NATIONAL PFD WEAR RATE OBSERVATIONAL STUDY
2005
With Comparison Data from 1998 to 2004

Conducted By

JSI Research & Training Institute, Inc.
Boston, Massachusetts

Thomas W. Mangione
Maria Rangel
Kim Watson

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I. Introduction

This report provides data and analysis on the 2005 National Personal Flotation Device (PFD) Wear Rate Observation Study with comparison information from the 1998 through 2004 studies. Tracking changes in PFD wear rates over time provides important statistics for those individuals and groups responsible for educating the public about boating safety, improving boating safety programs, and for legislative efforts targeting safety improvements for recreational boating. The Boating Statistics 2004 report, published by the Department of Homeland Security United States Coast Guard (USCG), shows that among the 484 drowning deaths in 2004, approximately 90% (436) of the individuals were not wearing a PFD. These statistics make it essential to not only track the national PFD wear rate among recreational boaters, but also to understand the circumstances and patterns in which PFDs are worn.

Calendar year 2005 marked the eighth year of PFD wear rate data collection efforts conducted by JSI. The eight years of data allow for a higher level of analysis (e.g., controlling for impact of influencing factors like age, weather, and boat type) in order to unmask potential trends and indicators of increased or decreased PFD wear among different groups of recreational boaters (i.e., adult boaters or male boaters). Overall, examining all groups of recreational boaters together, the average PFD wear rate for 2005 was 23.3%. However, this overall mean PFD wear rate obscures the influence of age and boat type on PFD wear. Section 1 of the report will go into further detail about the influence of these factors on PFD wear rates. Similar to the previous seven years of observation, 2005 presented no dramatic or significant changes in the PFD wear rates compared to previous years of observation, with the exception of sailboats. The following is a detailing of methods for data collection and data analysis efforts, and conclusions to be drawn based on eight years of PFD wear rate data.

II. Methods

To provide reliable and valid indicators of changes in PFD wear rates it was essential for observation procedures to remain as close as possible to those used in previous years. The same States have been observed for each of the eight years' data collection efforts, over the same period of time. The vast majority of the sites in each of 30 States observed in have remained the same for all eight years. The following is a detailing of the methods used in all eight years of data collection efforts.

Time period – Observations were conducted during the summer months of each year, beginning the weekend of July 4th and ending on Labor Day weekend.

Site selection – A total of 30 States were chosen in which to conduct observations. The States were originally selected by a stratified random sampling procedure. Approximately three-fourths of the coastal States (19 out of 26 States) were chosen, and approximately one-half of the inland States (11 out of 24) were selected. Four sites from each State were visited; except in California, where eight sites were observed due to the size of the State. The 124 sites represented a wide range of water venues including lakes, rivers, harbors and bays, and intra-coastal waterways. The sites were selected based on consultations with local offices of the USCG, members of the local Coast Guard Auxiliary or Power Squadron, and State boating or fishing law enforcement agencies. Sites were selected based on representativeness of the boating activity in the State, as well as their proximity to one another to allow for relatively short travel between sites. In addition, sites needed to have suitable shore-based viewing locations that would make it possible to observe PFD wear, aided with high-powered binoculars.

Observational procedures -- Observations were conducted for four-hour periods either in the morning or the afternoon of a Saturday or Sunday. The goal was to observe as many boats

as possible during a four-hour time frame. Viewing locations were on shore usually at a narrowing, bridge, or near a marina to facilitate observations. Two-person teams observed boating activity. One team member made the observations using high-powered binoculars and called out the information, which was then recorded on observation forms by the second team member. Team members alternated responsibilities frequently to ward off fatigue. In addition to recording information on boating activity and PFD wear, observers recorded data about the site. This included information on weather and water conditions. JSI project staff trained the observers during two half day sessions. The first half-day training consisted of reviewing the observation manual, observation forms, and required equipment. The observation manual contained procedures, definitions, and pictures of various types of boats to facilitate consistent classification by the observers. The second half-day of training allowed observation team members an opportunity to practice using the required equipment and observation forms with the assistance and guidance of a JSI project staff member.

Observation Forms -- There were two observation forms designed. The first was the boat observation form, which was intended to record information on the boat and people on the boat. The second form was the site form, which was designed to record information about the site, weather and water condition. The forms have remained the same from year to year, with the exception of two changes made in 1999 and one change made in 2004. These changes are discussed in detail below.

A) Boat Forms -- Observers recorded the observation time period in two hour blocks of time (8 AM to 10 AM, 10 AM to 12 PM, 12 PM to 2 PM, 2 PM to 4 PM, 4 PM to 6 PM); the type of boat observed (skiff, speedboat, cabin cruiser, personal watercraft (PWC), pontoon boat, houseboat, sailboard, day sailor, cabin sailboat,

rowboat, inflatable, canoe, kayak, and other); the type of propulsion (outboard motor, inboard motor, sail only, sail and auxiliary motor, paddles/oars, air fan, and other); length of boat (under 16 feet, 16-20 feet, 21-25 feet, and over 25 feet); type of operation (motoring, sailing, paddling, drifting, or at anchor); and activity engaged in (fishing, fishing tournament, water-skiing, white-water, high speed racing, swimming, pleasure boating, and other). Observers also recorded operator/passenger status; gender (male, female, or unknown); age (under six, six to 12, 13 to 17, 18 to 64, 65 or older); PFD wear (wearing or not wearing); PFD type (old or new). In addition, if the boat was involved in water-skiing, observers indicated which boaters were skiing at the time.

B) Site Form -- At each site, the observers recorded the beginning time and ending time of the observation period, water type (lake, river, harbor/bay, Great Lake, intra-coastal waterway) and water temperature. The following environmental factors were measured by observers at each two hour time block during the observation period: air temperature; wind speed; wave height (less than six inches, six inches up to two feet, or over two feet); weather (sunny, partly cloudy, cloudy, raining, or stormy); and visibility (good, fair, or poor).

Over the past eight years of observations only three categories of information have been changed. In 1999, the original six to 17 year old age category was divided into a six to 12 year old group and a 13 to 17 year old group. Also in 1999, the boat category of canoes/kayaks was separated to record canoes and kayaks individually. In this report, PFD wear rates are reported for both the combined and separated categories of age and canoes and kayaks to allow for seven years of data to be included in the analysis. Finally, in 2004 the USCG requested that JSI breakout the boat size categories from three (under 16 feet, 16-25 feet and over 25 feet) to four

categories (under 16 feet, 16-20 feet, 21-25 feet and over 25 feet). Given that 2004 and 2005 are the only years to record observations using the expanded boat size categories, only the frequencies for the focus category variable will be presented in this report. For any higher level analysis, the original boat size categories will be used so that all eight years of data will be used in the analysis.

III. Overall Summary Statistics

To date, 115,171 boats and 313,236 boaters have been observed (Figure 1). Across the eight years, the number of boats, types of boats, length of boats, operation and activity of boats, as well as the age and gender of the boaters observed has remained fairly consistent (see Figures 1 through 7). This indicates that the sites chosen have yielded diversity in the boats and boaters observed each year, but also a diversity that has remained consistent across the years. These figures demonstrate that the degree of representativness of the sample of recreational boaters and their boating habits has remained constant across the eight years. Figures 8 through 13 illustrate the weather and water conditions across the sites from year to year. Like the boat and boater data, across all of the sites the mixture of the weather and water conditions has remained fairly constant over the years. Therefore, any changes reported in PFD wear rates were not due to changes in types of boats or boaters observed from year to year, and most likely not due to fluctuations in weather or water changes across the sites.

