Marine Institute commissioned a survey of vessels operating in the north Irish Sea (north VIIa, roughly north of Wicklow) that was completed by the Economic and Social Research Institute during January and February 2000. The dataset contains observations on forty vessels, which represents roughly 50 percent of the sample. The low response rate is due in part to what transpired to be a somewhat dated copy of the vessel register with several vessels having being decommissioned for some time. The survey sought to contact vessel operators rather than listed owners therefore any deficiencies in the sampling list in respect of ownership did not adversely affect the response rate. With the practical absence of investment in new vessels it is unlikely that the sampling list was significantly deficient in this respect.

The Irish Sea Fishery

The average vessel operating in the Irish Sea is one that is over 32 years old, 20 metres in length, wooden hulled, hold capacity for 270 boxes and can stay at sea for up to 5 days. The predominant gear on board includes a stern gallows, net drum, and a power operated winch. Over half of vessels have either a refrigerated or insulated hold with about one quarter of vessels having both. Nephrops trawl is the predominant target/method with this being the exclusive method for about one-third of vessels. Bottom otter white fish trawl is the second most prevalent method with one quarter of vessels completely relying on this method. Other gears used include beam trawling and dredging. Where vessels use several gears, the main combinations are nephrops trawl with either bottom otter white fish trawl or dredging.

The average crew size on an Irish Sea vessel is 4.5 persons, predominately working on a share basis. Actual time fishing varies substantially with an average of 38 five-day weeks, though some vessels fish the entire year. Based on the surveyed vessels, mean vessel income is estimated to be roughly £170,000. Income on the larger more commercial vessels is substantially higher while it appears that revenue on some of the smaller vessels would be insufficient to support even one crewmember full time. Median vessel revenue is roughly £120,000. Expenditure on maintenance and modernisation of gear, equipment and vessels averaged £38,000. Running costs averaged over £50,000 for the year, which included expenditures on fuel, commission, and ice but excluding the payments to crew and administrative costs such as insurance.

These figures give some indication of the size of the fishery and its importance to the economy. Although it is a relatively small component of the national economy the industry is concentrated in only a few ports and therefore is quite important in these coastal communities. The figures also illustrate the level of economic activity that would be affected by policies to immediately curtail fishing for the purpose of revitalising depleted stocks. It is the importance of fishing to these communities that is part-cause of the inertia to move on stock conservation.

Fishermen and Conservation

To assess fishermen's awareness of the level of over-exploitation in the Irish Sea, vessel skippers were asked about their primary target species and whether these fish were being caught before they attained optimal size. Generally, fish being caught before they reach their optimal size is an indication of over-exploitation. The survey questions focused on fishermen's primary target species with which they would be most familiar. Responses are presented in Table 3. Across the various species a significant proportion of fishermen believe that fish are being caught before they reach optimal size but opinion is far from unanimous. Just prior to the survey, the critical state of Irish Sea cod stocks received considerable media coverage and it is therefore surprising that the majority of responding fishermen believe that cod are not being caught before they reach optimal size. However, the results may reflect some ambiguity in the interpretation of optimal size, optimal size differing depending on for whom it is optimal. Optimal size for biological sustainability will differ from the optimal economic size for fishing vessels.

Table 3: Fishermen's Opinions on Conservation

Primary target species (Max 3 per vessel)		Fish are generally being caught before they reach their optimal size?		Value of older larger fish outweighing more numerous smaller fish?	
Species	No. of responses	Yes	No	Yes	No
Nephrops	29	17	12	23	6
Cod	17	6	11	14	3
Whiting	5	3	2	4	1
Sole	2	2	0	2	0
Plaice	9	7	2	7	2
Ray/Skate	6	0	6	4	1
Haddock	7	7	0	6	1
Monk Fish	9	3	6	7	2

Fish stock regeneration proposals frequently involve reduced fishing effort to allow stocks to recover, after which fishing resumes. On resumption of fishing increased regulation is usually required to ensure that stocks are not depleted again. Purported benefits of such programs include healthier fish stocks and for the fishermen improved revenues. Improved fishing revenues arise because the additional value of older larger fish potentially outweighs the value of more numerous smaller fish that are the norm prior to conservation. Also, improved stocks may lead to a lower effort per unit catch and therefore reduced costs. Successful conservation programs require the support and involvement of fishermen, though it is not obvious that replenished fish stocks can support employment and vessel numbers at original levels.

