THE *PRESTIGE* OIL SPILL AND ITS ECONOMIC IMPACT ON THE FISHING SECTOR IN GALICIA (SPAIN)

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ABSTRACT

The sinking of the oil tanker the *Prestige* in November 2002 off the coast of Galicia in Spain had an important social, environmental and economic impact. The aim of this paper is to carry out an initial analysis of the costs relating to a halt in the activity of an essential part of fishing activity in Galicia between November 2002 and December 2003. We have followed three different steps to do this: the evaluation of the compensation given to fishermen, the estimation of the loss of income on account of the drop in production and then the estimation of these losses by means of questionnaires. The results obtained following these three steps are compatible and the estimated losses for the Galician fishing sector have already exceeded 76 million €.

Keywords: Prestige oil spill, economic impact, fishing sector in Galicia.

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1. INTRODUCTION

On 18 November, the oil tanker *Prestige*, having sailed for several days with a gash in her hull, broke in two and sank some 133 miles off the coast of Galicia (north-west Spain). Most of the 77,000 tonnes of heavy fuel the tanker was transporting was spilled into the sea. The pollution mainly affected the coast of Galicia (a coastline where one of the EU's main fishing communities is located[1]) forcing the public administrations (both the Spanish government as well as the Galician regional government) to adopt urgent measures, both in order to tackle the oil slicks and guarantee the health safety of fish consumers as well as to alleviate the economic effects caused by the obligatory halt in the activity of the fishing sector affected.

The evaluation of the social costs related to the oil spills has become more and more relevant in recent decades, as both the private and public costs of market goods and services (cleaning, restoring, losses of the fishing sector and the tourism industry) as well as the costs of non-market goods and services (of active and passive use) have been included in analyses[2].

Some two years after the *Prestige* incident, it has been established that the economic, social and environmental impacts linked to the disaster have been extremely serious[3]. In this paper we aim to evaluate some of these in 2002 and 2003: those costs linked to the loss of income for the fishing sector in Galicia as a result of the halt in fishing activity due to the oil spill from the *Prestige*. In order to carry out such an evaluation we will use three different means: the cost of the palliative measures introduced by the Spanish public administrations (compensation for fishermen affected by the halt in activity); the indirect estimation of the losses (by studying the evolution of data on production); and the direct estimation of the reduction in income (using questionnaires to be filled out by a representative sample of fishermen). These three steps constitute, in that order, the following parts of this paper. Lastly, we will sum up the main conclusions reached.

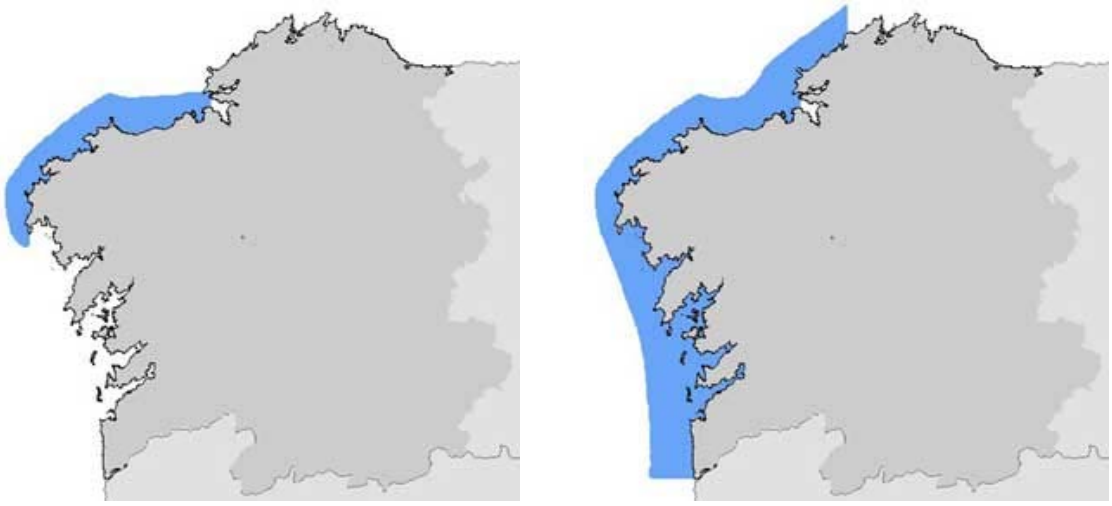
2. THE COST OF PREVENTIVE AND PALLIATIVE MEASURES

Given the magnitude of the catastrophe, the Public Administrations at its different levels (regional and state governments) instigated action which can be classified in two groups, that is, preventive action and palliative action.

Preventive action basically consisted of marking the zones where fishing was banned and the fishermen's and shellfish fishermen's associations affected by the obligatory halts in activity. With these

preventive measures the aim was, on the one hand, to ensure that fish and shellfish products not apt for human consumption did not reach the market and, on the other, that fishing activity did not hinder the clean-up operation.
As we can see in figure 1, the initial areas where fishing was banned (18 November 2002) centred on the north-western coast of Galicia, affecting principally fishermen and shellfish fishermen of the coastal fleet. The prohibited zone was gradually extended, first towards the north (the seine, longline gillnet fleets) and later towards the south, reaching the mouth of the River Miño (the border with Portugal) and affecting other fleet segments (barnacle fishermen, bottom trawling, aquaculture, etc.).