Figure 1 Number of Boats and People Observed

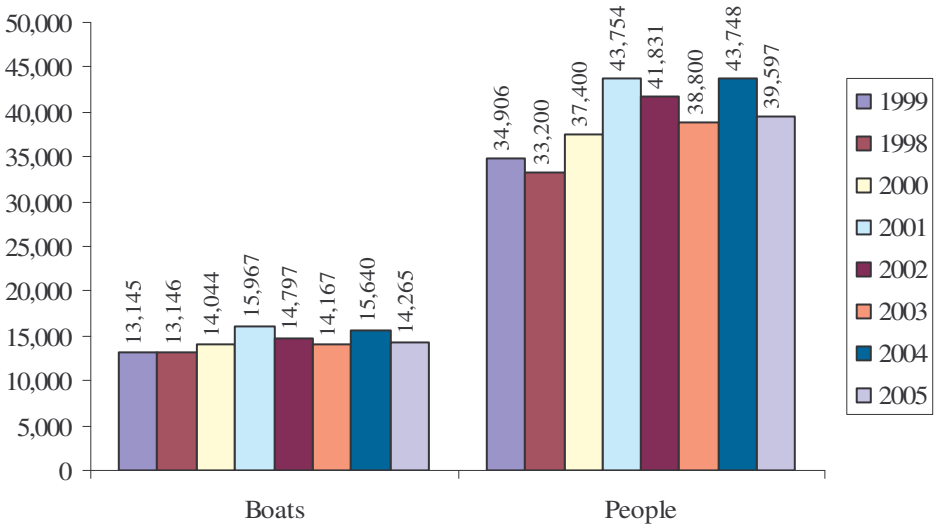


Figure 2 Types of Boats Observed

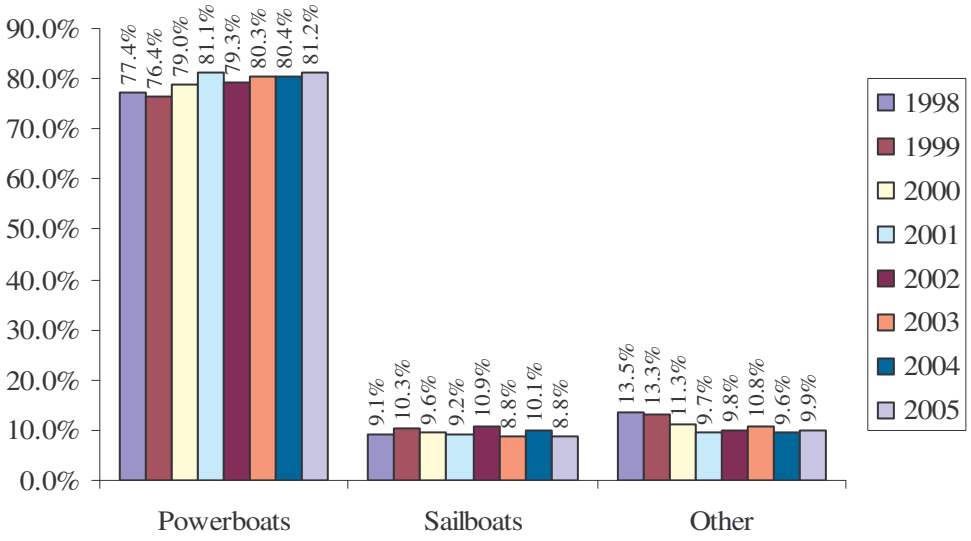


Figure 3 Length of Boats Observed

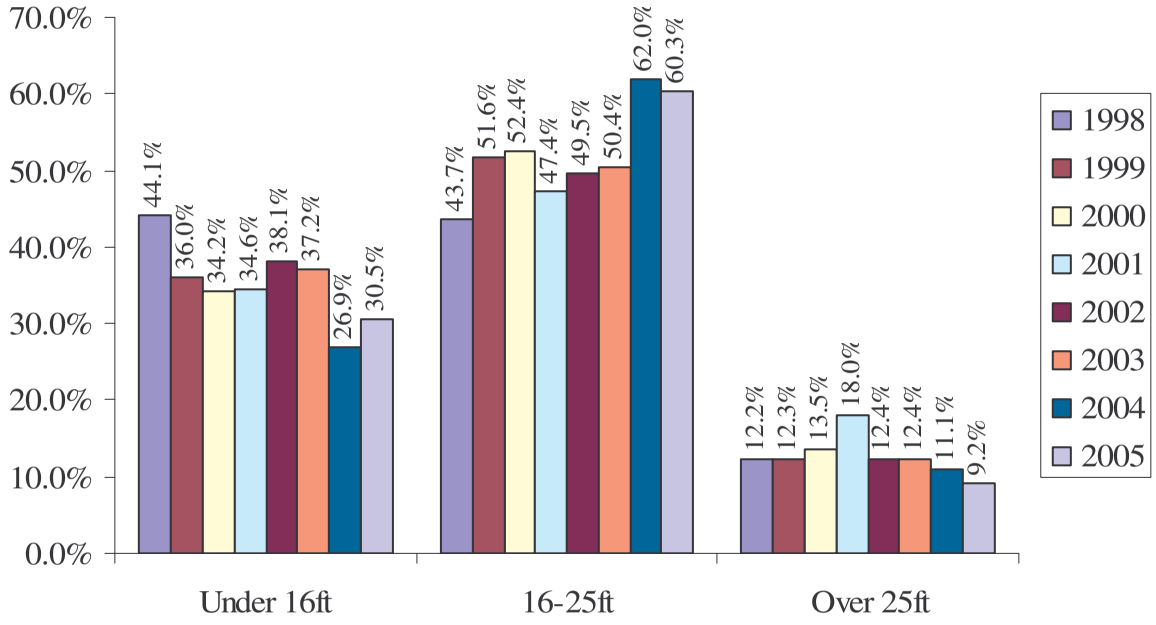


Figure 4 Operation of Boats Observed

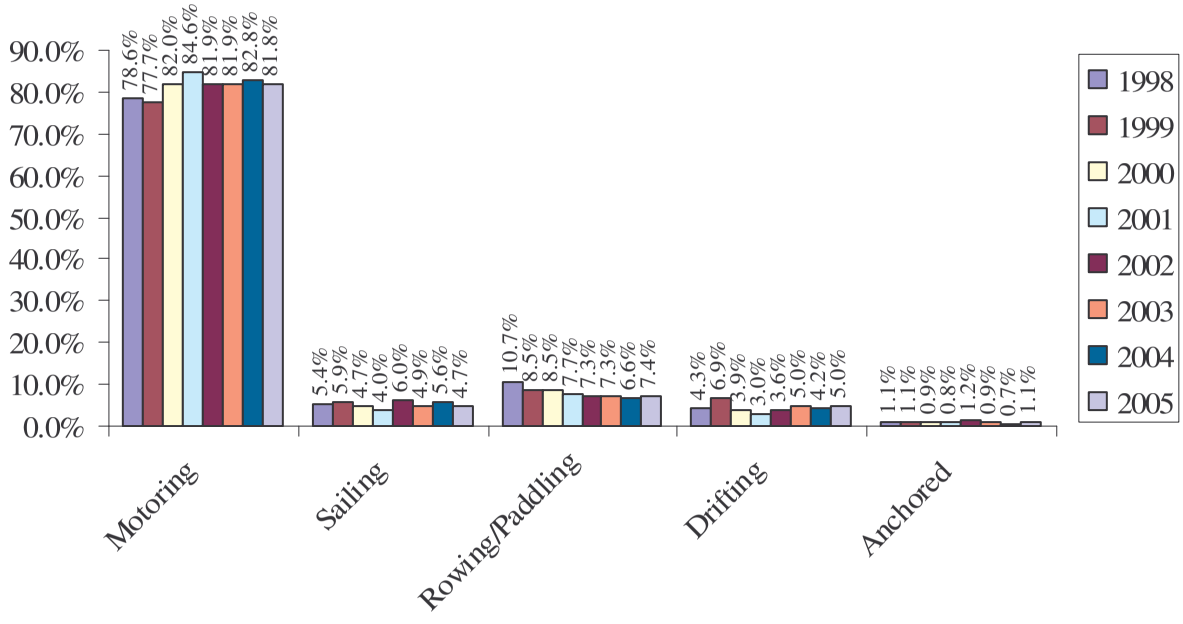
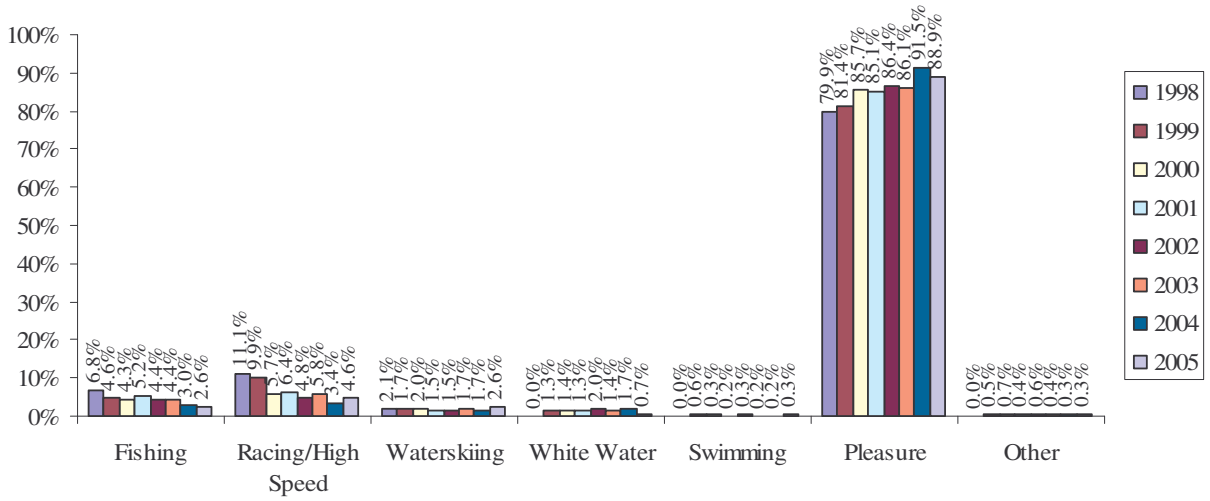


Figure 5 Activity of Boaters on Observed Boats



***In 1998 observations were recorded as Fishing, Racing, Waterskiing and Pleasure/Other and cannot be subdivided.**

Figure 6 Gender of Boaters Observed

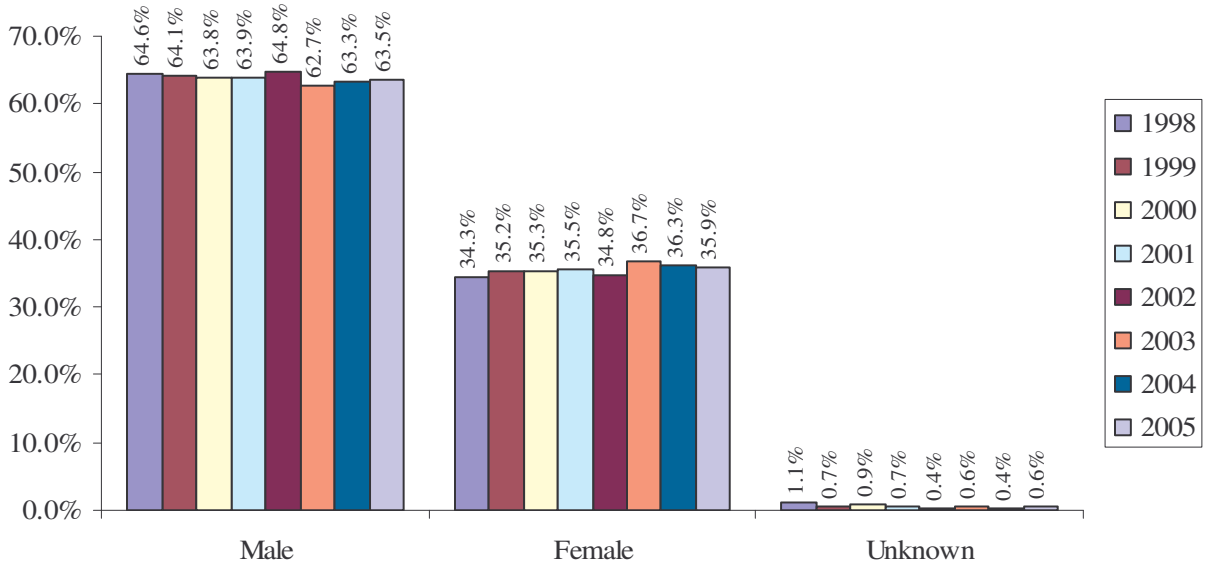
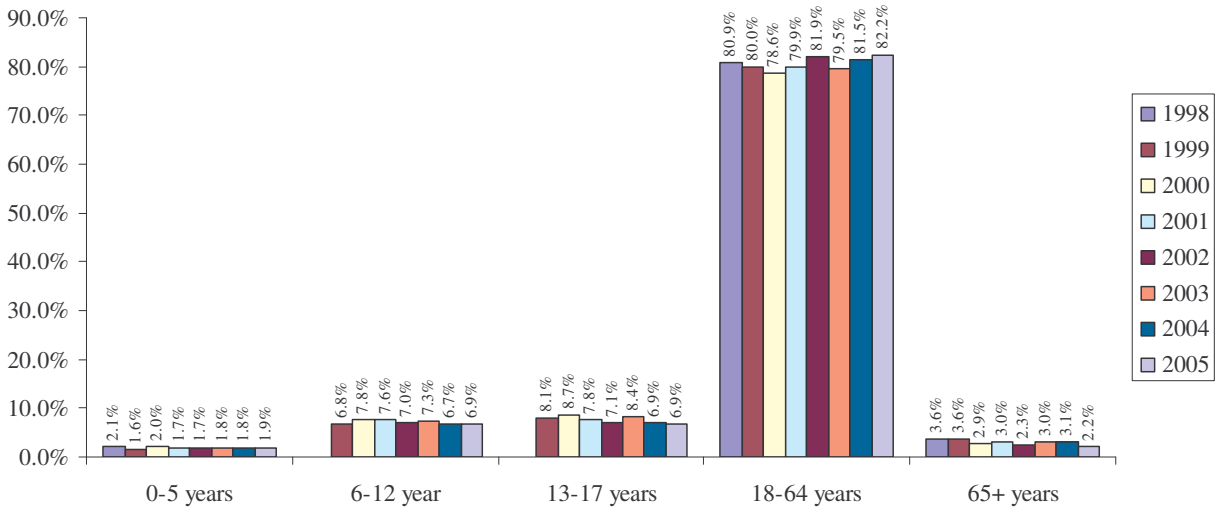


