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A PRELIMINARY ECONOMIC ANALYSIS OF RECREATIONAL FISHING LOSSES RELATED TO THE EXXON VALDEZ OIL SPILL

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December 18, 1992

A Report to the Attorney General of the State of Alaska

This report represents a formal rendition of the initial estimate of recreational fishing losses we presented in the fall of 1990. First, the changes that took place in recreational fishing activities as a result of the Exxon Valdez oil spill must be determined, and then a dollar value must be placed on those changes. To estimate the impacts of the spill on sport fishing activity, one must consider the impact on the number of anglers, the number of sport fishing trips, the areas fished, the species fished for, and the length of these trips (*i.e.*, the number of days fished). Placing a dollar value on these changes is usually done using the travel cost or contingent valuation methodologies.

Estimating precisely the changes in recreational fishing behavior due to the Exxon Valdez oil spill is an extremely complex task. The complexity, in large part, is due to the fact that while it is possible to estimate the recreational fishing activities that took place after the Exxon Valdez oil spill, the recreational fishing activities that would have taken place in the absence of that spill are inherently unobservable. Recreational fishing data collected by the Alaska Department of Fish and Game for the years preceding the Exxon Valdez oil spill exhibits three primary characteristics relevant to our task: (1) an upward trend in recreational fishing activities, (2) some year-to-year variation around that trend, and (3) variation in fishing patterns associated with variations in fishing quality, *e.g.*, fishing might vary with the size of a particular salmon run. This data also suggests that areas outside Prince William Sound that were impacted by the spill are likely to be quite important in determining recreational fishing losses because of the substantial amount of sport fishing there.

A wide range of estimates on the effects of the Exxon Valdez oil spill on recreational fishing may be obtained by using alternative assumptions. The key assumptions involve the treatment of the baseline year, the trend in sport fishing activities, the geographic scope of the particular area examined, trips taken by the oil spill clean-up workers, trip substitution versus trip loss, possible losses in 1990, and the dollar values placed on different types of changes in recreational fishing patterns.

At the low end of the range there are no recreational fishing losses. This conclusion can be obtained by adopting 1987 as the base year rather than 1988, by assuming there is no temporal trend in the sport fishing data, and assuming any impacts are limited to just the area immediately affected by the spill. This set of assumptions is clearly inconsistent with the data. First, there is a clear upward time trend in the quantity of recreational fishing. Second, the earlier Jones & Stokes (1987) work for the Alaska Department of Fish and Game clearly shows close interconnections between recreational fishing at different locations throughout Southcentral Alaska.

The high end of the range is 580 million dollars, an estimate obtained by considering impacts throughout Southcentral Alaska, estimating the fishing that would have occurred in 1989 and 1990 by extrapolating from the increase between 1987 and 1988 to 1989, subtracting trips taken in 1989 in the spill area by households involved in the spill clean-up, treating the reduction in trips as an indicator of lost quality throughout Southcentral Alaska, and assuming all the lost trips were of the highest valued type. This set of assumptions is also inconsistent with the data. First, the increase in activity between 1987 and 1988 appears to be much larger than that suggested by the trend over a larger period of time. It is unlikely that an increase of this magnitude could be maintained on an annual basis. Second, fishing at some Southcentral locations was probably not affected by the spill. Third, many of the households involved in the spill clean-up actually live in the spill area and would probably have fished in the spill area. These three factors suggest that this estimate of the number of lost sport fishing trips is much too large. Finally, many of the lost fishing trips were probably not the highest valued trips.

The data contained in Mills (1990, 1991a, 1991b) and in Jones and Stokes (1987) may be used to substantially narrow this huge range for recreational fishing losses. We do this below, but first it will be useful to discuss some key aspects of the available data and their implications.

Perhaps the key uncertainty is the baseline relative to which impact is to be measured. There are two generic approaches to setting a baseline. The first approach is to compare the events in one year (*e.g.*, 1989) with the events of a previous year (*e.g.*, 1988) or with an average of previous years. The second approach is to compare the year with some projection of what would have been expected in that year absent the spill. This projection would be based on a model such as a regression equation incorporating a time trend and other explanatory variables intended to capture the year-to-year variation in the quality of fishing opportunities in Alaska. In principle, the second approach is the better method. The first approach will provide satisfactory results only if there is no time trend in the variables of interest and no systematic differences between conditions in the year(s) of interest and the conditions in the year(s) to which the comparison is being made. As noted, there is an obvious upward trend in the data. Furthermore, 1988, at least in some areas, may have been a better than average year in Southcentral Alaska for fishing quality.

