doi:10.1111/j.0361-3666.2007.01004.x

The *Prestige* oil spill and its economic impact on the Galician fishing sector

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The sinking of the Prestige *oil tanker on 18 November 2002 off the coast of Galicia, Spain, had important economic, environmental and social ramifications. The aim of this paper is to carry out an initial analysis of the costs related to a halt in fishing activities in Galicia between November 2002 and December 2003. This involves three different steps: an assessment of the cost of the preventative and palliative measures introduced by Spanish public administrations (compensation for affected fishermen and shellfish fisherman); an indirect evaluation of the implications of the disaster (via a study of data on production); and a direct appraisal of the economic impact of the event (reduction in income), using questionnaires completed by a representative sample of fishermen and shellfish fisherman. The results obtained from these three methods of estimating losses are compatible. By December 2003, losses to the Galician fishing sector stood at an estimated EUR 76 million.*

Keywords: economic impact, Galicia fishing sector, oil spill, *Prestige*

Introduction

On 18 November 2002, the *Prestige* oil tanker, having sailed for several days with a gash in its hull, broke in two and sank some 130 miles off the coast of Galicia in northwest Spain. The bulk of the 77,000 tonnes of heavy fuel that the tanker was transporting spilled into the Atlantic Ocean. The pollution mainly affected the northwest coastline, home to one of the European Union (EU)'s main fishing communities.[1] Spanish public administrations—the central government and the Galician regional government—were forced to introduce urgent measures to tackle the oil slick, to guarantee the health of fish consumers, and to alleviate the economic effects caused by the obligatory termination of fishing activities.

Evaluation of the social costs of oil spills has become increasingly relevant in recent decades, as analyses have come to include both the private and public costs of market goods and services (cleaning, restoration, losses to the fishing sector and the tourism industry) and the costs of non-market goods and services (active and passive).[2]

Some three years after the *Prestige* incident, it is clear that the disaster has had extremely serious economic, environmental and social consequences.[3] In this paper, we seek to evaluate the costs linked to a loss of income for the fishing sector in Galicia in 2002–03 because of the cessation of activities. This involves three different steps:

- an assessment of the cost of the preventative and palliative measures introduced by Spanish public administrations (compensation for affected fishermen and shellfish fisherman);

Disasters, 2007, 31(2): 201–215.
Published by Blackwell Publishing, 9600 Garsington Road, Oxford, OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA

- an indirect evaluation of the implications of the disaster (via a study of data on production); and
- a direct appraisal of the economic impact of the oil spill (reduction in income), using questionnaires completed by a representative sample of fishermen and shellfish fisherman.

These steps make up the following three parts of the paper. In the final section we sum up the main conclusions reached.

The cost of preventative and palliative measures

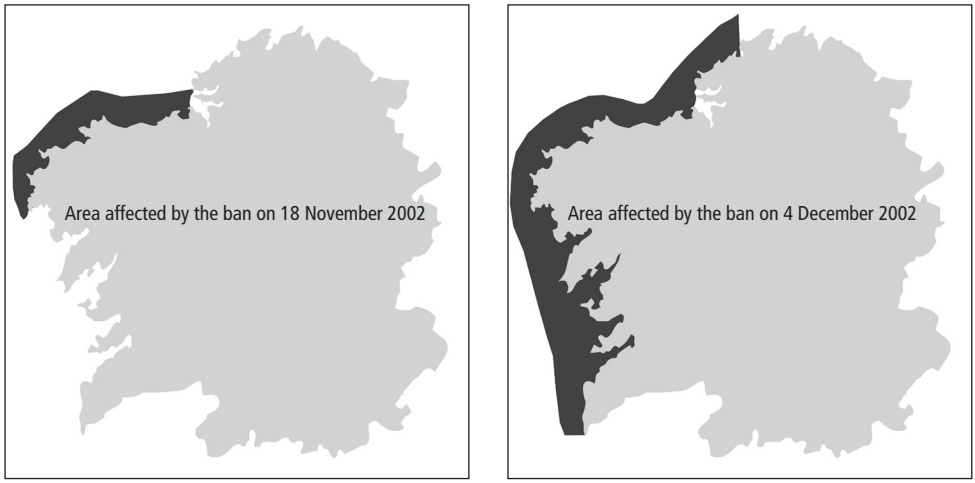
Given the magnitude of the catastrophe, public administrations at different levels (regional and state governments) instigated action that can be classified as preventive and palliative.