Figure 7 Age of Boaters Observed*



***In 1998 observations were recorded as 6-17 years and therefore cannot be subdivided.**

Figure 8 Water Temperature in which all Boats Operated

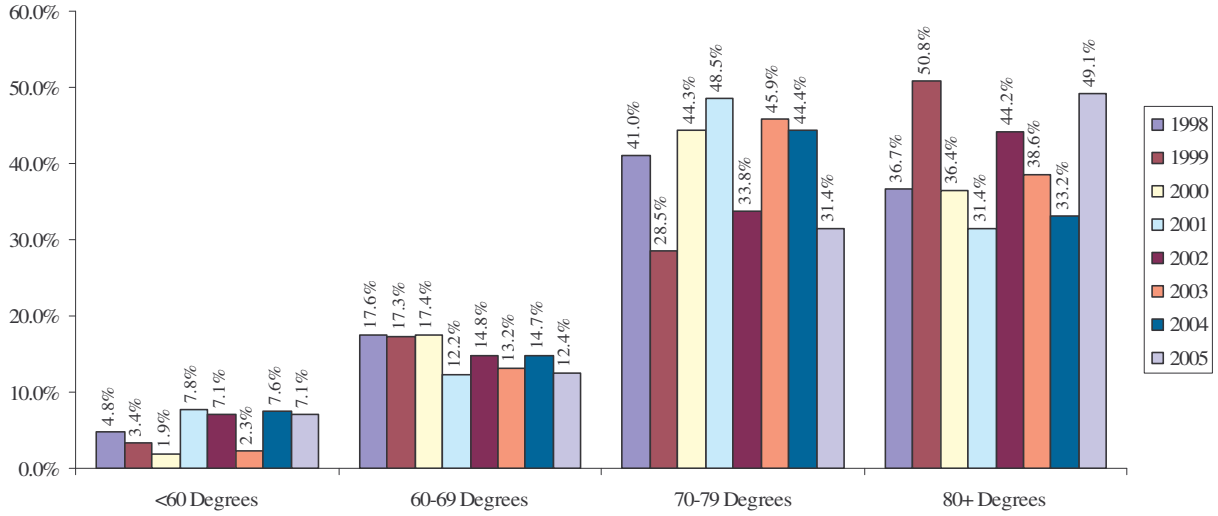


Figure 9 Water Current in which all Boats Operated

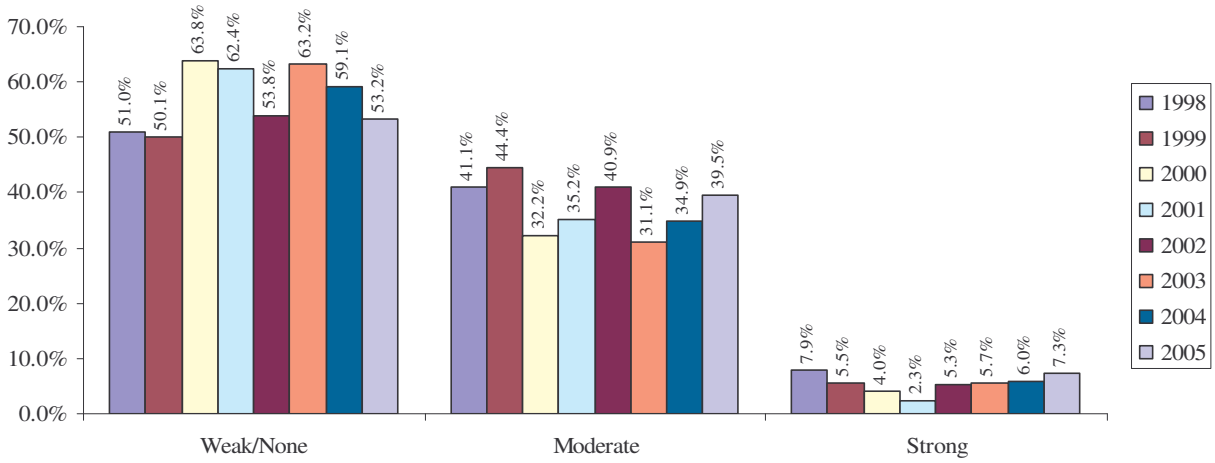


Figure 10 Wave Height in which all Boats Operated

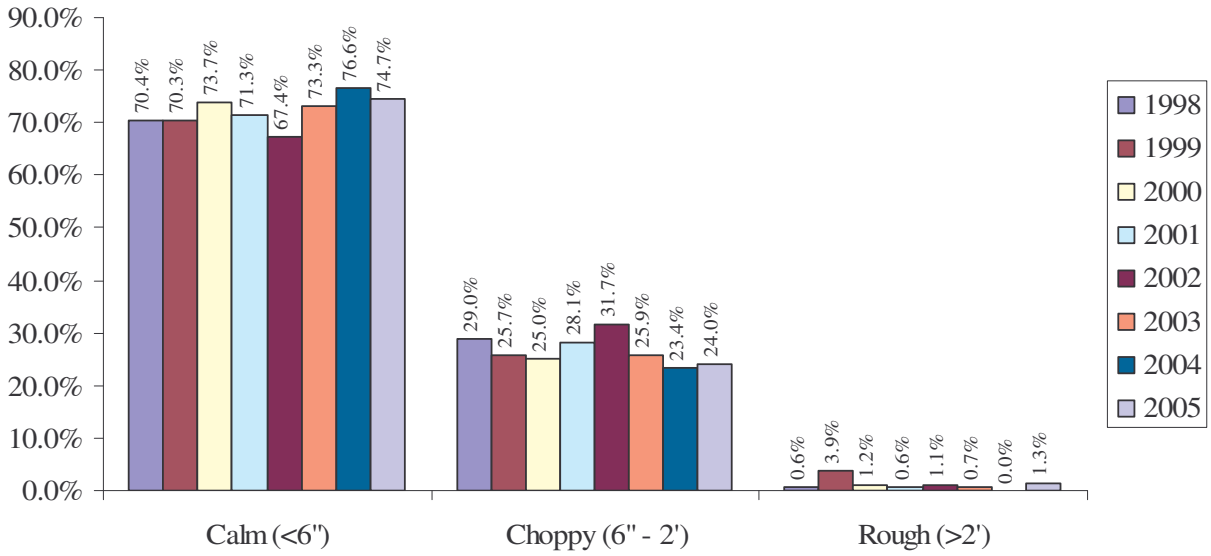


Figure 11 Visibility in which all Boats Operated

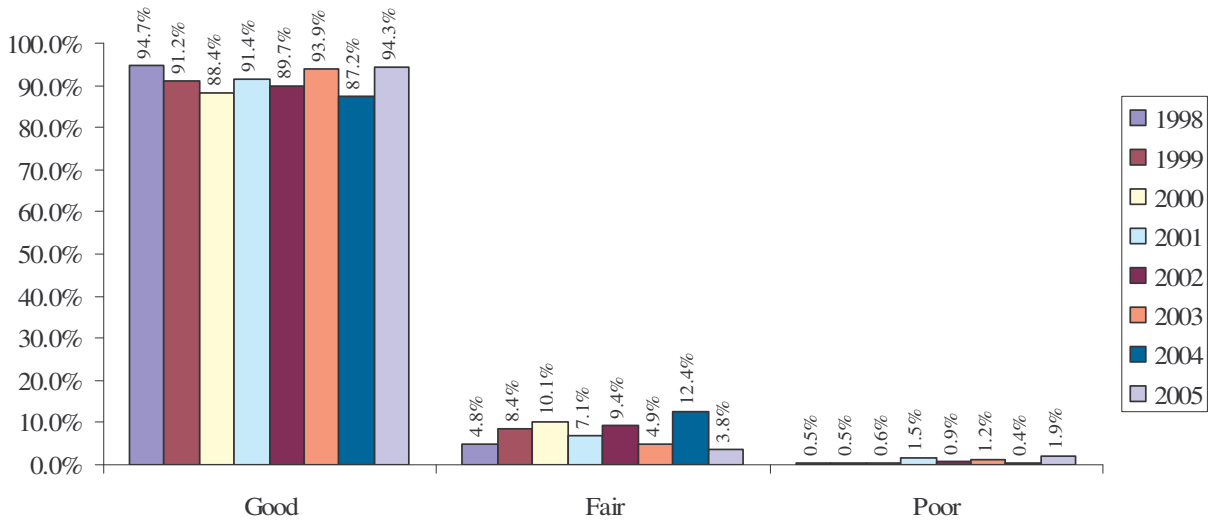


Figure 12 Weather in which all Boats Operated

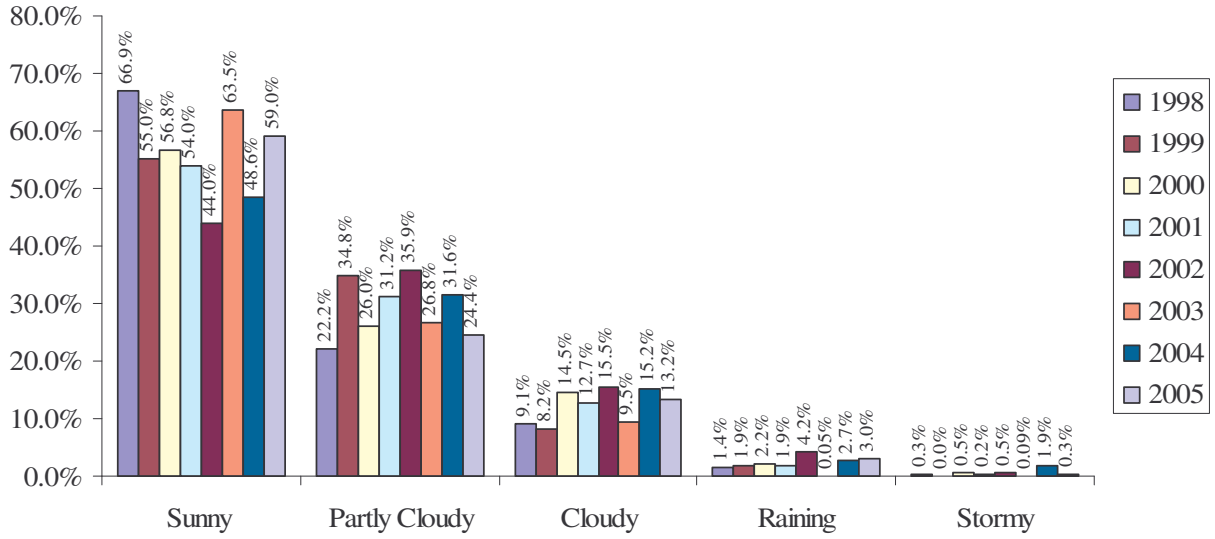
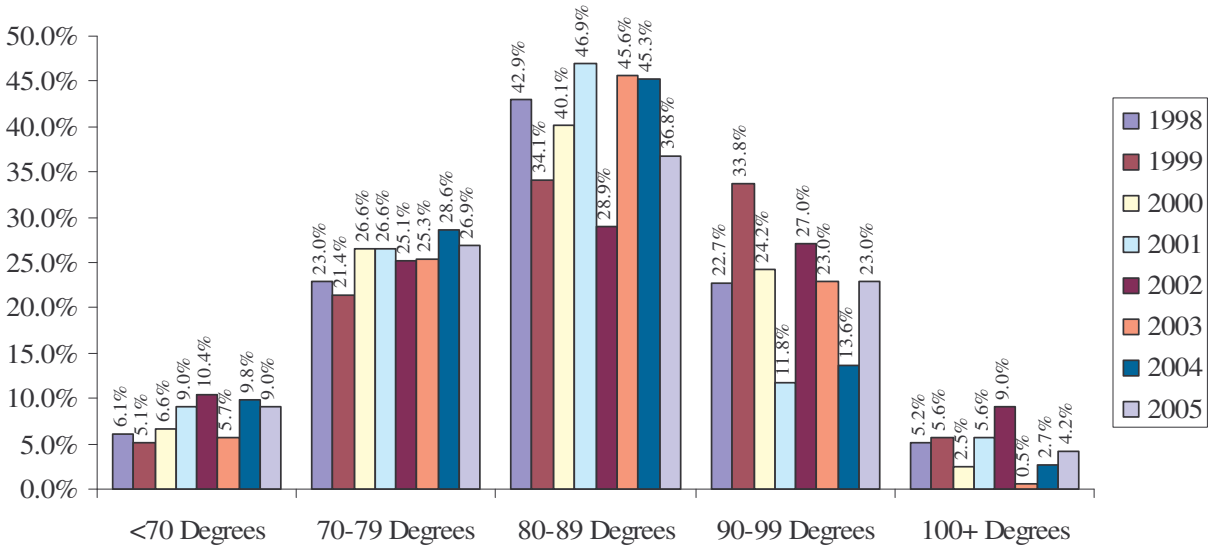


