United States Coast Guard
Office of Investigation and Analysis

Analysis of Fishing Vessel Casualties

A Review of Lost Fishing Vessels and Crew Fatalities, 1994 - 2004

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EXECUTIVE SUMMARY

During a three-week period in the winter of 1998/1999 four clam/conch vessels were lost in Mid-Atlantic waters, which resulted in the deaths of 11 fishermen. After this cluster of accidents, a task force of government and industry representatives was chartered to study trends in fishing vessel (F/V) safety and to make recommendations for reducing loss of life and property. The Task Force's report of March 1999 provided a series of short-term and long-term recommendations.[1] The report also included a high-level review of casualty data for calendar years 1994 – 1998.

Shortly after the Task Force report was released, industry and senior Coast Guard managers requested more details about fishing vessel casualties. The Compliance Analysis Division collaborated with the Fishing Vessel Safety program manager and prepared a follow-on review to provide information about why and how such incidents occurred. That report was distributed in October of 1999. This document is the third edition of the casualty study with newly added data for calendar years 2001 through 2004.[2] The resulting updated data set includes such factors as:

- Operation of the vessel at the time of the incident.
- Geographic or location information of the incident.
- Participation of the vessel in the voluntary exam program and its decal status.
- Causal information about vessel loss, (what went wrong).
- Causal information about deaths and missing persons.
- Assistance by Good Samaritan vessels, and
- Availability and use of lifesaving equipment.

Analysis of the casualty data is presented in two parts: vessel losses, and crew fatalities. Each part begins with overall summaries and descriptive statistics. From that starting point, a more detailed "drill down" analysis is provided on the data. In other words, for each of the two groupings, the broad based information was examined in increasing detail, in order to "peel back," or focus on, the most significant factors involved in these fishing vessel incidents.

For the eleven-year period from 1994 through 2004, there were 1398 lost vessels and 641 fatalities. Of those fatalities, 328 occurred at the same time a vessel was lost. Overall, this is an average of 127 lost vessels and 58 fatalities per year.

The information showed that the majority of fishing vessel losses and deaths occurred in the 17th and 8th Coast Guard Districts.[3]

[1] U.S. Coast Guard, *Living To Fish, Dying To Fish*, Fishing Vessel Casualty Task Force Report, Washington, DC, March 1999. This report is available at: http://www.uscg.mil/hq/g-m/moa/marin.htm

[2] A description of the data sources used in this report, along with a discussion of applicable assumptions and constraints, is presented in Appendix B.

[3] Except where noted, this data is not normalized because reliable vessel and workforce population data is not available for the fishing fleet. With this in mind, fleet size is assumed to be essentially uniform for the period of this study, as will be explained in more detail, later in this document.

For both vessel losses and personnel casualties, ***it was found that a majority of these incidents were <u>not</u> directly related to fishing operations, but to other activities, such as traveling to or from port. Most often, fishermen are dying because their vessel sank and they found themselves in the water***. Further, the analysis of personnel casualties indicates links between water conditions and the use of lifesaving equipment, especially survival suits. In particular, most of the water exposure deaths were along the West and Northeast coasts, where the water is coldest. Use of survival suits was infrequent in such incidents. However, ***when use of survival suits was reported, more crewmembers survived – more than double the survival rate.***

Given the Coast Guard's limited authority over fishing vessel design and maintenance, analysis of this data illustrates that when vessels have the safety equipment prescribed by Federal Regulations, and fishermen <u>use</u> the equipment properly, their chances of survival increase significantly.

A. MAIN POINTS

1. During this period 1,398 fishing vessels were lost. Of those lost vessels, 1,133 (just over 81%) had Certificates of Documentation, rather than state registration, (pg. 5).

2. Fishing vessel losses followed a normal pattern of variation, averaging 127 losses per year, (pg. 6).

3. In 1995 and from 1999 through 2000, there was an increase in voluntary dockside exams; comparatively there was a decrease in vessel losses, (pg. 7).

4. Overall, the majority of vessel losses occurred in the 17th, 8th, and 7th Districts, (p. 8).

5. When grouped by region, vessel losses decreased slightly along the West and East Coasts. However, there was a slight increase along the Gulf of Mexico, (pg 8).

6. When shown as a rate (losses/1000 vessels), losses occurred more often on longer vessels, (pg 9).

7. Fishing vessels between 21 and 40 years of age, with a valid Certificate of Documentation, sustained the greatest loss. Also, most vessels were constructed of either wood (48%), or steel (24%), (pg 10).

8. Most fishing vessel losses (71%) occurred while engaged in non-fishing operations, (pg. 11).

9. Together, flooding and fire were 55% of the fishing vessel losses, (pgs. 12-13).

10. In the 11 year period of this study there were 641 crewmember fatalities, or an average of 58 per year, (pg. 15).

11. The U.S. fishing industry suffered its worst casualty in 50 years with the loss of the *ARCTIC ROSE*. The vessel disappeared in the Bering Sea the night of 1 April 2001, resulting in 1 deceased and 14 missing crewmembers, (pg 15).

12. Overall, the majority of deaths occurred in the 17^{th} and 8^{th} Districts, (pg. 15).

13. Most incidents (92%) result in either one or two fatalities, indicating that multiple-fatality incidents are relatively rare. Thus, it would be necessary to address a relatively large number of incidents in order to reduce the fatality counts significantly, (pg. 15).

14. Examination of the events leading to death confirmed that water exposure was, by far, the most significant factor in personnel loss, (pg. 16).

15. Deaths from water exposure were higher along the West and Northeast coasts than in any other region because of more severe environmental conditions, (pg. 17).

16. Vessel related fatalities tend to be higher in the months of October through January, (pp. 18).

17. When presented as a rate (fatalities per vessel lost), vessel-related fatalities were the lowest in the warmer waters of the Gulf of Mexico and along the Southeast U.S. coast, (pp. 19 -20).

18. Nearly 42% of all vessel-related fatalities occurred on steel hulled vessels. Population data showed that steel vessels are generally larger than vessels of other hull materials. Consequently, they are able to operate farther offshore, with larger crews. Given the higher risk factors of crew size and distance from shore, it may be appropriate to focus preventive efforts on steel vessels, (pg. 21).

19. At least 2 fatalities resulted from inadequate training, (pg.20).

20. Beginning in calendar year 2000, there was a downward shift in the number of fatalities per year. It appears that the increased emphasis on safety equipment and procedures, which began in 1999/2000, has contributed to a measurable reduction in fatalities. However, the trend has leveled off. To reduce the fatality rate further may require additional improvements in safety, (pp. 22 -23).

21. Each District showed a downward or level trend in fatalities, except for 1st District (Northeast U.S.). The 1st District showed an upward fatality trend due to several multiple-fatality incidents in 2003 and 2004, (pg. 22).

22. The recent drop in vessel-related fatalities was independent of vessel losses, which showed no measurable change. Given that the potential for fatalities is constant, this is another indication that the recent emphasis on lifesaving equipment, training and procedures has been beneficial, (pg. 23).

23. In cold waters, fishermen survive more than twice as often when lifesaving equipment is used, (pg. 24).

24. Loss of lives was much lower among those vessels that received a safety decal. When deaths did occur, the vessel was lost suddenly with little time to respond, (pg. 25).

25. A significant, but unknown, number of crewmember fatalities were prevented, because Good Samaritan vessels were present for nearly 3 of every 10 vessels lost. Hypothetically, as many as 788 fatalities may have been prevented. However, such vessels may be serving as a substitute for properly maintained lifesaving equipment, thereby hiding the true risk from vessel losses. (pp. 26-27).

26. With 24% of the total (154 of 641), falls overboard were the second largest group of fatalities. PFD/survival suit usage was reported for none of those fatalities, (pg.28).

27. The highest number of fall overboard fatalities occurred in the 8th District, accounting for 40% of the total (61 of 154). Given that the 8th District has the warmest waters and, thus, the longest survival times, it is likely that many of the fatalities were preventable with PFD's. This appears to be a region where increased emphasis on safety equipment, drills and training would be beneficial, (pg.28).

28. To eliminate some fatalities, it will be necessary to prevent vessel loss, (various).

B. LOST VESSELS

Overview

After extracting and examining the Marine Safety Information System (MSIS) and Marine Information for Safety and Law Enforcement (MISLE) casualty data, the Coast Guard databases showed 1,398 fishing vessels (Documented and State Registered) were lost from calendar year 1994 through 2004 (Figure 1). On average, 127 fishing vessels were lost each year. The maximum and minimum number of vessel losses was 166 and 85 in calendar years 1996 and 2000, respectively (Figure 1). Of the 1,398 vessels, 1,133, or just over 81%, had Certificates of Documentation issued by the Coast Guard, instead of state registration numbers. The population of fishing vessels holding a valid Certificate of Documentation was 28,323 in 2004.

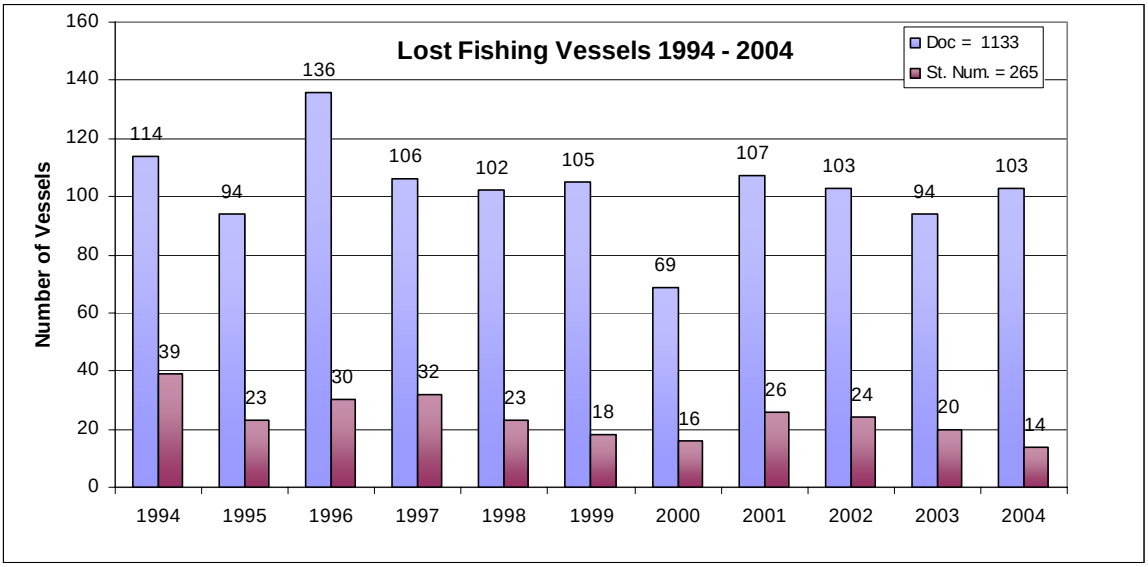


Figure 1

The question might be whether the state numbered vessel casualties are under-reported, thus skewing the accident rate towards documented vessels. Total loss of a vessel is a serious occurrence, which will rarely go unreported. Further, Investigating Officers learn of such incidents from the Search and Rescue units of the Coast Guard and other sources, even when the vessel's owner fails to submit a report. Additionally, a preliminary report by the First Coast Guard District showed a virtually identical case distribution to that shown in this paper. It was found that 78% of all First District fishing vessel casualties, whether or not the vessel was lost, occurred on documented vessels[4]. Thus, the data set is considered complete and unbiased in this respect.

[4] *State Registered v. Documented. A study of Disparity in Safety Carriage Equipment Requirements.* (Draft). First Coast Guard District Marine Safety Division. Authors of the report described an aggressive program in the First district to identify all fishing vessel casualties, using a variety of sources. Cited with permission of the authors.

Vessel Loss Trend

In determining whether the number of Fishing Vessel losses fell within expected tolerances, a control chart of the data (Figure 2) was used.[5] Over the 11 year period the fishing vessel fleet lost an average of 127 vessels per year. The upper control limit for this number of losses is 189. It could be presumed that the fishing vessel losses for each year followed a normal (expected) pattern – never going beyond its control limits.

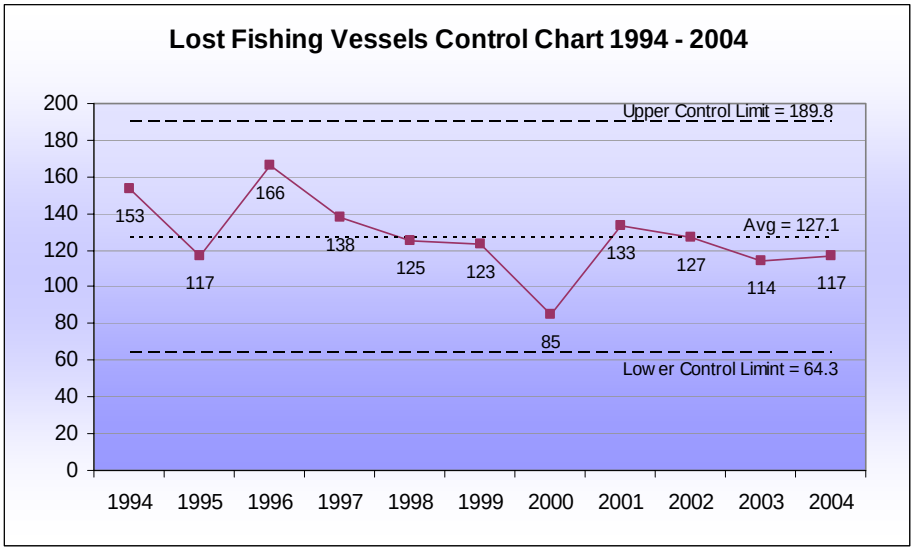


Figure 2

The reduction of vessel losses in the year 2000 might be explained by increased emphasis on fishing vessel safety after the 1999 Task Force report was released. Here are some highlights:

- On April 28, 1999 the Assistant Commandant for Operations and the Assistant Commandant for Marine Safety & Environmental Protection, after consultation with the Commercial Fishing Industry Vessel Safety Advisory Committee, released an official message describing a series of short term and long-term actions to enhance safety. Based on the Task Force report, the short-term actions included increased emphasis on safety items during at-sea boardings, additional training for boarding officers and stepped up outreach activities.
- During the fall and winter of 1999, each of the Coast Guard Area Commanders announced their own initiatives to reduce fishing vessel casualties – "Operation Safe Catch" in Atlantic Area and "Operation Safe Return" in the Pacific Area. As suggested in the Commandant's message, these initiatives placed additional emphasis on safety items during at-sea boardings.
- There was also a sharp increase in the number of dockside exams as indicated by the upper line on Figure 3.

[5] Wheeler, Donald J., *Understanding Variation: The Key to Managing Chaos*, SPC Press, Inc., Knoxville, TN, 1993, pg. 134. This methodology is described in Appendix C.

Comparison of Lost F/Vs to Dockside Exams

The Coast Guard's voluntary dockside examination program includes an outreach component, intended to raise awareness of vessel watertight integrity, stability, and maintenance problems that often lead to vessel loss. This is a possible benefit of dockside examinations that is not included in law or regulation. Of course, the voluntary nature of the program suggests a self-selection bias. In other words, the exams are not focused on vessels that need the most safety improvements, nor are the exams randomly distributed throughout the fishing fleet. Instead, vessel owners and operators that are already interested in safety improvement will request the exam.

Figure 3 compares the lost fishing vessels to the voluntary dockside exams by year. In 1995, and from 1999 through 2000, there was an increase in dockside exams. Comparatively there was a decrease in vessel losses for those periods. The area of fishing vessel casualty prevention that could not be accounted for was the Law Enforcement Boardings due to limited data. Of the 1,398 lost vessels, 873 (62%) never had an examination, 261 (19%) had current fishing vessel decals, 257 (18%) had expired fishing vessel decals, and 7 (1%) had an unknown exam status.