Preventive action basically consisted of marking out the zones where fishing was forbidden. The objective was to ensure that fish and shellfish products unsuitable for human consumption did not reach the market and that fishing activities did not hinder the clean-up operation.

As shown in Figure 1, the initial areas where fishing was banned (after 18 November 2002) were concentrated along the northwest 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 (such as barnacle fishermen, bottom trawling and aquaculture).

From 30 January 2003, the Galician regional government began to develop a calendar specifying which activities could recommence. This calendar was conditioned by negotiations with the affected fishermen and shellfish fishermen as well as by the caution

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



Source: Xunta de Galicia, http://www.xunta.es

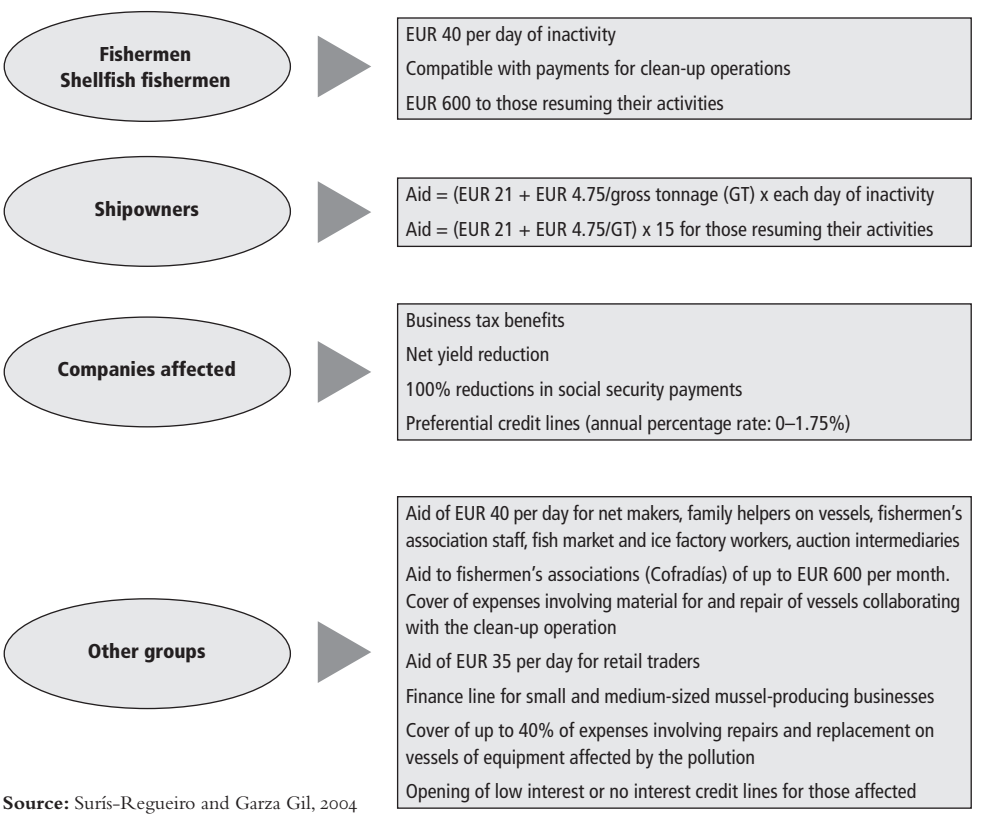
generated by information on the detection of new slicks or on the state of the seabed where some of the oil was deposited.

In accordance with available data, the ban, which lasted for more than eight months and successively affected different zones and fleet segments, was gradually lifted. On 1 February 2003, the prohibition on shellfish fishing ended in the inner waters (rias) of the southern zone of Galicia. In this same area, from 24 February, some types of traditional vessels were allowed to restart activities, and after 17 March, the resumption of fishing with pots was authorised. At the beginning of April, the rias in the northern zone of Galicia were reopened to shellfish fishing, and from mid-April 2003, the ban on all other types of fishing methods and equipment was lifted, except in Costa da Morte in northwest Galicia (the area that suffered the greatest direct impact). Finally, on 8 October 2003, all proscriptions were lifted on fishing and shellfish fishing in waters belonging to the Galician regional government.

