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**Title:** Summary National PFD Wear Rate Observational Study, 1998-2003

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**SUMMARY**  
**NATIONAL PFD WEAR RATE OBSERVATIONAL STUDY**  
**1998-2003**

**Submitted to:**  
**NTSB Forum on PFD Use**  
**August 25, 2004**

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## **INTRODUCTION**

This paper provides analysis on data from the National Personal Flotation Device (PFD) Wear Rate Observation Study: 1998 – 2003. The United States Coast Guard reported in the 2002 Boating Statistics report that among the 524 drowning deaths in 2002, 442 of the individuals were not wearing a PFD. It is estimated that 90% of drownings could be prevented if every boater wore a PFD (U.S. Coast Guard, 1998). Given the role of the U.S. Coast Guard to promote recreational boating safety and to reduce injuries and fatalities, it is sensible for the U.S. Coast Guard to not only track the national PFD wear rate among recreational boaters, but also to understand the circumstances and patterns in which PFDs are used. This information can then assist in tailoring boating safety messages, education programs, and potentially legislative efforts appropriately.

## **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 across the six years of observations. Observations began the weekend of July 4<sup>th</sup> and ended on Labor Day weekend of each year. Using stratified random sampling, a total of 30 states were chosen to conduct observations in (19 coastal and 11 inland states). 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. Sites were selected in consultation with local offices of the USCG and based on representativeness of the boating activity in the state, availability of decent shore-based viewing locations, and proximity to the other sites for that state.

Observations were conducted at each site for four-hour periods, either in the morning or the afternoon of a Saturday or Sunday, by a two-person observation team. Viewing locations were on shore, usually at a narrowing, or near marinas or bridges. One team member made the observations using high-powered binoculars and called out the information, while the second team member recorded all information on observation forms; team members alternated roles frequently to ward off fatigue. Observers also recorded data about site, weather and water condition. JSI project staff trained the observers during half-day training sessions; which consisted of reviewing the observation manual, observation forms, required equipment, and finally guided practice using the required equipment and observation forms at a recreational boating venue.

Two types of observation forms were designed to capture data. The first type was the boat observation form, which was intended to record information on the boat and people on the boat. The second type of form was the site form, which was designed to record information about the site, weather and water conditions. Over the past six years of observations only a few categories of information have been changed. In 1999, the 6 – 17 year old age category was divided into a 6 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.

### **Overall PFD Use: 1998 to 2003**

Based on observations of 85,266 boats and 229,891 boaters, the wear rate overall, for all types of boats and all types of boaters across the six years was 22.2% (see Table 1). Even though many factors influence wear rates, and at any particular location for a particular year there may be fluctuations, the large number of boats and boaters observed have evened out these factors and therefore make this rate representative.

However, this single, overall number is not as useful as it could be since it turns out there are small groups of boaters who have dramatically higher wear rates, and therefore the overall statistic might be skewed if in any one year there was an arbitrary increase in the numbers of those types of boats or boaters observed. Therefore, in order to more clearly understand the trends in wear rates we have separated the analysis for Personal Water Craft (PWCs) from other types of boats and separated youth (boaters under 18 years old) from adults (boaters 18 years and older) in the analyses.

PWCs have extremely high average wear rates (96.2%--Table 2) over the six years due to boater common sense and the fact that PFD use is mandated in all states. When PWCs are separated out from this statistic, wear rates for all boaters in the remaining types of boats declines to 17.0% (Table 2) as a six year average. Youth in all types of boats, excluding PWCs, also have substantially higher wear rates (56.7%--Table 3) average wear rate over the six years. When youth are separated out from the overall statistic, the wear rate for adults in all types of boats, excluding PWCs, declines to 9.3% (Table 3). Later in this paper we will return to looking more closely at PFD wear behavior of youth and factors that influence it.