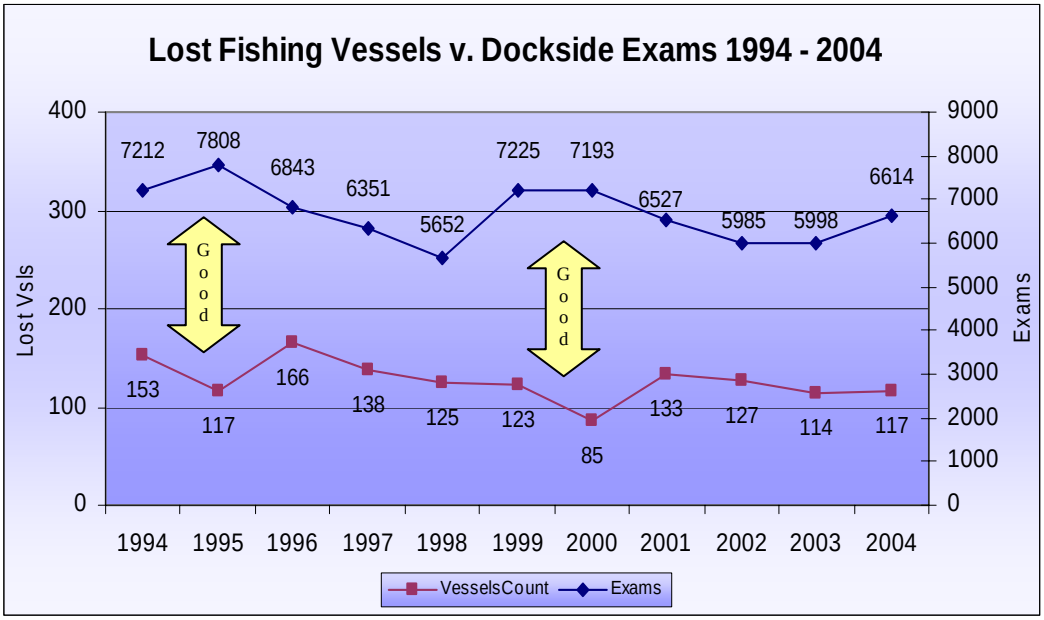


Figure 3

Lost F/Vs by Year and District

The table below displays the vessel losses by District and Year. The top three Districts having the highest number of fishing vessel losses were the 17th, 8th, and 7th Districts – for a total of 805 casualties (58%). A map of the Coast Guard Districts is shown in Figure 5, on the next page.

Lost Fishing Vessels By Year and District 1994 - 2004												
District	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Total**
17	42	26	47	38	31	43	22	29	23	22	15	**338**
8	25	23	29	25	21	19	14	28	26	27	31	**268**
7	21	13	20	23	20	17	14	17	20	18	16	**199**
1	28	17	17	15	6	10	14	15	24	14	20	**180**
11	24	13	24	20	14	16	9	16	12	8	13	**169**
13	9	15	13	11	13	8	4	19	10	9	13	**124**
5	2	7	11	4	13	6	7	7	11	10	6	**84**
14	2	3	4	2	6	3	1	2	1	6	2	**32**
9	0	0	1	0	1	1	0	0	0	0	1	**4**
Total	**153**	**117**	**166**	**138**	**125**	**123**	**85**	**133**	**127**	**114**	**117**	**1398**

Table 1

Vessel Losses, By Region

As depicted in Figure 4, vessel losses are shown, by three large regions: the West Coast (D17, D13, and D11); East Coast (D1, D5, and D7); and the Gulf Coast (D8). Within this period the West Coast had 631 losses, East Coast 463, and the Gulf Coast 263. As shown by the line graph, the West Coast has continued with a gradual decrease in vessel losses while the East Coast maintained a slight decrease. Conversely, the Gulf Coast has experienced a slight increase of vessel losses throughout this period.

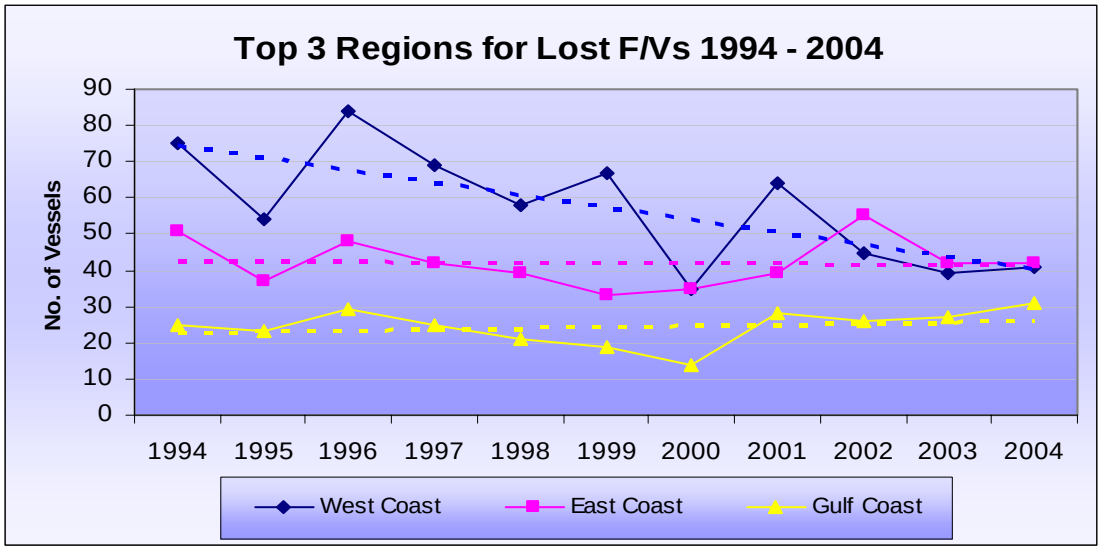


Figure 4

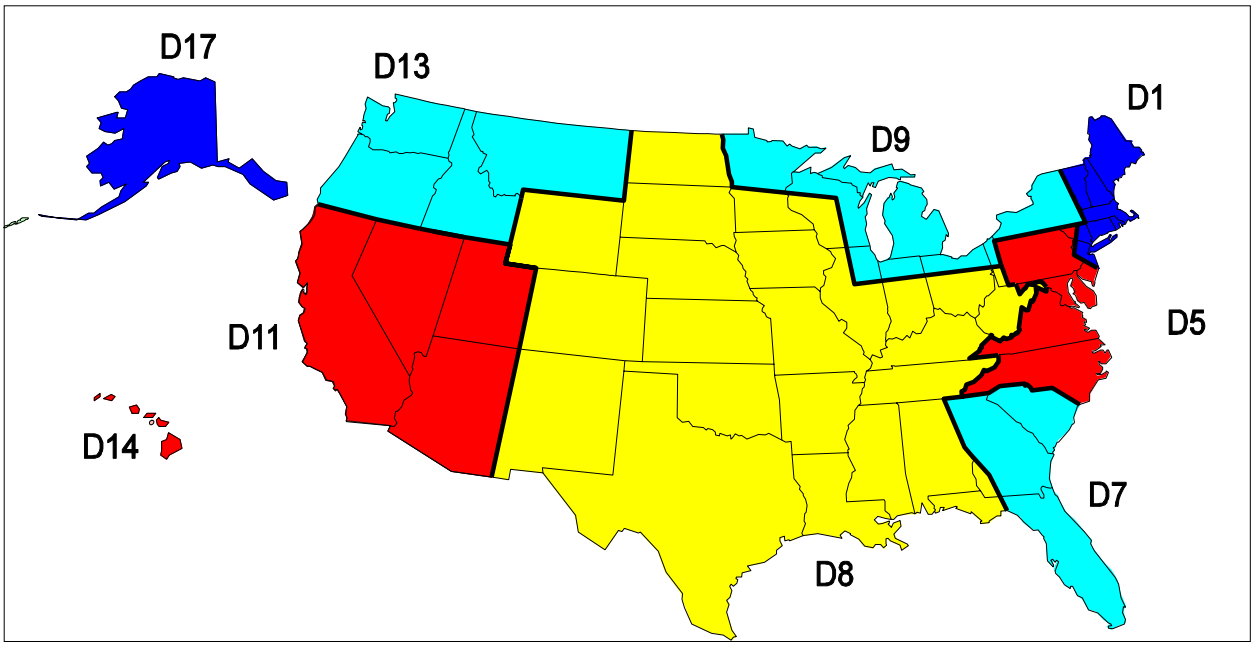


Figure 5

F/Vs Loss Rate by Length

The fishing vessel loss rate by vessel length is shown in Figure 6 for documented vessels greater than 20 feet (1,132 vessels). A line has been added for each corresponding length range showing the rate of vessel loss per 1000 vessels.[6] These "normalized" figures clearly show that accident rates increase with vessel length, with a sharp spike in the 60 ft. to 70 ft. range. A variety of factors could influence this increase in accident rates. However, the likely explanation is larger vessels generally are capable of operating further from shore, with the potential for longer voyages or exposure to more severe environmental conditions.

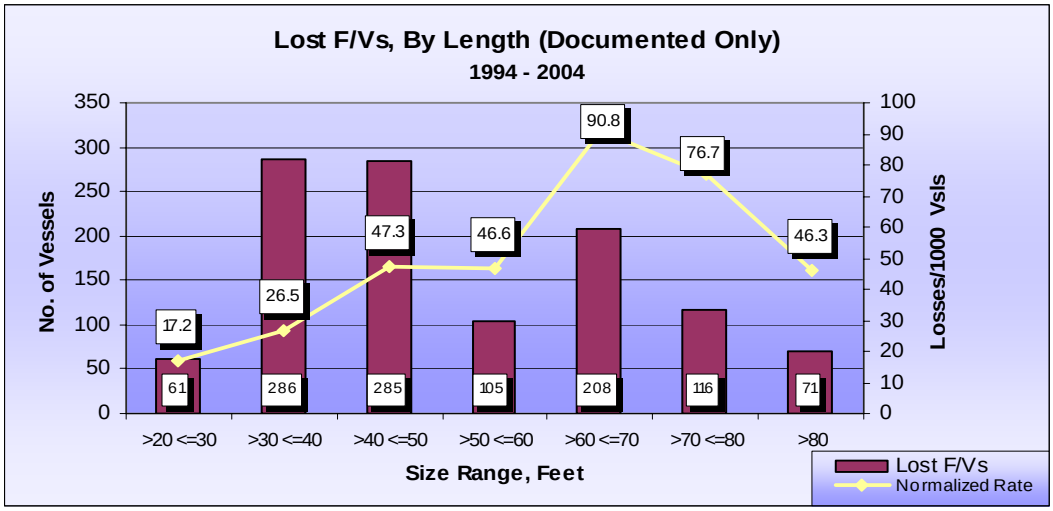


Figure 6

[6] Lost F/Vs within each length category divided by the total number of F/Vs within these categories. (Total Documented F/V Population for 2004 = 28,323)

Documented F/V Population

The table below compares the hull material of lost documented fishing vessels to the 2004 Documented Fishing Vessel Population.[7] Between the years of 2001 and 2004, there was an average of 27,549 documented fishing vessels. At the end of 2004, the active documented fishing vessel size topped-out at 28,323, which was used for the comparison below in Table 2. This table shows that, over an 11 year period, the fishing vessel fleet has been reduced by approximately 4% of its population.

Documented F/V Population Comparison 1994 - 2004			
Hull Material	**Vsl Losses**	**Vsl Population**	**% Lost**
Alum	21	1128	2%
Concrete	8	76	11%
FRP	261	11878	2%
Steel	277	5851	5%
Wood	548	9311	6%
Unk Mat.	18	79	23%
Total	**1133**	**28323**	**4%**

Table 2

Lost Documented F/Vs by Age and Hull Material

Shown in Table 3 are the Documented Fishing Vessel losses by age and hull material. Fishing vessel losses occurred predominately within the vessel age range of 21 to 40 years. This age group accounted for 672 (59%) of the fishing vessel losses. Vessels made of wood sustained the greatest loss over this period followed by steel hull vessels. The breakdown of the hull material consists of the following: Wood - 548 (48%); Steel - 277 (24%); Fiberglass Reinforced Plastic (FRP) – 261 (23%); Aluminum – 21 (2%); Concrete – 8 (1%); and Unknown Material – 18 (2%). Documented vessels accounted for 6 unknown in age and 18 unknown in hull materials. State Numbered vessels accounted for 240 unknown in age and 215 unknown in hull materials.

Documented Lost Fishing Vessels Age and Hull Material 1994 - 2004													
Age	**<= 10**	**11 <= 20**	**21 <= 30**	**31 <= 40**	**41 <= 50**	**51 <= 60**	**61 <= 70**	**71 <= 80**	**81 <= 90**	**91 <=100**	**Unk Age**	**Total**	**% of Total**
Alum	2	8	4	0	7	0	0	0	0	0	0	21	2%
Concrete	0	1	5	2	0	0	0	0	0	0	0	8	1%
FRP	6	56	162	35	0	0	0	0	0	0	2	261	23%
Steel	14	44	112	73	17	6	8	0	1	0	2	277	24%
Wood	1	15	143	122	64	91	47	32	26	5	2	548	48%
Unk Mat.	0	3	9	5	1	0	0	0	0	0	0	18	2%
Total	**23**	**127**	**435**	**237**	**89**	**97**	**55**	**32**	**27**	**5**	**6**	**1133**	**100%**

Table 3

[7] The Vessel Population data was gathered from the MISLE database. From 1997 through 2000, there was an average of 26,011 documented fishing vessels according to the MSIS database. The Coast Guard transitioned from MSIS to MISLE in December of 2001.

The line diagram below (Figure 7) compares the vessel losses by age to the hull material as mentioned in the table above. The hull material of Concrete and Unknown Material were grouped into "Other" category and the Unknown Age category was excluded from this diagram.

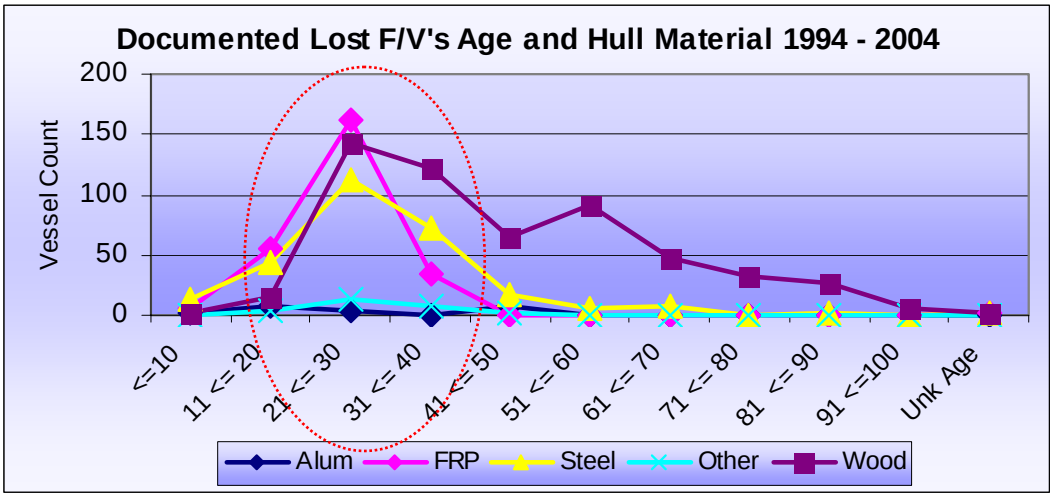


Figure 7

Pre-Casualty Operation

Figure 8 describes how the vessel was being operated prior to the time of the casualty occurrence. As displayed, 616 (44%) of the fishing vessel's losses occurred while the vessels were transiting (non-fishing mode). Other categories involving non-fishing modes were Moored, Inbound, Outbound, Towing, Being Towed and Fueling, all totaling 919 (71%) fishing vessel losses.