Palliative action, meanwhile, refers to the measures intended to compensate economically fishermen and shellfish fisherman for the most immediate effects resulting from the halt in operations.

Palliative measures came into effect from 18 November 2002 and essentially comprised economic aid for ship owners, crew, fishermen and shellfish fishermen affected

Figure 2 Main forms of aid and groups involved



Source: Surís-Regueiro and Garza Gil, 2004

Table 1 Total budget per type of expense, regional government of Galicia

Type of expense	Value in EUR 1,000		
	2002	2003	Total
Aid to compensate 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**	**113,196.77**	**146,415.42**

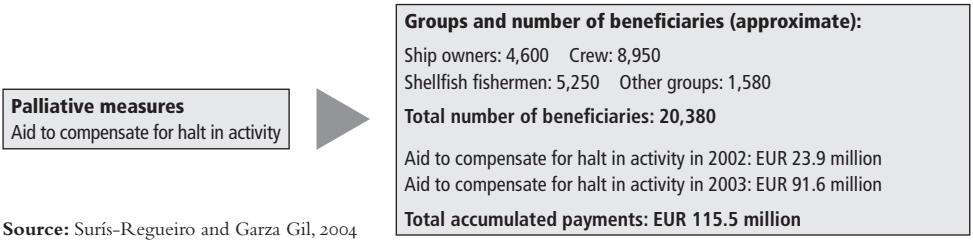
Source: Xunta de Galicia, http://www.xunta.es

by the suspension of activities. Later, complementary initiatives were introduced, such as an increase in the volume of aid, tax benefits, 100 per cent reductions in social security quota payments, campaigns to promote Galician fishing products, and the establishment of preferential credit lines for those affected. Furthermore, as the effects of the spill were extended in time and space (towards other areas of the coast), more groups became eligible for assistance: fishermen and shellfish fishermen from other areas; 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 forms of aid and groups involved.

The different public administrations in Spain had to spend substantial amounts of money on all of the preventive and palliative measures. Table 1 shows the expenses budgeted for by the Galician regional government in relation to the *Prestige* catastrophe.

Between 2002 and 2003, total expenses rose from EUR 33.2 million to EUR 113.2 million. The greatest expense was aid to compensate for the halt in fishing activity, representing almost 80 per cent of the total (EUR 115.5 million of a total of EUR 146.4 million spent over the two years). As shown in Figure 3, the total number of beneficiaries of public aid in 2002 and 2003 exceeded 20,000, of whom 44 per cent were crew on coastal fishing vessels, 26 per cent shellfish fishermen and 22 per cent coastal ship owners—the remainder belonged to other groups directly affected, such as net makers and fishermen's association staff.

Figure 3 Beneficiaries of palliative measures in Galicia



Source: Surís-Regueiro and Garza Gil, 2004

Indirect evaluation of the economic impact

An indirect evaluation of losses caused by the *Prestige* disaster involves analysing the evolution of data on fishing production (with regard to weight and value). To do so, it is necessary to have access to statistical data on the development of these variables in the years prior to the accident, allowing us to make comparisons between normal seasons and the extraordinary event in question.

The most complete and accessible source of information on fishing and shellfish production affected by the sinking of the *Prestige* is http://www.pescadegalicia.com. This digital platform contains information (by month and species) on fresh fish landed and sold at auction in Galician ports since 1998.

Having access to monthly information is vital for fishing and shellfish fishing industries because the natural characteristics of species of commercial interest can condition the intensity of their exploitation throughout the season. The economic consequences resulting, for example, from a halt in fishing activity in the winter months differ significantly from those that would occur if such a suspension were introduced in the summer.[4]

Table 2 shows monthly trends for fresh fish and shellfish products, by weight and value,[5] and the prices on Galician markets between 1998 and 2003.