Figure 13 Air Temperature in which all Boats Operated



IV. RESULTS

1. OVERALL PFD WEAR: 1998 to 2005

1.1 Overall Trends: 1998 to 2005

Figure 1.1 reports the trend in the overall mean PFD wear rate for all observed boaters. The main factors that influence the average wear rate are the type of boat and the age of the boater. While the proportions of types of boats and age of boaters have remained fairly consistent over the eight years of observation (see Figure 2 and Figure 7 from Section 3), slight fluctuations in the proportion of types of boats observed or age of boaters observed can influence the overall PFD wear rate for that year. In order to control for these types of spurious influences on the interpretation of possible trends, the analysis of the PFD wear rate data statistically adjusts for the age of the boater and the type of boat observed. This procedure calculates the average wear rate for each year, controlling for the influence of the above-mentioned factors not only within each year, but across the years. This statistically controlled wear rate can then be interpreted both within each year and across the years as a more clear reflection of wear rate trends. The primary finding from this analysis is that overall there has been no significant change in PFD wear rates among all observed boaters over the eight years of observation (see Figure 1.1).

This presentation of the overall wear rate, however, obscures some critical differences in wear rates based on type of boat and age of the boater. In order to better appreciate these differences, the following analyses break down this average into trends for subgroups organized by age of boater and by type of boat.

Wear rates for PWC are almost universal for both adults and children (see Tables 1.3 and 1.4). These high wear rates are likely a product of State laws mandating PFD wear on PWC (all States except Hawaii) and the aggressive support of wearing behavior conducted by the manufacturers of PWC. Because these rates are so high in comparison with almost all other types of boats, showing an overall average wear rate with PWC included inflates the overall average in a way that is not readily apparent and that is highly susceptible to the exact number of PWC observed in each year. Therefore, additional analyses were performed without PWC in the calculation.

Figure 1.1 shows the impact of PWC for each year's overall average wear rate by both including and excluding PWC from the analysis. With PWC in the analysis, the overall wear rate was 22.1% over the eight years of observations; with them out of the overall wear rate calculation, the average drops to 17.4%.

1.2 Age Trend <u>Excluding</u> Boaters on PWC

Another dynamic that is obscured by presenting overall average wear rates is the impact of age on wear rates. Table 1.2 shows the wear rates for age groupings across the eight years of observations. For children under six years of age, wear rates range from a low of 81.4% in 1998 to an observed high of 94.9% in 2004 and a slight dip in 2005 to 93.1%. This extremely high wear rate is most likely a reflection of: 1) States' PFD laws mandating wear for children under six and in some instances under 13; 2) common sense on the part of the parent; and 3) possible impact of safe boating campaigns directed toward encouraging children to wear PFDs.

For children six to 12 years old, the trends observed have been more of a slow and steady increase in PFD wear. In 1999 (the first year this category was used) to 2004, the wear rates for

this group increased (69.1% in 1999 compared to 81.6% in 2004), with a slight, but not significant, decrease to 80.6% in 2005. Adolescents 13 to 17 years old experienced an increase from 24.1% in 1999 (the first year the age category was used) to 32.8% in 2005.

For adults (18-64 years) overall wear rates do not show any evidence of an increasing or decreasing trend across the eight years of data. Wear rates for adults fluctuate between 8.5% and 10.9% over the eight years, without the inclusion of adult recreational boaters on PWC. Wear rates for older adults (65+ years) declined from an observed high in 1998 of 13.6% to 6.8% in 2002. In 2003 the wear rate increased to 9.4%, declined again in 2004 to 8.3% and increased to 11.0% in 2005. Overall, there is no evidence of any increasing or decreasing trend in wear rates for this age group. The overall mean PFD wear among all adult recreational boaters, excluding boaters on PWC, has ranged from an observed high of 11.0% in 1998 to a low of 8.5% in 2001 with an average of 9.3% (see Figure 1.2).

In addition to demonstrating the PFD wear rates across the eight years of data for each recorded age category, Table 1.2 also reveals the dramatic division in PFD wear rates among boaters less than 18 years old (youth) and boaters 18 years or older (adults). Given this natural division, the remaining analyses have been divided into youth and adults.

1.3 Trends for Adults (18 years or older) for Different Types of Boats

Table 1.3 shows two important types of information. The table shows the tremendous variation in PFD wear rates for adults (18 years or older) across the various types of boats observed, and it also shows the trends or lack of trends in PFD wear rates among adults within each boat type across the eight years of data.

The highest wear rates were seen among adults using PWC, with a near 100% wear rate each year (see Table 1.3). There was no evidence, however, of any increasing trend. Kayaks demonstrated the next highest wear rates, with no evidence of an increasing trend, with rates in the mid 80's percent with the exception of 2005 when the rate dipped to 74.1%.

Speedboats/runabouts, which make up the most popular type of boat observed, show low PFD wear rates among adults, fluctuating around 4.5% over the eight years of data, with no indication of an increasing or decreasing trend. The next most frequently observed boat was the cabin cruiser. Wear rates among adults on cabin cruisers were very low, fluctuating around 1.5% over the eight years. PFD wear rates on canoes have fluctuated quite a bit over the eight years of observations, from a high of 33.8% in 2000 to a low of 14.8% in 2005, with no demonstrated consistent trend across the eight years of data.

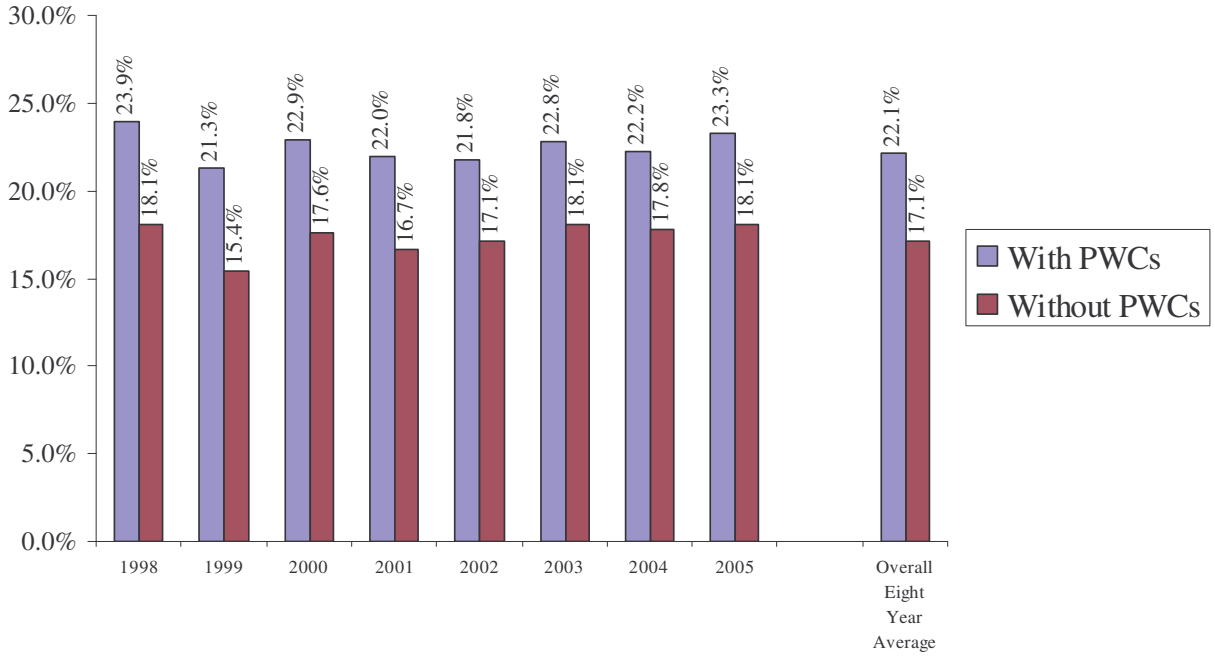
The only types of craft that demonstrated an increasing trend in PFD wear rates were day-sailor sail boats and cabin sailboats. From 1998 to 2002, wear rates for adults on day-sailor sail boats steadily increased from 27.7% to 46.7% for this type of craft. In 2003 PFD wear rates dipped to 38.4% but the rates continued their previous climb with a rate of 49.7% in 2004 and a rate of 56.4% in 2005. PFD wear rates on cabin sailboats jumped from 5.6% in 1998 to 9.1% in 1999 and then fluctuated between 9% and 11% through 2004; however in 2005 a notable jump was observed to 15.4%.

1.4 Trends for Youth (less than 18 years) for Different Types of Boats

Table 1.4 depicts how wear rates for youth (less than 18 years old) vary by type of craft and also indicates the possibility of trends for increasing wear rates. Information in this table should be interpreted with caution since many of the cells show relatively few boaters (i.e., less than 50 youth boaters observed each year for a specific boat type).

Similar to adult wear rates on PWC, youth wear rates were near 100% across the eight years of data. This is again reflective of the States' PFD laws mandating PFD wear on PWC for operators and passengers, regardless of age as well as common sense and aggressive industry marketing. The identification of trends in PFD wear for other types of boats is somewhat more difficult to determine due to the smaller sample sizes for many types of boats. The table, however, shows a slight increase in PFD wear among youth boaters on speedboats/runabouts since 2000. Among youth boaters on speed boats, the PFD wear rate has gone from 55.2% in 2000 to 63.5% in 2005. For most years wear rates (although fluctuating some) have stayed relatively high for day sailors (71.1% lowest reading and 92.0% highest reading); cabin sailboats (58.2% lowest reading and 69.4% highest reading); canoes (57.7% lowest reading and 75.0% highest reading); kayaks (83.3% lowest reading and 94.3% highest reading); skiffs (49.5% lowest reading and 68.2% highest reading).