Irish Sea skippers' views on conservation programs that redress the imbalance in age classes, trading off the higher value of older larger fish against more numerous smaller fish are also presented in Table 3. An overwhelming majority of fishermen believe that if the primary Irish Sea target species were allowed grow, the additional value of older larger fish would outweigh the revenue from more numerous smaller fish. Compared to the question on optimal size of caught fish the response here is clearer – fishermen believe that there is imbalance in the age classes of fish stocks, too few older fish compared to young fish and that there are potential economic benefits from stock conservation measures.

Fishing activity that concentrates on smaller younger fish is essentially caused by the imbalance in age classes, which itself is due to over-fishing, a viscous circle. In the Irish Sea several species concentrate on the same grounds creating additional management problems relating to by-catch. One remedy for stock replenishment is effort reduction. However, unilateral effort reduction by individual vessels is fruitless in two respects. First, benefits from reduced effort will not materialise if other vessels continue their original high levels of fishing effort. Initiatives such as the closed areas for cod in spring 2000 are required instead. Second, in addition to the risks surrounding stock recovery, economic returns will not be guaranteed proportionately to individual vessel's investments and sacrifices that allow stocks recover.

Risk and uncertainty surrounding conservation projects impede the progress to conserve and rebuild stocks. Uncertainty exists because fishermen are generally unsure what is involved for them, whether they will be able to make a living in the presence of conservation projects. But given a specific conservation project proposal, uncertainty is not the limiting factor as this can be overcome through information and education. It is due to the high level of risk involved in conservation projects that many fishermen are likely to oppose or be sceptical of conservation plans. Significant initial investment and sacrifice, in terms of forgoing catch and income, is required in conservation proposals with the expected return coming in later years. There is risk that either the vessel will be unable to survive economically in the interim or that fish stocks will not recover as expected. Similar to any business investment opportunity we would expect that fishermen seek returns to adequately compensate for the level of risk. Conservation projects that fail to provide sufficient return for the investment and risk involved are unlikely to find widespread support among fishermen.

Attitudes to Risk

Previous work on Irish Sea vessels suggested that the risk premium for conservation projects in the early 1990s was quite high with time discounted rates of return between 52-60 percent required on stock replenishment projects (Hillis and Whelan, 1992). A decade later, interest rates were at historically low levels with mortgage rates as low as 3.5 percent and unsecured borrowing at 10 percent during 1999. It is likely that the required return on conservation projects may now be lower and that attitudes to risk have changed over the period. The survey of Irish Sea vessels provided an opportunity to assess fishermen's current attitudes to risk.

The recent study sought to collect two types of information with respect to risk: fishermen's subjective discount rate on risk free money, and their subjective discount rate on a specific stock replenishment program with quantitative descriptions on future returns.

The question collecting information on fishermen's subjective risk free discount rate offered a choice between particular cash amounts now and at specified times in the future (for example, £1,000 cash now versus £1,200 in one year's time). The results from the survey suggested discount rates from as low as 0-5 percent to greater than 50 percent. The median subjective discount rate was approximately 20 percent, which at face value appears implausibly high. A priori we would expect the discount rate to be similar to the bank rate for unsecured borrowing, which at this time was approximately 10 percent. If we ignore outliers with discount rates greater than 50 percent the median for the remaining observations is approximately 15 percent, a rate closer to what we might expect. There is no separate evidence from the survey that the observations with discount rates greater than 50 percent, nine in total, could been deemed outliers but it seems implausible that their discount rate for risk free returns could be so high.

The second stage is assessing fishermen's aversion to risk involved presenting a detailed stock replenishment project that involved specified reductions in profits in the first two years of the project and thereafter returning to improved profitability. The proposal specified how profits would change in each of eight years of the project, with the last few years of the project being described as an improved stable equilibrium compared to profitability prior to stock replenishment. The decision facing fishermen involved agreeing to reduce fishing effort and therefore reduced profits in the first two years leading to improved profits in the following years. The risk in the project is again twofold, whether the vessel can continue to operate until profitability improves and whether the stock replenishment program actually works. Respondents to the survey were asked a series of questions that traded off various initial profit cuts against improved profits in the future, the answers of which were used to bracket fishermen's subjective discount rate incorporating the risk associated with the described stock replenishment project.

We would expect to find that the discount rate incorporating risk is higher than the risk free discount rate, the premium is essentially payment for the risky nature of the project. The questions involved were quite complex involving a lot of information. Interviewers explained the concept through dialogue and with the aid of diagrams and tables and checked for the respondent's understanding of the stock replenishment project prior asking specific questions (the appendix to the paper contains this component of the questionnaire).