The baseline issue is complicated by the lack of a definitive indicator of recreational fishing activity. There are three available measures of recreational fishing activity: number of anglers, number of fishing trips, and number of days fished. In addition, each of these measures can be further subdivided by the location of the angler's home (*e.g.*, Alaskan residents versus non-residents), and by the location of the fishing activity (*e.g.*, the immediate spill area [Figure 1] versus the rest of Southcentral Alaska).

Figure 2 displays data for 1984-1989 for the number of anglers, trips, and days for the Exxon Valdez oil spill area. All of these indicators show a clear downward jump between 1988 and 1989. Considering the different sub-areas comprising the Exxon Valdez oil spill area independently, there is a small drop in all three indicators of recreational fishing activities for the Prince William Sound sub-area, a small increase for the Kodiak sub-area, and a large drop for the Kenai Peninsula sub-area. As would be expected these changes are concentrated in saltwater rather than freshwater fishing. The pattern of fishing by residents of the Exxon Valdez oil spill area is fairly constant over time with a slight dip between 1988 and 1989 in the number of anglers and trips. The biggest change is a dramatic drop (Figure 3) in the number of trips to the spill area by Alaska residents living outside the spill area. The number of non-resident anglers fishing in the spill area is essentially unchanged while the number of days fished in 1989 shows a 15% increase over 1988. For the Southcentral non-oil spill area, there is an increase in the number of anglers from 1988 to 1989, a decrease in the number of days, and a very noticeable drop in the number of trips. In contrast to Southcentral Alaska, other regions of Alaska showed an increase in all three measures of fishing activity for both residents and non-residents.

Why was there such a big decrease in the number of sport fishing trips (and to a lesser extent the number of fishing days) Southcentral Alaskan residents took in 1989? There are four possible reasons: (A) the quality of sport fishing opportunities was reduced because of the spill, so that some anglers stopped or reduced their fishing that year; (B) the boats that anglers would have used to go fishing either in areas impacted by the oil or in other parts of the state were diverted for use in the clean-up operations so that boats for fishing were scarce; (C) increased congestion at some sites outside the spill area due to a reduction in fishing opportunities in the spill area resulted in a reduction in fishing quality; (D) residents who would have gone fishing were so busy in the summer of 1989 working on the cleanup that they had no time to go fishing (*i.e.*, they were prevented from fishing by a lack of time or interest, rather than by a lack of boats or by poor fishing quality). If (D) is the reason, the reduction in sport fishing is probably not due to a loss in service flows. But reasons (A), (B), and (C) point to a decrease in the available recreational services.

With respect to non-residents, there are three alternative reasons for an increase in the number of non-residents sport fishing in Southcentral Alaska in 1989: (E) fishing conditions (or advertisements) in 1989 were so good that non-resident anglers flocked there; (F) non-residents make their plans a year in advance, and fishing conditions had been so good in 1988 that many out-of-state anglers decided to go there for 1989; (G) many out-of-state people came to Alaska in the summer of 1989 in connection with the oil spill (*e.g.*, as clean-up workers, reporters, or participants in the damage assessment/litigation), and they took advantage at least once of the opportunity to go fishing. These reasons have very different implications for natural resource damages. If (E) or (F) are the reasons, there may be losses that would constitute natural resource damages. With (E), if recreational fishing quality turned out to be less than expected due to closed sites, lack of boats, congestion or other spill-related phenomena, then the non-residents clearly did not receive the benefits from fishing expected when the decision to undertake the trip to Alaska was made. With (F), the trend data suggests that there would probably have been even more non-resident sport fishing in 1989 absent the spill. Here, one would need data on cancellations to verify this possibility.

The loss in trips is much more pronounced than the loss in days. Fisherman throughout Alaska seem to have shifted to taking fewer, but longer trips. Table 1 shows that the number of trips in 1989 relative to 1988 was down in each of the three major regions of Alaska, but that the number of days was up everywhere but Southcentral Alaska. An examination of historical data for this ratio suggests a reasonable amount of fluctuation in this statistic. Prior to the Exxon Valdez oil spill, the ratio of trips to days had taken on values similar to the one observed in 1989 on several occasions. As a result, we assume the shift to fewer and longer trips is unrelated to the spill and concentrate on the number of fishing days which suggests less of a spill-related effect than the number of trips.