Figure **1**. Zones where fishing and shellfish fishing was banned in Galicia.

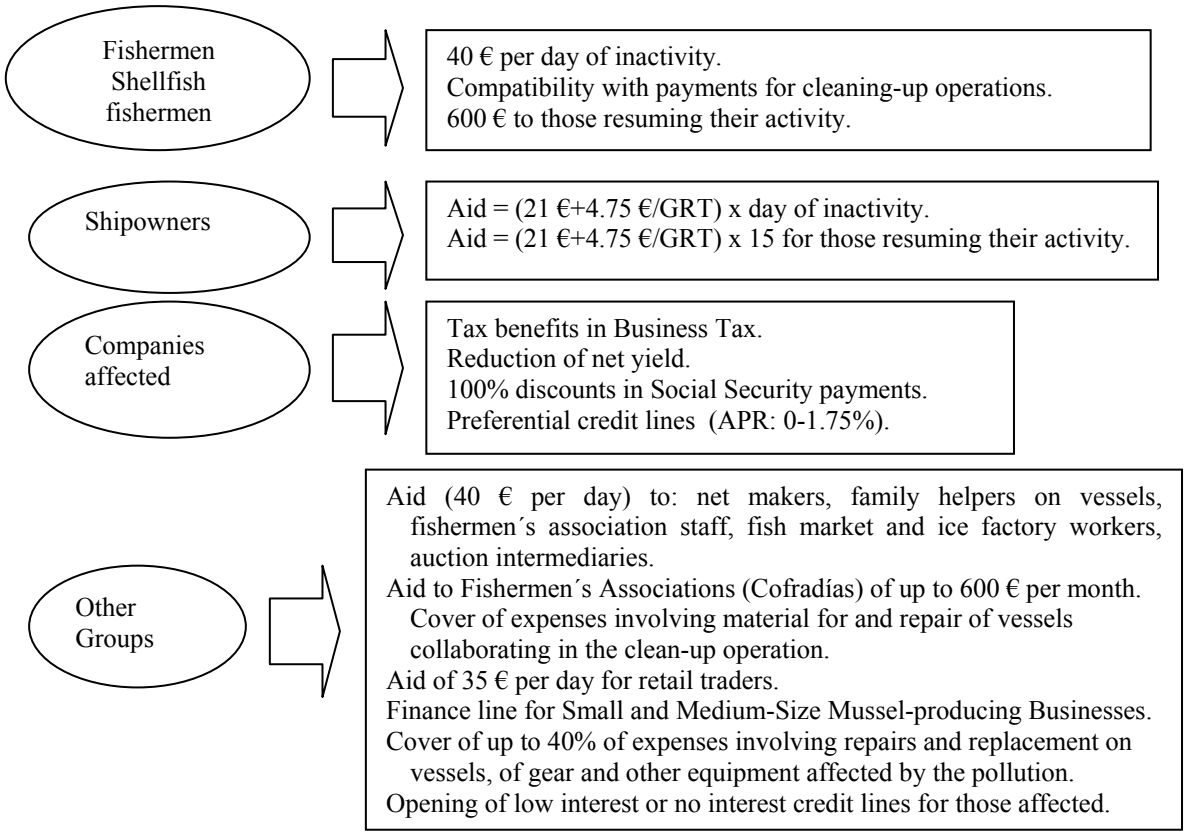


Area affected by the ban at 18-Nov-2002 Area affected by the ban at 4-Dec-2002

Source: Xunta de Galicia; Regional Ministry for Fisheries and Maritime Affairs (http://www.xunta.es).

As of 30 January 2003, the regional government began to establish a calendar on the basis of which activity in the banned zones could begin again. This calendar was conditioned both by negotiations with the fishermen and shellfish fishermen affected as well as by the precaution that resulted from information on the detection of new slicks or on the state of the seabeds where some of the oil spilled was deposited.
In accordance with all the information available, the lifting of the ban took place gradually, lasted over eight months and affected successively different zones and fleet segments. On 1 February 2003, the ban was lifted for shellfish fishing in the inner waters (rias) of the southern zone of Galicia. In this same zone, and after 24 February, some types of traditional vessels were allowed to restart their fishing activities, and after 17 March fishing with pots was authorised to begin again. At the beginning of April the rias in the northern zone of Galicia were opened up to shellfish fishing once more and as of the middle of April the ban on all the other types of fishing methods and gear was lifted except in the zone most directly affected (the Costa da Morte in the north-western area of the Galician coast). Finally, on 8 October 2003 all the bans were lifted for fishing and shellfish fishing in waters belonging to the Regional Government of Galicia.
The second type of action, **palliative action,** refers to the measures which were intended to compensate fishermen economically for the most immediate effects resulting from the halt in their activity.
The palliative measures began on 17 November 2002 and consisted basically of the implementation of a series of economic aid for shipowners, crewmen and shellfish fishermen affected by the bans placed on their habitual activities. Later, complementary measures were introduced, such as the increase in the volume of aid, tax reductions, discounts in Social Security quota payments, the establishment of campaigns to promote Galician fishing products and preferential credit lines for those affected. Also, as the effects of the spill extended in time and space towards other areas of the coast, more groups of those affected who were able to avail of the different types of aid were incorporated: fishermen and shellfish fishermen from other areas affected, net makers and repairers, fishermen's association staff, fish market and ice factory workers, auction intermediaries, retailers and fish and shellfish traders. Figure 2 summarises the main aid and groups involved.