Figure 1.1 Overall Mean PFD Wear Rates: 1998 – 2005*
With and without PWC in the calculation



*The factors controlled for in this analysis were: Age and Boat Type

Table 1.2 PFD Wear by Age <u>Excluding</u> Boaters on PWC*

	1998	1999	2000	2001	2002	2003	2004	2005
Age	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N
0-5 yrs	81.4% (672)	80.6% (500)	89.1% (716)	91.7% (703)	90.1% (676)	90.3% (658)	94.9% (743)	93.1% (714)
6-12 yrs	**** ****	69.1% (2104)	72.1% (2696)	76.6% (3122)	79.2% (2752)	79.7% (2627)	81.6% (27411)	80.6% (2487)
13-17 yrs	**** ****	24.1% (2244)	30.5% (2725)	31.2% (2893)	32.4% (2575)	32.0% (2767)	29.8% (2572)	32.8% (2230)
6-17 yrs	53.7% (4061)	46.1% (4348)	51.1% (5421)	54.7% (6015)	56.5% (5327)	55.1% (5394)	56.5% (5313)	60.2% (4717)
18-64 yrs	10.9% (25470)	8.8% (24321)	10.1% (27100)	8.5% (32528)	9.2% (31742)	10.1% (28551)	9.7% (33319)	9.9% (30176)
65+ yrs	13.6% (1203)	12.9% (1147)	9.9% (1040)	6.9% (1276)	6.8% (922)	9.4% (1106)	8.3% (1331)	11.0% (823)

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*Factor controlled for: Boat Type.
****In 1998 observations were recorded as 6-17yrs and therefore cannot be subdivided.

Figure 1.2 PFD Wear Among All Adult Boaters Excluding PWC*

* The factor controlled for in this analysis was: Boat Type.

Table 1.3 PFD Wear by Type of Boat for Adults (greater than 17 years old)*

Boat Type	1998 Wore PFD Valid N	1999 Wore PFD Valid N	2000 Wore PFD Valid N	2001 Wore PFD Valid N	2002 Wore PFD Valid N	2003 Wore PFD Valid N	2004 Wore PFD Valid N	2005 Wore PFD Valid N
Skiff/Utility	13.2% (2032)	10.0% (1867)	10.3% (1903)	9.7% (2469)	5.9% (3177)	10.4% (4214)	7.9% (4429)	7.2% (5038)
Runabout/Speedboat	5.5% (13196)	4.2% (13195)	5.3% (14463)	4.5% (16985)	4.3% (14066)	4.6% (13057)	3.9% (16633)	4.7% (13643)
Cabin Cruiser	1.3% (4012)	1.8% (3396)	1.6% (4391)	1.2% (6222)	1.9% (7111)	1.7% (5119)	1.0% (5242)	1.1% (5054)
Houseboat	0.8% (252)	0.0% (151)	0.0% (216)	0.6% (162)	0.8% (124)	0.0% (328)	5.6% (216)	0.4% (219)
Pontoon	4.7% (1359)	4.0% (1231)	6.2% (1458)	1.9% (1929)	2.7% (1796)	2.9% (1610)	2.9% (1770)	4.1% (1849)
PWC	96.5% (1959)	94.2% (1899)	97.4% (1761)	96.0% (2091)	95.8% (1798)	94.7% (1589)	95.5% (1721)	95.3% (1858)
Sailboard	100% (55)	16.4% (46)	94.0% (30)	80.6% (15)	83.2% (55)	96.7% (27)	92.9% (40)	53.0% (20)
Day Sailor	27.7% (975)	30.7% (739)	35.6% (791)	37.9% (604)	46.7% (1124)	38.4% (815)	49.7% (984)	56.4% (736)
Cabin Sailboat	5.6% (1882)	9.1% (2635)	11.3% (2744)	10.2% (3224)	9.5% (2908)	10.2% (2307)	10.1% (3125)	15.4% (2328)
Inflatable/Raft	55.3% (978)	36.6% (610)	30.6% (630)	38.4% (590)	58.5% (671)	43.0% (732)	51.3% (842)	44.5% (636)
Rowboat/Dinghy	20.0% (50)	24.4% (82)	37.2% (118)	18.7% (119)	27.3% (193)	22.8% (117)	10.1% (38)	59.2% (71)
Canoe	**** ****	17.7% (809)	33.8% (714)	23.6% (750)	15.4% (701)	30.4% (607)	26.7% (622)	14.8% (679)
Kayak	**** ****	82.7% (611)	85.7% (646)	84.4% (697)	85.7% (663)	81.4% (658)	87.0% (694)	74.1% (675)
Canoe/Kayak	44.2% (1794)	45.9% (1420)	58.6% (1360)	53.1% (1447)	49.7% (1364)	56.8% (1265)	58.6% (1316)	44.4% (1354)
Other	64.5% (88)	63.8% (96)	27.4% (36)	0.0% (38)	23.3% (75)	28.5% (66)	25.6% (15)	17.6% (51)

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*Factors controlled for: Age.
****The 1998 observations were recorded as Canoe/Kayak and therefore cannot be subdivided.

Table 1.4 PFD Wear by Type of Boat for Youth (less than 18 years old)*

	1998	1999	2000	2001	2002	2003	2004	2005
Boat Type	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N	Wore PFD Valid N
Skiff/Utility	55.5% (373)	52.7% (338)	49.5% (369)	68.2% (441)	54.9% (557)	63.2% (768)	60.7% (641)	63.3% (781)
Runabout/Speedboat	55.6% (2777)	51.6% (2744)	55.2% (3776)	58.8% (3987)	59.4% (3479)	60.0% (3369)	60.0% (3574)	63.5% (2966)
Cabin Cruiser	42.2% (438)	42.6% (418)	48.2% (587)	48.3% (774)	50.7% (690)	45.3% (659)	49.6% (529)	54.6% (528)
Houseboat	20.5% (39)	8.7% (46)	12.7% (64)	25.7% (44)	30.3% (30)	17.8% (63)	24.7% (35)	12.9% (38)
Pontoon	61.6% (238)	38.3% (272)	46.3% (379)	54.8% (455)	55.6% (399)	51.8% (338)	48.5% (394)	64.6% (440)
PWC	98.0% (497)	96.0% (551)	99.1% (649)	99.1% (691)	98.8% (502)	98.0% (562)	98.5% (543)	98.3% (652)
Sailboard	100.0% (1)	0.0% (3)	100.0% (7)	66.7% (6)	75.0% (4)	n/a (0)	92.1% (48)	100% (1)
Day Sailor	80.3% (117)	71.1% (114)	81.6% (81)	92.0% (85)	82.1% (113)	84.3% (107)	87.5% (83)	73.4% (67)
Cabin Sailboat	64.1% (167)	58.3% (230)	61.5% (241)	58.2% (333)	63.5% (264)	60.6% (216)	68.3% (192)	69.4% (259)
Inflatable/Raft	72.8% (265)	29.2% (384)	52.7% (279)	49.9% (282)	82.7% (282)	61.7% (247)	68.4% (308)	67.2% (122)
Rowboat/Dinghy	71.4% (14)	11.1% (9)	47.1% (15)	60.3% (32)	54.7% (31)	88.6% (21)	58.0% (11)	77.1% (17)
Canoe	**** ****	57.7% (142)	74.6% (222)	62.4% (181)	71.1% (98)	75.0% (130)	60.3% (146)	69.4% (101)
Kayak	**** ****	83.3% (84)	89.2% (96)	94.3% (91)	83.7% (47)	91.6% (108)	91.2% (85)	88.7% (94)
Canoe/Kayak	72.1% (283)	67.3% (226)	78.9% (318)	73.1% (272)	74.5% (145)	82.9% (238)	71.3% (231)	79.6% (195)
Other	100.0% (21)	82.8% (64)	82.3% (21)	70.2% (7)	59.8% (9)	44.9% (26)	79.5% (10)	59.2% (17)

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*Factors controlled for: Age.
****The 1998 observations were recorded as Canoe/Kayak and therefore cannot be subdivided.

2. BOATER CHARACTERISTICS

In the next three sections we present aggregated information from the eight years of observations by showing wear rates for different features of boater characteristics, boat characteristics (Section 3) and characteristics of the observation sites (Section 4).

2.1 Gender

There are small gender differences among observed youth boaters (56.5% for boys and 59.8% for girls) and negligible gender differences among adults (9.1% for men and 9.6% for women).

Table 2.1 PFD Wear by Gender Excluding Boaters on PWC

	Youth		Adult	
Gender	Wore PFD	Valid N	Wore PFD	Valid N
Male	56.5%	25,919	9.1%	157,850
Female	59.8%	18,992	9.6%	83,059
Unknown	71.9%	840	15.8%	891

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2.2 Age and Gender Combined

The combined age and gender table allows for an analysis of how gender influences PFD wear within each age category. As age increases, PFD wear decreases for both males and females. The only age category in which there is a notable gender difference is among the six to twelve year olds (74.6% for boys and 79.7% for girls).

Table 2.2 PFD Wear Age by Gender Excluding Boaters on PWC

	Male		Female		Unknown	
Age	Wore PFD	Valid N	Wore PFD	Valid N	Wore PFD	Valid N
0-5 yrs	89.6%	2,995	90.2%	2,060	73.0%	333
6-12 yrs	74.6%	10,407	79.7%	7,789	74.6%	339
13-17yrs	29.2%	10,266	31.7%	7,712	51.9%	79
18-64 yrs	9.1%	152,487	9.7%	80,414	15.6%	910
65+ yrs	9.6%	5,842	9.4%	2,992	11.1%	9

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3. BOAT CHARACTERISTICS

3.1 Length of Boat

The analysis of PFD wear by the length of the boat may demonstrate the effect of boaters' perceived stability and risk of falling overboard and their impact on PFD wear, especially among adult boaters. PFD wear declines as boat length increases for both youth and adults. On boats less than 16 feet, the youth had a wear rate of 64.1%, compared to 48.7% for boats over 25 feet in length. For adults on boats of less than 16 feet, a wear rate of 24.2% was found, compared to 3.1% for adults on boats over 25 feet.

Table 3.1 PFD Wear by Length of Boat Excluding Boaters on PWC

	Youth		Adult	
Length	Wore PFD	Valid N	Wore PFD	Valid N
Under 16ft	64.1%	9,739	24.2%	46,333
16 – 25ft	57.8%	31,214	6.5%	152,006
Over 25ft	48.7%	4,770	3.1%	43,011

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3.1A Length of Boat Expanded Categories

In 2004, the observation forms subdivided the 16 to 25 feet size category into 16 to 20 feet and 21 to 25 feet. Data from the 2004 and 2005 observations are shown in Table 3.1A. As future data are added to this new size category division, it will further enable analysis on the impact of size of boat on PFD wear. For youth there was not much difference in the 16-20 foot category (61.1%) versus the 21-25 foot category (64.9%), but it did go against the trend of decreased wear with increased length. For adults, there was a big decline in PFD wear moving from under 16 feet (31.1%) to 16-20 feet (6.8%) and then consistently smaller wear rates as boat length further increased; 21-25 (5.7%) and over 25 feet (3.0%).

Table 3.1A Length of Boat Expanded Categories Excluding Boaters on PWC

2004 and 2005 Only*

	Youth		Adult	
Length	Wore PFD	Valid N	Wore PFD	Valid N
Under 16ft	71.0%	1,524	31.1%	8,491
16 – 20ft	61.1%	6,7323	6.8%	32,808
21 – 25ft	64.9%	2,2,37	5.7%	14,815
Over 25ft	53.0%	973	3.0%	9,469

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*2004 was the first year the boat size categories were sub-divided into 4 categories.

3.2 Type of Propulsion

Type of propulsion can also be viewed as a rough indicator of type of boat and stability of the boat. Over the eight years of observations, PFD wear rates by type of propulsion mirror the wear rate patterns for types of boats (see Tables 1.3 and 1.4). Youth PFD wear rates varied somewhat across propulsion type, but rates were most likely moderated somewhat by mandatory laws for age groups. Highest wear rates for youth were seen on "sail only" sailboats (82.6%) and almost as high for paddle craft (73.9%).