Different types of fisheries have different dollar values associated with their closure or reduction in quality. For instance, a Kenai king salmon trip is worth over an order of magnitude more than an Arctic grayling trip near Fairbanks. A more comprehensive analysis would look in some detail at the exact pattern of change in recreational fishing; a reduction in the number of fishing days is only part of the picture. For every loss of a fishing day, there are likely to be many more fishing days which took place at less desirable sites or for less desirable species. Thus, the reduction in fishing days in Southcentral Alaska should be considered an indicator of a more general and widespread loss in quality. The economic model of sport fishing used by the Alaska Department of Fish and Game (Jones and Stokes, 1987) is a large nested-logit travel-cost model which explicitly incorporate these substitution possibilities between sites, species, and their influence on the decision of the number of sport fishing trips taken.[1] We have not fully used that model's capability in this report, although the per day values taken from it necessarily incorporates this chain of quality changes.

Any estimate of lost recreation days is complicated by the presence of a large number of spill clean-up workers in the spill area. This increase in the local population of potential fishermen, consisting of local spill workers, Alaskan spill workers from outside the oil spill area, and non-resident spill workers, probably masked to some degree what would have otherwise been a much larger decrease in fishing days. It is difficult to adequately assess this factor, but additional analysis of the data in Mills (1991b) would probably shed some light on how many oil spill clean-up workers in the three groups fished. Making corrections for the latter two groups would tend to increase the number of recreation days considered lost.

Determining the effects of the Exxon Valdez oil spill on sport fishing for 1990 is much more problematic than for 1989. The disruption of sport fishing activities in Southcentral Alaska caused by closures, fear of contamination, the unavailability of boats, and congestion at some sites outside the spill area were quite apparent in 1989. Many of these difficulties had been resolved by the fishing season of 1990, although clearly there were some residual effects. In addition the tabulations in Mills (1991b) for the spill area are quite helpful in illuminating what happened inside and outside the spill area in 1989. We do not have a set of similar tabulations

[1]A travel cost model looks at how the number of trips to a site changes as a function of the cost of visiting the site. A nested logit travel cost model looks at multiple sites and typically incorporates characteristics of site quality. It would have also been possible to use the contingent valuation survey technique to obtain dollar values. The contingent valuation results in Jones and Stokes (1987) suggest similar values to ones from the travel cost model used here.

for the 1990 fishing season. The year 1990 is also further away from the pre-spill activity data, and as a result extrapolations tend to be more questionable. The data for 1990 suggest that sport fishing activities have bounced back, but they have not increased quite as much as one would have expected them to have increased in the absence of the Exxon Valdez oil spill.

Based on the discussion above and a more detailed examination of the data, a plausible lower bound can be found by considering the reduction in fishing days between 1988 and 1989 in the immediate spill area (*i.e.*, 17,923 days), ignoring whether households participated in the oil spill clean-up, and valuing lost days at the average value from Jones and Stokes (1987) of $204 per day (a somewhat conservative estimate since a large fraction of the lost days were highly valued halibut and silver salmon fish days). This calculation yields a lower bound estimate of $3.6 million dollars.

A plausible upper bound can be found by considering the lost days (rather than trips) for 1989 [127,527] and 1990 [40,669] in the Southcentral area[2] based on a prediction from a simple trend regression equation using the pre-1989 data coupled with the higher value of $300 per day since the lost days appear to be concentrated in the higher valued salmon and saltwater fisheries. This calculation yields an upper bound estimate of $50.5 million dollars.

An estimate close to the center of this range can be obtained by augmenting the 1989 loss in the spill area predicted from the simple trend regression with 50 percent of the sport fishing days of clean-up households and 50 percent of the predicted lost days in Southcentral Alaska outside the spill area. To these 1989 days, add 50 percent of the lost 1990 Southcentral Alaskan

[2]Because we are using the larger Southcentral Alaska area, the role of clean-up workers is ignored here since most were probably from Southcentral Alaska and would have fished elsewhere in Southcentral Alaska in the absence of the spill.

recreation days suggested by the simple trend regression. This calculation gives a total of 124,185 lost recreation days. Multiplying this number of days by $250 per day yields a mid-range estimate of $31.0 million dollars.

The upper and lower bounds could be tightened by performing additional work in three areas. First, the raw data underlying the various reports we have relied upon could be further analyzed. Second, supplementary data on recreational fishing trip cancellations, boat availability in different locations, the composition of clean-up worker households, and the size of salmon runs and the commercial catch in various locations could be collected. Third, formal behavior models to help explain and link these various data sets could be constructed.