Figure 2. Main palliative measures for those affected in Galicia.



Source: Surís and Garza (2004).

This whole process of preventive and palliative measures led the different public administrations in Spain to outlay substantial amounts of money. Figure 3 shows the expenses budgeted for by the regional government of Galicia in relation with the *Prestige* catastrophe.

Figure 3**.** Total budget per type of expense drawn up by the Regional Government of Galicia.

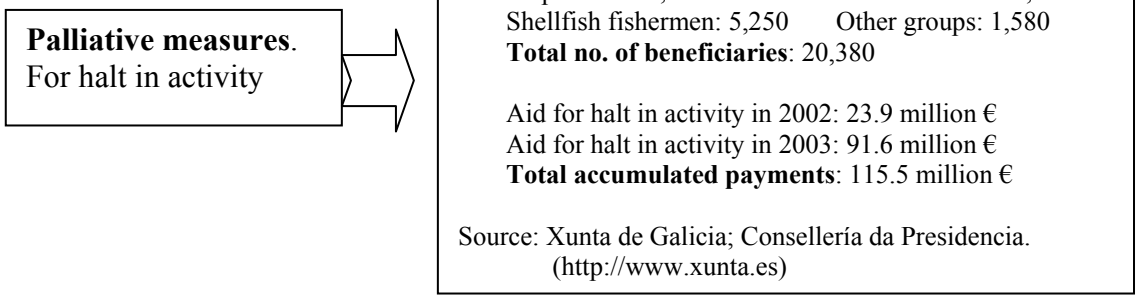
Type of expense	**(in 1000 €)**		
	2002	**2003**	**Total**
Aid for halt in fishing activity	23,894.59	91,631.82	115,526.41
Assistance and equipment for volunteers	4,530.01	146.98	4,676.99
Advertising and information campaigns	0.00	6,973.47	6,973.47
Collection, transportation and storage of oil	722.48	2,575.21	3,297.69
Fight against pollution	3,922.15	8,907.03	12,829.18
Other expenses	149.42	2,962.26	3,111.68
Total	33,218.65	113,196.76	146,415.41

Source: Xunta de Galicia; Regional Ministry of Economic Affairs and Finance. (http://www.xunta.es).

During the years 2002 and 2003 outlays rose to 33.2 and 113.2 million €, respectively. The most relevant expenses are related to the aid given to those affected by the measures taken to halt fishing and shellfish fishing activity and which represent almost 80% of the total (some 115.5 million € of a total of 146.4 million € spent over the two years). As is shown in figure 4, the total number of beneficiaries of public aid in 2002 and 2003 exceeds 20,000, 44% of which were crew members on coastal fishing vessels, 26%

shellfish fishermen, 22% coastal shipowners and the remaining 8% belongs to other groups directly affected (net makers, fishermen's association staff, etc.).

Figure 4. Beneficiaries of palliative measures in Galicia.



3. INDIRECT EVALUATION OF THE ECONOMIC IMPACT

We can carry out an indirect approach to the losses caused by the *Prestige* disaster analysing the evolution of the data on fishing production (with regard both to weight and value). To do so, it is necessary to have at our disposal statistical information on the evolution of these variables in the years prior to the accident, which will allow us to establish comparisons between the results obtained in normal seasons and the information affected by the extraordinary event in question.

The most complete and accessible information on the fishing and shellfish production affected by the *Prestige* disaster is that which the regional government of Galicia has made available through its digital platform (http://www.pescadegalicia.com). This source provides information (monthly and per species) on the fresh fish landed and sold at auction in the ports of Galicia since the year 1998. The possibility of having access to information on a monthly basis is of vital importance in the case of the fishing and shellfish fishing industries because, as we know, the natural characteristics common to each species of commercial interest can condition the greater or lesser intensity of their exploitation throughout the season (there are close seasons for some species at certain times of the year, the abundance of some species changes considerably depending on the season of the year, etc.). In this way the economic consequences resulting, for example, from a halt in fishing activity in the winter months would differ significantly from those which would occur if such a halt took place in the summer months[4].

In figure 5 we can see the monthly evolution, in weight and value[5], and the resulting prices, of the fishing and shellfish fishing production sold at the Galician markets from 1998 to 2003.

As we can verify, production in physical terms shows significant monthly differences and cyclical behaviours in accordance with the time of the year. Thus, for example, in the January months total production is usually approximately 9,000 tonnes, while production for August stands at approximately 13,000 tonnes (40% higher). Furthermore, fishing production usually reaches its highest levels in the summer months and its lowest levels in winter. During the period when the impact of the pollution from the *Prestige* was at its peak, from November 2002 to February 2003, production fell to its lowest levels in relation to the production reached in the same months in the previous years.

The oscillation in the monthly offer of fishing products and the changes in the composition per species according to the season of the year have clear repercussions on the average prices reached and, therefore, on the total income obtained. As we can see in figure 5, in constant monetary terms the average monthly prices remain stable at around 2.5 €-03 per kilo, reaching their highest levels in the December and January months each year, precisely when there is a lower physical production and a high demand for certain high-value fish products (for the Christmas period).