The responses are presented as the raw results and also adjusted for internal consistency with respect to the risk free questions. The stock replenishment questions assumed that fishermen's investment horizon is eight years, that is, data for eight years was presented in the tabular information on the questionnaire. It is likely that investment horizons differ between fishermen so fishermen were also asked how many years do they require initial investment outlay be repaid to consider an investment a good one. This information allows responses to the stock replenishment questions be interpreted both over an eight year period and the respondent's specified time horizon.

The median subjective discount rate incorporating risk, an eight-year time horizon, without internal respondent consistency checks, is approximately 30 percent. This is as expected, higher than the risk free discount rate, which was 15-20 percent. The responses vary from a low of 0-10 percent to greater than 60 percent but the mode response was in the range 30-40 percent.

These results assume that fishermen base their investment decisions on an eight year horizon when in fact fishermen indicated investment horizons between one and fifteen years with an average of just above six. When responses are interpreted using the fishermen's specified time horizon the results were not always consistent. That is, given responses to the stock replenishment questions their required internal rate of return over the respondent's specified investment horizon was negative. It is possible to give explanations for these inconsistencies but it would be conjecture and instead we continue with analysis of the consistent responses. Some responses showed the risk free rate higher than the rate with risk and these observations were also not considered in subsequent analysis. Excluding the inconsistent observations, twenty-two of the original forty vessels remain. The median subjective discount rate incorporating risk and varying length time horizons is in the region of 60 percent. However, in trying to bracket the subjective discount rate using the additional information from the investment horizon question the results are less precise. In ten of the twenty-two cases we only have lower bound estimates of the discount rate, i.e. the results indicate that a respondent's subjective discount rate is greater than 40 percent for example and not 40-50 percent.

Overall, the subjective discount rate for a stock replenishment project is quite high. The risk premium associated with such projects is roughly 40-45 percent (60 percent less 15-20 percent) and indicates that fishermen perceive a high level of risk in such projects. The policy implications for a stock replenishment project are quite clear. Though fishermen believe stock replenishment programs actually could work for Irish Sea fisheries, fishermen's participation in such projects cannot be assumed. Fishermen recognise that stock replenishment projects are risky and would seek compensation for taking these risks. The empirical results of the survey of Irish Sea fishermen indicate that the return fishermen would require to participate in such projects is quite high, at least 30-40 percent but possibly as high as 60 percent. However, the results also indicated that fishermen's subjective risk free discount rate was also quite high at 15-20 percent compared to an unsecured borrowing rate of roughly 10 percent. A summary of these results is presented in Table 4.

Table 4: Summary of Subjective Discount Rate Estimates

	Median	Mode	Minimum	Maximum
Risk Free	15-20%	15-20%	0-5%	>50%
With risk and 8 year investment horizon	~ 50%	>60%	10-20%	>60%
With risk and vessel specific investment horizon	~58%	>40%	5-15%	>64%

Note: Inconsistent observations, i.e. risk free rate greater than with-risk rate, excluded.

4. CONCLUDING COMMENTS

Irish Sea fish stocks are at dangerously low levels. The data on landings and the spawning stock biomass of the species presented in this paper shows the extent of the decline over the last decade and a half. At present stocks of Irish Sea cod are perceived to be under the most serious threat. To support stock recruitment the EU fisheries directorate banned access in specific areas in the north Irish Sea between mid February and the end of April 2000 to protect adult fish that congregate in this area during spawning. The Irish Sea is a mixed fishery with several other species such as nephrops, prawns, haddock and flat fish in the same protected area. The cod conservation measures just mentioned are designed to allow exploitation of these other species without threatening cod but most of these other species are themselves in decline. Combined conservation measures are really required.

Combined species conservation measures require the support and participation of fishermen. This paper assessed fishermen's views on the need for conservation measures and the likelihood of their participation in such measures. With the decline in landings over a continued time period fishermen are aware of the vulnerability of fish stocks. Fishermen are also aware of the need for conservation measures, which was clearly demonstrated in the responses to conservation questions presented in Table 3. There is not consensus on whether the fish are being caught before they reach their optimal size but the responses on age class imbalance are clear. Fishermen believe that there are too few older fish, which is in essence the stock decline problem. Fishermen generally indicated that if the average fish harvested now was allowed to grow further, the increased value of the fish in the future would outweigh the future return on current harvesting of the younger smaller fish.