Adult PFD wear rates showed somewhat different patterns compared to youth, and also greater variation. The highest wear rates for adults were seen on boats using paddles (53.7%), followed by sail only boats (47.0%). Substantially lower rates were observed on larger, motor powered boats (10.2% on auxiliary powered sail boats, 6.6% on outboard powered boats, and 2.8% on inboard/stern driven boats).

Table 3.2 PFD Wear by Propulsion Type on Boats Excluding Boaters on PWC

	Youth		Adult	
Propulsion	Wore PFD	Valid N	Wore PFD	Valid N
Power boat-Outboard	57.7%	15,814	6.6%	81,271
Inboard/Sterndrive	55.8%	22,673	2.8%	112,783
Sail only	82.6%	757	47.0%	6,143
Sail & motor	62.3%	1,894	10.2%	21,349
Other boat-Outboard	65.0%	440	18.6%	2,074
Paddles/Oars	73.9%	3,154	53.7%	14,674
Other	38.5%	697	29.9%	1,211

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3.3 Type of Operation

For youth, PFD wear rates have been higher on boats that were in motion as opposed to drifting or anchored. Wear rates were particularly high on boats under sail (74.7%) and rowing/paddling craft (74.9%). For motoring boats (including auxiliary sailboats running on their engines) the rates were 57.2%. Even for drifting and anchored boats in which wear rates were lower, the youth wear rates were reasonably high (45.2% and 44.6% respectively).

For adult boaters the pattern is similar to the youth. The highest wear rates were seen on boats that were rowing/paddling (55.8%), followed by a distant second among sailing boats (27.4%). Wear rates on boats motoring excluding PWC (but including auxiliary sailboats running on their engines) were considerably lower at 4.7%. As might be expected the lowest rates were seen for anchored/moored boats (3.8%).

Table 3.3 PFD Wear by Operation of Boat Excluding Boaters on PWC

	Youth		Adult	
Operation	Wore PFD	Valid N	Wore PFD	Valid N
Motoring	57.2%	38,676	4.7%	201,369
Sailing	74.7%	1,372	28.7%	14,103
Rowing/Paddling	75.7%	2,852	55.5%	13,488
Drifting	46.0%	2,068	13.8%	8,551
Anchored/Moored	43.0%	391	3.3%	2,264

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3.4 Type of Boating Activity

Among youth and adults, waterskiing is the activity that has the greatest effect on PFD wear (76.3% and 22.1%, respectively). There is also an indication that adults involved in fishing show a slightly higher wear rate (10.6%) than average. It is likely that some of these boaters were involved in fishing tournaments and many of these tournaments require participants to wear PFDs while their boat is underway.

Table 3.4 PFD Wear by Type of Boating Activity Excluding Boaters on PWC

	Youth		Adult	
Activity	Wore PFD	Valid N	Wore PFD	Valid N
Fishing	48.4%	1,467	10.6%	10,707
Waterskiing	76.3%	2,849	22.1%	5,273
Racing/High speed	52.5%	1,407	5.8%	10,691
Pleasure/Other	57.6%	39,655	9.0%	212,739

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4. SITE CHARACTERISTICS

4.1 Type of Water

The type of water in which the boat is operating does not have a big impact on wear rates for youth. Those rates seem to be largely determined by age factors, types of boats and legal mandates. The highest overall rates for youth were seen in harbors (62.0%) followed closely by bays, inlets or sounds (59.1%).

For adults fresh water venues showed the highest overall rates (12.5% on rivers, 11.9% on the Great Lakes, and 9.8% on other lakes or reservoirs) while substantially lower rates were seen on saltwater venues (7.2% on bays, 5.9% on harbors, and 1.4% on intra-coastal waterways). These patterns probably reflect the differences in size and types of boats that are most typical in these venues.

Table 4.1 PFD Wear by Type of Water Excluding Boaters on PWC

	Youth		Adult	
Type of Water	Wore PFD	Valid N	Wore PFD	Valid N
Bay, inlet, or sound	59.1%	8,032	7.2%	61,564
Harbor	62.0%	1,833	5.9%	15,379
Intracoastal waterway	46.9%	1,040	1.4%	6,122
River, stream, creek, or canal	58.5%	10,839	12.5%	58,236
Lake pond, or reservoir	57.9%	22,611	9.8%	90,046
Great Lake	58.6%	705	11.9%	5,988
Other	60.6%	691	4.0%	4,465

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4.2 Time of Day

Relatively little variation was seen among youth or adults according to the time of day of the observations.

Table 4.2 PFD Wear by Time of Day Excluding Boaters on PWC

	Youth		Adult	
Time	Wore PFD	Valid N	Wore PFD	Valid N
8 to 10AM	56.9%	5,564	10.1%	30,343
10 to 12PM	58.8%	12,402	8.3%	64,377
12 to 2PM	58.5%	7,055	11.6%	36,334
2 to 4PM	57.3%	13,503	9.7%	68,506
4 to 6PM	59.1%	6,971	7.6%	39,373
6PM+	69.0%	407	8.9%	2,722

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4.3 Water Temperature

PFD wear rates tend to be higher as water temperatures decrease for both youth and adults. Wear rates for youth are 53.8% in waters at 80° or above and rise to 68.8% in water temperatures below 60°. A similar pattern for adults is seen although the overall levels are much lower. In waters of 80° or more, adult wear rates average 5.3% and climb to an average of 20.0% for waters less than 60°. This pattern for both youth and adults indicates the greater risks of falling into cold water seem to be taken into account when boaters make decisions to wear a PFD.

Table 4.3 PFD Wear by Water Temperature Excluding Boaters on PWC

	Youth		Adult	
Water Temperature	Wore PFD	Valid N	Wore PFD	Valid N
below 60	68.8%	2,092	20.0%	13,263
60-69	64.2%	6,822	18.6%	36,027
70-79	58.8%	18,551	8.0%	93,473
80 or above	53.8%	17,124	5.3%	88,871

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4.4 Air Temperature

Air temperature continues to have an effect on both youth and adult wear rates. For adults there is a sizeable and very clear trend that higher air temperatures are associated with lower wear rates. At temperatures of 100° or greater adult wear rates average 3.9%, while in air temperatures below 60° adult wear rates climb to 25.3%. Comfort of PFDs may be playing a role at both temperature extremes. At high temperatures most PFDs may be perceived as too "hot" to wear, whereas in colder air temperatures the additional warmth from wearing a PFD may be seen as beneficial. There is a similar pattern for youth although the relative change is smaller than for adults. At temperatures over 100, the youth rate is 55.8% and rises to 73.0% as temperatures decrease to below 60 degrees. It is interesting to note that adults, however, still enforce PFD wear among children no matter how warm the air temperature.

Table 4.4 PFD Wear by Air Temperature Excluding Boaters on PWC

	Youth		Adult	
Air Temperature	Wore PFD	Valid N	Wore PFD	Valid N
Below 60	73.0%	315	25.3%	2,563
60-69	66.7%	2,640	16.5%	18,948
70-79	61.2%	11,759	11.0%	61,522
80-89	57.2%	17,881	8.1%	93,980
90-99	54.8%	10,817	6.8%	51,650
100 or above	55.8%	2,088	3.9%	10,136

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4.5 Wind Speed

PFD wear rates among youth and adults remain fairly consistent across the wind speed categories and there appears to be no clear pattern in wear rates by wind speed.

Table 4.5 PFD Wear by Wind Speed Excluding Boaters on PWC

	Youth		Adult	
Wind Speed	Wore PFD	Valid N	Wore PFD	Valid N
<5 knots	58.2%	31,495	9.4%	157,413
5-9.9 knots	59.6%	11,269	8.7%	66,438
10+ knots	54.9%	2,574	10.5%	15,952

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4.6 Wave Height

As expected, as wave heights increase (e.g., boats become less stable) the wear rates increases for adults, indicating that perceived likelihood of falling in the water plays a significant role in PFD wear among adults. The average wear rate for adults in rough water is 33.4% and falls to an average of 8.4% in calm water across all types of boats, excluding PWC.

Wear rates for youth tend to be less responsive to wave height, which is probably due to high wear rates induced by mandatory laws.

Table 4.6 PFD Wear by Wave Height Excluding Boaters on PWC

	Youth		Adult	
Wave Height	Wore PFD	Valid N	Wore PFD	Valid N
Calm	57.6%	34,505	8.4%	171,780
Choppy	60.4%	10,959	10.6%	67,238
Rough	60.9%	422	33.4%	2,776

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4.7 Strength of Water Current

For both youths and adults, as boating moves into "strong" current conditions, wear rates increase. The increase for youths is comparatively modest, rising to 66.4%, compared to 56.1% in moderate currents and 58.7% in weak currents.

For adults, the effect is more dramatic with wear rates increasing to 26.5% in strong currents compared to 7.3% and 8.9% in moderate or weak current conditions.

Table 4.7 PFD Wear by Strength of Water Current Excluding Boaters on PWC

	Youth		Adult	
Current	Wore PFD	Valid N	Wore PFD	Valid N
Strong	66.4%	2,120	26.5%	13,187
Moderate	56.1%	13,932	7.3%	92,546
Weak/None	58.7%	29,662	8.9%	134,624

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4.8 Visibility

Across the years there have been relatively few boats observed in poor visibility conditions. This is probably a product of fewer boats going out in such conditions and the attempts to avoid sending observers to sites that are in the midst of very bad weather circumstances as an efficiency control for the study. This relative lack of variation in visibility in the observation data set may then contribute to the lack of a clear pattern emerging in relation to wear rates.

Table 4.8 PFD Wear by Visibility Excluding Boaters on PWC

	Youth		Adult	
Visibility	Wore PFD	Valid N	Wore PFD	Valid N
Good	58.4%	42,933	9.3%	220,241
Fair	56.3%	2,638	9.7%	19,368
Poor	48.4%	366	9.2%	2,259

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4.9 Weather Conditions

There is a similar lack of variability in weather conditions, as seen in the visibility conditions, within the observational data set. There are relatively few boaters observed in raining or stormy conditions; this is particularly true for youth. This fact may then also limit the ability to uncover any clear patterns for wear rates based on weather. For youth there is no evidence that poor weather increases wear. This finding is tempered by the fact that wear rates for youth are relatively high in good weather conditions and that a very low number of youth are observed in raining or stormy conditions.

For adults, there is a reduction in numbers of boaters observed in raining conditions, but the numbers are large enough to identify what seems to be a modest association with wear rates. In sunny conditions, overall wear rates for adults are 9.0%, whereas in raining conditions it rises to 13.2%. However, among stormy weather the PFD wear rate for adults drops to 9.4%, which should be viewed with caution due to the small numbers of observations, but also may reflect the probability that of the boats in these conditions a greater proportion are large boats.