The combination of quantities and prices obviously gives the result of the total first-sale income obtained. Income also seems to enjoy a certain cyclical stability and usually ranged between a minimum of 25 million €-03 per month and maximums which scarcely exceeded 40 million €-03 per month, depending on the time of the year. Throughout the series considered, only for four months was the first-sale at market income obtained from fishing and shellfish fishing lower than 25 million €-03, more precisely the months from December 2002 to March 2003.

With the earlier information we have observed how the production consequences of the halt in activity as a result of the oil spill are perfectly clear using this added information. Thus, given the regular and stable

behaviour that the markets where the fresh fish products sold at first sale in Galicia would seem to show, we could adopt the average monthly information for the last four monthly observations available before the catastrophe as an indicator or reference of a normal annual production[6]. That is, for the months from January to October, the average for the monthly production for the period 1999-2002, and for the months of November and December, the same average but for the period 1998-2001[7].

Figure 5. Evolution of the fresh fish and shellfish sales in Galicia 1998-2003.

Year	Month	Sales (tonnes)	Prices (€-03/kg)	Value (1000 €-03)	Year	Month	Sales (tonnes)	Prices (€-03/kg)	Value (1000 €-03)
1998	Jan	9,568.1	3.02	28,882.6	2001	Jan	9,277.4	3.20	29,646.8
	Feb	13,779.7	2.31	31,769.8		Feb	10,975.0	2.81	30,786.4
	Mar	16,488.8	2.23	36,762.5		Mar	11,747.4	2.71	31,841.4
	Apr	13,725.1	2.35	32,269.0		Apr	11,094.0	2.56	28,394.5
	May	14,003.7	2.29	32,088.5		May	12,166.6	2.47	29,992.5
	Jun	17,806.3	2.07	36,906.4		Jun	13,926.4	2.20	30,675.1
	Jul	15,814.9	2.53	39,935.6		Jul	12,416.7	2.62	32,570.3
	Aug	15,704.2	2.18	34,173.2		Aug	12,834.0	2.65	34,060.6
	Sep	19,490.6	1.95	38,005.6		Sep	12,626.6	2.26	28,496.9
	Oct	15,326.4	2.11	32,350.6		Oct	12,707.8	2.46	31,217.4
	Nov	14,525.7	2.36	34,250.6		Nov	12,347.4	2.65	32,660.6
	Dec	11,872.4	3.43	40,731.1		Dec	10,751.6	3.58	38,537.9
1999	Jan	9,080.6	2.90	26,296.3	2002	Jan	9,082.7	2.90	26,358.2
	Feb	11,960.5	2.63	31,396.7		Feb	9,974.3	2.53	25,276.8
	Mar	13,540.9	2.61	35,317.0		Mar	11,459.4	2.25	25,787.9
	Apr	11,893.9	2.53	30,077.6		Apr	13,646.9	2.13	29,055.1
	May	13,799.5	2.47	34,153.3		May	11,637.0	2.43	28,314.8
	Jun	14,670.2	2.55	37,358.3		Jun	10,838.3	2.56	27,793.1
	Jul	14,490.4	2.65	38,360.0		Jul	12,186.9	2.80	34,144.2
	Aug	15,583.3	2.37	36,921.7		Aug	11,181.9	2.98	33,293.8
	Sep	14,785.1	2.41	35,638.0		Sep	11,610.6	2.49	28,960.6
	Oct	13,387.4	2.53	33,817.4		Oct	11,726.7	2.64	30,987.2
	Nov	12,858.4	2.86	36,823.6		Nov	8,986.3	3.10	27,886.6
	Dec	10,231.6	4.15	42,465.8		Dec	5,697.6	3.76	21,445.0
2000	Jan	8,666.7	3.21	27,840.5	2003	Jan	4,900.9	3.49	17,086.5
	Feb	12,273.9	2.52	30,874.2		Feb	7,467.0	2.62	19,528.7
	Mar	14,517.6	2.34	34,036.5		Mar	9,706.7	2.52	24,413.0
	Apr	11,798.2	2.42	28,535.9		Apr	11,031.5	2.27	24,997.2
	May	14,133.0	2.45	34,571.1		May	9,817.1	2.78	27,330.5
	Jun	12,907.8	2.52	32,494.5		Jun	10,203.0	2.52	25,685.0
	Jul	13,100.4	2.61	34,213.4		Jul	13,075.7	2.45	32,074.9
	Aug	15,338.0	2.31	35,453.4		Aug	11,212.1	2.58	28,877.6
	Sep	13,265.3	2.33	30,968.0		Sep	14,113.8	2.41	33,983.8
	Oct	11,710.8	2.59	30,299.1		Oct	13,225.2	2.56	33,851.6
	Nov	9,927.7	3.28	32,542.6		Nov	10,605.8	2.60	27,603.3
	Dec	7,662.6	4.37	33,506.0		Dec	9,321.1	4.20	39,109.0

Source: Xunta de Galicia; Regional Fisheries and Maritime Affairs Ministry (http://www.pescadegalicia.com).