In Table 4 the wear rate trends for all Adult boaters, in all boats excluding PWCs is shown for each of the six years of observations. The most notable feature of these rates is their relative stability over the six years. There were no discernable trends in the overall averages for adults. Because other factors such as weather conditions, local circumstances, and the particular mixture of types of boats observed fluctuate from year to year, these yearly trend statistics are presented with a host of these factors statistically controlled for (type of boat, size of boat, type of power, type of movement, activity of boat, water temperature, air temperature, wind speed, water roughness, current, and time of day).

Table 4 presents trend information over the six years for adults by specific type of boats. This chart shows first that there is substantial variation in use based on types of boats. The highest average wear rates for types of boats is seen for PWCs (fluctuating between 93.8% and 97.8%), kayaks (fluctuating between 81.0% and 86.1%) and canoes (fluctuating between 20.8% and 28.8%). None of these types of boats, however, demonstrate any discernable increasing trend in wear rates over the six year period.

Speedboats/runabouts, which make up the most popular type of boat observed, show relatively low PFD wear rates for adults, fluctuating between 3.9% and 5.5% over the six years of data, again with no indication of an increasing trend. The next most frequently observed boat was the cabin cruiser. Wear rates for adults on cabin cruisers were very low, fluctuating between 1.2% and 2.0% over the six year period.

The only types of boats that demonstrated any consistent 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 24.8% to 46.1% for this type of craft. In 2003, the previously observed increase declined to 39.1% but this wear rate was still higher than any previous year except for 2003. In addition, PFD wear rates on cabin sailboats increased from 4.9% in 1998 to 12.4% in 2001. Since then, the wear rates have essentially leveled off with minimal fluctuation.

Further analysis of the wear rates statistics shows that there are factors which influence wear rates and that these effects offer clues as to how boaters decide whether to put on a PFD. Figure 1 illustrates how adult wear rates on boats less than 16 feet, excluding boaters on PWCs and boaters who were waterskiing, are influenced by type of propulsion and water temperature. The average, overall PFD wear rate for adults on all boats less than 16 feet is 22.7%. When the

type of propulsion of the craft if factored into the analysis, however, wear rates are dramatically influenced. Adult boaters who are paddling have average wear rates of 71.9%; those who are sailing 54.6%; those who are drifting 18.3%; those who are motoring 8.3% and those who are anchored 5.6%. The figure then goes on to demonstrate how water temperature, for each propulsion type, further influences PFD use among adults for boats less than 16 feet long. In each circumstance where boats are moving, boating in colder water (less than 60 degrees) increases wear rates notably compared to very warm water situations (over 80 degrees 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. This may offer a strategy to increase wear rates by focusing on increasing boater awareness of risks and seriousness of consequences.

### **Youth Wear Rate Trends and the Impact of Laws**

Table 3 demonstrates the overall PFD wear rates for youth of different ages and the trends over the past six years for all types of boats except PWCs. For youth under six years and six to twelve years old, the average PFD wear rate was 88.8% and 75.6%, respectively. The overall PFD wear rate dropped sharply among adolescents (13 to 17 years old) to 29.8%. These higher wear rates for youth under age 13 are most likely a product of parental common sense and legal mandates in many states. Note that there is small increasing trend for youth six to twelve years old.

There is, however, a considerable amount of variation in the types of PFD laws mandating use for youth across the observed states. An analysis of state laws shows the following state PFD law categories (See Figure 2).

- 1) *No Law – “no mandated use for any youth”*
- 2) *Law for youth under 6 years – “all boats but only for youth under six years old”*
- 3) *Partial Coverage Law – “only some boats for youth under 13 (and/or not all ages between age 6 and 13)”*
- 4) *Full Coverage Law – “all boats mandated for all youth under 13”.*

A more detailed analysis of youth PFD wear rates reveals that the level of PFD law in effect for youth makes an impact on wear rates. In Figure 3 results are shown for the four different levels of legal mandate by the three age groups combining data from 1999 through 2002. For each age group, more youth wear PFDs when there is some level of legal mandate. For youth under six years of age, wear rates are increased by about five to eight percentage points over what is already a relatively high wear rate in the no law states (83.4%).