Table 4.9 PFD Wear by Overall Weather Conditions Excluding Boaters on PWC

	Youth		Adult	
Weather	Wore PFD	Valid N	Wore PFD	Valid N
Sunny	57.8%	27,197	9.0%	133,225
Partly cloudy	58.9%	12,814	9.5%	71,764
Cloudy	58.7%	4,996	9.4%	30,266
Raining	59.9%	691	13.2%	5,348
Stormy	58.8%	233	9.4%	1,220

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5. IMPACT OF BOAT AND ENVIRONMENT CHARACTERISTICS ON PFD WEAR RATES

Figures 5.1, 5.2, 5.3 and 5.4 demonstrate the power of the aggregated data set, data from 1998 to 2005, to analyze PFD wear rates under very specific circumstances. In particular, these figures show the impact of boat characteristics or environmental characteristics on wear rates. In all of these figures, the factors presented represent at some level a measure of risk of either capsizing or seriousness of capsizing. Figure 5.1 shows how adult wear rates on small boats (less than 16 feet) are influenced by type of propulsion in combination with water temperature and wave height. Figures 5.2 and 5.3 illustrate how PFD wear rates for adults on day sailor boats are effected by size of boat and whether the day sailor is involved in a race or not. Finally, Figure 5.4 shows how wear rates for adults on canoes are affected by boat size and water temperatures.

In Figure 5.1, the overall average wear rate for adults on all boats less than 16 feet is 24.1% (excluding PWC and the individual waterskier on boats involved in waterskiing.) This figure shows the dramatic influence of type of propulsion on wear rates. Note, of course, type of propulsion is a good proxy measure for types of boats (paddle-craft, sailboats, and motorboats). Of course, in the categories of “drifting” or “moored” clearly these represent a mixture of types of boats. Adults on boats that were anchored, presumably mostly while fishing or passengers were swimming off of the boat, had a very low wear rate (4.9%). At the other extreme, adults on boats that were being paddled showed a very high wear rate (71.3%). Adults on boats that were being sailed also showed a relatively high wear rate (60.6%). In contrast, adults on boats that were motoring showed a relatively low wear rate (8.5%). In between was the wear rate among adults on boats that were drifting (19.8%).

However, the figure then adds to the picture the effect of water temperature on wear rates within each of these propulsion categories. The figure shows two contrasting water temperature conditions: very cold water (less than 60 degrees Fahrenheit and hence dangerous if capsizing) and very warm water (over 80 degrees Fahrenheit and hence little danger of hypothermia if capsizing). In each propulsion category, water temperatures make an additional significant influence on wear rates. Cold water always produces an increase in wear rates. For boats being paddled, there is almost a doubling of wear rates in very cold water compared to warm water circumstances (45.3% wear rates increasing to 89.3% in very cold water). For boats that are sailing, again there is an increase in wear rates as water gets colder, but a more modest level of increase from 63.2% in warm waters to 75.0% in very cold water. For boats that are drifting there is a fairly large influence on wear rates increasing from 6.8% in warm waters to 34.9% in very cold waters. For boats that are motoring, an effect of water temperature is still observed, but again at modest levels. The rates go from 4.9% in warm waters to 16.7% in very cold waters. Actually for boats that were anchored neither water temperature nor wave height made any impact on the very low wear rates to begin with in this category.

In the final stage of the chart the further impact of wave height is shown, above and beyond propulsion (i.e., type of boat) and water temperature. Three levels of wave height were coded by the observers; calm with waves less than six inches in height, choppy with waves between six inches and two feet, and rough with wave height greater than two feet. For boats that were being paddled in very cold waters, when the water was choppy or rough, wear rates increased almost to universal levels (94.2% and 99.6% respectively). However, even though the boat was being paddled in very cold water, if the waves were calm there was a slight decrease in wear rates to 83.9%. Likewise for boats paddled in warm waters, wave heights altered wear

rates in the expected directions. The same effects were seen for drifting boats in very cold waters and motoring boats in very cold waters. (For boats under sail, wave height did not add significant information beyond the effect of water temperature.)

These findings suggest that boaters' wear rate behaviors are the product of an assessment of risk of falling overboard, or capsizing, plus an assessment of the seriousness of the consequences of falling overboard, or capsizing.

Figure 5.2 focuses on day-sailor sailboats and shows how boat size impacts PFD wear rates. This figure shows the detailed effects of boat length on wear rates for day sailors. Boat length is divided into four categories (2004 and 2005 data only): less than 16 feet, 16 to 20 feet, 21 to 25 feet, and over 25 feet in length. Wear rates for all day-sailor sailboats during this two year period averaged 52.6%. However, there is a dramatic effect of boat length on wear rates. For day-sailors less than 16 feet in length, the wear rate is 75.5%, dropping to 40.2% for 16 to 20 foot boats, and then to 21.5% for 21 to 25 foot day-sailors, and finally to 10.8% for day-sailors over 25 feet in length.

Figure 5.3 also shows the effects of boat length of wear rates for day-sailor sailboats, but in this chart only the three length measures used from 1998 on are reported. However, in addition, the impact of whether the sailboat was involved in a "race" is also shown. For the eight years of data, the average wear rate for all day-sailors observed was 40.6%. This is lower than the previous figure, since this figure covers the full eight years of observations and there has been a steady trend of increasing PFD wear on day-sailors over this eight year period. However, the very strong effect of boat length is also seen in this figure; 55.6% for sailboats under 16 feet, 33.2% for those in the 16 to 25 foot category, and 12.9% of those greater than 25 feet in length. What is interesting to note, however, is the impact of race participation on the smaller day-

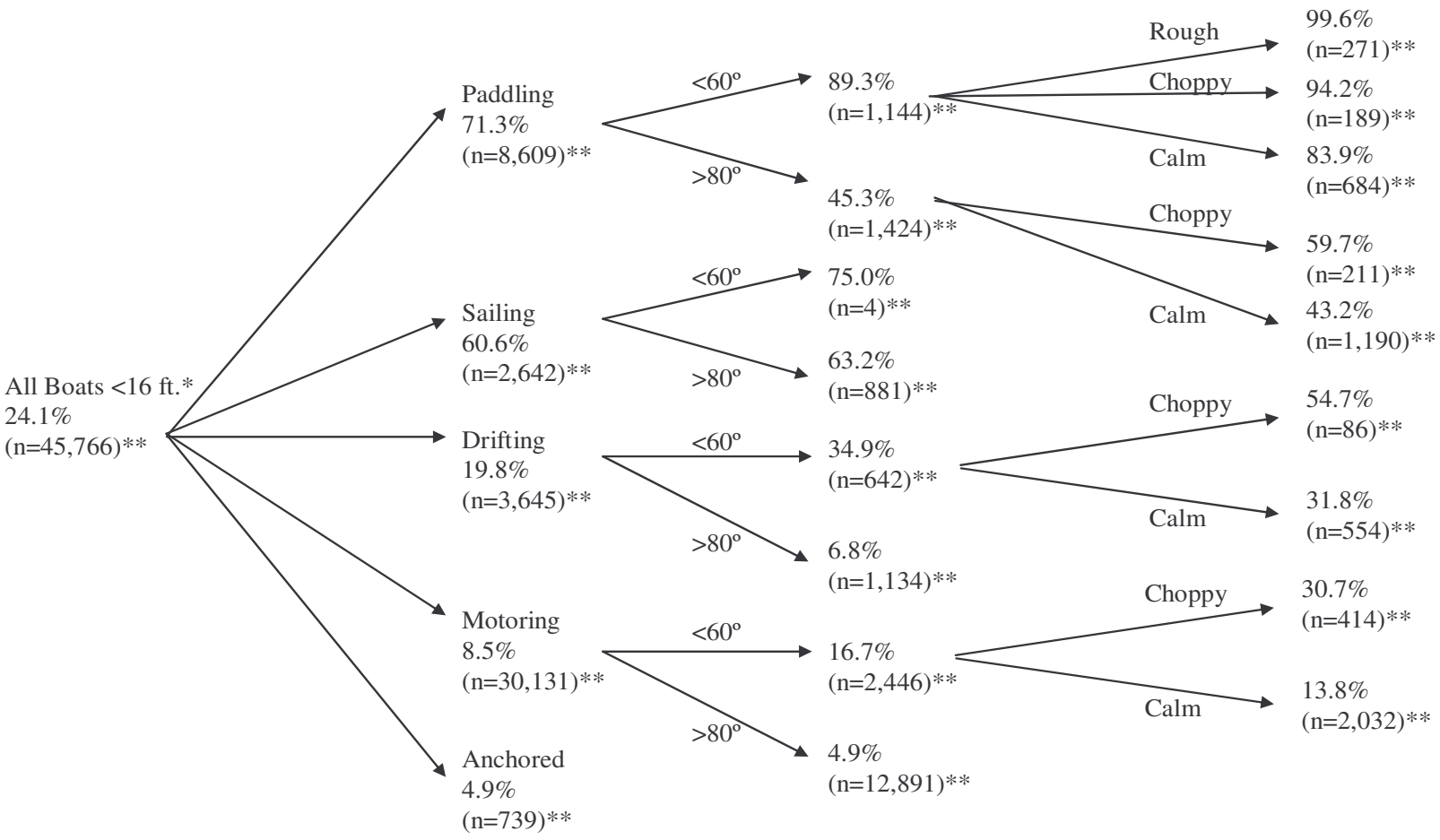
sailors. Wear rates rise to almost universal levels with those under 16 feet who were racing showing a 98.0% wear rate, and those in the 16 to 25 foot category and involved in a race were observed at 95.5% wear rates.

Figure 5.4 demonstrates the impact that boat size and water temperature have on PFD wear rates among adults on canoes. Note the size category was collapsed from the original three options (less than 16 feet, 16-25 feet and over 25 feet), to two options (less than 16 feet and 16 feet and over). The overall eight year average wear rate for all canoes was 22.9%. For smaller canoes (those less than 16 feet) wear rates rise to 57.3% while larger canoes (over 16 feet) the wear rates drop to 8.1%. However, again it is seen that water temperatures make a significant impact on wear rates within these groups. For the smaller canoes, in cold waters less than 60 degrees, wear rates climb to 82.6% whereas in warm waters (more than 80 degrees) the wear rates drop to 35.1%. Likewise among the larger canoes, those operating in colder waters show wear rates up to 36.5% from the average of 8.1%, and falling back down to 2.4% for larger canoes in warm waters (over 80 degrees).

Again Figures 5.2, 5.3 and 5.4 suggest that boaters take into consideration the risk of the boat capsizing as well as the seriousness of the consequences of being forced into the water.