Comparing the scenario of reference with the situation actually observed from November 2002 to December 2003, we can obtain an initial idea of fish production losses caused by the *Prestige* disaster. As we can see in figure 6, we estimate as a whole that over the 14 months of the period under study some 29,000 tonnes less than is usual (scenario of reference) were commercialised, 7,800 tonnes of which can be attributed to the months of November and December 2002 and the rest, some 21,400 tonnes, to the year 2003. The highest losses in production coincide with the first months after the catastrophe, a period in which the majority of fishing and shellfish fishing was stopped. Thus, production in the last two months of 2002 fell almost a third with respect to the usual figures. In 2003, the drop in total production stood at around 15% with respect to the base scenario[8].

In monetary terms (values expressed in constant units with respect to the base year 2003), the evolution of the losses followed a similar path to that relating to physical production: higher in the first months after

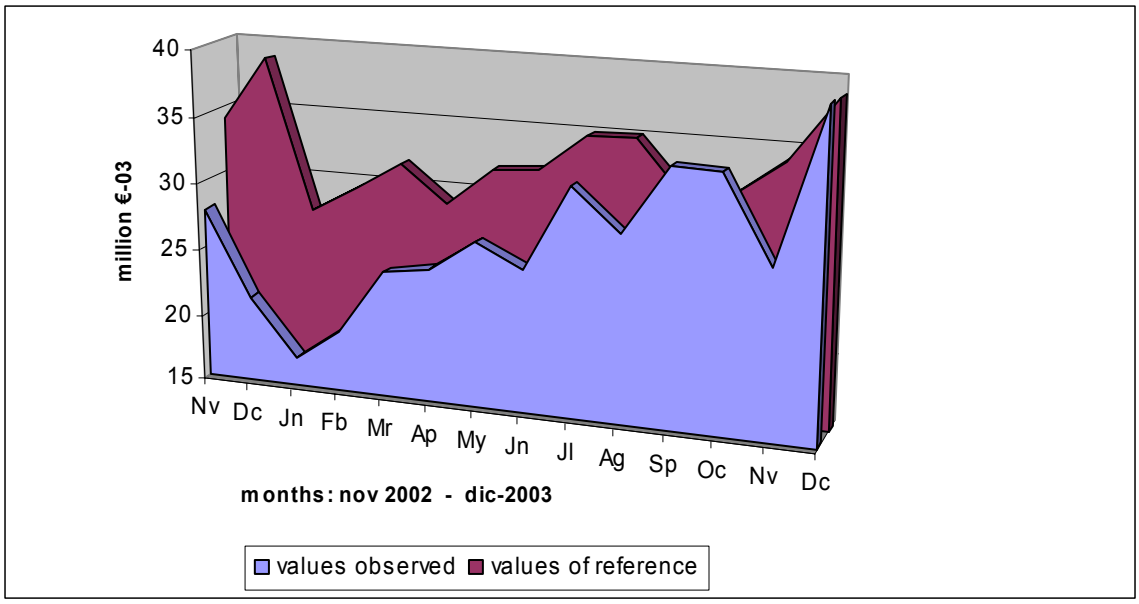
the event, lessening, with some changes, as the months passed. This can be clearly seen in figure 7, where the values of reference would mark the normal evolution of income, while those observed are the ones which were actually registered in the period under study. Thanks to price behaviour, losses in income are relatively lower than in physical terms. Production losses estimated for the two months in 2002 rose to 23.5 million €-03 (which implies a 32.31% reduction with respect to the normal or reference value which would be obtained for these two months and a reduction of 6.09% with regard to the annual income of reference) and those accumulated over the 12 months of 2003 were 52.4 million €-03 (a 13.54% reduction with respect to the income which we estimate must be normal yearly income). Overall, accumulated loss of income in the 14 months we have been studying rose to almost 76 million €-03[9].

Figure 6. Total fish production losses in Galicia.

		Situation of reference		Situation observed		Difference	
		Tonne	**1000 €-03**	**Tonne**	**1000 €-03**	**Tonne**	**1000 €-03**
2002	Nov	12,414.82	34,069.36	8,986.28	27,886.64	-3,428.54	-6,182.72
	Dec	10,129.56	38,810.21	5,697.62	21,444.98	-4,431.94	-17,365.23
2003	Jan	9,026.85	27,535.47	4,900.88	17,086.55	-4,125.97	-10,448.92
	Feb	11,295.91	29,583.52	7,467.04	19,528.72	-3,828.87	-10,054.79
	Mar	12,816.32	31,745.72	9,706.72	24,412.97	-3,109.60	-7,332.75
	Apr	12,108.23	29,015.75	11,031.45	24,997.18	-1,076.78	-4,018.57
	May	12,934.04	31,757.93	9,817.08	27,330.45	-3,116.96	-4,427.48
	Jun	13,085.67	32,080.24	10,203.05	25,685.00	-2,882.62	-6,395.25
	Jul	13,048.59	34,821.96	13,075.73	32,074.91	27.14	-2,747.05
	Aug	13,734.30	34,932.37	11,212.14	28,877.61	-2,522.16	-6,054.76
	Sep	13,071.92	31,015.86	14,113.81	33,983.76	1,041.89	2,967.90
	Oct	12,383.19	31,580.27	13,225.21	33,851.62	842.02	2,271.36
	Nov	12,414.82	34,069.36	10,605.75	27,603.26	-1,809.07	-6,466.10
	Dec	10,129.56	38,810.21	9,321.11	39,109.03	-808.45	298.82
Accum.	2002	22,544.38	72,879.57	14,683.89	49,331.62	-7,860.48	-23,547.95
Accum.	2003	146,049.40	386,948.66	124,679.97	334,541.07	-21,369.43	-52,407.59
	Total	168,593.78	459,828.23	139,363.86	383,872.69	-29,229.92	**-75,955.54**

Source: Xunta de Galicia; Ministry for Fisheries and Maritime Affairs (http://www.pescadegalicia.com).