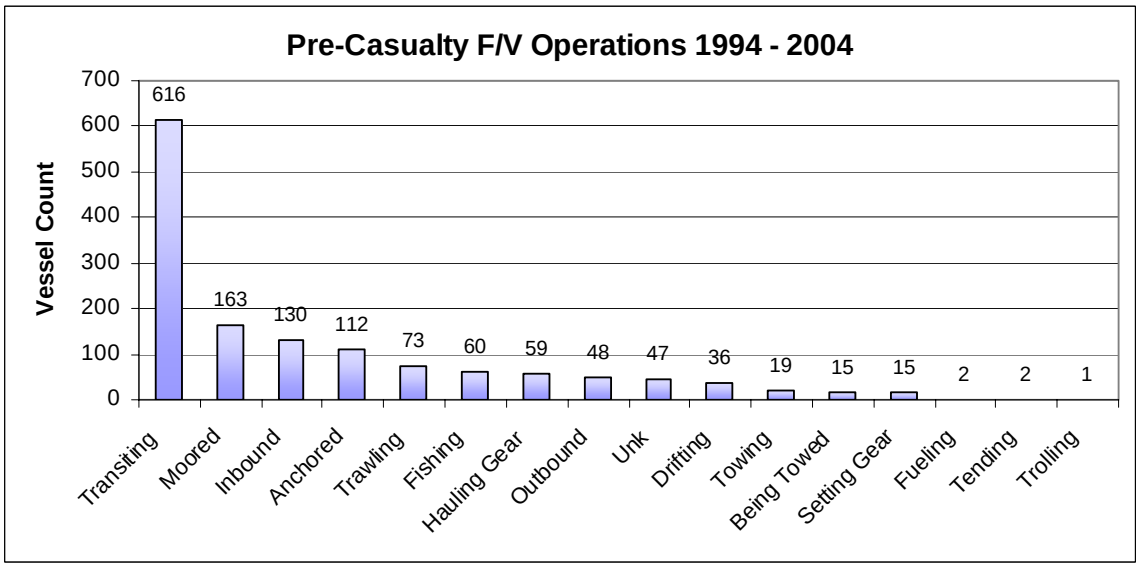


Figure 8

Causes of F/V Loss

The leading cause of vessel losses was flooding as depicted in Figure 9. Vessel flooding contributed to 35% of the vessel losses during this period. Fires onboard vessels were the second leading cause of vessel losses, having contributed to 20% of the losses during this period.

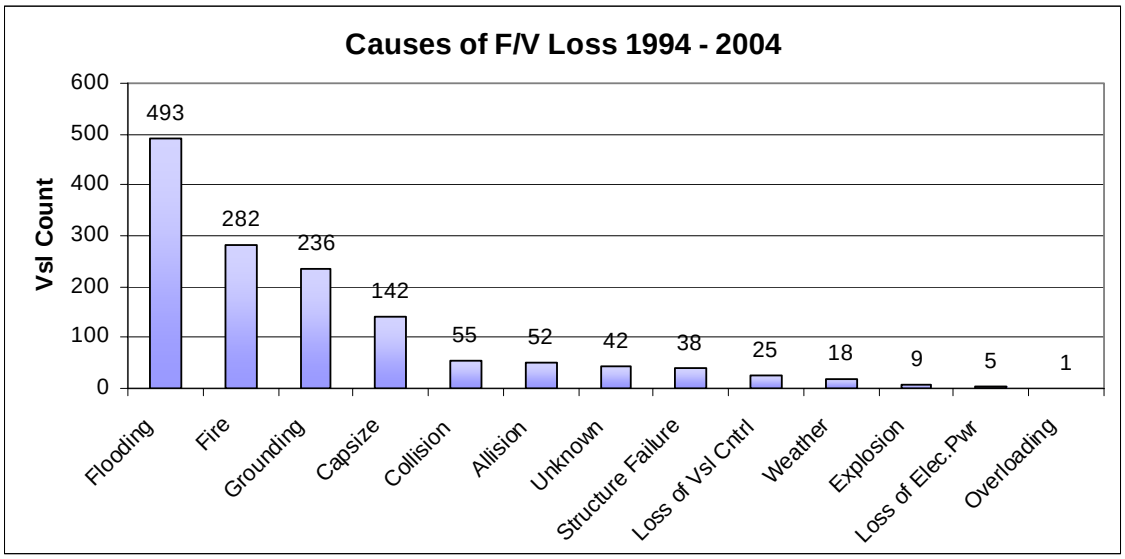


Figure 9

Causes of F/V Flooding

The leading cause of vessel loss, as indicated by Figure 9, was flooding. The major causes leading to flooding were broken down into five categories in Figure 10 which consisted of Hull/Machinery Failure, Weather, Human Factors, External Fault, and Unknown. The area that contributed most to vessel flooding was Hull/Machinery Failure. Hull/Machinery Failure accounted for 69% of the fishing vessel losses due to flooding and 25% of all casualties involving fishing vessel loss for this period. The Hull/Machinery Failure consisted of the following: Hull damage from casualties (i.e. grounding & allisions), Failure of hull material (i.e. wood planking, steel wastage), Failure of engine exhausts systems, etc.

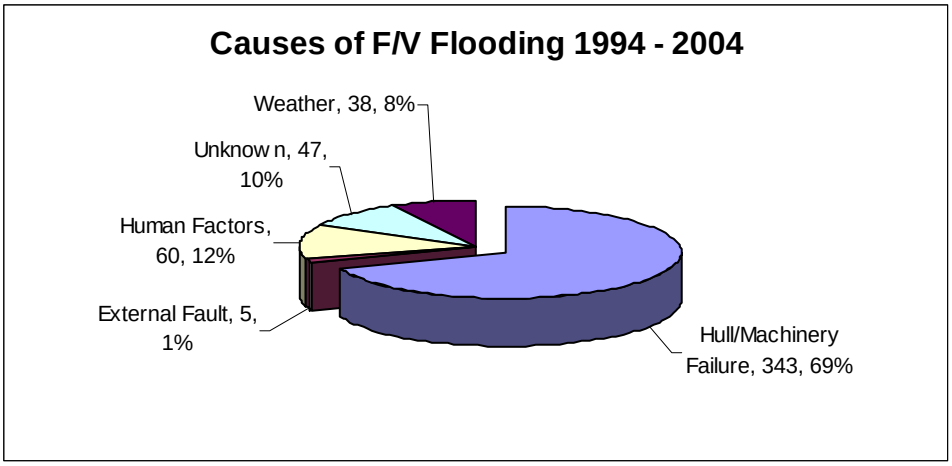


Figure 10

F/V Fire Locations

The second leading cause of vessel loss was Fire. In evaluating the casualty reports, it was somewhat difficult to determine the cause of most fires; however the location was easily retrieved. As indicated below, 68% of the fire locations occurred within the vessel's engine room. Further analysis was not feasible beyond this point due to the level of investigation.

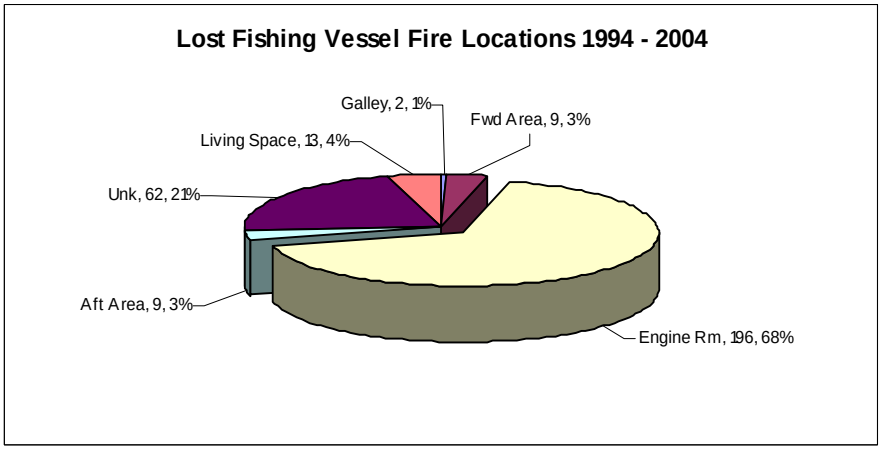


Figure 11

Summary of Lost Fishing Vessel Information

During this period there was a loss of 1,133 documented fishing vessels. This number of lost vessels makes up 4% of the entire fishing vessel population (Table 2). The control chart in Figure 2 indicated that the numbers of fishing vessel losses throughout the period were within normal limits of variation. This would indicate that we can expect approximately 127 documented fishing vessels to be lost each year in the future, unless a substantial regulatory shift concerning the vessel's material condition and machinery can be implemented.

The Federal Regulations promulgated under the 1988 Commercial Fishing Industry Vessel Safety Act (46 CFR, Part 28) primarily focus on lifesaving and firefighting equipment. For a limited number of vessels, there are additional requirements for navigation equipment, machinery safeguards, and stability tests. However, it would be difficult to show that strict compliance with the fishing vessel safety regulations would prevent vessel losses. Further, the data presented on the preceding pages shows that most losses are due to flooding (predominately Hull/Machinery Failure) and fires (predominately Engine Room) while the vessel is in transit - problems that are largely not covered in the current regulations.

C DEATHS AND MISSING PERSONS

Overview

The fishing vessel casualty data for calendar years 1994 through 2004 included 468 reports involving loss of life. Those 468 incidents resulted in 641 deaths or missing persons, or an average of 58 fatalities per year. Nearly half of all fatalities (297) occurred at the same time the fishing vessel was lost, involving 146 of the lost vessels described in the preceding section of this report. Significant among the vessel losses was the sinking of the *ARCTIC ROSE* on or about 1 April 2001, with 1 deceased and 14 missing crewmembers. The *ARCTIC ROSE* sinking was the worst fishing vessel casualty since the *GUDRUN* disappeared off the Atlantic coast on 1 January 1951, with the same number of fatalities.[8]

Fatalities By Coast Guard District

Fatalities by Coast Guard District are shown in Table 4. Like vessel losses, the highest number of fatalities occurred in the 17th (Alaska) and 8th Districts (Gulf of Mexico).

Fishing Vessel Fatalities, By Year And District												
Fishing Fatalities, By Year And District												
District	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Grand Total
17	18	17	22	3	13	19	5	23	13	7	6	146
08	6	16	17	13	11	16	4	11	12	10	9	125
01	14	5	8	11	8	6	11	10	2	13	9	97
11	17	5	11	11	12	12	3		4	2	6	83
13	10	9	6	10	7	5	5	8	2	3	1	66
07	7	2	3	8	7	7	5	1	4	5	3	52
05	3	4	7	4	6	12	3	4	1	3	3	50
14		4	8	1	3		1	1				18
09					4							4
Grand Total	75	62	82	61	71	77	37	58	38	43	37	641

Table 4

Distribution Of Fatalities

The number of fatalities per incident is summarized by the histogram in Figure 12. Together, incidents with either one or two fatalities are 92% of the cases and 77% of the fatalities. In risk management terms, it will be necessary to address a relatively large number of incidents in order to further reduce fatality counts significantly.

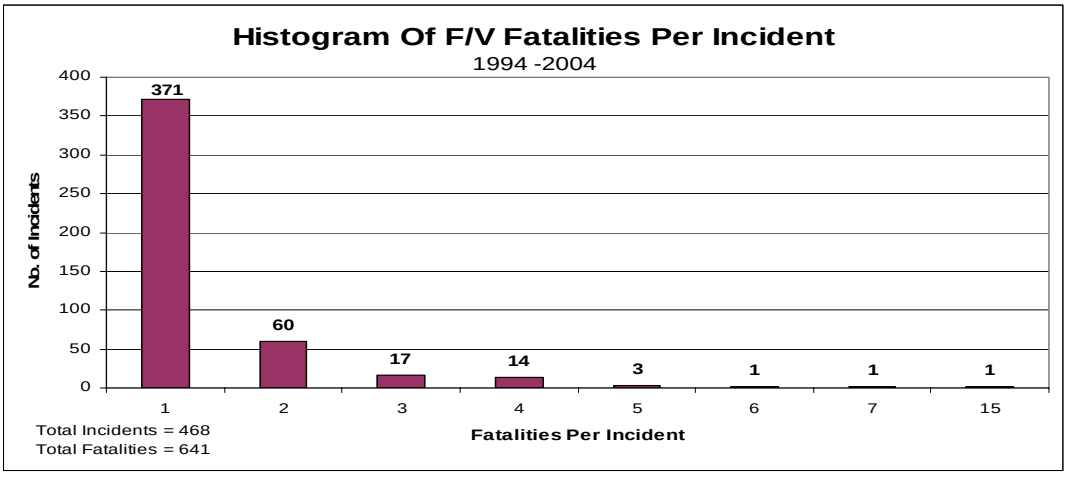


Figure 12

[8] The *ARCTIC ROSE* and *GUDRUN* casualties were both subjects of Marine Boards of Investigation, which can be viewed at: http://www.uscg.mil/hq/g-m/moa/reportindexcas.htm

Fatalities By Casualty Type

Table 5 summarizes the fatalities by casualty type. Since there can be numerous events in an incident the first, or initiating, event is used in this analysis. For example, a vessel might experience a fire, then flood and sink, resulting in a death by drowning. In this scenario, the casualty would be counted as a fire since it was the first event in the sequence of events resulting in a personnel casualty.

Casualty Type	Sum Of Dead/Missing
Vsl. Flooding/sinking/capsize	328
Fall into water	154
Pulled overboard by gear	29
Diving Accident	27
Dangerous Atmosphere	18
Caught in winch	16
Smoke Inhalation - Vsl. Fire	10
Unknown Injury Type	10
Crushed by gear	10
Struck by line	7
Struck by Moving Object - Other	7
Drowned while attempting to unfoul propeller	4
Caught in lines	3
Vsl. Collision	3
Fall onto surface	3
Blown Overboard By Explosion	3
Struck A Fixed Object	3
Electrical shock	2
Vsl. Grounding	1
Exposure - Other	2
Fell overboard, crushed between dock and vessel	1
Total	**641**

Table 5

As shown in both Table 5 and Figure 13, just over half (51%) of all fishing vessel deaths are attributed to flooding, sinking, or capsizing of the vessel. Another 24% of the fatalities were falls overboard. ***With three-quarters of all fatalities, water exposure is by far the most significant factor in personnel loss***. The next largest group of accident types includes fishermen that were struck by or caught in lines or other equipment, for 7% of the total.