There are significant monthly differences in production and different forms of cyclical behaviour depending on the time of the year. For example, in the month of January, total sold weight is usually approximately 9,000 tonnes, while in August it is around 13,000 tonnes (40 per cent higher). Furthermore, fishing production typically attains its highest levels in the summer months and its lowest in the winter. During the period when the impact of the pollution from the *Prestige* was at its peak (November 2002 to February 2003), production fell to its lowest level in relation to that in the same months in previous years.

The fluctuation in the monthly catch and changes in composition per specie according to the season have clear impacts on average prices and, therefore, on total income. As Table 2 shows, in constant monetary terms average monthly prices remain stable at around EUR 2.5 €-03 per kilogramme (kg), and reach their highest level in December and January each year, precisely when there is less production and greater demand for certain high-value products (for the Christmas period).

Income has also enjoyed a certain amount of cyclical stability and has usually ranged between a minimum of EUR 25 million €-03 per month and a maximum that has scarcely exceeded EUR 40 million €-03 per month, depending on the time of the year. Over the course of the series considered, only for four months (December 2002–March 2003) was first-sale market income from fishing and shellfish fishing less than EUR 25 million €-03.

Given the seemingly stable behaviour of the markets where fresh fish products were first sold in Galicia, we could use the average monthly information for the four observations of the same month immediately before the catastrophe as an indicator of normal monthly production (our scenario of reference).[6] That is, for the months between January and October, we have employed the monthly production average for the period 1999–2002, and for the months of November and December, the same average but for the period 1998–2001.[7]

Table 2 Fresh fish and shellfish sales in Galicia, 1998–2003

Year	Month	Sales (tonnes)	Prices (€-03/kg)	Value (1,000 €-03)	Year	Month	Sales (tonnes)	Prices (€-03/kg)	Value (1,000 €-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
	June	17,806.3	2.07	36,906.4		June	13,926.4	2.20	30,675.1
	July	15,814.9	2.53	39,935.6		July	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
	June	14,670.2	2.55	37,358.3		June	10,838.3	2.56	27,793.1
	July	14,490.4	2.65	38,360.0		July	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
	June	12,907.8	2.52	32,494.5		June	10,203.0	2.52	25,685.0
	July	13,100.4	2.61	34,213.4		July	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, 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 due to the *Prestige* disaster. As Table 3 shows, over the 14 months of the period under study some 29,200 tonnes less than usual (scenario of reference) was commercialised, approximately 7,800 tonnes of which can be attributed to the months of November and December 2002 and the rest, around 21,400 tonnes, to the year 2003. The highest production losses coincide with the first months after the catastrophe, a period when the majority of fishing and shellfish fishing was banned. Thus, production in the last two months of 2002 fell by almost one-third with respect to the norm. In 2003, the decrease in total production was around 15 per cent in relation to the base scenario.[8]

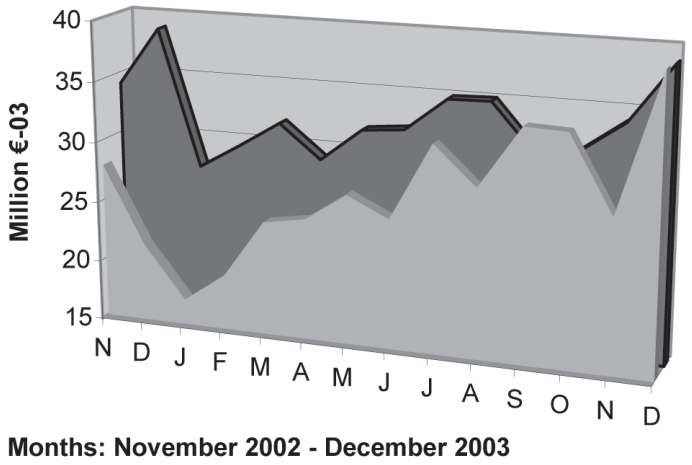
Monetary losses (values expressed in constant units with respect to the base year, 2003) followed a similar path to those pertaining to physical production: higher during the initial months after the event, lessening, with some changes, as months passed. This can be clearly seen in Figure 4, where values of reference signify the normal evolution of income, while values observed are the ones that were registered in the period under study. Thanks to price behaviour, income losses are lower than physical losses.