Figure 7. Evolution of the income observed and the income of reference in Galicia.



Source: Xunta de Galicia; Regional Ministry for Fisheries and Maritime Affairs (http://www.pescadegalicia.com).

4. DIRECT EVALUATION OF THE ECONOMIC IMPACT

We will now carry out a direct estimation of the effects of the oil slicks from the *Prestige* on the income of the Galician fisheries sector from information gathered from questionnaires carried out on representative segment samples.

The population field we are investigating is made up of the fishing vessels which are based at ports in Galicia and which exploit, in the main, the closest natural resources directly affected by the oil spill off the Galician coastline. The questionnaire requested information corresponding to annual periods with regard to the financial years 2001, 2002 and 2003. The basic sample unit was the individual or legal entity owning a fishing vessel. We carried out a random stratified sampling, as in order to draw up the sample we divided up the directory population into two large groups: companies with vessels under 100 GRT (for the most part, with just one worker) and the companies with vessels of 100 GRT or over (with more than one paid employee). The field work was developed by a specialist company throughout the second half of 2004. Filling out the questionnaire was not obligatory, which led to many of them being rejected or filled out incorrectly. Therefore, while the stratum of the larger vessels was covered satisfactorily (see figure 8), insofar as the smaller vessels were concerned, we were unable to cover more than 60% of the sample foreseen initially[10].

Figure 8. Total population, initial sample and final sample.

	No. vessels	**Initial sample**	**% population**	**Final sample**	**% population**
Fleet ≥ 100 GRT	172	17	9.88%	17	9.88%
Fleet < 100 GRT	5,142	103	2.00%	62	1.21%
Total	5,314	120	2.26%	79	1.49%

Source: University of Vigo, Dep. of Applied Economics.

In short, and with all the necessary caution, we understand that the information gathered from the sampling allows us to understand the trends in the recent evolution of fishing and shellfish fishing activity on the Galician coastline after the *Prestige* disaster.

From the 79 questionnaires that made up the sample in the end, we were able to obtain the results set out in figure 9. This information is only significant of the trend observed, hence the need to express it in constant[11] and relative terms.

Given the figures established above, we would emphasise the following:

- In average terms, the coastal fishery companies surveyed stated that in the year 2002 they turned over, in real monetary terms, 9.5% less than in 2001. This percentage rose to almost 22% in 2003.
- Those surveyed also stated that the operating costs relating to the intermediate consumption of goods and services fell in 2002 and 2003 with respect to 2001 (3% and 18%, respectively).
- As a consequence of the above, the percentage loss in the generation of income (Value Added) was slightly higher than the respective drop in the production level. 12% loss in 2002 and 23.3% in 2003.
- The evolution of the labour costs has been quite similar to the evolution of production costs. A result which is coherent with the system of crew share which operates in coastal fishing.
- The other part of the Added Value, the retained earnings (includes Gross Retained Earnings, Mixed Income and Production Tax) falls considerably with respect to 2001, almost 16%, and 25.5% in 2002 and 2003, respectively.
- Both the number of those surveyed who stated having received subsidies as well as the average amount of said subsidies rose considerably.
- Employment did not vary in the same way, falling between 2.7% and 4% with respect to that registered in 2001.

Figure 9. Relative evolution of the mean data observed in the sample.

(**In €-03**)	**2001**	**2002**	**2003**	**AVR 02/01**	**AVR 03/01**
Turnover	112,828.59	102,053.71	88,024.41	-9.55%	-21.98%
Intermediate consumption	30,020.86	29,105.75	24,500.74	-3.05%	-18.39%
Gross Added Value	82,807.73	72,947.96	63,523.67	-11.91%	-23.29%
Staff costs	37,711.14	34,951.71	29,908.26	-7.32%	-20.69%
Retained earnings	45,096.59	37,996.25	33,615.41	-15.74%	-25.46%
Companies subsidised (in no.)	7	36	55	414.29%	685.71%
Subsidies*	2,045.38	2,398.38	6,427.43	17.26%	214.24%
Employment (in nos. of people)	3.71	3.61	3.56	-2.70%	-4.04%

*Note: Mean among those who confirmed they received some kind of subsidy.
Source: University of Vigo, Dep. of Applied Economics; on the basis of a sample of 79 companies.

From the questionnaire we can also obtain interesting information on the factors which, in the opinion of those surveyed, had a significant influence on the lower rates of annual turnover. Among the fishing companies which stated that their rates of turnover fell with respect to 2001 (which was the case for 86% of the fishing companies surveyed) the questions linked directly with an ecological disaster appear as the main factors which lead to a drop in income. Around 90% of those interviewed see the factors linked directly to the *Prestige* disaster, the subsequent drop in demand, the damage to the image of their products and the negative evolution of prices as important or very important. (A summary of these perceptions can be seen in figure 10).