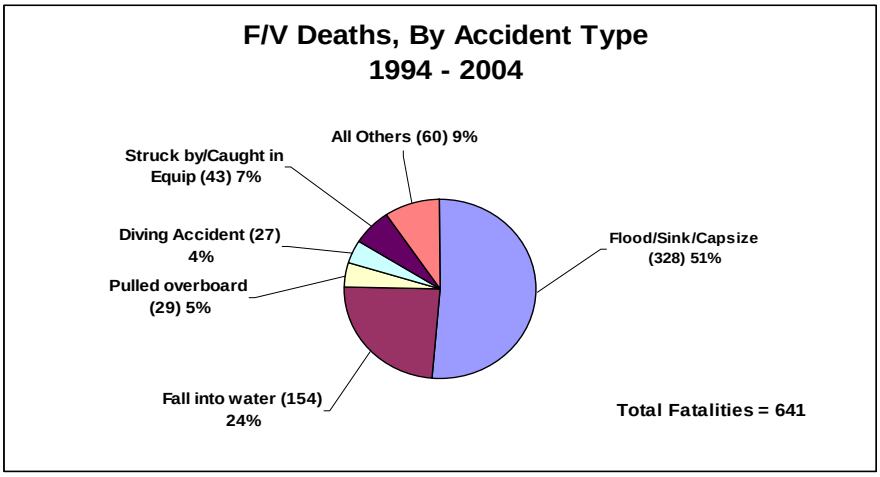


Figure 13

Deaths With Vessel Loss

Since half of all personnel casualties are associated with the loss of a vessel (328 of 641), it is useful to look at them separately. Figure 14 shows this group, arranged by Coast Guard District. (A map of the Coast Guard Districts is shown in Figure 5, on page 9.) The four highest counts are along the West and Northeast coasts of the U.S., accounting for nearly three-fourths (71%) of the vessel-related deaths.

The distribution of fatalities along the U.S. coastline is even more significant when one considers the figures for the 8th Coast Guard District, along the Gulf of Mexico. Overall, the 8th District had the second highest number of fatalities behind the 17th District (Alaska), with 125 and 146, respectively. Conversely, vessel-related fatalities in the warmer Gulf of Mexico waters ranked 5th among the 9 Coast Guard Districts. In fact, there were no vessel-related fatalities in the 8th District for 2000 and 2003. The large percentage of casualties on the West and Northeast coasts can be attributed to more severe conditions, especially cold-water exposure.[9] It is well known that survival times decrease rapidly as water temperature decreases.[10] Thus, the availability and use of survival equipment becomes more critical as the water becomes colder.

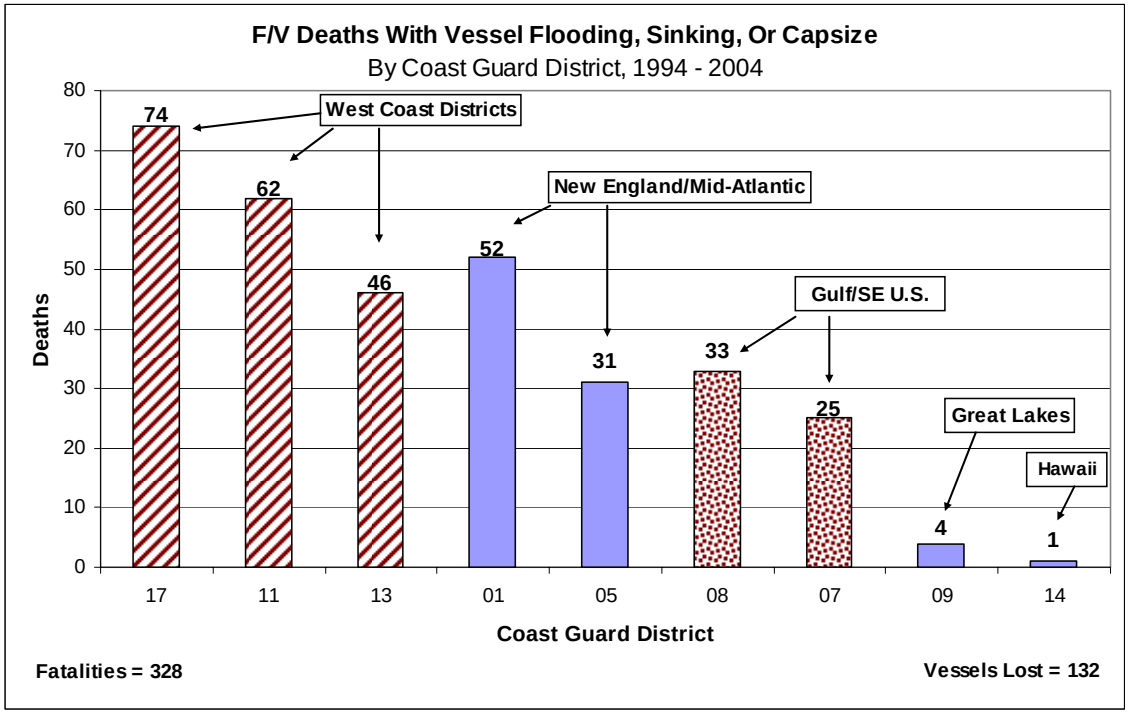


Figure 14

[9] Cold water conditions exist year round along the West Coast because of the Aleutian, California, and Davidson currents, which run parallel to shore.

[10] An overview of this topic is provided in the internet version of *The Ships Medicine Chest and Medical Aid at Sea*, Health & Safety Directorate, U.S. Coast Guard Headquarters: http://www.uscg.mil/flag/g%2Dwk/wkh/smc/

Cold Water Fatalities

As noted above, most vessel-related fatalities (71%) occurred in the more severe conditions off the West and Northeast coasts. Given this apparent relationship to environmental conditions, time of year is a factor as well. The chart in Figure 15 shows the vessel-related fatalities by month, along with a best-fit trend line. The chart shows that fatality counts tend to be higher in the months of October through January. The trend was examined with the *ARCTIC* ROSE incident included and excluded. The incident made only a slight change in the overall trend.

The monthly distribution for West and Northeast coast incidents was, also, examined separately. The trend was essentially the same as the nationwide pattern. However, the difference between the months of October through January and the other months was a bit greater.

It is noted that the dates of various fishing seasons may be a factor in the monthly fatality figures. For example, the Alaska crab season occurred each year during winter months. In any case, the combination of location and time of year showed increased numbers of fatalities.

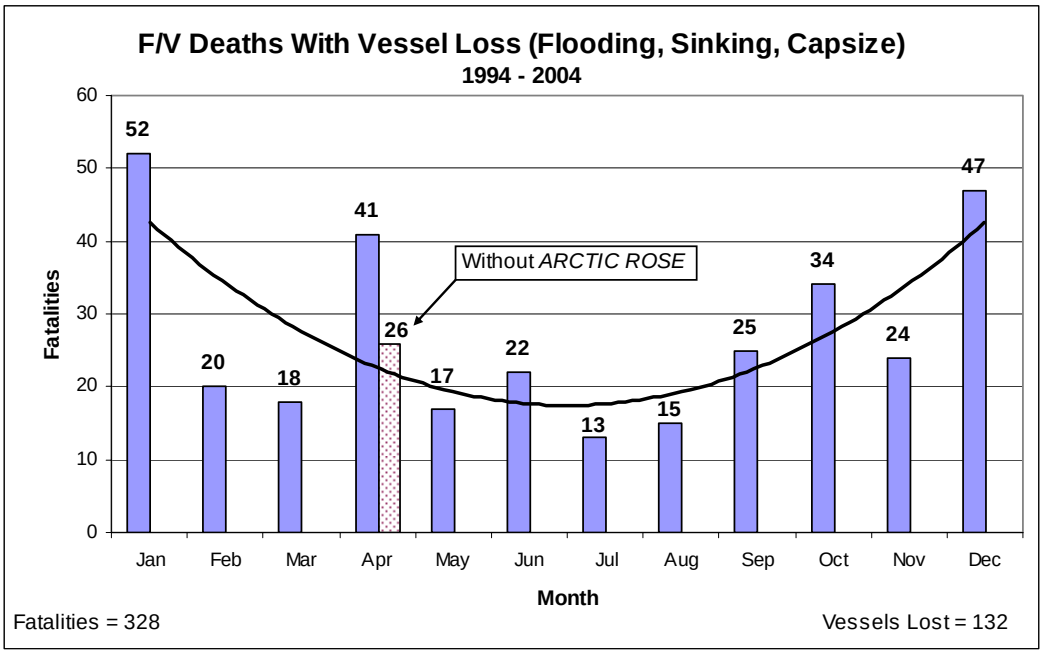


Figure 15

Fatalities In Warmer Waters

Given that most vessel-related fatalities occurred in the coldest locations or the coldest months, the numbers of fatalities in the warmer waters of the Gulf of Mexico and Southeast U.S. coast, shown on Figure 14, seem rather high. The fatality counts for those areas are comparable to waters of the Mid-Atlantic area, (the 5th Coast Guard District).

To provide a direct comparison between districts, a fatality rate can be calculated by using the number of vessel-related fatalities per vessel lost. Using this comparison, the difference between regions is more distinct. The lowest fatality rates were along the Gulf of Mexico and Southeast U.S. coast, (the 8th & 7th Coast Guard Districts), as shown in Table 6. As expected, the highest rates occurred along the West Coast, with an intermediate value for the Northeast. The West Coast fatality rate is more than double that of the 7th and 8th Districts.

Table 6 also shows a high fatality-per-vessel rate for the Mid-Atlantic/5th District. However, that value was inflated by two unusually serious casualties in 1999. On 6 January the *BETH DEE BOB* capsized, resulting in the deaths of all 4 crewmembers. Less than 2 weeks later, on 18 January, the *ADRIATIC* sank, with 4 more crew fatalities. In fact, the *BETH DEE BOB* and *ADRIATIC* casualties were among the incidents that led to the 1999 Fishing Vessel Casualty Task Force. For the other 10 years of this study, the average number of vessel-related fatalities in the 5th District is less than 3, with a maximum of 5 in any year. Treating 1999 as an "outlier", (i.e., an unusual value due to rare circumstances), the adjusted fatality rate is comparable to the New England area, (.59 v .56).

Coastal Area	District	Vessels Lost	Fatalities	Fatalities Per Lost Vessel
New England/Mid-Atlantic	1	93	52	0.56
	5	40	31	0.78
Gulf/Southeast U.S.	7	90	25	0.28
	8	118	33	0.28
West Coast	11	95	62	0.65
	13	63	46	0.73
	17	124	74	0.60

Table 6

Casualty reports showed that vessel-related fatalities in the 7th and 8th Districts involved a number of factors, in addition to water temperature. In general, the vessels were lost suddenly, often in severe weather conditions. Of 38 warm water incidents, 14 vessels capsized. Six of the capsizings occurred during severe weather, and 2 more resulted from fishing gear that snagged an obstruction. Of 10 vessels that sank, 5 occurred during severe weather and 3 began flooding, which was discovered too late for corrective action. Two vessels disappeared with their crews, and 3 more were found with no survivors. Thus, some of the incidents occurred too quickly for the use of lifesaving equipment.

Also, there were 5 collisions, 2 fires, 1 grounding and a vessel that sank while moored. While each of those incidents ultimately led to a flooding, sinking or capsizing, they are considered misclassified, for the purposes of this comparison.

Of the 58 warm water fatalities, 12 persons were trapped in their vessel or its rigging. Fifteen persons entered the water and died from drowning or hypothermia. Seventeen persons are missing or died from unknown causes. The remaining 14 fatalities resulted from the misclassified incidents described above.

These incidents showed that persons can survive much longer in warmer waters – but not indefinitely. Survival times in the warmer waters were measured in hours, instead of minutes for cold waters such as Alaska. For example, two crewmembers held onto a life ring after their vessel sank in the Gulf of Mexico. One of them was rescued by a Coast Guard aircraft approximately 18 hours after entering the water. The other crewmember succumbed to hypothermia less than an hour before the aircraft arrived.

Even in warmer waters, the importance of lifesaving equipment was apparent. Most survivors were recovered in either a Personal Flotation Device (life jacket) or a life raft. Conversely, most of the deceased crewmembers entered the water with no lifesaving equipment. The use of a life raft was reported 4 times. On two occasions, a life raft was discovered by a passing vessel, and the crewmembers had been in the raft for 2 days or more.

Finally, there is one incident that shows the importance of training. On 11 December 1997, the *GULF KING 15* burned and sank in the waters of the Gulf of Mexico, approximately 60 miles south of Freeport, Texas. All three crewmembers were able to abandon the vessel. However, none of the crew knew how to properly deploy the life raft. Instead of launching the raft correctly, the crew removed the raft from its container and threw it overboard, uninflated. The three crewmembers clung to the undeployed raft for several hours. Eventually, one of the crew drowned after letting go of the raft. The vessel's master, in a very weakend condition, drowned while being rescued by a Good Samaritan fishing vessel.

In summary, the review of warmer water incidents highlighted the following:

- ***Some incidents happened too quickly for effective use of lifesaving equipment, or trapped crewmembers on board. To eliminate fatalities from such incidents, it would be necessary to prevent the vessel losses.***
- ***Even with longer survival times in warmer waters, lifesaving equipment is essential.***
- ***At least two fatalities could have been prevented by training in the use of lifesaving equipment.***

Fatalities v. Hull Material

In Table 7, vessel-related fatalities are compared to all vessels lost to flooding, sinking or capsizing. The last 2 columns of the table show the vessel losses and fatalities as a percentage of their respective totals. For vessel losses, the highest percentages involved wood and steel hulls, respectively. However, those percentages are reversed for fatalities, with steel-hulled vessels accounting for nearly 42% of the vessel-related fatalities.

The losses of steel and wood vessels tend to follow the overall population of documented fishing vessels, as shown in Table 2. Steel vessels were 20.6% of the population and 26.9% of the losses. Similarly, wood vessels were 32.9% of the population and 36.5% of the vessel losses.

It is appears that the high percentage of fatalities on steel vessels is due to their size and area of operation. Using the 2004 documented vessel population; the average length for steel vessels was 71.7 feet. The average wood vessel was 44.1 feet in length. Thus, steel vessels would be capable of operating farther from land, with larger crews – two factors of increased risk. Further, the location of fatalities involving steel vessels tends to confirm that they do operate in more remote and severe conditions. Of the 137 fatalities on steel vessels, 85% occurred along the West and Northeast coasts of the U.S. Conversely, the fatalities on wood vessels were more evenly distributed, with the highest percentage, 23.6%, occurring in the Mid-Atlantic area.

Comparison of Vessel-Related Fatalities to Vessels Lost, by Hull Material				
Hull Material	**Vessels Lost**	**Vessel-Related Fatalities**	**% Vessels Lost**	**% Fatalities**
Wood	205	55	36.54	16.77
Steel	151	137	26.92	41.77
FRP	101	54	18.00	16.46
Aluminum	6	4	1.07	1.22
Other	0	1	0.00	0.30
Unknown	98	77	17.47	23.48
Totals	**561**	**328**		

Table 7

Vessel-Related Fatality Trend

Beginning in calendar year 2000, there is an apparent downward shift in the vessel-related fatality trend, as shown in Figure16. (For comparison purposes, the *ARCTIC ROSE* casualty is shown separately, as indicated by the dotted line.) The control charting methodology described earlier can be used to further evaluate this trend. Calendar years 1994 – 1999 were used to calculate the average, upper and lower control limits, (i.e., the "base period"). Using this methodology, the reduction in fatalities that began in 2000 can be considered statistically significant. In other words, the reduction signals an improvement in vessel-related fatalities that is not explained by the normal year-to-year variation. According to *Wheeler*, either of the following two criteria may be used to support this conclusion. The fatality trend meets both of them;[11]

1. One value (for 2002) dropped below the lower control limit, **OR**;
2. Three of the four most recent values were closer to the lower limit than to the average. This criterion is exceeded, since four of the last five values are near the lower limit.

Thus, it appears that the increased emphasis on safety equipment, training and drills, which began in 1999/2000, has contributed to a measurable reduction in fatalities. If this trend continues, one can expect an average of 18 vessel-related fatalities per year, instead of the previous 37. Actual counts can be expected to fluctuate between 8 and 28, (i.e. the new trend limits). The control chart also indicates that the trend has leveled off. To reduce the fatality rate further would require additional improvements in safety.