References

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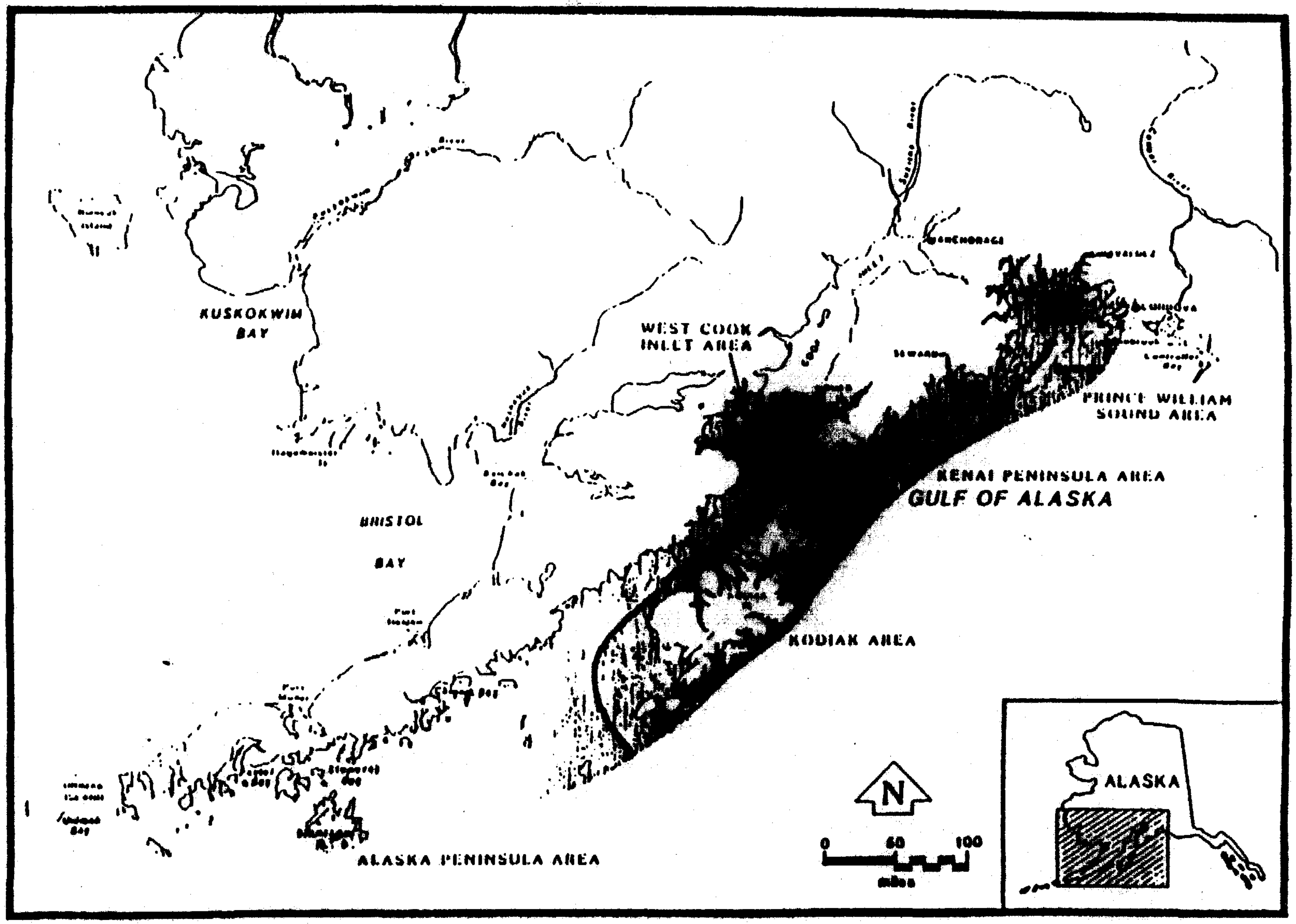

Figure 1. Map of the Exxon Valdez Oil Spill Area

Source: Mills (1991b)