Figure 10. Fishermen's perceptions (%) of the effect of different factors on the drop in income.

Factors	1	2	3	4	Mean
a) General evolution of the economy	38.98	32.20	16.95	11.86	1.79
b) Drop in demand	56.52	34.78	4.35	4.35	1.55
c) Negative effects of the *Prestige*	59.18	28.57	6.12	6.12	1.42
d) Damage to the image of products	46.00	40.00	10.00	4.00	1.73
e) Negative evolution of prices	48.28	43.10	8.62	0.00	1.76
f) Competition from products from other countries	25.49	19.61	33.33	21.57	2.73
g) Losses in international fishing Agreements	6.12	18.37	28.57	46.94	3.44
h) Changes in the public regulation of activity	6.25	16.67	37.50	39.58	3.30
i) The imminent incorporation of other countries in the EU	4.08	6.12	20.41	69.39	3.79
j) The internal situation of my company	8.33	25.00	43.75	22.92	3.00
k) Employment questions	4.00	56.00	20.00	20.00	2.67
l) Own or outside technical advances	4.17	29.17	29.17	37.50	3.12
m) Reduction of natural stocks	24.49	22.45	46.94	6.12	2.48

Note: 1 = very important; 2 = important; 3 = not very important; 4 = not important at all.
Source: Vigo University, Dep. of Applied Economics; based on a sample of 79 companies.

Those surveyed were also asked about other damages linked to the disaster. In 2002, out of all 79 companies surveyed only 18 affirmed they had suffered economic losses linked to the costs of repairs to and the cleaning of their vessels as a result of the pollution from the oil tanker (an average of 1,165 €-03 per company affected). As can be seen in figure 11, some of the fishing companies surveyed stated that they had suffered costs as a result of repairing their vessels and cleaning equipment at port because of the pollution, as well as other costs linked to the loss or deterioration of fishing gear and equipment.

Figure 11. Other economic losses associated with the *Prestige*.

	2002 no.	Mean 2002 (€-03)	2003 no.	Mean 2003 (€-03)
Repairs to and cleaning of vessel	18	1,165.5	23	1,216.1
Repairs to and cleaning of equipment	6	1,822.7	10	3,905.2
Loss or deterioration of gear or equipment	13	999.5	16	1,250.3

Source: Vigo University, Dep. of Applied Economics; based on a sample of 79 companies.

In order to be able to carry out a estimation of the losses in income in 2002 and 2003 as a result of the halt in fishing activity after the sinking of the *Prestige*, we can use as the basis for our estimate the information provided by the Galician Institute of Statistics for the fishing segments which correspond to floating shellfish fishing and coastal fishing for the year 2001[12]. In accordance with this official source, these fleet segments had an annual turnover in 2001 of 270.03 million €-03 (39.59 million €-03 from the floating shellfish fishing segment and 230.44 million €-03 from the coastal fishing segment). If to this information we apply the percentage annual reduction estimated directly by means of our sample, we will obtain the results which can be seen in figure 12.

Figure 12. Direct estimates of the losses in fishing income.

(thousands of €-03)	2002	2003
Estimated turnover	244,242.87	210,678.04
Estimated losses in income	25,787.94	59,352.77
% losses in turnover	9.55%	21.98%

Source: Vigo University, Dep. of Applied Economics.

As we can verify, our direct estimates show a loss in accumulated turnover over the two years equalling 85.14 million €-03 (30.3% corresponding to 2002 and the remaining 69.7% to 2003)[13]. This amount involves average impact indicators of 9.55% and 21.98% for 2002 and 2003, respectively, in relation with the turnover for the year 2001.

5. **CONCLUSIONS**

By means of the three ways of evaluation used we can say that the losses in income in Galicia as a result of the halt in fishing activity caused by the oil spill from the tanker *Prestige* in 2002 and 2003 are situated at between 76 and 115.5 million € (see figure 13).

Figure 13. Summary of the losses as a result of the halt in fishing activity in Galicia.
(in millions of €-03)

Ways for estimating losses	**2002**	**2003**	**Total**
Public compensation for fishermen	23.89	91.63	115.53
Reduction in income estimated indirectly	23.55	52.41	75.96
Reduction in income estimated directly	25.79	59.35	85.14

Source: Vigo University, Dep. of Applied Economics.

As we were able to verify in the monthly production series and from the dates when the preventive measures were enforced (ban on fishing activity), the reductions in fishing income levels occurred mainly in the first six months after the catastrophe (from mid-November 2002 until the end of May 2003).
The reduction in income estimates for 2002 are fairly similar to the cost of the compensation measures taken by the public administration. The same thing does not occur with the estimates for 2003, where considerable divergence between the figures estimated and the effective outlay of the public administration in the form of compensation exists. Part of this difference could be explained by the fact that, as the effect of the oil slicks began to extend, the palliative measures also had to be applied to other groups involved in the fishing industry (fish market workers, ice factory workers, family members who also help out with the vessels, net repairers, action intermediaries, etc). Another factor which would explain this difference is related to the recovery of the landings in the last months of the year[14], which led to monthly income higher than the average for the same months in previous years.
As a consequence of the reduction in fishing activity in Galicia on account of the *Prestige* disaster, income directly lost exceeded 75 million € in the first 14 months[15]. In short, it would seem clear that the economic damages caused to the fishing sector in Galicia are extremely high, and well-founded fears exist that such losses last into the future, as the medium and long-term effects that the oil spill could be having on the already-damaged ecosystem and the fish species exploited and commercialised that inhabit such an ecosystem are as yet unknown.