The final section of the paper examined how fishermen discount future returns. Survey results of Irish Sea fishermen indicated that they placed a risk premium on a specific investment proposal involving returns from fishing in the future. The estimates in Table 4 are subject to a significant margin of error given the relatively few observations and the nature of the limits to which a complex stock replenishment program can be explained in a survey. However, the results are indication that the desired risk premium will be high. Elsewhere in the survey fishermen supported the need for stock replenishment measures but the evidence of high discount premiums required for acceptance of risky stock replenishment programs suggests that the voluntary and free participation by fishermen cannot be assumed. Curtailing fishing will impinge on incomes significantly and voluntary participation of fishermen in conservation measures is most unlikely unless there are alternatives with which to supplement incomes.

References

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APPENDIX

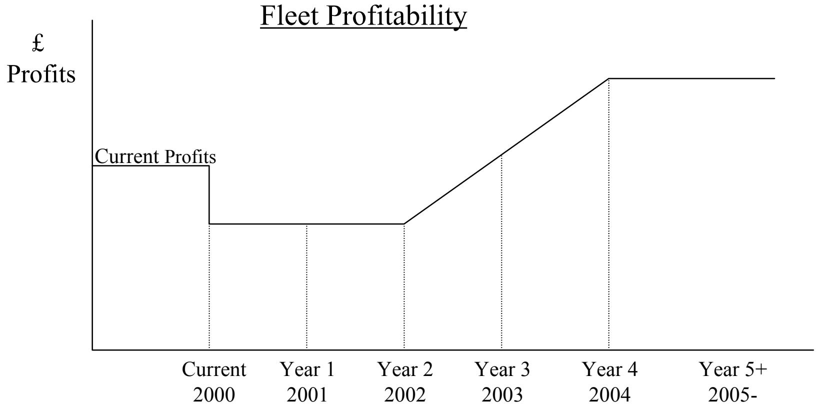
This appendix contains a section of the questionnaire that illustrates the type of questions used to elicit fishermen's attitudes to risk. During the course of the survey the interviewer read the **bold text** and followed the instructions outlined in the in the brackets below.

One option the government could pursue in the future to improve profitability of the Irish Sea fleet is to increase fish stocks through further regulation. Such an option would be based on the advice of biologists and scientists who believe that after a reduction in catch for a period of two years, fish stocks would improve sufficiently for profitability in the fishing fleet to increase. After the two years the fish caught will be generally larger and more valuable and less effort would be required to catch a given amount of fish. Total profits of all boats fishing in the Irish Sea would increase. The increase in profits would be permanent so long as the fishery is carefully and effectively regulated to prevent stocks being depleted again.

[Interviewer give respondent Card A and explain graph]

CARD A

Fleet Profitability



Suppose the government, on the advice of biologists and scientists, did introduce a program like this where profits fall in the first two years, as we have just seen in the diagram but profits increase permanently thereafter compared to initial profitability. Obviously all fishermen would be required to participate.

[Interviewer show Card B]

As you can see on this card by the third year profits are expected to increase by 5% compared to initial profits, by 10% in year 4 and by 20% in the years after. These profit increases are compared to initial profits before the program and not year on year increases. If the fish stocks are carefully managed, the scientists expect the profit increases to be permanent.

CARD B

Year 1 (2001)	Year 2 (2002)	Year 3 (2003)	Year 4 (2004)	Year 5 (2005)	Year 6 (2006)	Year 7 (2007)	Year 8 (2008)
Reduction in profits	Reduction in profits	+5%	+10%	+20%	+20%	+20%	+20%

Q.45 **Do you understand how the program would work?**

Yes .... □1 No .... □2 → explain further.

I haven't mentioned yet how much profit would have to fall in the first two years to achieve the profit increases outlined for the later years.

Q.46 [Interviewer show Card C and begin question]
Suppose the initial profit reduction and subsequent increases were as shown on this card. I'm talking about a reduction of 16% in year 1 and 5% in year 2 followed by a profit increases of 5% in year 3, 10% in year 4, and 20% in the following years, would you support such a program?

Yes .... □1 → Go to Q.47
No .... □2 → Go to Q.50

CARD C

Year 1 (2001)	Year 2 (2002)	Year 3 (2003)	Year 4 (2004)	Year 5 (2005)	Year 6 (2006)	Year 7 (2007)	Year 8 (2008)
-16%	-5%	+5%	+10%	+20%	+20%	+20%	+20%

DISCUSSION

Dr. Jennifer Stewart: The motivation for the paper is concern over fish stocks in the Irish Sea. Declining stocks will require conservation measures. However, these measures will be unsuccessful unless supported by the fishing industry. First, Dr. Curtis examines the state of the fish stock in the Irish Sea and then he examines skippers' attitudes towards risk associated with conservation measures.