Table 3 Total fish production losses in Galicia

		Situation of reference		Situation observed		Difference	
		Tonnes	1,000 €-03	Tonnes	1,000 €-03	Tonnes	1,000 €-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
	June	13,085.67	32,080.24	10,203.05	25,685.00	-2,882.62	-6,395.25
	July	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
Accumulated	2002	22,544.38	72,879.57	14,683.89	49,331.62	-7,860.48	-23,547.95
Accumulated	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, http://www.pescadegalicia.com

Figure 4 Evolution of income observed and income of reference in Galicia



Source: Xunta de Galicia, http://www.pescadegalicia.com

Production losses estimated for the two months in 2002 rose to EUR 23.5 million €-03, implying a 32.31 per cent reduction with respect to the normal or reference value that would be obtained for these two months and a decrease of 6.09 per cent with regard to normal annual income. Those accumulated over the 12 months of 2003 were EUR 52.4 million €-03, a 13.54 per cent decline in relation to the income that we estimate must be normal annual income. Overall, accrued loss of income in the 14 months under study rose to almost EUR 76 million €-03.[9]

Direct evaluation of the economic impact

We will now perform a direct evaluation of the effects of the *Prestige* disaster on the income of the Galician fisheries sector using information gathered from questionnaires presented to representative segment samples.

The population field under investigation comprises fishing vessels based at ports in Galicia and which primarily exploit the closest natural resources to those directly affected by the oil spill. The questionnaire requested information for financial years 2001, 2002 and 2003. The basic sample unit was the individual or legal entity that owned a fishing vessel. We carried out random stratified sampling. To draw up the sample we divided the directory population into two large groups: companies with vessels under 100 gross tonnage (GT) (for the most part, with just one worker); and companies with vessels of at least 100 GT (with more than one paid employee). A specialist company, Sondaxe, developed the fieldwork during the second half of 2004. Completion of the questionnaire was not obligatory, resulting in many being rejected or filled out incorrectly. Therefore, while larger vessels were covered satisfactorily (see Table 4), we were unable to cover more than 60 per cent of the small vessel sample initially foreseen.[10]

Table 4 Total population, initial sample and final sample

	Number of vessels	Initial sample	% population	Final sample	% population
Fleet ≥ 100 GT	172	17	9.88%	17	9.88%
Fleet < 100 GT	5,142	103	2.00%	62	1.21%
Total	**5,314**	**120**	**2.26%**	**79**	**1.49%**

Source: Department of Applied Economics, University of Vigo

Information gleaned from the sampling helps us to understand recent trends in the evolution of fishing and shellfish fishing along the Galician coastline after the *Prestige* disaster.

From the 79 questionnaires that ultimately made up the sample, we were able to obtain the results set out in Table 5. This information is only significant in relation to the observed trend in the economic performance of the Galician fishing sector after the *Prestige* incident, hence the need to express it in constant[11] and relative terms.

Given the figures above, we wish to emphasise the following:

- On average, the coastal fishery companies surveyed stated that in 2002, they amassed, in real monetary terms, 9.5 per cent less than in 2001. This figure rose to almost 22 per cent in 2003.
- Those surveyed also reported that operating costs related to intermediate consumption of goods and services fell in 2002 and 2003 with respect to 2001 (3 per cent and 18 per cent, respectively).
- Consequently, the percentage loss in the generation of income (value added) was slightly higher than the respective drop in the level of production—a 12 per cent loss in 2002 and a 23.3 per cent loss in 2003.

Table 5 Relative evolution of the mean data observed in the sample

(Units 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 (no.)	7	36	55	414.29%	685.71%
Subsidies**	2,045.38	2,398.38	6,427.43	17.26%	214.24%
Employment (no. of people)	3.71	3.61	3.56	-2.70%	-4.04%

Notes

* Annual Variation Rate

** Mean among those who confirmed that they received some kind of subsidy

Source: Department of Applied Economics, University of Vigo

- The evolution of labour costs is quite similar to that of production costs, a result that is consistent with the crew-share system for coastal fishing.
- The other part of value added, retained earnings (comprising gross retained earnings, mixed income and production tax), declined considerably with respect to 2001, almost 16 per cent, and by 25.5 per cent in 2002 and 2003, respectively.
- The number of fishing companies that have received subsidies rose considerably. The average amount of those subsidies has also increased.
- Employment did not vary in the same way, falling between 2.7 per cent and 4 per cent in comparison to 2001.