In addition, this trend was examined for each District and found to be consistent with the nationwide pattern – except for the 8th and 1st Districts. The trend for the 8th District (Gulf of Mexico) was virtually flat, indicating no measurable change in fatality rates. However, there was more variation in recent years, with no vessel-related fatalities in 2000 and 2003.

The First District showed an increasing trend. The increase can be attributed to several multiple-fatality incidents in 2003 and 2004. There were 3 incidents in 2003, with 9 fatalities (nearly half the vessel-related total). In 2004, the *F/V NORTHERN EDGE* capsized and sank, with 5 of the 6 crewmembers being lost. Thus, the data suggests that the First District (Northeast coast) is an area of concern.

The vessel-related fatality trends, along with best-fit curves for each Coast Guard District are provided in Appendix D. No charts are provided for the 9th (Great Lakes) or the 14th (Hawaii) Districts, because there were too few data points to produce a trend in those areas.

[11] Wheeler, Donald J., *Understanding Variation: The Key to Managing Chaos*, SPC Press, Inc., Knoxville, TN, 1993, pg. 57.

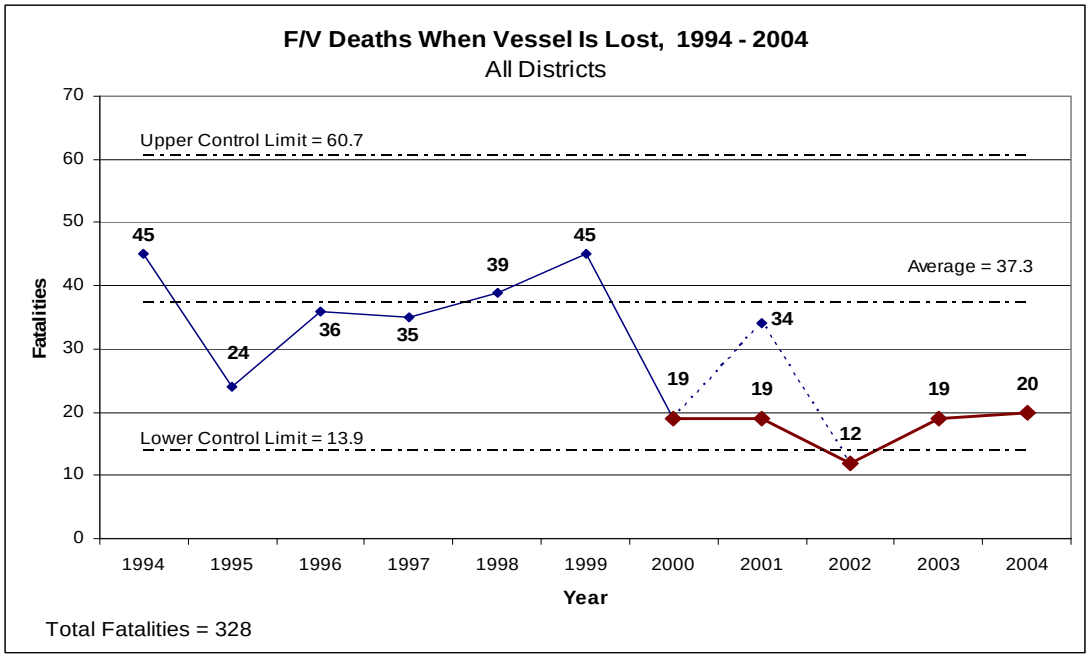


Figure 16

Comparison To Vessel Losses

While the number of vessel-related fatalities has dropped dramatically in recent years, there has been no corresponding change in vessel losses. The previous section of this report showed a brief drop in 2000, followed by a return to earlier levels. Further, a control chart of vessel-loss data revealed only normal year-to-year variation. Given that the potential for fatalities is constant, this is yet another indication that the recent emphasis on lifesaving equipment, training and drills has been beneficial.

Use Of Safety Equipment

The summary data presented earlier shows that nearly 8 of 10 (76%) fatalities resulted from water exposure. The 1988 Commercial Fishing Industry Vessel Safety Act and associated Federal Regulations, implemented in the Fall of 1991, address water exposure through emergency equipment, training and drills. Thus, one would expect a reduction in fatalities among the fishing vessels that have on board, and when crewmembers properly use, the required emergency equipment. There has been some apparent improvement. During the 11 years prior to the implementing regulations of the Fishing Vessel Safety Act, 1981 through 1991, there were 1154 fatalities, or an average of 105 per year. For the most recent 11 years, from 1994 through 2004, there were 641 fatalities, or 58 per year (44% lower).[12] This high-level comparison suggests that the change in safety requirements had the intended effect.[13] However, this comparison includes other fatality types, such as on-deck accidents. To get more details on the usage and benefits of emergency equipment, each of the casualty reports was reviewed individually, and the results are presented below.

[12] The fatality figures for 1981 – 1991 were extracted from the Coast Guard's *CASMAIN* database, which predates the MSIS system.
[13] Again, these figures are not "normalized" or referenced to the number of persons working on fishing vessels, fishing activity, economic changes or other factors, such as weather. Thus, the population is assumed to be constant throughout the period. Indeed, there would have to be a dramatic drop in the worker employment to negate the 44% reduction in fatalities.

From 1994 through 2004, the primary event leading to water exposure fatalities was vessel loss, followed by falling overboard. Of the 328 fatalities resulting from vessel loss, the usage rates of survival equipment, shown in Table 8, were very low. For PFDs (Personal Flotation Devices)/Survival Suits, the usage rate was 15%. At the incident level, the usage rates for rescue boats, EPIRB's, and radios were 20%, 34%, and 35% respectively. Thus, it is reasonable to assume that many of these fatalities were preventable with use of the required emergency equipment. It is notable, however, that 115 of the 328 fatalities, or 35%, showed "available, no time for use" for PFD/Survival Suit utilization. Generally, these fatalities occurred when the vessel was lost suddenly, such as capsizing, or when a problem, such as engine room flooding, was not discovered in a timely manner. ***As noted previously, to eliminate such fatalities it would be necessary to prevent vessel losses.***

	Used (%Used)	Not Used	Not Applicable[14]	Unknown
PFD/Survival Suit	48 (15%)	178	1	101
Rescue Boat	65 (20%)	154	18	91
EPIRB	113 (34%)	74	22	119
Radio	115 (35%)	69	1	143

Table 8

Survival Rates In Cold Waters

A survival rate can be calculated by comparing the number of persons on lost fishing vessels to the number of survivors. From Figure 14, we know the greatest number of deaths from vessel flooding, sinking or capsizing occurred along the West and Northeast coasts (234 deaths and 113 lost vessels), apparently because of more severe water conditions. Because of the more severe conditions, we also know that the use of lifesaving equipment is more crucial along the West and Northeast coasts. Thus, survival rates were prepared for the vessel-related fatalities in those cold water areas as shown on Table 9.

For incidents where survival suit/PFD usage is known, the results indicate that ***fishermen survive more than twice as often when survival equipment is properly used***.

This is considered to be a significant finding.

In fact, this result is understated. Of the 51 survivors that did not use a survival suit in cold waters, 17 of them were saved by using a life raft. Conversely, the fatalities among persons who used survival suits are explained in the investigation reports. Those 34 fatalities involved suits that were damaged, did not fit, or were not completely donned. ***This highlights the importance of maintaining lifesaving equipment and practicing its use.*** It is likely that emergency drills would have detected the damaged and inadequate survival suits before they were needed, thereby preventing as many as 34 fatalities.

[14] The "Not Applicable" values represent incidents where survivors were able to step directly onto another vessel without first entering the water, or other circumstances where the equipment was not required or not needed.

SURVIVAL RATE COMPARISON			
West And Northeast Coasts of the U.S., 1994 - 2004			
Survival Suit Usage	**Persons At Risk**	**Survivors**	**Survival Rate**
Used	87	53	61%
Not Used	191	51	27%
Unknown	66	6	N.A.
Overall	**344**	**110**	**32%**

Table 9

Voluntary Dockside Examinations

Data from the Coast Guard's voluntary dockside exam program provides another indicator of safety. Since the program began in 1992, exam results were recorded in the marine safety databases. Vessels meeting all requirements were issued decals to display onboard. Of the 328 fatalities resulting from a vessel loss, 69% occurred on vessels with no decal or with a decal over 2 years old (unofficially "expired") as summarized in Table 10. This is another indication that safety equipment, and the increased awareness gained through interaction with crewmembers during dockside exams, is saving lives.

Since 30% of the fatalities (98) occurred on vessels with decals, each of the investigation reports was reviewed for additional details. The reports showed that nearly all of the vessel losses occurred suddenly, with little time to respond. The fatalities occurred on 34 vessels that were lost by capsizing (14), flooding (16), collision (3), and fire (1). In nearly all of these casualties crewmembers were either unable to use survival equipment or, in a few cases, could not fully don a survival suit before entering the water. In six of the incidents, the first indication of distress was an EPIRB alert. Once again, most of the current fishing vessel safety regulations focus on emergency response, in lieu of preventing vessel loss. ***In the incidents just described, it would be necessary to prevent the vessel losses in order to eliminate the fatalities.***

Deaths When Vessel Is Lost	
Decal Status	**Dead/Missing**
None	190
Current	98
Expired	36
Unknown	4
Total	**328**

Table 10

Good Samaritan Rescues

The casualty reports often mention that crewmembers were rescued by nearby vessels. However, this information was not captured in the Coast Guard databases in a way that could be electronically searched and analyzed. Therefore, the narrative information in each case report was read to determine how often crewmembers were rescued by Good Samaritan vessels.

The reports showed that Good Samaritan vessels rescued one or more crewmembers in 391 of the 1398 vessel losses, or 28% of all incidents. The distribution of these cases, by year, is proportional to and parallels the overall vessel losses very closely, as shown in Figure 17. Throughout the 11 year period, between 23% and 33% of all lost vessels received Good Samaritan assistance.

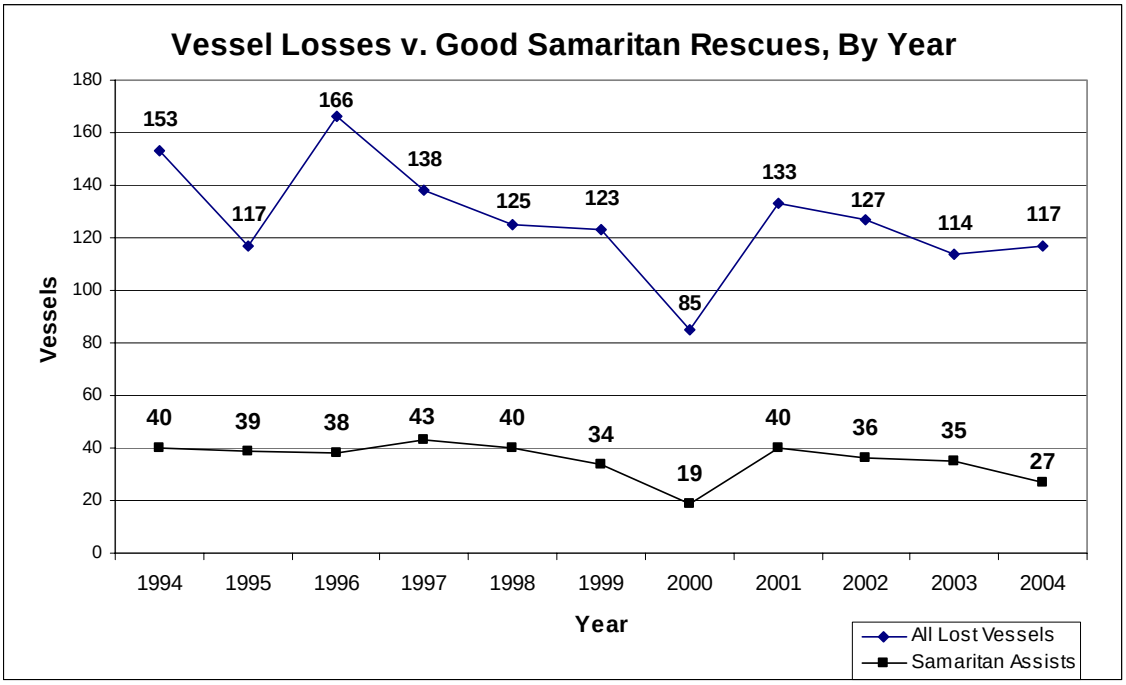


Figure 17

The significance of Good Samaritan rescues becomes apparent when compared to vessels where no assistance was available, as summarized on Table 11.

Of the 391 vessels that received Good Samaritan assistance, only 21 of them resulted in one or more fatalities for a total of 33 persons (0.08 fatalities per vessel). Conversely, there were 125 vessels lost with fatalities but no Good Samaritan assistance. Those incidents resulted in 264 fatalities, or 2.1 fatalities per vessel.

	Lost Vessels With Good Samaritan Assistance	Lost Vessels With Fatalities, But No Good Samaritan Assistance	All Lost Vessels With Fatalities
Vessels	391	125	146
Persons At Risk	1170	350	444
Fatalities	33	264	296
Fatalities/Vessel Lost	**0.08**	**2.11**	**2.03**
% Of Persons At Risk	**2.8%**	**75%**	**67%**

Table 11

Of the 21 vessels with fatalities during Good Samaritan assistance, the case reports showed that most of the vessels were lost suddenly. Eleven of the vessels capsized; seven sank quickly; two vessels were involved in collisions, and; one vessel suffered an engine room explosion. However, there was at least one survivor in each of these incidents making it possible to get some details about the deaths.

Of the 33 fatalities in this group, ten persons died when they were either trapped inside their vessel or were entangled in fishing gear. Eleven persons died after entering the water, with no time to don a survival suit or PFD. Two more persons died in survival suits that were not fully closed. Except for the engine room explosion, crewmembers entered the water before arrival of the Good Samaritan vessel.

The accident reports showed that lack of lifesaving equipment was a critical factor in 19 of the 33 fatalities. Conversely, nearly all of the survivors were recovered in either survival suits or life rafts. Thus, it is concluded that:

- ***A significant, but unknown, number of crewmember fatalities were prevented, since Good Samaritan vessels were present for nearly 3 of every 10 vessels that were lost. Hypothetically, 788 lives may have been saved, if one assumes the same death rate as the vessels with no Good Samaritan assistance:***
  264 deaths/125 incidents = 2.1 deaths per incident.
  (391 assisted vessels x 2.1) - 33 actual fatalities = 788 fatalities prevented.
- ***While it is fortuitous that Good Samaritan vessels were present to rescue crewmembers, the true risk from vessel losses may be hidden. Good Samaritans may be serving as a substitute for properly maintained lifesaving equipment. Yet, it would not be prudent to expect Good Samaritan vessels to be nearby when needed.***
- ***Even when a Good Samaritan vessel is nearby, lifesaving equipment is essential.***

Falls Overboard

Overall, falls overboard resulted in the second largest number of fatalities, with 24% of the total, (154 of 641.) PFD/survival suit usage was reported for none of the 154 fatalities, although "unknown" was reported for 45 persons. Also, investigating officers noted the use of alcohol in 22 of the fatalities and drug use twice.

Table 12 summarizes the falls overboard fatalities, by District and year. The highest number of fatalities occurred in the 8th District, accounting for 40% of the total. In fact, nearly half of all 8th District fatalities were falls overboard, (61 of 125). Further, this is the only District that recorded falls overboard fatalities every year of the 11 year period. Given that the 8th District has the warmest waters and, thus, the longest survival times, the number of falls overboard fatalities appear to be abnormally high. The data provides no reasons for this high number of fatalities. However, this appears to be a region where increased emphasis on safety equipment, drills and training would be beneficial.