Youth between six and twelve years of age in “no law” states show a wear rate of 64.5%. This rate goes up somewhat for the six to twelve year olds when they are observed in states that have mandated use only for younger youth (70.4%). The rates are noticeably higher, however, for six to twelve year olds when the laws specifically include their age range (80.6% and 78.6% for partial and full mandates). For youth between the ages of 13 and 17, there is no indication that laws targeting youth under 13 years of age spill-over to those who are 13 to 17 years old.

In Figures 4, 5 and 6 this information is further broken down for each age group by the length of boat on which they were observed. For youth under six years of age, length of boat makes some difference only in those states that have laws only targeting boaters under six years old. As boat length increases, wear rates go down (97.0%, 89.2% and 79.7%, respectively for under 16 feet, 16-25 feet, and over 25 feet in length). For the no law states, and the states that have a broader age mandate, length of boat does not affect wear rates among youth under six years old.



For youth between the ages of six and twelve (Figure 5), all levels of legal mandates make some impact on wear rates no matter what the length of the boat is. For boats of under 16 feet in length the change in wear rates goes from 71.2% with no laws to 79.2%, 85.7% and 82.7% as the level of mandate expands. For boats 16 to 25 feet the wear rates change from 64.3% with no laws to 70.3%, 80.2% and 79.9% as the mandate expands to include this age group. Even among larger boats (those over 25 feet), there is evidence for this age group that wear rates increase from 48.3% with no laws to 62.4%, 75.0% and 57.1% as the mandate expands to include this age group.

For youth between the ages of 13 and 17 (Figure 6) the amount of evidence of any “spill-over” effects depends on the length of the boat. For smaller boats, under 16 feet in length, there is no evidence of any “spill-over” effects from mandates for younger youth. It should be noted however, that across the board, these are the lengths of boats where wear rates are highest for adolescents ranging from 47.5% to 33.2% for the different levels of legal mandates. Remember PWCs are not included in these analyses but if they were, the average wear rate would increase. For boats that are 16 to 25 feet in length, there is evidence of a modest increase when the mandate is directed at all youth up to age 13. Wear rates for adolescents are 23.0% and 20.7% in states that either have no mandates or only mandate use for youth under six years of age compared to 30.3% and 28.2% for states that have a mandate for the youth under 13 years old. For boats over 25 feet where wear rates are very low for Adults, the data show that wear rates are higher for the teenagers in all the states that have some type of law applying to youth (11.0% in no law states compared to 17.2%, 20.9% and 12.8% as the mandate expands).

In an effort to encourage uniformity among states regarding PFD laws for youth, the USCG, in December 2002, instituted an interim PFD rule. The rule mandates PFD use among

boaters under 13 years old on all recreational boats while the boat is underway, unless the child is below deck or in an enclosed cabin (US DOT 2002). The interim rule applies only in states that currently do not have, or have not enacted, a PFD law for youth under the age of 13 years. It does not, however, supercede state PFD laws for youth on recreational boats already in place. In essence, the rule was created to ensure there are no gaps in PFD laws for youth under 13 years old.

The six years of data available, and the change last year among the observed states with “No Law” to a “Full Coverage Law” due to the federal interim rule, offers an opportunity to assess the impact of having such a law on wear rates among youth. Among the observed states, eight were impacted by the interim rule (CO, HI, MN, NC, SD, VA, WI, and WY). All of these states had “No PFD Law” for youth on recreational boats in 2002, and changed to essentially having a “Full Coverage Law” for all youth under 13 years old on any recreational boat.

Among youth 0-5 years old, the PFD wear rate has been consistently high across the six years of observations. In 2000, there was a dramatic increase in the observed PFD wear rate compared to 1998 and 1999 observations. With the following years’ data, however, the dramatic increase leveled off. Among youth 6 – 12 years old, PFD use dipped slightly in 2000 and since has increased each following year; between 2002 and 2003, wear rates increased from 73.7% to 75.8%, respectively. Overall it appears that the interim rule has had little to no impact yet on PFD use among youth 12 years old and younger. Future years of observational data will help to elucidate the potential impact of the federal rule.