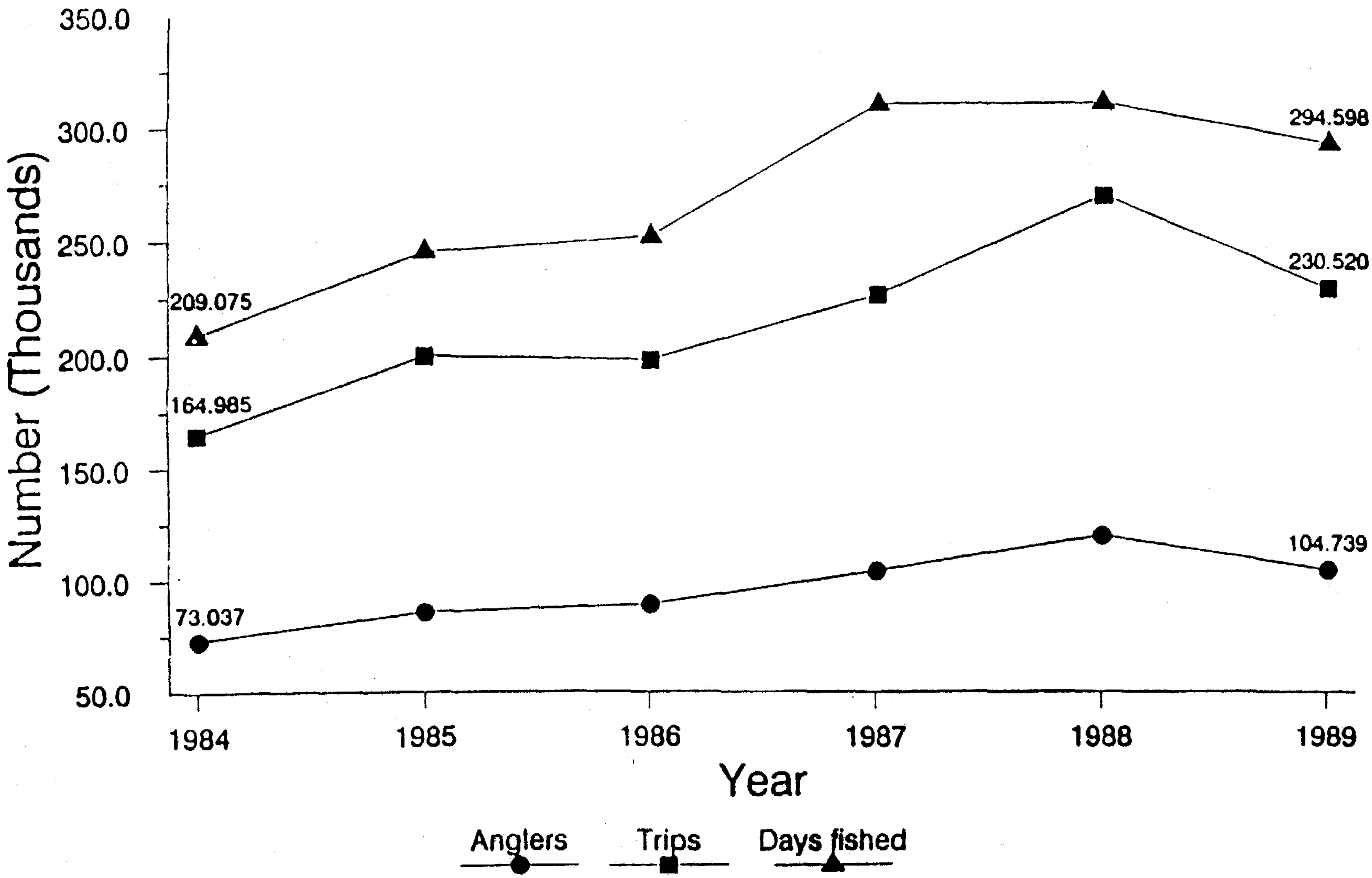

Figure 2. Sport fishing effort for the Exxon Valdez oil spill area, 1984-1989.

Source: (Mills, 1991b)