Fall Overboard Fatalities, By Year and District												
District	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Totals**
01	3	1	2	4	3	2	2		1	3	1	**22**
05		1	1	1	1	3		2	1	1	1	**12**
07	3		3	1	2	2	1	1	1			**14**
08	3	7	10	5	9	7	3	5	4	6	2	**61**
11		1	1	3		1	1		1			**8**
13	1	2	1		2	1	2		1	1		**11**
14		1	1		1							**3**
17	2	4	3		1	4	2	4	2		1	**23**
Totals	**12**	**17**	**22**	**14**	**19**	**20**	**11**	**12**	**11**	**11**	**5**	**154**

Table 12

The trend in falls overboard fatalities is shown in Figure18, along with control limits. Similar to vessel-related fatalities, the number of falls overboard fatalities shifted downward after the 1999 Fishing Vessel Safety Task Force initiatives. Also, the fatality count for 2004 is very close to the lower limit, which suggests a significant improvement. However, it is too soon to know if this is a trend or a short-term anomaly.

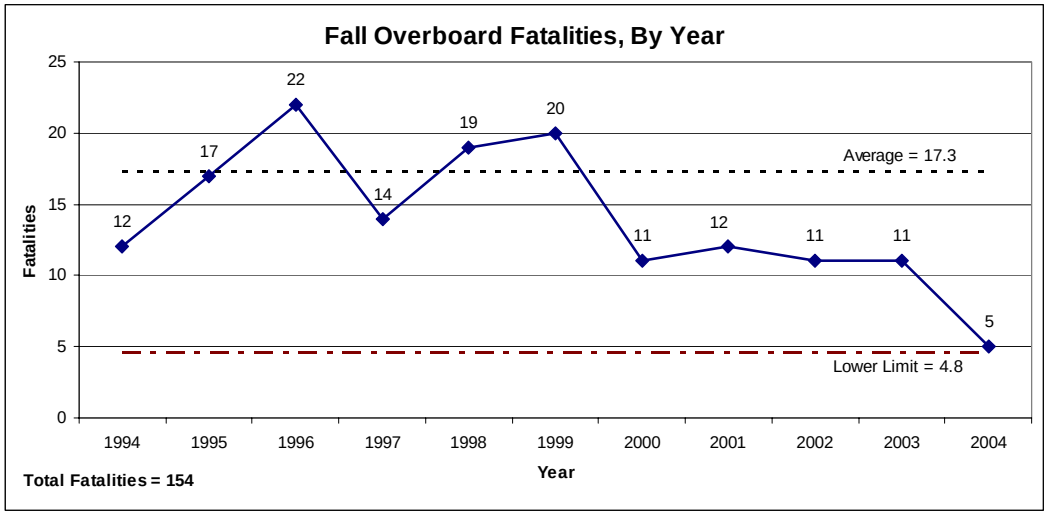


Figure 18

Data Interpretation

In this section, the most important factors leading to loss of life on fishing vessels were sought. The findings and conclusions are summarized as follows:

- **Descriptive Statistics** – For the eleven year period of this report, there were 468 incidents that resulted in 641 fatalities, or an average of 58 fatalities per year. Those incidents included 146 of the lost vessels described earlier. The largest number of fatalities occurred in the 17th (Alaska), 8th (Gulf of Mexico), and 1st (Northeast U.S.) Coast Guard Districts, for 57% of the total. Incidents with one or two fatalities accounted for 92% of the cases and 77% of the fatalities. Consequently, it will be necessary to address a relatively large number of incidents in order to reduce fatality counts significantly.

- **Casualty Type -** When the incidents were grouped by the first casualty event, water exposure was the most prevalent factor. Vessel floodings, sinkings, and capsizings accounted for 51% of the deaths and missing persons. Another 24% of the fatalities were falls overboard. The next highest category, deaths from being struck by or caught in moving equipment, was 7% of the overall total.

- **Deaths From Vessel Loss –** For this sub-group of fatalities, loss of life was dramatically higher on the U. S. West and Northeast coasts than in other regions (71% of the total). The most likely reason for this is more severe conditions, especially cold water. Also, fatalities were higher during the months of October through January. While there may be a number of seasonal variables, it is known that Alaska crabbing has occurred in the same timeframe.

- **Fatalities In Warm Waters –** When presented as a rate (fatalities per vessel lost), the vessel-related fatalities were the lowest in the warmer waters of the Gulf of Mexico and along the Southeast U.S. coast. However, the number of incidents in that region was high enough to warrant further review. It was concluded that:

  Some incidents happened too quickly for effective use of lifesaving equipment, or trapped crewmembers on board. To eliminate fatalities from such incidents, it would be necessary to prevent the vessel losses.

  Even with longer survival times in warmer waters, lifesaving equipment is essential.

  At least two fatalities could have been prevented by training in the use of lifesaving equipment.

- **Hull Material** – Nearly 42% of all vessel-related fatalities occurred on steel vessels. Vessel population data showed that steel vessels are generally larger than vessels of other hull materials. Consequently, they are able to operate farther offshore, with larger crews. Casualty data confirmed that 85% of the fatalities on steel vessels occurred in regions with the most severe conditions – the West and Northeast coasts. Given the higher risk factors of crew size and distance from shore, it may be appropriate to focus preventive efforts on steel vessels.

- **Fatality Trends -** Beginning in calendar year 2000, there was a downward shift in the number of vessel-related fatalities. A control chart was used to confirm that the drop in fatalities was statistically significant, (i.e., more than normal year-to-year variation.) If the trend continues, one can expect an average of 18 vessel-related fatalities per year, instead of the previous 37. Thus, it appears that the increased emphasis on safety equipment, training and drills, which began in 1999/2000, has contributed to a measurable reduction in fatalities. However, the trend has leveled off. To reduce the fatality rate further would require additional improvements in safety.

  Also, the trends were examined for each District and found to be consistent with the nationwide pattern – except for the 8th and 1st Districts. The trend for the 8th District (Gulf of Mexico) was virtually flat, indicating no measurable change in fatality rates. The First District showed an increasing trend, which can be attributed to several multiple-fatality incidents in 2003 and 2004. Thus, the data suggests that the First District (Northeast coast) is an area of concern.

  Further, it was found that the drop in fatalities was independent of vessel losses, which showed no measurable change. Given that the potential for fatalities is constant, this is yet another indication that the recent emphasis on lifesaving equipment, training and procedures has been beneficial.

- **Use of Lifesaving Equipment –** For fatalities related to vessel loss, the use of lifesaving equipment was very low. Also, for the West and Northeast coast incidents, survival rates were calculated based on lifesaving equipment usage. The data showed survival rates more than doubled when the equipment was used, even though data about lifesaving equipment usage was not always available.

  Of the 328 fatalities resulting from vessel loss, only 30% of the vessels had participated in the voluntary dockside exam program and received a safety decal. Conversely, when fatalities occurred on vessels with decals, the vessels were lost suddenly, with little or no time to respond. In those casualties crewmembers were unable to use survival equipment or, in a few cases, could not fully don a survival suit. ***In such incidents, it would be necessary to prevent the vessel losses in order to eliminate the fatalities.***

- **Good Samaritan Rescues –** When fishing vessels were lost, Good Samaritan vessels were frequently on hand to rescue crewmembers (over 28% of the incidents). There were very few fatalities during such incidents, and when fatalities did occur, the vessels were lost quickly due to flooding, capsizing, collision or fire. Further, the small number of fatalities showed that lifesaving equipment is important, even when help is nearby. It was concluded that:

  Fatalities would have been significantly higher without the assistance from Good Samaritan vessels. Hypothetically, as many as 788 deaths may have been prevented.

  Good Samaritans may be serving as a substitute for properly maintained lifesaving equipment. Thus, the true risk from vessel losses may be hidden.

- **Falls Overboard –** Overall, falls overboard resulted in the second largest number of fatalities, with 24% of the total. PFD/survival suit usage was reported for none of the fatalities. It was learned that 40% of these fatalities occurred in the 8th District, (Gulf of Mexico.) Given that the 8th District has the warmest waters and, thus, the longest survival times, it is likely that many of the fatalities were preventable with PFD's. This appears to be a region where increased emphasis on safety equipment, drills and training would be beneficial. There was a sharp drop in falls overboard fatalities in 2004. However it is too soon to know if that was the beginning of a trend, or a short-term anomaly.

Taken together, the above findings indicate the following:

- ***Deaths can be avoided when lifesaving equipment is available and properly used, as required by the existing regulations in Title 46 of the Code of Federal Regulations***.

- ***Factors leading to vessel loss will have to be addressed in order to reduce some fatalities below current levels, especially for incidents that occur suddenly, such as sinkings and capsizings.***

APPENDIX A: SELECTED CASUALTIES

Described below is a sampling of fishing vessel casualties that occurred in recent years.

The ***ARCTIC ROSE.***

Some time between 10:00 pm on 1 April 2001 and 3:35 am on 2 April 2001, the F/V *ARCTIC ROSE* sank in the Bering Sea. The first indication of distress was an EPIRB alert that was received by the 17th Coast Guard District command center at 3:35 am on 2 April. A Search and Rescue case was initiated and USCG aircraft were sent to the EPIRB location. At 0840, a Coast Guard C-130 arrived and located the vessel's EBIRB at 58°56.9'N, 175°56.3'W. A large debris field and oil sheen was found in the vicinity. Shortly after arriving on-scene, the F/V *ALASKAN ROSE* recovered the body of David Rundall from the water. A subsequent search by Coast Guard aircraft, two cutters and two Good Samaritan fishing vessels in the immediate area failed to recover additional personnel. Fourteen persons are missing at sea and presumed dead.

The *ARCTIC ROSE* casualty was the subject of a Marine Board of Investigation. The board's report is available at: http://www.uscg.mil/hq/g-m/moa/reportindexcas.htm.

Engine room fire and explosion.

October 20, 2002 – While en route to retrieve longline fishing gear in the Bering Sea, a fire erupted in the engine room of the fish processing vessel *GALAXY*. At the time, there were 26 persons on board. Believing that the ship's fixed CO_2 firefighting system had extinguished the fire, crewmembers began ventilating the engine room. Moments later a violent backdraft explosion ejected three crewmembers overboard. Two of the three crewmembers were quickly recovered. The third slipped away from the grasp of the ship's designated rescue swimmer and disappeared. At about the same time, the master transmitted a MAYDAY call to a nearby Coast Guard LORAN station and began evacuating the vessel. The remaining 25 crewmembers assembled in two groups on the vessel; 21 on the aft top deck and 4 on the main deck forward. The crew members on the aft top deck evacuated the vessel in the following manner:

- 12 crew members (three in survival suits and nine without) successfully abandoned the vessel by jumping into the liferaft. An unknown crew member cut the raft's sea painter with a knife and the raft floated free from the vessel. The F/V *GLACIER BAY* recovered the raft without incident approximately 1.5 - 2 hours later.
- Two crew members unsuccessfully attempted to abandon ship into the raft. One crewmember (wearing a survival suit) attempted to jump into the liferaft, but fell into the water and was not recovered. Another, with no survival suit unsuccessfully attempted to lower himself down the side of the vessel into the raft. The F/V *CLIPPER EXPRESS* recovered the latter person approximately 1.5 - 2 hours later without a pulse.
- One crewmember (wearing a survival suit) and a National Marine Fisheries Service observer, (no survival suit) jumped into the water and were recovered alive approximately 1.5 - 2 hours later by the F/V *CLIPPER EXPRESS*.
- Three crew members (none wearing survival suits) on aft top deck were rescued

by U.S. Coast Guard helicopter CG6021.

The remaining four crew members on the forward main deck, all wearing survival suits, were rescued as follows:

- One abandoned the vessel by jumping into the liferaft as it floated past the bow of the FPV *GALAXY*.
- One abandoned the vessel into the water and was recovered by the F/V *BLUE PACIFIC* within approximately five minutes of entering the water.
- Two were rescued by U.S. Coast Guard helicopter CG6021

Of the 26 persons on board, two are deceased and one is missing and presumed dead.

Good Samaritan vessel loses a crewmember.

On October 22, 2002, while underway in the Bering Sea, a crewmember was swept overboard while securing a life raft on the vessel's main deck. Subject was hit by a large unexpected wave.

F/V *CLIPPER EXPRESS* was returning to Dutch Harbor after assisting with rescue and search of survivors from the F/V *GALAXY*. The *CLIPPER EXPRESS* had picked up personnel of the F/V *GALAXY* and a life raft that had been dropped by a CG aircraft. While en-route back to port, the raft came loose and was being tossed around by the wind on the vessel's fwd deck. Three men went out on deck to secure the raft. One of the men went back up to the wheel house while the other two worked to secure the raft. None of them were wearing any sort of PFD.

One crewmember was under the ladder going up to upper deck and working to secure the raft. A large wave approx. 35-45' came from the port side unexpectedly and washed him overboard. A search was immediately initiated by the vessel and Coast Guard Aircraft. However, the crewmember was not located.

Poor maintenance and outdated lifesaving equipment.

June 6, 2000 – While returning from a 3-day fishing trip, the *INFINITY* began taking on water and sank quickly by the stern. The vessel was lost approximately 17 miles southeast of Cape Elizabeth, along the coast of Maine. One of the three crewmembers was rescued and the other two were recovered deceased. Among the many findings, the investigating officer's report included the following:

- An inexperienced helmsman did not notice the vessel losing freeboard by the stern. When the flooding was discovered by another crewmember, the vessel's stern was nearly under water.
- Water entered the vessels aft compartment through a leaking rudder post. There was no functioning bilge pump in that space.
- All of the crewmembers donned survival suits. However, all of the suits were well beyond their service lives. Significant amounts of water were found in the suits of the two deceased crewmen, because they did not fit properly. One of the two suits was too small. A zipper jammed on the other.
- The vessel's liferaft did not release.
- The vessel's EPIRB floated free, functioned properly and facilitated a quick response and recovery by Coast Guard aircraft.

Effective use of lifesaving equipment and procedures.	November 28, 2002 - While underway in the Gulf of Mexico, the operator of the *TWO C'S* heard the vessel strike an unknown submerged object. Shortly thereafter, the operator discovered water entering the bow area. He then woke the other two crewmembers called the Coast Guard on channel 16. All three crewmembers donned their lifejackets, readied the life raft for evacuation, and activated the EPIRB. Approximately one hour and forty-five minutes after striking the submerged object, the three crewmembers were rescued by a Coast Guard vessel.
Crewmembers rescued from Liferaft by a Good Samaritan vessel.	April 3, 2002 - Coast Guard Group Woods Hole was notified by the F/V *SEA FARMER*, via VHF radio, that the F/V *BIG DREAMER* was taking on water in the Atlantic Ocean, near Cape Cod. As the *BIG DREAMER* sank, the crew donned survival suits and entered a life raft. About the same time, Coast Guard Group Woods Hole issued an Urgent Mariners Information Broadcast and the F/V *TERESA MARIE IV* responded. The three crewmembers of the *BIG DREAMER* were rescued from the liferaft by the F/V *TERESA MARIE IV*.
Fatality while fishing alone.	March 28, 2002 - The F/V *DUSTIN SEA* was discovered beached on George Island, Alaska with no one on board. The vessel was found with the stabilizers set, the engine in gear and with the auto-pilot set. The vessel's only crewmember was found by another vessel, near the harbor entrance. The deceased was reported to have an abrasion near the hairline on his head. The subject had reported previously that he was having problems with his starboard stabilizer; he may have been knocked/slipped overboard when setting it.
Grounding and total loss of a vessel due to operator fatigue.	August 19, 2000 – The *PILIKIA* ran aground in Northwest Harbor, San Clemente Island California. Hull damage resulted in flooding and, subsequently, to total loss of the vessel. The operator, who admitted to falling asleep at the wheel, had only three hours of sleep in the preceding 24 hour period.
Overloading causes vessel to capsize.	December 13, 2003 - The F/V *ATLANTA* a 70 GT scalloper capsized and sank approximately 25 nm south of Chatham, MA with seven crewmen on board. Two crewmen died and one is missing. At the time of the incident the vessel was in the process of bringing the loaded port and starboard scallop dredges on board an already loaded deck. After placing the loaded starboard dredge on deck the crew proceeded to haul the port dredge on board when the vessel began to list to port, causing the deck cargo to also shift to port. Seeing this the captain accidentally grabbed the starboard dredge control by mistake, lifting the loaded dredge off the deck and causing it to swing to the portside. This caused the vessel to heel further and finally capsize. Five crewmen were able to launch and enter a life raft, where they fired off a flare which was seen by the nearby F/V *OCEAN REIGN*. At some point one of the crewmen in the raft died from hypothermia. All five were taken into port on the *OCEAN REIGN* arriving in New Bedford, MA on the morning of 14 December. The captain's body was later recovered from the water. One crewman is missing and presumed dead.
Master and mate drown while trying to save their vessel	October 7, 2000 – While heading to fishing grounds off the coast of Virginia, flooding was discovered in the engine room of the *CAROLINA BREEZE*. Attempts to dewater the vessel with onboard pumps and pumps supplied by Coast Guard helicopters were not successful. Five of the seven crewmembers were hoisted from the vessel. However, the master and mate remained onboard, attempting to save the vessel. When the helicopter returned the vessel was

gone. The mate was found hours later floating in the water in his immersion suit. The master was recovered from the vessel five days later. He was found in the pilothouse with his immersion suit on. The mate stated that the vessel was struck by a large wave over the stern and sank in less than one minute.