Figure 5.1 PFD Use by Adults on Boats Under 16 Feet*

Effects of Type of Propulsion, Water Temperature and Wave Height



* Includes boats <16 ft., excluding PWC and adults who are waterskiing

** Indicates the number of adults (>18 years old) observed.

Figure 5.2 PFD Use by Adults on Day Sailors

Effects of Size of Boat
2004 - 2005 Data Only

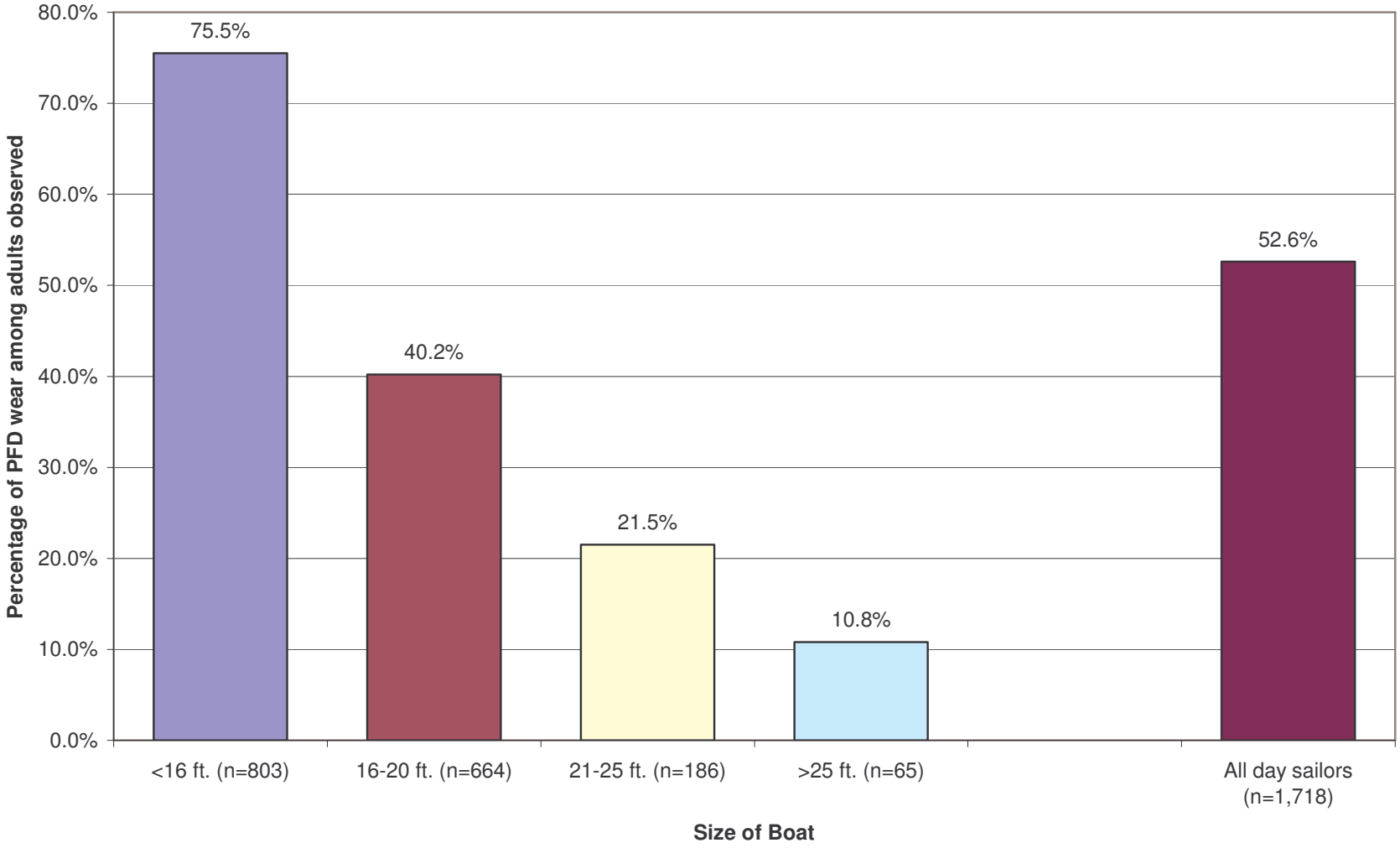
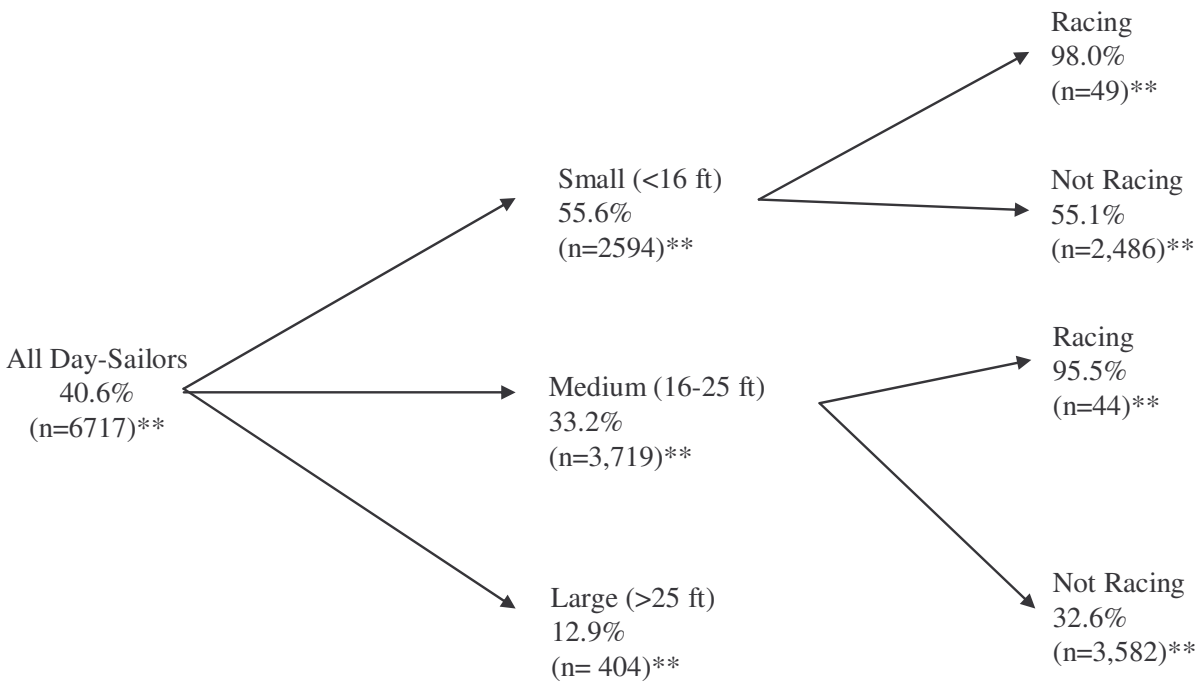


Figure 5.3 PFD Wear Rates for Adults on Day-Sailors

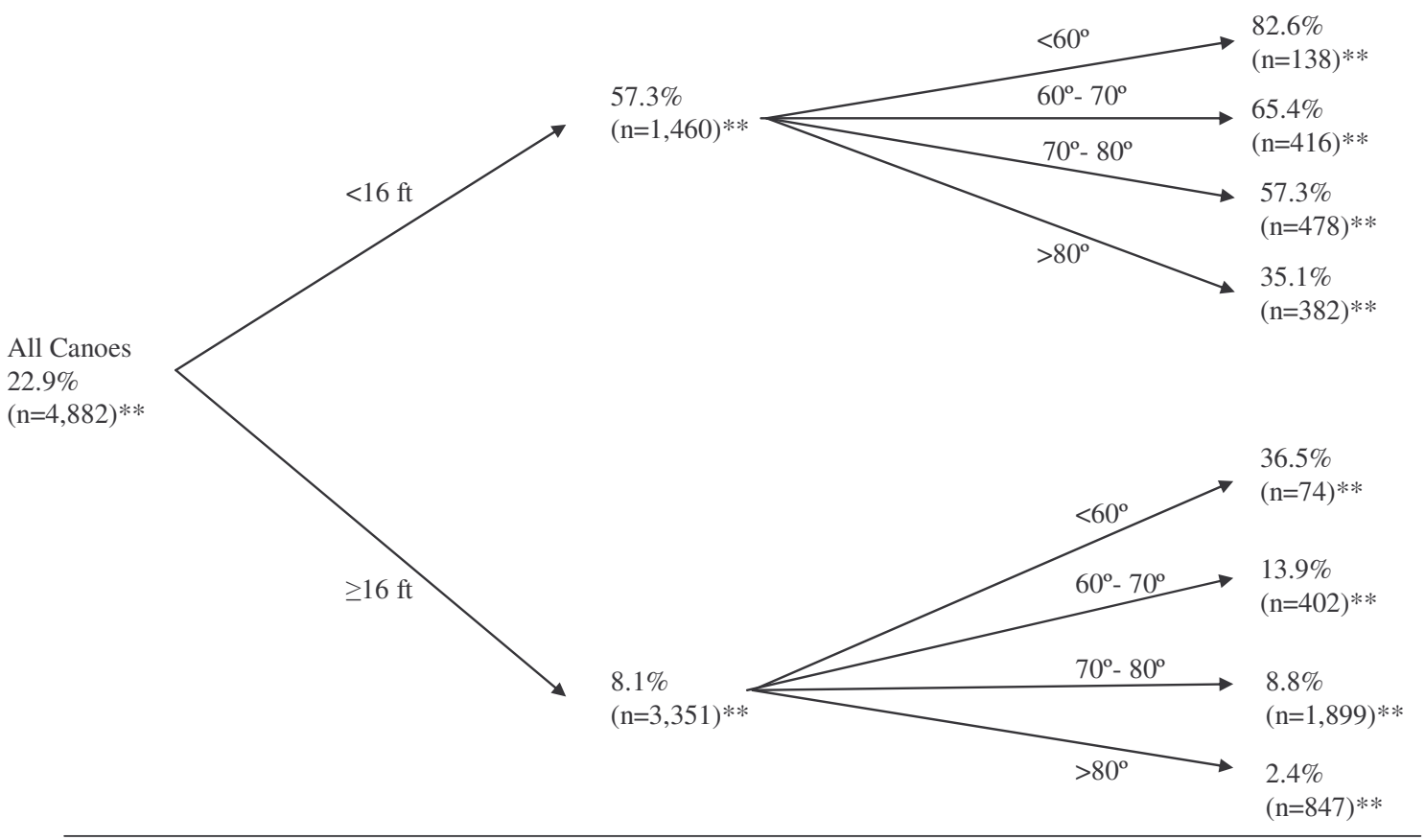
Impact of Size of Boat and Racing Status
1998-2005 Data



** Indicates the number of adults (>18 years old) observed.

Figure 5.4 PFD Use by Adults on Canoes

Effects of Size of Canoe & Water Temperature
1999 – 2005 Data Only



** Indicates the number of adults (>18 years old) observed.

6. CONCLUSIONS

This report covers observational data collected from 1998 to 2005. In this year's report: (1) trends in wear for types of boats and for various age groups were displayed; (2) data were aggregated across the eight years to assist in analyzing the impact of boater, boat and environmental characteristics on wear rates of adults compared to wear rates of youth; (3) data were presented showing the impact of environmental and boat characteristics on small boats under 16 feet in length; day-sailor sail boats and canoes. A summary of key findings are :

1. Adult wear rates are relatively low with a few exceptions—PWC, kayaks, inflatable/rafts and day-sailors.
2. The overall adult wear rates (across all boat types excluding PWC) have remained stable (and low) over the eight years of data.
3. Wear rates on PWC for both adults and children are almost universal. In all likelihood, a reflection of legal mandates.
4. Children's wear rates are relative high, particularly for younger children under the age of six years of age.
5. Children's (under 13 years of age) wear rates have increased about 10% over the eight years of data collection. In all likelihood, a reflection of legal mandates at the State and Federal level.
6. Adults increase their wear of PFDs under conditions that seemingly increase their risks (e.g. boating in small boats, rough water, strong current, cold water and cold air temperatures).

Given these findings, general conclusions can be made. The relatively stable wear rates among adults over the past eight years suggest that campaigns encouraging PFD wear are not succeeding in changing behavior among adult recreational boaters. There is evidence in the data that adults do alter their wear of PFDs when they perceive themselves at risk. For instance, wear rates are higher for small (unstable) boats, when water conditions are rough, and when water temperatures are cold. Additionally, an apparent barrier to wearing PFDs is their perceived bulky nature and uncomfortableness in warm weather; thus, newer inflatable PFDs may be a viable option to increase safety but in a comfortable and stylish manner.

7. REFERENCES

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