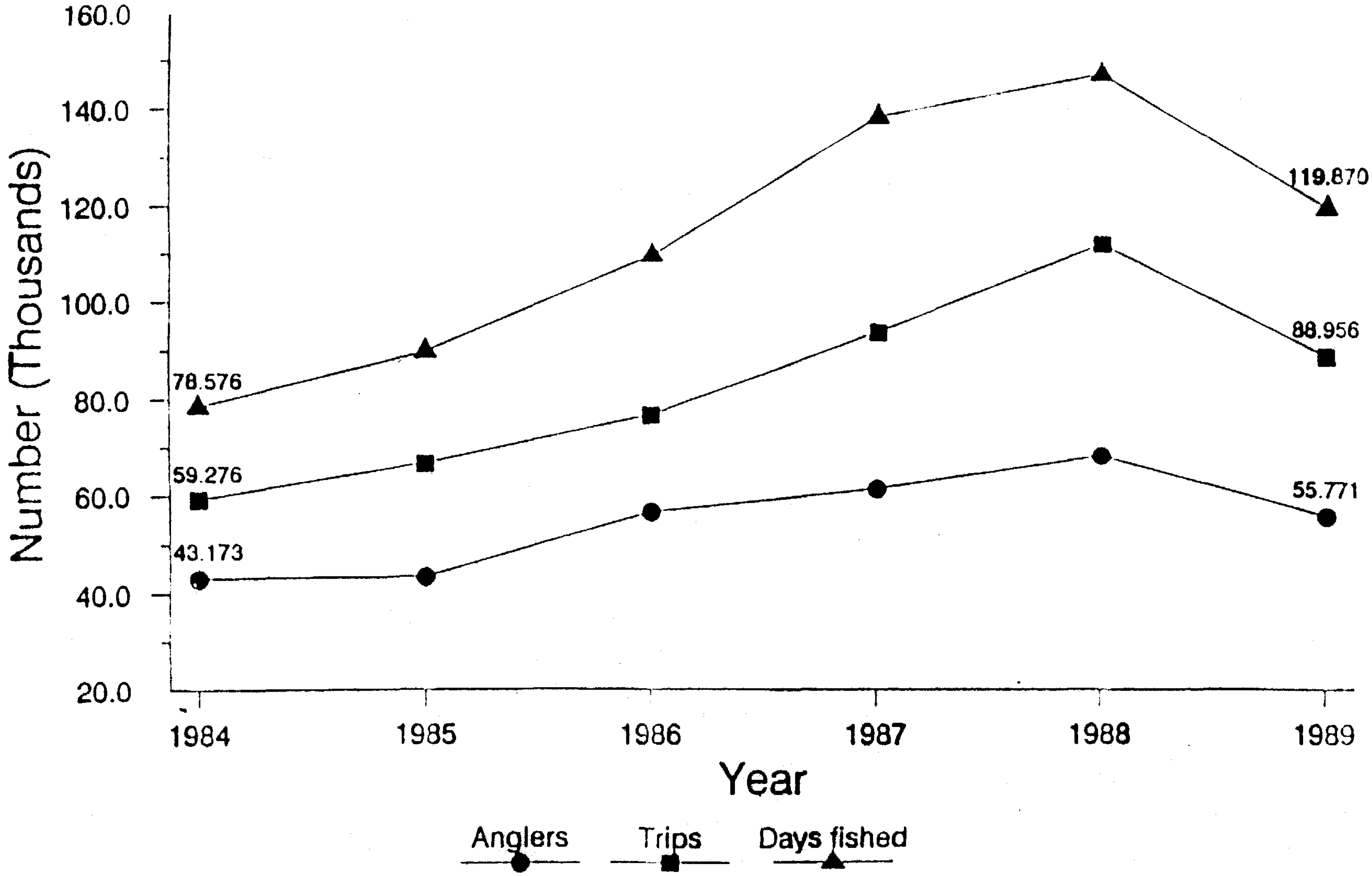

Figure 3. Sport fishing effort in the Exxon Valdez oil spill area by Alaskans residing outside the oil spill area, 1984-1989.

Source: (Mills, 1991b)

TABLE 1: CHANGE IN SPORTFISHING TRIPS AND ANGLER DAYS, 1989-1988

	1988	1989	DIFFERENCE 1989-1988	
SPORTFISHING TRIPS				
Southeast Alaska	328,350	320,670	(7,680)	- 2.3%
Southcentral Alaska	1,406,549	1,240,981	(165,568)	-11.8%
Arctic-Yukon-Kuskokwim	184,387	169,551	(14,836)	- 8.0%
TOTAL	1,919,286	1,731,202	(188,084)	- 9.8%
ANGLER DAYS				
Southeast Alaska	397,793	440,906	43,113	10.8%
Southcentral Alaska	1,679,939	1,583,381	(96,558)	- 5.7%
Arctic-Yukon-Kuskokwim	233,559	239,792	6,233	2.7%
TOTAL	2,311,291	2,264,079	(47,212)	- 2.0%
DAYS/TRIP				
Southeast Alaska	1.21	1.37		13.5%
Southcentral Alaska	1.19	1.28		6.8%
Arctic-Yukon-Kuskokwim	1.27	1.41		11.7%
TOTAL	1.20	1.31		8.6%