Capsizing of the ***NORTHERN EDGE***.

December 20, 2004 - The F/V *NORTHERN EDGE,* a 75ft scalloper with a crew of six persons capsized and sank approximately 45 miles off the coast of Massachusetts. One of the crewmembers was able to enter the vessel's liferaft, where he found the survival kit and used flares to hail other vessels working in the area. He was picked up by the F/V *DIANE MARIE* approximately 40 minutes after the sinking. The other 5 crewmembers are missing and presumed dead.

The *NORTHERN EDGE* was towing two scallop dredges, when it suddenly listed to the starboard side, possibly because one of the dredges became entangled on an obstruction. At that time, five crewmembers were on deck and the captain was in the wheelhouse.

Two crewmen cut the liferaft loose and it fell in the water. Another crewman jumped in the water to retrieve the raft. Grabbing the liferaft painter lanyard (line) the crewman swam back toward the vessel. The vessel then rolled further knocking him underwater before he could hand off the lanyard. Once the crewman resurfaced, he swam back to the liferaft, popped it open and climbed in. At that point there were three other crewmembers on the stern of the vessel and one in the water attempting to swim to towards the liferaft. The vessel then capsized with none of the remaining crewmembers reaching the liferaft. Among the many findings, the investigating officer's report included the following:

- When the vessel first heeled over, the main deck watertight doors were open, allowing water to enter the engineroom and accomodation spaces.
- Most of the freeing ports on the main deck were closed, trapping sea water on deck.
- No records or witnesses were discovered to indicate that the required training or safety orientation had been conducted. However, the sole survivor had received safety training elsewhere.

APPENDIX B: ABOUT THE DATA SOURCES

The Data Source

The data for this review was extracted from the Coast Guard's marine safety databases, known as MSIS (Marine Safety Information System) and MISLE (Marine Information for Safety and Law Enforcement). Casualty data was collected in MSIS from 1 January 1992 through 13 December 2001. Thereafter, MSIS was replaced by the MISLE system.

The following criteria were used to extract fishing vessel casualty data from the casualty databases:

- The service of the vessel, at the time of the casualty, was recorded as a fishing vessel.
- At least one crewmember was listed as dead or missing, OR;
- The vessel was reported as a total loss.

Quality Control - As part of the case review, described in more detail below, case reports not meeting the criteria for this study were eliminated. This included the following:

- Duplicate records.
- Vessels that were damaged, but not a total loss.
- Vessels that were misclassified or not being used for fishing.
- Fatalities from natural causes, (e.g., heart attack, stroke, etc.).

Also, to get the most complete data set possible, records of the Fishing Vessel Safety program office were used to crosscheck query results.

Assumptions and Constraints

Data Collection - It is important to note that policy does not specifically require all of the information needed for this study, although the information system was capable of recording most of the information in various locations. In fact, investigating officers have significant discretion in the amount of information collected based on the severity of the incident, reporting policy, and other factors.

Often, vessel casualties were only investigated because they resulted in pollution - not to determine the cause of the vessel loss. Thus, each case report, including the narrative entries, was reviewed in order to fill in missing data items, which provided many additional details. Results were dependent upon the writing style and thoroughness of the investigating officer, which varied from a few brief sentences to many typed pages. Unfortunately, this case review process often resulted in values being shown as "Unknown." Of course, more automated and easily repeatable methods of data analysis are preferred to the labor-intensive procedures used in this study. Policy, data reporting, and data quality procedures are regularly reviewed to support future data analysis requirements.

Missing Values - In many cases where a vessel was lost and all persons on board were rescued, no details were available about the rescue, the use of lifesaving equipment, or the number of persons on board. For these cases, the lifesaving information is recorded as "Unknown".

Population v. Sample Size - For purposes of this study, the data set is considered to be the

entire population of lost fishing vessels and personnel casualties. Those are incidents with serious consequences and will rarely escape the Coast Guard's attention. It is believed that any cases missing from the data, due to lack of notification, clerical, or other error, are few in number and will not affect the results of this study. Further, the number of records available for analysis is large - 1398 for lost vessels and 641 for personnel loss, which would negate the affect of any missing records. Of more concern to this study are the previously mentioned missing values that had to be recorded as "unknown."

Normalization - As noted in the Fishing Vessel Task Force report, demographics about the size and composition of the fishing industry, especially the number of workers, is not readily available. Further, recent attempts to estimate the worker population have resulted in widely varying estimates. Thus, most of the figures presented in this document are "as reported" to Coast Guard information systems without statistical normalization or leveling. (An exception to this is a review of the subset of documented vessel losses. The population of documented vessels is in the Coast Guard's information system.) No comparisons with other industries were made in this report. For analysis purposes, it is assumed that the number of vessels and workers in commercial fishing did not change significantly between 1994 and 2004. For 1996, 1997 and 1998, surveys by Coast Guard Personnel[15] estimated the number of fishing vessels as 106,647; 103,774; and 102,075. From the highest to lowest value, across all three years; a difference of 4.3%.

The Office of Compliance, in the Inspection and Compliance Directorate has recognized the need for better population data and intends to sponsor research in this area, as a long term goal of their Fishing Vessel Safety Action Plan.

Reviewer Interpretation/Bias - In the MSIS and MISLE systems, investigating officers can describe a casualty as a series of events, each with associated causes. When available, the case reviewers for this study used the first event as the cause of vessel loss or fatality. For incidents with no reported events, the case reviewers determined the cause by reading other information in the case report. For example, a vessel might suffer a hull failure, followed by flooding, then sinking. In this example, an investigator might report, given the best available information, the first event as flooding, without knowing of the hull failure event. If the investigator provides no events, a case reviewer may determine the cause of vessel loss as sinking, without knowing of the hull failure or the flooding. This, of course, may insert additional bias into the data. However, this method was preferred to leaving a large number of values as "unknown."

[15] U. S. Coast Guard, Office of Compliance; Marine Safety, Security, and Environmental Protection Directorate, unpublished fishing vessel safety statistics.

APPENDIX C: CONTROL CHARTING METHODOLOGY

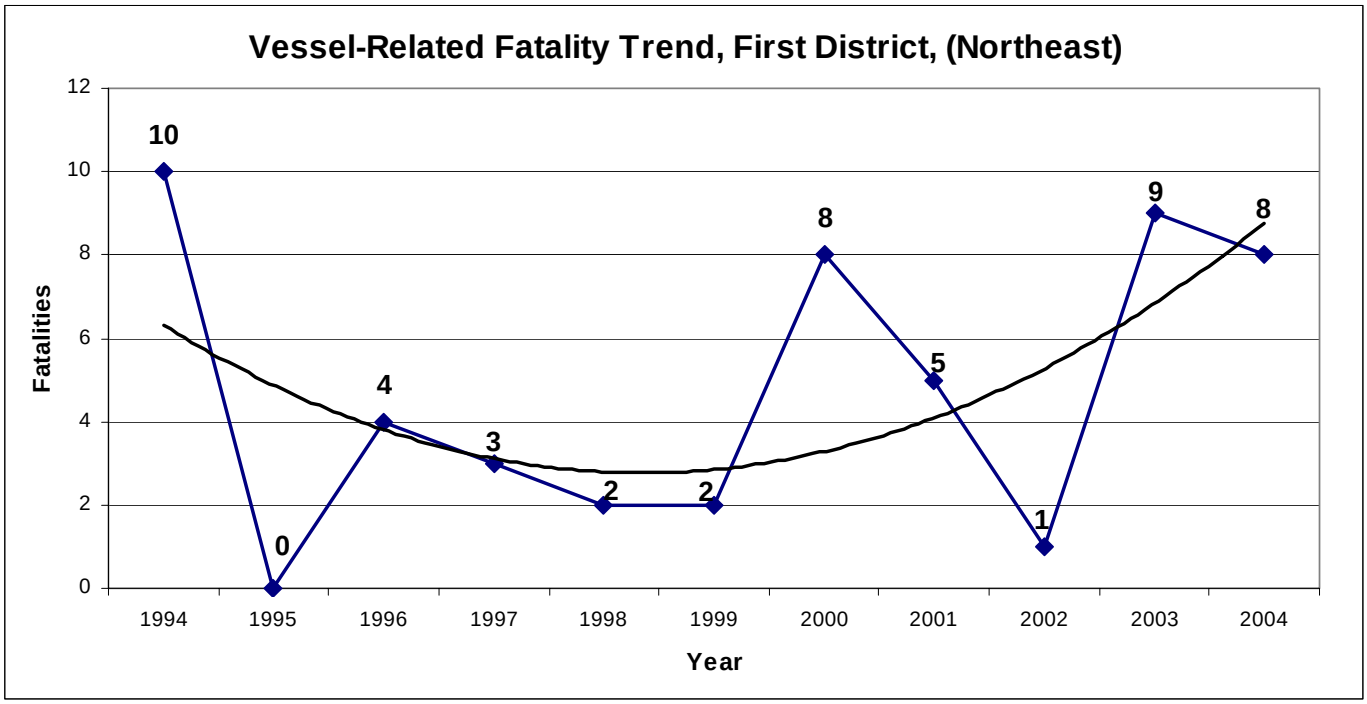
The methodology for developing the control charts used in this document is summarized as follows:

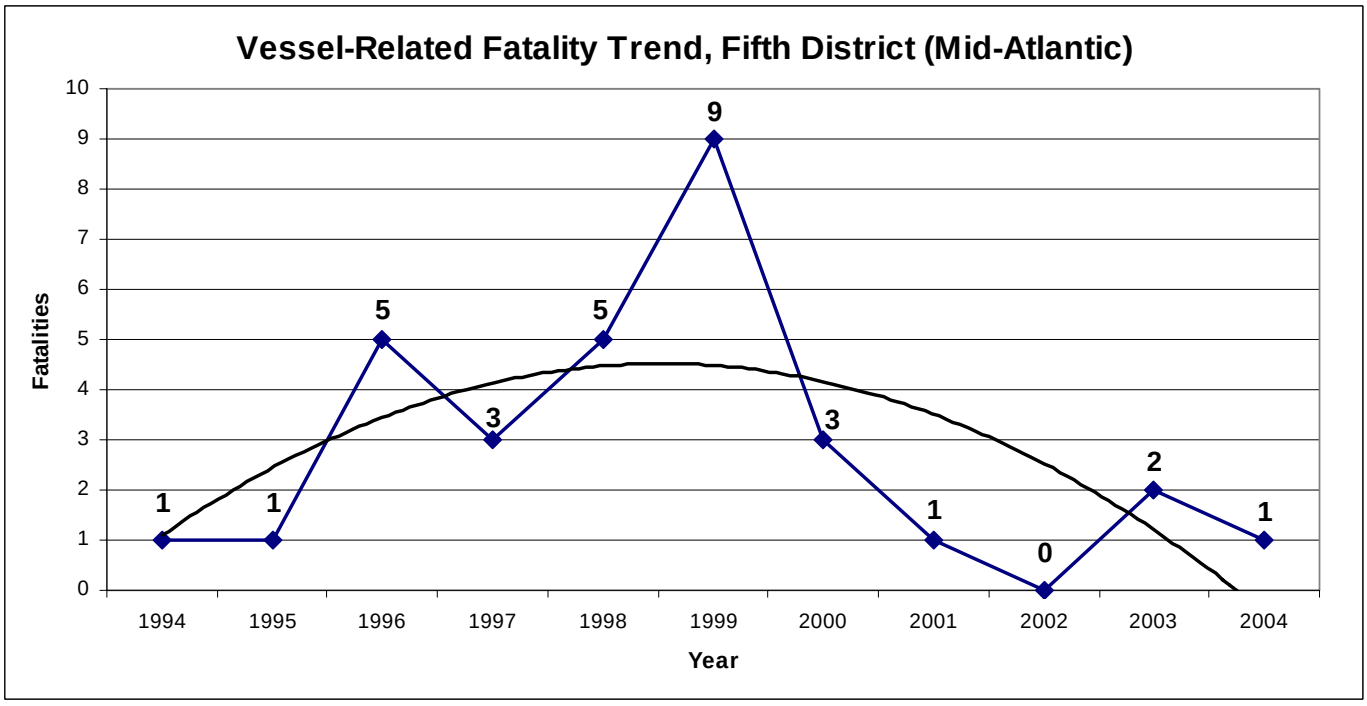
- Use the average of the individual observations (**X**), for the central line.
- Calculate the average moving range, (m**R**). This is done by finding the difference in the individual observations, the moving ranges, (e.g., the difference between the 1994 losses and the 1995 losses is 36), then averaging the moving ranges.
- Calculate the upper control limit, (UCL). UCL = **X** + (2.66 x m**R**).
- Calculate the lower control limit, (LCL). LCL = **X** - (2.66 x m**R**).
- Display the individual values, the central line, the upper control limit, and the lower control limit on a line chart.