## **SUMMARY AND RECOMMENDATIONS**

Legal mandates for youth make an impact on wear rates. They increase wear rates even for young youth (for whom wear rates are already high). They particularly make a difference for

youth in the six to twelve year old category in all sizes of boats and the effects are greatest when laws apply to this age group directly. There is even some evidence of “spill-over” effects to the 13 to 17 year old group not covered by any legal mandates, although these are modest; and are most seen when the laws apply to youth up to age 13. In addition, the increase over wear rates in no law states is most apparent in boats over 16 feet in length.

States that do not mandate use for all youth up through age 12 on all boats should be encouraged to expand their mandates as this will clearly increase wear rates. States should also consider expanding the mandate to higher ages (such as 16 or even through age 17) as there are also indications that parents and youth would respond to these mandates.

Finally, although parents are clearly already cognizant of the sensibleness of having their younger youth wear PFDs even when there are not laws mandating such use, it is also clear that they respond positively when the law mandates use. This compliance with laws holds out promise for even higher levels of compliance if laws and advertising work hand in hand to encourage such use. Furthermore, the willingness of parents to see that their youth comply with the law, opens up possibilities that either education or legal mandates may be able to change parents’ wearing behaviors.

## **APPENDIX: TABLES AND FIGURES**

**Table 1: Overall Mean PFD Wear Rate: 1998 - 2003**

<b>Overall Mean</b>
22.2%

**Table 2: Overall Mean PFD Wear Rate for PWCs vs. All Other Boats: 1998 - 2003**

<b>Boat Type</b>	<b>Overall Mean</b>
PWCs	96.2%
All Other Boats	17.0%

**Table 3: PFD Use by Age Excluding Boaters on PWCs\***

Age	1998 Wore PFD	1999 Wore PFD	2000 Wore PFD	2001 Wore PFD	2002 Wore PFD	2003 Wore PFD	'98 – '03** Wore PFD
0-5 yrs	81.2% (n=608)	81.6% (n=478)	90.2% (n=628)	92.5% (n=672)	89.8% (n=633)	90.7% (n=633)	88.8% (n=3253)
6-12 yrs	****	69.2% (n=2018)	72.0% (n=2291)	75.7% (n=2872)	79.5% (n=2607)	79.0% (n=2539)	75.6% (n=13301)
13-17 yrs	****	22.4% (n=2162)	31.2% (n=2230)	30.4% (n=2661)	31.5% (n=2417)	30.0% (n=2679)	29.8% (n=13204)
6-17yrs	52.8% (n=3602)	46.1% (n=4180)	52.1% (n=4521)	53.9% (n=5533)	56.4% (n=5024)	57.4% (n=5218)	52.8% (n=26510)
Youth	57.3% (n=4210)	49.8% (n=4658)	56.6% (n=5149)	58.0% (n=6205)	60.0% (n=5657)	58.4% (n=5851)	56.7% (n=29763)
18-64 yrs	9.3% (n=22280)	8.7% (n=23471)	10.9% (n=24017)	9.0% (n=29893)	8.4% (n=29891)	10.0% (n=27900)	9.0% (n=144262)
65+ yrs	9.4% (n=1099)	9.4% (n=1081)	11.0% (n=929)	9.5% (n=1177)	7.8% (n=863)	10.3% (n=1082)	8.9% (n=5491)
Adult	9.3% (n=23379)	8.7% (n=24552)	10.9% (n=24946)	9.1% (n=31070)	8.3% (n=30754)	10.0% (n=28982)	9.3% (n=163682)

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2003 National Observational PFD Wear Rate Study

\*Factors controlled for: Gender, Boat Type, Boat Size, Movement of Boat, Activity of Boat, Water Type, Wave Height, Water Current, Water Temperature, Wind Speed, Visibility and Weather.

\*\* For the '98 – '03 analysis there is no need to control for the co-variables as was done with the individual year analysis.