From the questionnaire, we can also obtain interesting information on the factors that, in the opinion of interviewees, had a significant bearing on lower annual earnings. Among the fishing companies that stated that their rate of turnover fell with respect to 2001—which was the case for 86 per cent of those surveyed—the questions linked directly to an ecological disaster appear to be the main source of explanation for the reduction in income. Around 90 per cent of interviewees believed that variables linked directly to the *Prestige* disaster, the subsequent drop in demand, damage to the image of their products and the negative evolution of prices were important or very important. Table 6 summarises these perceptions.

Those surveyed were also asked about other types of damage connected to the disaster. Only 18 of the 79 companies surveyed affirmed that they had suffered economic

Table 6 Fishermen's perceptions of the effect of different factors on the fall in income

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

Notes
1=very important; 2=important; 3=not very important; 4=not important at all

Source: Department of Applied Economics, University of Vigo

Table 7 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 equipment	13	999.5	16	1,250.3

Source: Department of Applied Economics, University of Vigo

losses in 2002 due to the cost of repairing and cleaning their vessels as a result of the pollution caused by the *Prestige* (an average of EUR 1,165 €-03 per company affected) (see Table 7).

To calculate income losses in 2002 and 2003 due to the termination of fishing activity after the sinking of the *Prestige,* we drew on information provided by the Galician Institute of Statistics on floating shellfish fishing and coastal fishing for 2001.[12] These fleet segments had an annual turnover in 2001 of EUR 270.03 million €-03 (EUR 39.59 million €-03 from the floating shellfish fishing segment and EUR 230.44 million €-03 from the coastal fishing segment). Applying the percentage annual reduction estimated directly by means of our sample, we obtain the results shown in Table 8.

Table 8 Direct estimates of fishing income losses

	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%

Note
* Units in thousands of €-03

Source: Department of Applied Economics, University of Vigo

Our direct estimates show a loss in accumulated turnover over the two years of EUR 85.14 million €-03 (30.3 per cent corresponding to 2002 and the remainder to 2003).[13] This amount is based on average impact indicators of 9.55 per cent and 21.98 per cent for 2002 and 2003, respectively, in relation to turnover in 2001.

Conclusion

The three evaluation methods point to income losses in Galicia in 2002 and 2003 due to the cessation of fishing following the *Prestige* oil spill of between EUR 76 and 115.5 million (see Table 9).

We were able to verify from the monthly production series and from the time when preventive measures were in force (the ban on fishing activity) that decreases in fishing

Table 9 Summary of losses because of the halt in fishing activity in Galicia (in millions of €-03)

Method of 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: Department of Applied Economics, University of Vigo

income occurred mainly in the first six months after the catastrophe (from mid-November 2002 until the end of May 2003).

Income reduction estimates for 2002 are fairly similar to the cost of compensation measures introduced by Spanish public administrations. The same is not true, though, for estimates for 2003: there is considerable divergence between the estimated figures and public administration expenditure on compensation. In part, this difference can be explained by the fact that, as the effect of the oil slick began to widen, the palliative measures had to be applied to other groups involved in fishing, such as fish market and ice factory workers, family members who help out on vessels and net repairers. Another factor pertains to the recovery of landings in the final months of the year,[14] which led to a monthly income level higher than the average for the same months in previous years.

The decline in fishing activity in Galicia because of the *Prestige* disaster produced direct income losses of between EUR 76 and 115.5 million in the first 14 months.[15] Furthermore, well-founded fears exist that such losses could extend into the future, as the medium- and long-term effects of the oil spill on the already-damaged ecosystem and the fish species that inhabit it are unknown.

Acknowledgements

The collaboration and support of the Galician Economic and Social Council made this study possible. We are also grateful for the financial support of the Galician regional government (Xunta de Galicia) (PGIDIT04CS0300913PR) and the Spanish Ministry of Education and Science (SEJ2004-05711).