For all types of fish, there has been a continuous decrease in the spawning stock biomass. Simultaneously, the yearly catch as a percentage of the spawning stock biomass has been high. Together these trends indicate that the Irish Sea fish stock is in danger of collapse and that over-exploitation may be the cause. Conservation measures are called for to reverse these trends, but the impact on the fishing industry needs to be considered.

Skippers were surveyed about their views on the need for conservation measures and their discount rates. There was a split on whether fish were being caught before they reached optimal size, but there was more general agreement that the value of fewer older fish outweighed that of numerous younger fish. The skippers' rate of time preference was measured by presenting them with a series of choices between receiving an amount today or more in the future. The estimated median rate of time preference was 15 percent. A more complicated description of the possible effects of a conservation programme was presented to skippers to elicit their risk premium. The estimated median value was 40-45 percent.

There is evidence of the need for conservation programmes. There is support that such programmes are needed, in particular, to change the age composition of the fish stock. Skippers have a high time discount rate and risk premium. This aversion to risk will need to be considered when designing policy.

I am not an expert on fisheries, but I am interested in survey design and most of my comments will be about the questions asked and the interpretations of the responses. The first puzzle to arise from the survey is the unexpected response to the question about whether fish are being caught at their 'optimal' size. Despite media coverage of concerns about the state of the Irish Sea fish stock, there is a fairly even split on this question, although there are differences according to the primary target species. Dr. Curtis suggests this puzzle may be due to differences in the interpretation of 'optimal size' (i.e., biological versus economic). His suggestion highlights a common problem in survey work; exactly how are respondents interpreting the questions?

An easy game to play is to come up with alternative interpretations. For example, I would suggest that the more consistent answer to the next question about the value of fewer older fish outweighing the value of numerous younger fish throws some light on this puzzle. In this second question, skippers tend to indicate that conservation measures would be beneficial to the fish stock. The difference in these questions is that the first question seems to ask about personal behaviour while the second question asks about the behaviour of others. Skippers have more information on the size of their own catch compared to their knowledge of other skippers' catches. They may feel that they are reporting on themselves. The second question asks about the state of the fish stock which is a consequence of all skippers' behaviour. Individuals may find it easier to report problems when they are not implicating themselves. "I behave appropriately, it is the others who don't."

Dr. Curtis finds a high time preference rate and a high risk premium for conservation programmes. He indicates that the risk of conservation has two aspects. First, there is concern whether the ship can economically survive a period of reduced revenue. Second, there is concern about the final outcome of the conservation programme. It should be highlighted that the risk surrounding the outcome of the programme includes a large number of factors, such as the reliability of scientists' predictions, the Irish governments' commitment, other governments' commitment, the behaviour of other skippers, environmental changes, and, of course, anything on the demand side. Therefore, it may not be surprising that the risk premium is high given so many potential sources of risk.

Dr. Curtis uses two different questions to estimate a time preference rate and a risk premium rate for conservation measures. For the time preference rate, skippers were presented with a choice between an amount today and a higher amount in the future and asked to choose. By varying the amounts, a time preference rate can be determined. These are relatively straightforward questions, especially compared to the next set.

In the next set of questions the impact on revenues over an eight year period of a conservation programme was presented to skippers. They were told there would be a decrease in revenue in the first two years and then there would be a given set of increases over the next six years. By varying the decrease in revenues, we can determine how much the skippers are willing to sacrifice now for future benefits.

I would draw an analogy between the second type of question and willingness-to-accept questions. It has generally been observed that the amount indicated in a willingness-to-accept question, where the respondent is being asked to give up a good, will always be larger than the response to a willingness-to-pay question. Possible explanations in the literature are: 'endowment effect' - people value goods more highly once they have them, 'substitution effect' - different movements along indifference curves, and 'imprecise preferences.'

In the first set of questions there is a gain either way to the skipper. In the second question, skippers are being asked to sacrifice revenue. If the difference between willingness-to-accept and willingness-to-pay exists in this scenario, then it would seem to suggest that the skippers over-value the revenue sacrificed leading to an overestimate of the risk premium. The results from this paper can then be thought of as a maximum bound on the risk premium. Perhaps more consistent questions would be “How much are you willing to pay today for X amount in a year?” (which can obviously be converted to a discrete choice question) and “How much would you pay for a fishing permit if your future revenue stream would be as in Table B?”