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



**Table 5 PFD Use by Type of Boat for Adults (>18 years old)\***

Boat Type	1998		1999		2000		2001		2002		2003	
	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	11.5%	1853	10.0%	1798	11.4%	1712	7.7%	2359	7.1%	3039	10.8%	4132
Runabout/Speedboat	5.5%	11563	4.4%	12740	5.3%	12984	3.9%	15810	4.4%	13373	4.5%	12796
Cabin Cruiser	1.4%	3483	1.7%	3279	1.7%	4020	1.2%	5633	1.5%	6715	2.0%	5010
Houseboat	0.3%	189	0.1%	151	0.2%	82	0.7%	158	0.8%	122	0.1%	320
Pontoon	4.6%	1282	2.7%	1124	6.9%	1242	2.1%	1831	3.0%	1646	2.9%	1583
PWC	97.1%	1753	93.8%	1793	97.5%	1489	95.9%	1861	95.8%	1651	94.8%	1555
Sailboard	99.5%	55	23.1%	46	71.3%	21	65.4%	11	90.8%	45	94.7%	26
Day Sailor	24.8%	865	29.8%	694	37.6%	700	37.3%	454	46.1%	1036	39.1%	799
Cabin Sailboat	4.9%	1539	8.0%	2556	11.8%	2468	12.4%	2719	9.2%	2736	11.1%	2211
Inflatable/Raft	54.9%	900	44.9%	603	43.2%	453	40.8%	552	46.4%	573	45.5%	716
Rowboat/Dinghy	19.6%	46	21.7%	82	36.0%	97	20.6%	108	25.8%	170	29.5%	109
Canoe	****	****	20.8%	790	33.7%	563	19.4%	712	26.6%	608	28.8%	580
Kayak	****	****	81.0%	593	85.6%	570	86.1%	685	84.3%	618	84.1%	635
Canoe/Kayak	49.1%	1518	51.5%	1383	59.3%	1133	43.8%	1397	59.0%	1226	57.3%	1215
Other	56.4%	86	56.8%	96	12.4%	34	14.3%	38	38.5%	73	31.2%	65

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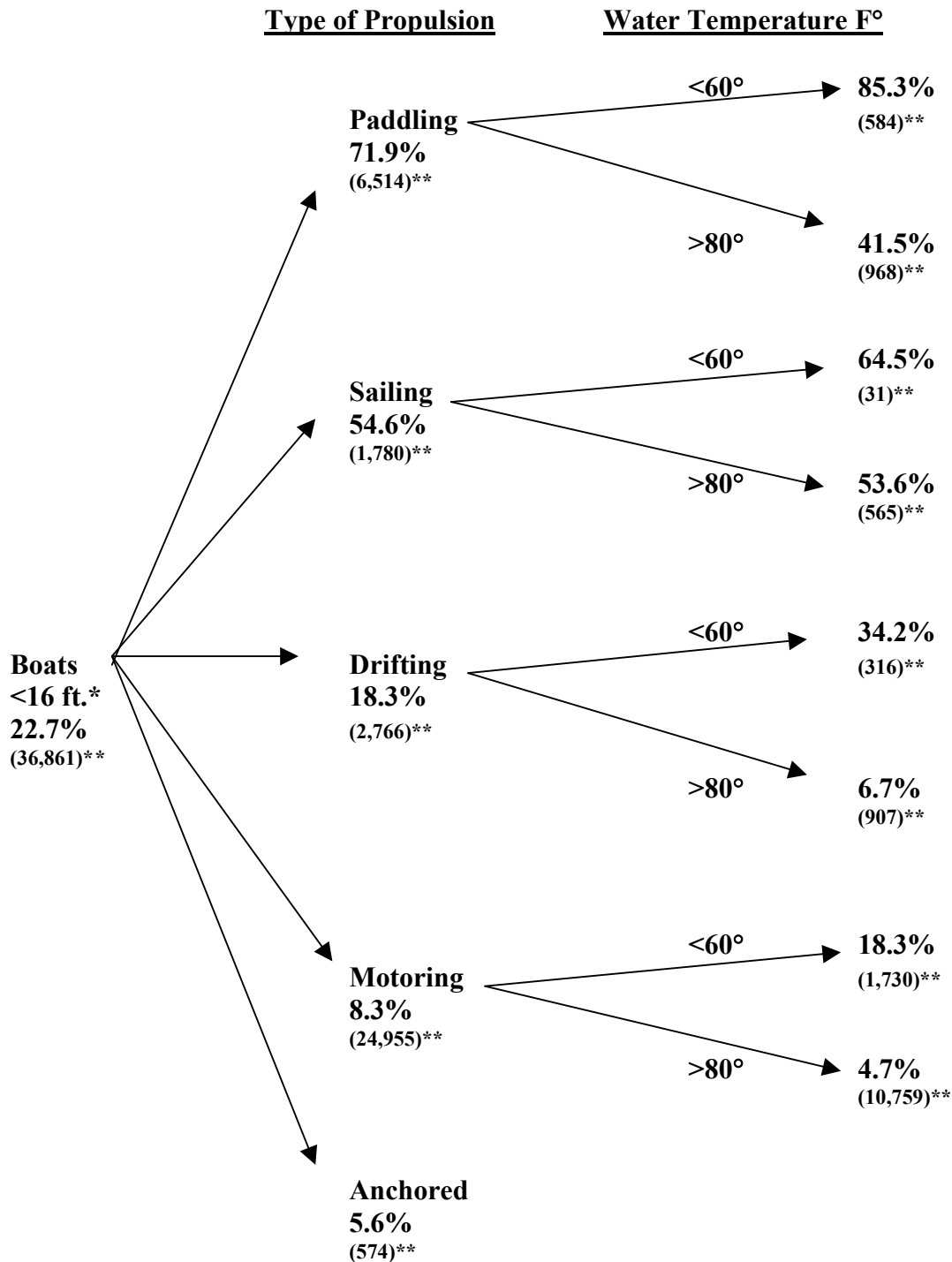
2003 National Observational PFD Wear Rate Study