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Endnotes

[1] The fishing and aquatic sector in Galicia is responsible for generating around 2.2 per cent of the region's gross domestic product (GDP). It has an annual turnover of more than EUR 1.2 billion and employs over 40,000 people, representing approximately 50 per cent of the Spanish fishing sector as a whole and about 10 per cent of the EU's fishing sector (Varela-Lafuente and Prada Blanco, 2005).

[2] The development of these studies is closely linked to the need to evaluate the social costs of accidents such as the Amoco Cadiz in 1979 in Brittany, France (Bonnieux, Dauce and Rainelli, 1980; Bonnieux and Rainelli, 1991; 1993; Grigalunas et al., 1986; Hay and Thébaud, 2002), or the Exxon Valdez in 1989 in Alaska, United States (Cohen, 1995; 1997; Carson and Hanemann, 1992; Carson et al., 2003).

[3] Some preliminary evaluations of these impacts have been published in collective papers, including those by González Laxe (2003) and Prada and Vázquez (2004). Interesting studies have also been published on the socio-political consequences (García Pérez, 2003) and on the role of Spanish scientists (Freire, Fernández and Muiño, 2005) after the *Prestige* disaster.

[4] To estimate the economic damage caused to Brittany's fishing sector by the Amoco Cadiz spill, authors such as Bonnieux, Dauce and Rainelli (1980) and Sorensen et al. (NOAA, 1983) adopted different regression models (with temporal tendencies, with Autoregressive Integrated Moving Average (ARIMA)-type coefficients per season, etc.) in which different time periods were considered, but always drawing on monthly production information.

[5] Monetary values are expressed in constant Euros for the year 2003 (€-03). The Spanish harmonised retail price index (RPI) series—a monthly indicator provided by the National Institute of Statistics (http://www.ine.es)—was used as a deflator, permitting a change of base year from 1996 to 2003.

[6] We are aware that, in recent years, different occurrences have influenced global production levels, including: production crises among some species, such as the sardine and more recently, the hake; the frequency of storms during certain seasons, preventing fleets from fishing; and excessively rainy seasons, leading to high mortality rates in shellfish fishing areas of the rias. However, with the exception of those variables associated with the *Prestige,* the influence of these factors on total commercial fish production would seem to be diminished or, at least compensated for, by other effects.

[7] This criterion of comparing production for one year, specifically 2004, with the averages from the four-year period before the *Prestige* accident (1998–2002) has also been used by 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 Xunta de Galicia's Regional Ministry for Fisheries and Maritime Affairs and published in November 2004.

[8] We also know that part of the commercial fresh fish catch sold in Galician ports comes from fleets that 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). However, the regularity of the landings of this fleet and the stability of the prices obtained do not affect overall results.

[9] This is a relatively modest figure if compared to the early estimates of some institutions, such as the Galician Chambers of Commerce (Cámaras de Comercio, 2003) and the Trade Union Comisiones Obreras (Comisións Obreiras de Galicia, 2003). In the former case, they foresaw losses in turnover of

in the region of EUR 230 million. In the latter case, they set the losses at a minimum of EUR 144 million. However, the percentage impact on normal income is 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 per cent in the first year.

[10] The response to the questionnaire was greater in the larger vessels category, which has a more highly organised business structure (account books, administrative staff, etc.). This allowed companies to answer the questionnaire at less cost and with less effort. We also observed that the questionnaire response rate was greater in coastal areas initially affected the most by the pollution (Costa da Morte), something that should be kept in mind when evaluating the results.

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

[12] IGE (2004) (fishing macro aggregates, 2001–02).

[13] We are assuming that the *Prestige* disaster was responsible for all reductions in income in 2002 and 2003. In accordance with the answers to our questionnaire, fishermen believe that 95.54 per cent of physical production losses were directly connected to the *Prestige.*

[14] Although scientifically this hypothesis has not been corroborated, some politicians have linked this increase in landings in the last months of 2003 to a rise in the abundance of some species (possibly because of the halt in fishing activity).

[15] Not included in these figures are losses to the aquaculture sector or damage caused to fishermen's property by pollution (for example, the loss of equipment, the cost of repairing engines and cleaning hulls).

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