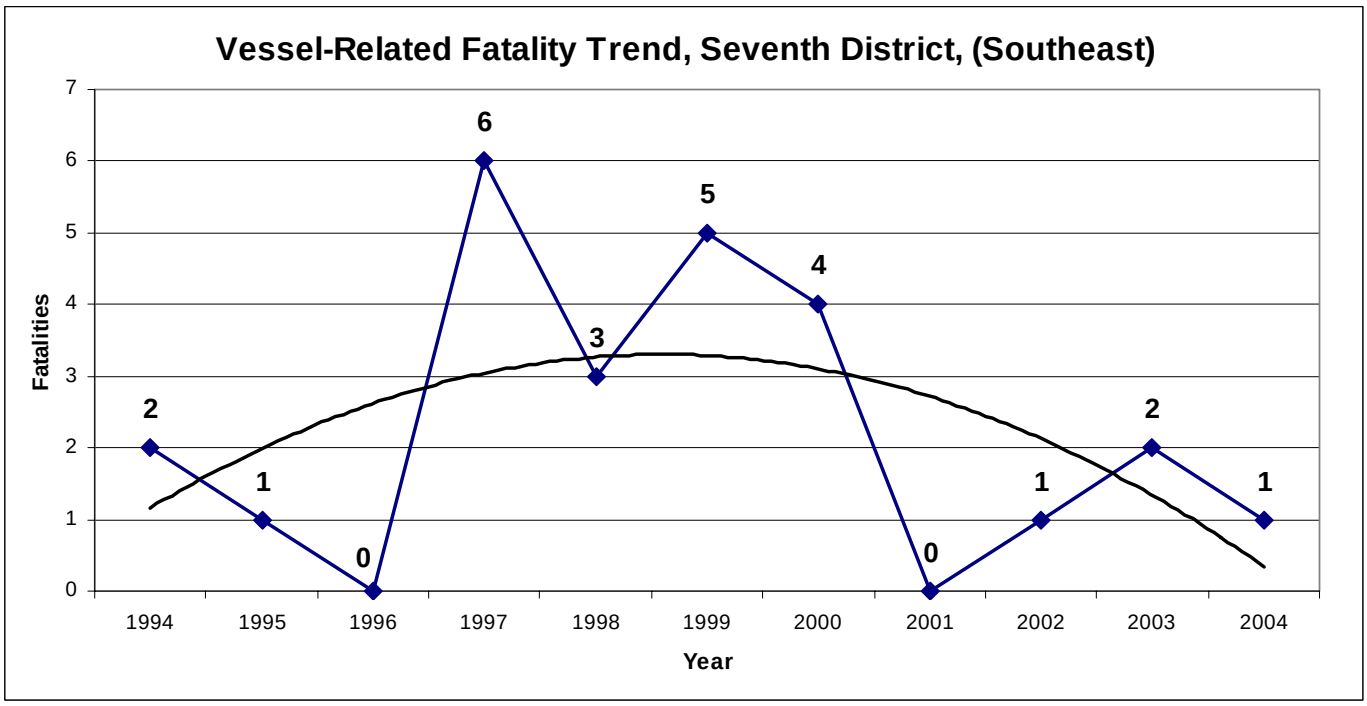
The trend line of the individual observations is interpreted by comparing them to the upper and lower control limits. Values that cross one of the limits are considered "out of control." In other words, the change cannot be explained by normal variation.

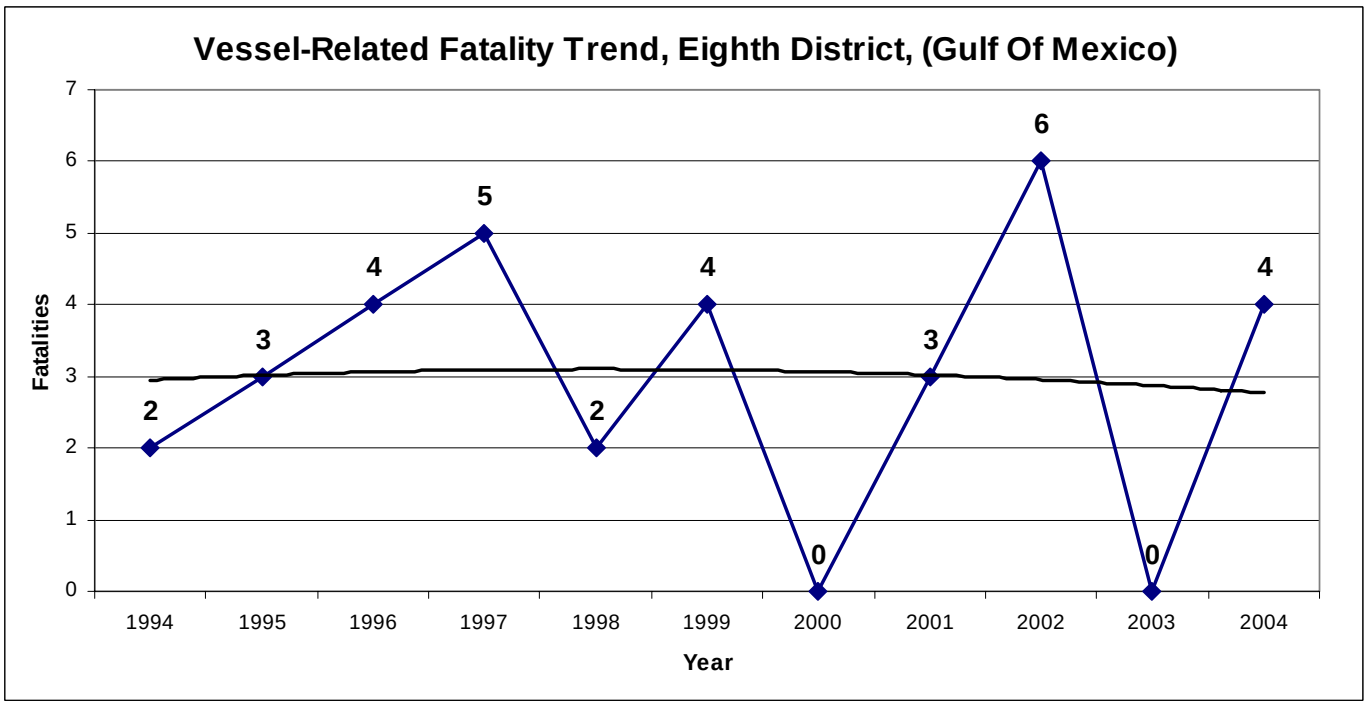
Source: Wheeler, Donald J., Understanding Variation: The Key to Managing Chaos, SPC Press, Inc., Knoxville, TN, 1993.

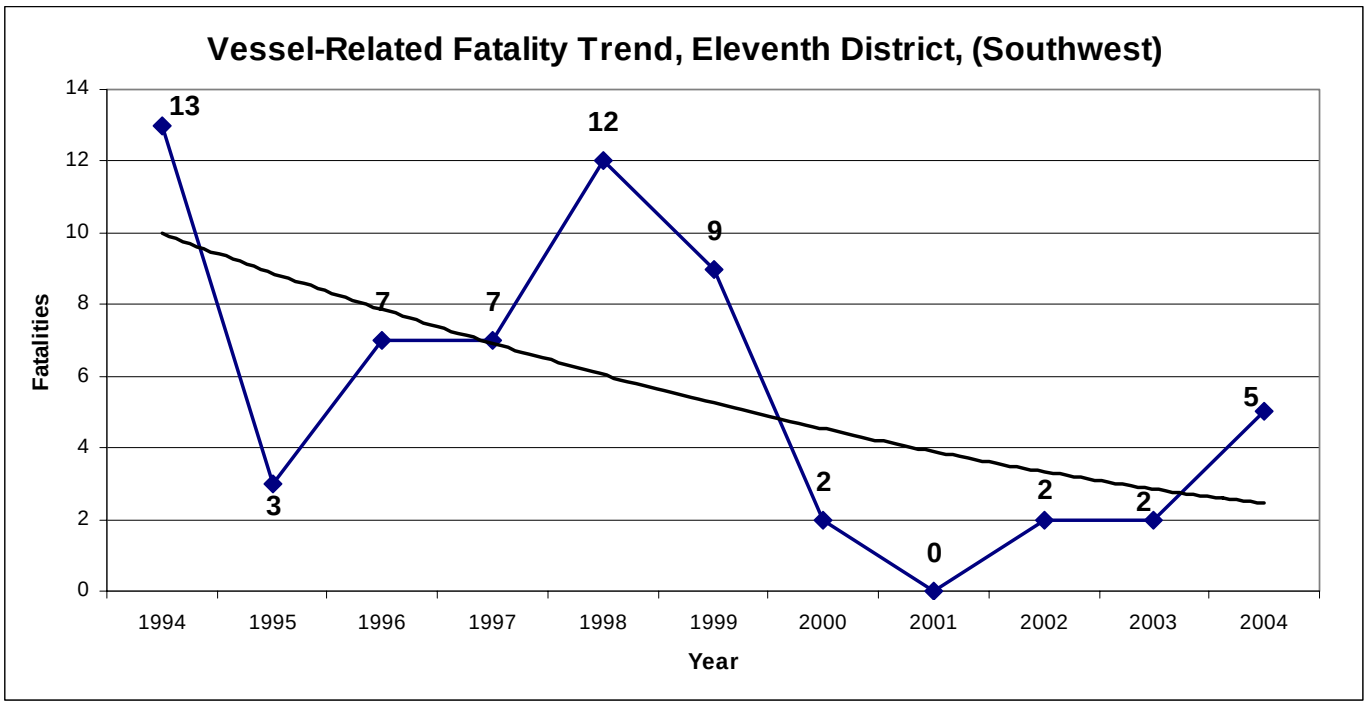
APPENDIX D: VESSEL-RELATED FATALITY TRENDS

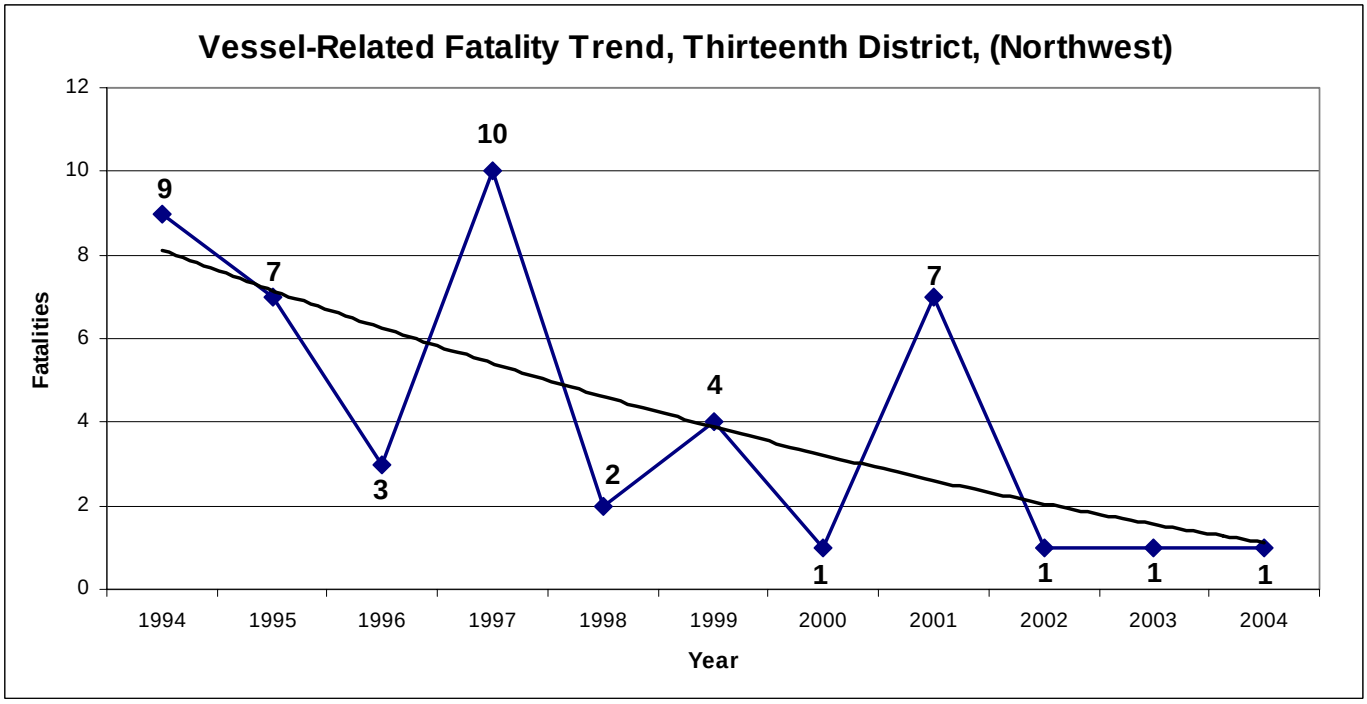


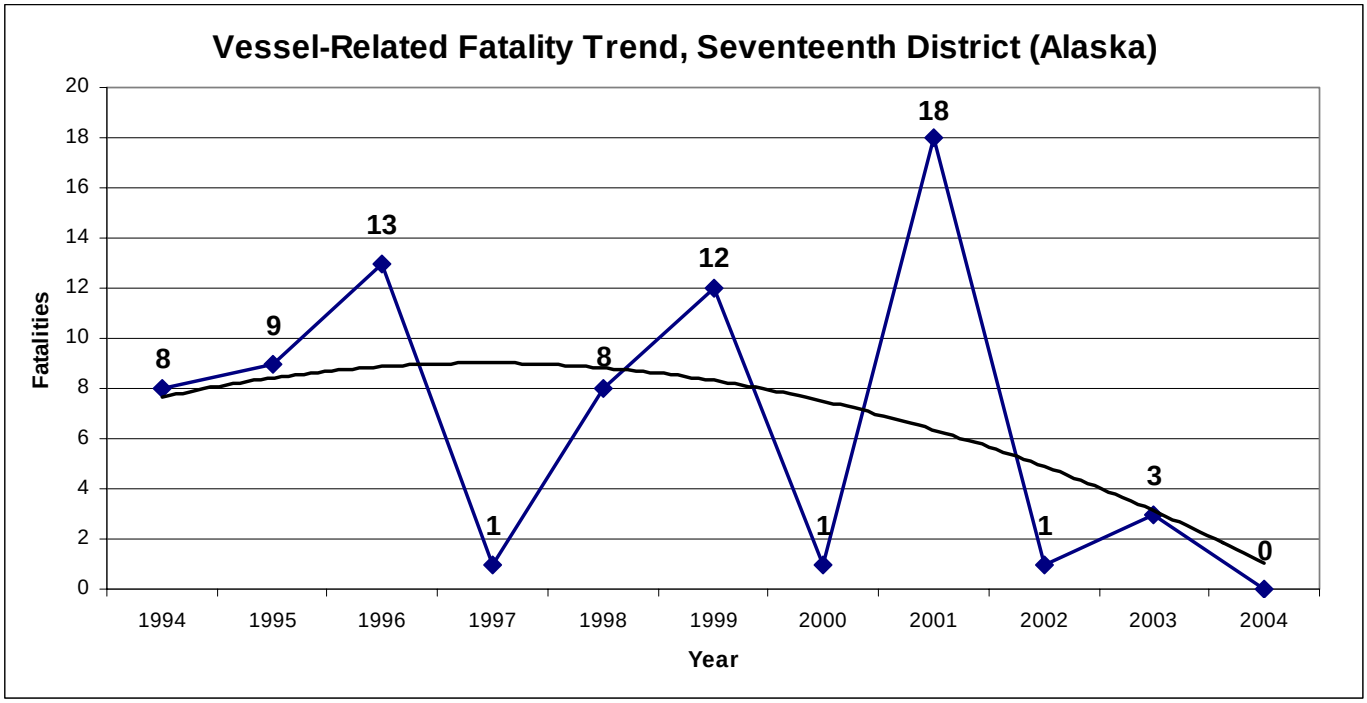



Vessel-Related Fatality Trend, Seventh District, (Southeast)
Fatalities
Year
0
1
2
3
4
5
6
7
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2
1
0
6
3
5
4
0
1
2
1


Vessel-Related Fatality Trend, Eighth District, (Gulf Of Mexico)
Fatalities
Year
0
1
2
3
4
5
6
7
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2
3
4
5
2
4
0
3
6
0
4


Vessel-Related Fatality Trend, Eleventh District, (Southwest)
Fatalities
Year
0
2
4
6
8
10
12
14
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
13
3
7
7
12
9
2
0
2
2
5


Vessel-Related Fatality Trend, Thirteenth District, (Northwest)
Fatalities
Year
0
2
4
6
8
10
12
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
9
7
3
10
2
4
1
7
1
1
1


Vessel-Related Fatality Trend, Seventeenth District (Alaska)
Fatalities
Year
20
18
16
14
12
10
8
6
4
2
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
8
9
13
1
8
12
1
18
1
3
0