\*Factors controlled for: Age\*\*, Gender, Size of Boat, Movement of Boat, Activity of Boat, Water Type, Wave Height, Water Current, Water Temperature, Wind Speed, Visibility, Weather.

\*\*The Age variable only controls for the effect of Adults 18-64 years old and 65+ years old.

\*\*\*\*The 1998 observations were recorded as Canoe/Kayak and therefore cannot be subdivided.

**Figure 1 PFD Use by Adults on Boats Under 16 Feet\***  
**Effects of Type of Propulsion & Water Temperature**



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

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

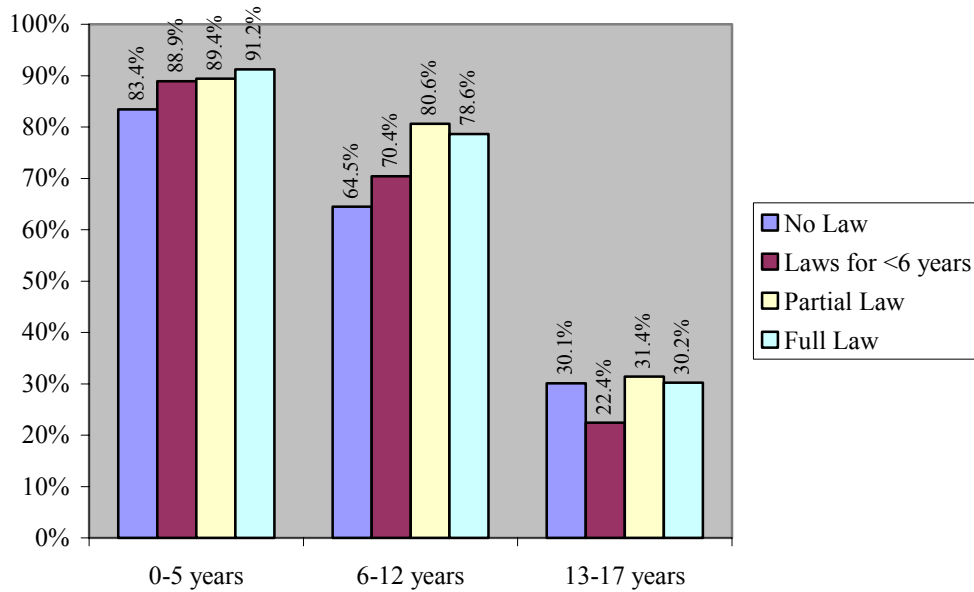


**Figure 2 Classification of State PFD Laws for Youth**

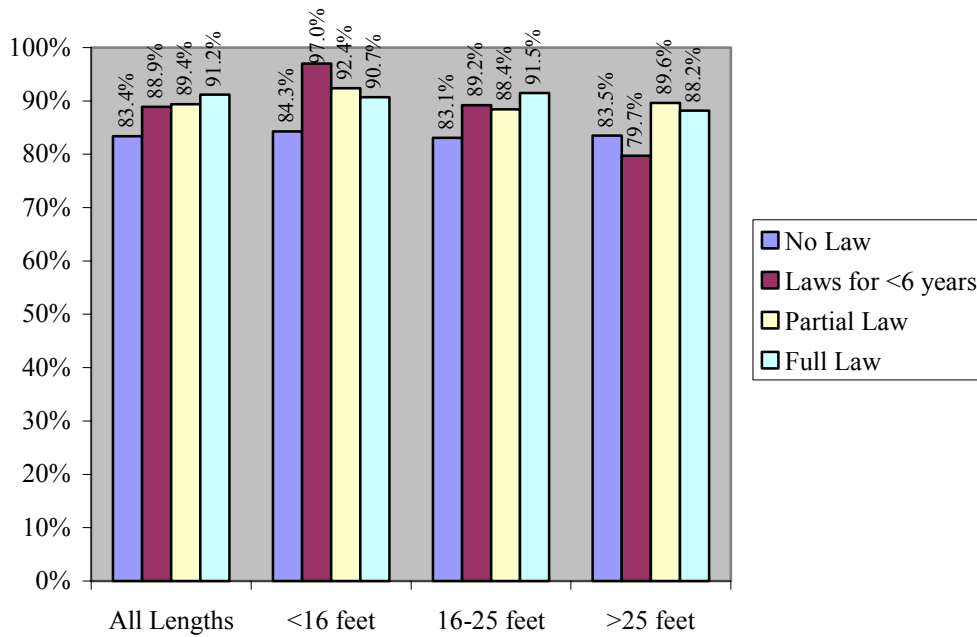
<u>State</u>	<u>No Laws</u>	<u>Laws for &lt;6yrs</u>	<u>Partial Coverage for under 13 yrs</u>	<u>Full Coverage for under 13 yrs</u>
AK				X
AZ				X
CA		X (1999-2000)	X (2001, 2002)	
CO	X			X (2003)*
FL		X		
GA			X	
HI	X			X (2003)*
KS				X
LA			X	
MA			X	
MD	X (1999-2000)	X (2001, 2002)		
ME			X	
MI		X		
MN	X			X (2003)*
MO		X		
NC	X			X (2003)*
NY			X	
OK			X	
OR				X
RI			X	
SC			X	
SD	X			X (2003) *
TN				X
TX			X	
UT				X
VA	X			X (2003)*
VT				X
WA			X	
WI	X			X (2003)*
WY	X			X (2003)*