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Endnotes

[1] The fishing and aquatic sector in Galicia forms around 2.2% of the GDP of the region, with a turnover of over 1200 million € annually, employing more than 40,000 people. These figures represent around 50% of the Spanish fishing sector as a whole and approximately 10% of the European Union fishing sector. M.M. Varela and A. Prada (Coord), 2005.

[2] The development of these studies is closely linked to the need to evaluate the social costs caused by accidents such as the Amoco Cadiz, in 1979 in Brittany, France (F. Bonnieux and P. Rainelli, 1980, 1991 and 1993; T. Grigalunas et al., 1986; J. Hay and O. Thébaud, 2002), or the Exxon Valdez, en 1989 in Alaska (M. J. Cohen, 1995, 1997; R.T. Carson et al. 1992, 2003).

[3] Some preliminary evaluations of these impacts have been published in collective papers such as those by F González-Laxe (Dir), 2003 and A Prada y M X Vázquez (Coord), 2004. Interesting studies have also been published on the socio-political consequences (J.D. García Pérez, 2003) or the role of Spanish scientists (J. Freire et al., 2005) after the tanker disaster.

[4] In order to estimate the economic damages caused to Brittany's fishing sector by the Amoco Cadiz spill, authors such as Bonnieux et al. (1980), Sorensen et al. (NOAA, 1983) and other experts (references taken

from Bonnieux and Rainelli, 1993), adopted different regression models (with temporal tendencies, with ARIMA-type coefficients per season, etc.) in which different time periods were considered, but always with monthly production information.

[5] The monetary values are expressed in constant Euros for the year 2003 (€-03). To do this we use as a deflator the Spanish harmonised RPI series, a monthly indicator provided by the National Institute of Statistics at http://www.ine.es, proceeding to a change of base year from 1996 to 2003.

[6] We are aware that in recent years different occurrences have influenced global production levels: production crises in some species such as the sardine and more recently hake, seasons where storms are more frequent which prevents fleets from fishing, excessively rainy seasons which caused high mortality rates in shellfish fishing areas of the rias, etc. However, with the exception of those associated with the Prestige, the influence of these factors on the total results of commercialised fish production would seem to be diminished or, at least, to be compensated for by other effects.

[7] This criterion of comparing production for one year, specifically 2004, with the averages obtained in the prior four-year period before the *Prestige* accident (1998-2002) has also been used by Y. Pazos et al. (2004) in the "Report on the evolution of the production of the main resources of commercial interest on the Galician coast" and in the "Report on the evolution of clam production en Galicia", both instigated by the Xunta de Galicia's Regional Ministry for Fisheries and Maritime Affairs and presented in November 2004.

[8] We also know that part of the fresh fish production commercialised in Galician ports comes from fleets which fish far from the area affected by the spill (mainly in the area known as Grand Sole, in the CIEM Vb, VI, VII and VIIabd zones), but the regularity of the landings of this fleet and the stability of the prices obtained do not alter the overall results.

[9] This is a relatively moderate figure if compared to the early estimates carried out by some institutions, such as the Galician Chambers of Commerce (2003) and the Trade Union Comisiones Obreras (2003). In the former case, they foresaw losses in turnover in the region of 230 million €. In the latter case, they set the losses at a minimum of 144 million €. On the other hand, the percentage impact on the normal income is also lower than that estimated by Bonnieux and Rainelli (1991) in the case of the Amoco Cadiz oil spill, where income from the fisheries sector in Brittany fell by 21% in the first year.

[10] There was a greater level of acceptance of and response to the questionnaire in the less numerous fleet (with larger vessels), which has a more highly organised business structure (accounts books, administrative staff, etc.) which allowed those companies to answer the questionnaire at a lesser cost and effort. We also observed that the tendency to answer the questionnaire was greater in the coastal areas initially affected the most by the pollution from the *Prestige* (the Costa da Morte area), a matter we should bear in mind when evaluating the results obtained.

[11] As in the previous cases, we used as the deflator the harmonised Spanish RPI series, provided by the National Institute of Statistics at http://www.ine.es.

[12] Instituto Galego de Estatística ,2004, Macromagnitudes da pesca Year 2001-02.

[13] In this operation we are assuming that all of the reductions in income in the years 2002 and 2003 were caused by the *Prestige* disaster. In accordance with the answers to our questionnaire, fishermen estimate that 95.54% of the losses in physical production were caused directly by the accident involving the tanker *Prestige*.

[14] Although scientifically this hypothesis has not been corroborated, some politicians linked this increase in the landing in the last months of 2003 to an increase in the abundance of some species, possibly because of the rest the natural resources experienced as a result in the halt in fishing activity.

[15] Not included in these figures are the losses caused to the aquaculture sector or the damages caused to fishermen's property by pollution: the loss of gear (nets, pots, etc.), the cost of repairing engines, cleaning hulls and equipment, etc.