\*Indicates Federal Law changed State Law

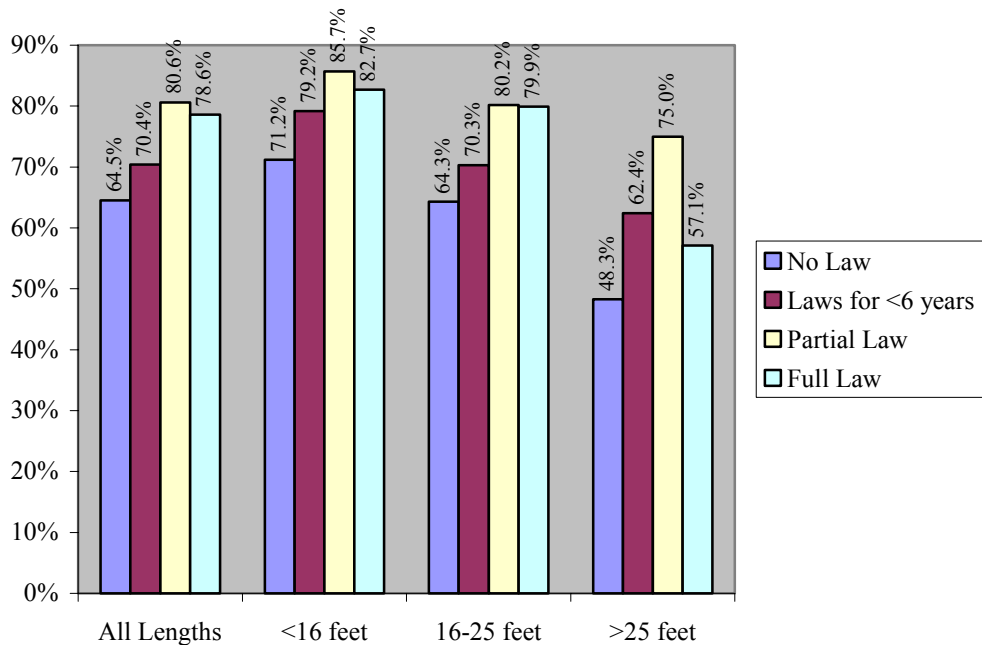
**Figure 3 PFD Use Among the Age Groups by Type of Law for All Boat Lengths**



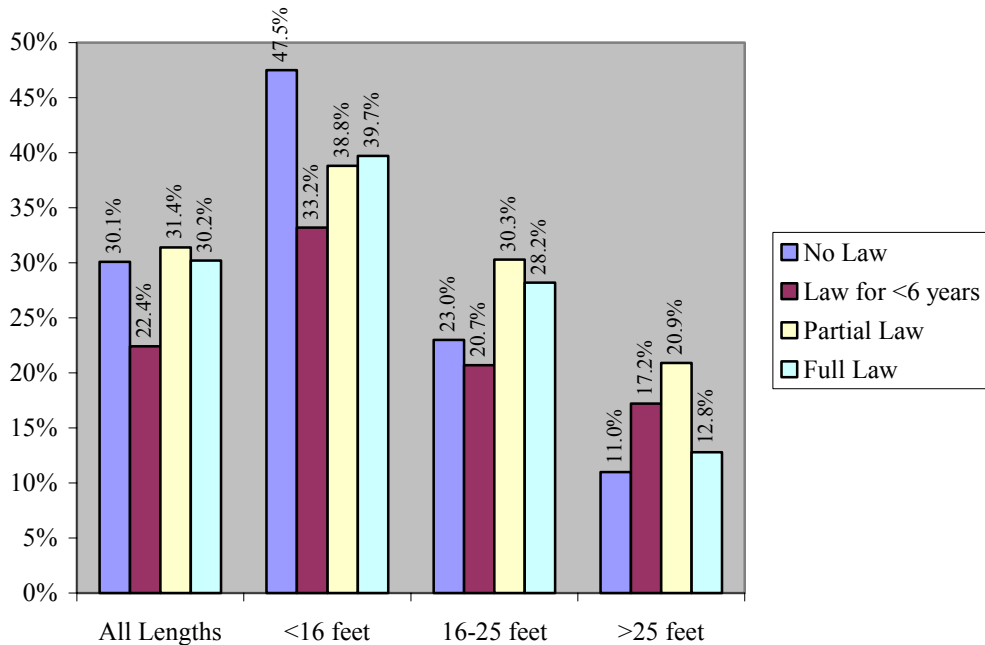
**Figure 4 PFD Use Among Youth 0-5 years by Length of Boat within each Level of Law Mandate**



**Figure 5 PFD Use Among Youth 6 to 12 years by Length of Boat within each Level of Law Mandate**



**Figure 6 PFD Use Among Adolescents 13 to 17 years by Length of Boat within each Level of Law Mandate**



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