2017 Life Jacket Wear Rate Observation Study

featuring

National Wear Rate Data from 1999 to 2017

YOUR BOATING DOLLARS AT WORK

Produced under a grant from the Sport Fish Restoration and Boating Trust Fund, administered by the U.S. Coast Guard.

2017 Life Jacket Wear Rate Observation Study

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National Wear Rate Data from 1999 to 2017

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I. INTRODUCTION

This report provides data and analysis on the 2017 National Life Jacket Wear Rate Observation Study with comparison information from the previous eighteen years' of studies (1999-2016). Tracking changes in life jacket 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 2016 Recreational Boating Statistics report, published by the United States Coast Guard (USCG), shows that among the 486 drowning deaths in 2016 where life jacket use or nonuse was known, 83% (404) of the individuals were reported as not wearing a life jacket. These statistics make it essential to not only track the national life jacket wear rate among recreational boaters, but also to understand the circumstances and patterns in which life jackets are worn.

Calendar year 2017 marked the nineteenth year of life jacket wear rate data collection efforts conducted by JSI Research & Training Institute. The cumulative years of data allow for a higher level of analysis (i.e., controlling for the impact of influencing factors like age, weather, and boat type) in order to unmask potential trends and indicators of increased or decreased life jacket wear among different groups of recreational boaters.

This year we added a new chapter that explores the impact of "risky" conditions on adult wear rates for each type of boat we observe. The analyses look both at individual risk factors and their effects on wear rates as well as investigating the result of multiple risks by creating a count of the number of "risky" conditions encountered by the boater. These analyses provide insights into how the boating public responds to encountered risks while boating.

Most information in this report is presented separately for adults (18+ years old) and youth (0 to 17 years old) since wear rates are substantially different for these two groups. Over the nineteen years of the presented data, the general distributions of age, gender, boat types, boat characteristics, and site characteristics have remained relatively stable. The appendix contains a detailed description of methods used and proportions of various boaters; boat and site characteristics are shown for the 1999-2017 period of data collection.

II. NATIONAL CORE DATA RESULTS

Adult Life Jacket Wear Rates on Open Motorboats 2006 to 2017

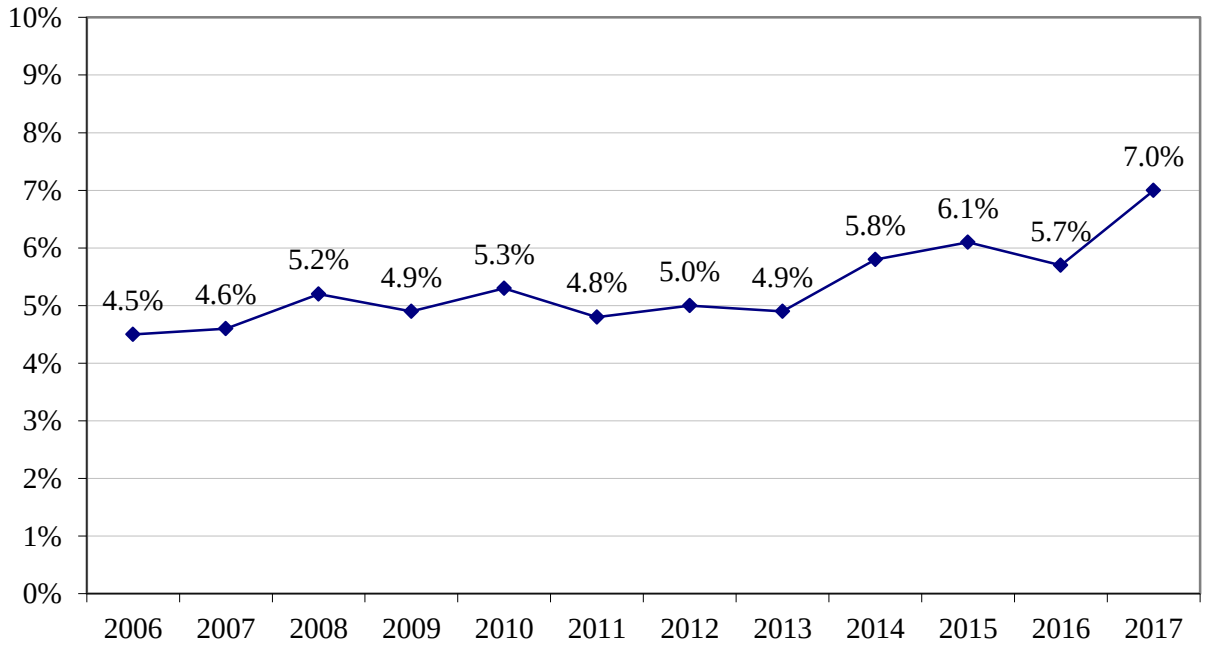
The National Boating Safety Advisory Council (NBSAC) recommended the creation of a strategic plan for the National Recreational Boating Safety Program in 2005. The goals, objectives, and strategies in this Plan can help all partners in boating safety work together to reduce the incidents of preventable deaths, injuries, and property damage. One of the objectives of all of the Strategic Plans since the 2005 plan is to increase the observed life jacket wear rate of adults in open motorboats. For the purposes of this measurement, "open motorboats" are a combination of the Skiff/Utility (hereafter as "skiffs") and Runabout/Speedboat (hereafter as "speedboats") categories that are individually presented later in this report. This objective was put in place beginning in 2006.

To ensure that comparisons to 2006 and each subsequent year are valid, the proportion of skiffs to speedboats in each state for each subsequent year was set to mirror the proportions found in 2006 since the wear rates for skiffs are generally greater than those for speedboats. For example, in 2006 the national proportion across all states of the number of skiffs to the number of speedboats was 22% versus 78%, but in 2011 the proportions were 31% to 69%. If proportions of these boat categories were not adjusted, the 2011 combined wear rate would appear more positive simply because JSI observed more skiffs relative to speedboats this year than in 2006. Similarly, the proportions are likely to fluctuate each year in each state.

Weighting each state's data to correspond to the 2006 state ratios, the adult wear rate for open motorboats in 2017 is 7.0% and represents a generally improving trend since 2006. (See Figure A for a chart showing these trends and also Table 2.2 on page 14.) This rate is the highest rate observed by the study to date. Since 2006 the wear rates for open motorboats have shown an increase by almost 56% since 2006 going from 4.5% to 7.0%.

Figure A – Adult Wear Rates on Open Motorboats* 2006-2017

(Weighted to 2006 Skiff-Speedboat Proportions for Each State)



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* The Open Motorboat category is created by grouping "Skiffs" and "Speedboat/Runabouts" together. Two factors are controlled for in this chart: Age (proportions of 18 to 64 and 65+ adults), and the proportion of Skiffs to Speedboat/Runabouts, which has been set each year within each state to reflect the proportions observed in 2006, the year in which the Strategic Plan goals were first measured. In addition, each state's contribution to the national average is weighted to reflect the 2006 proportions.

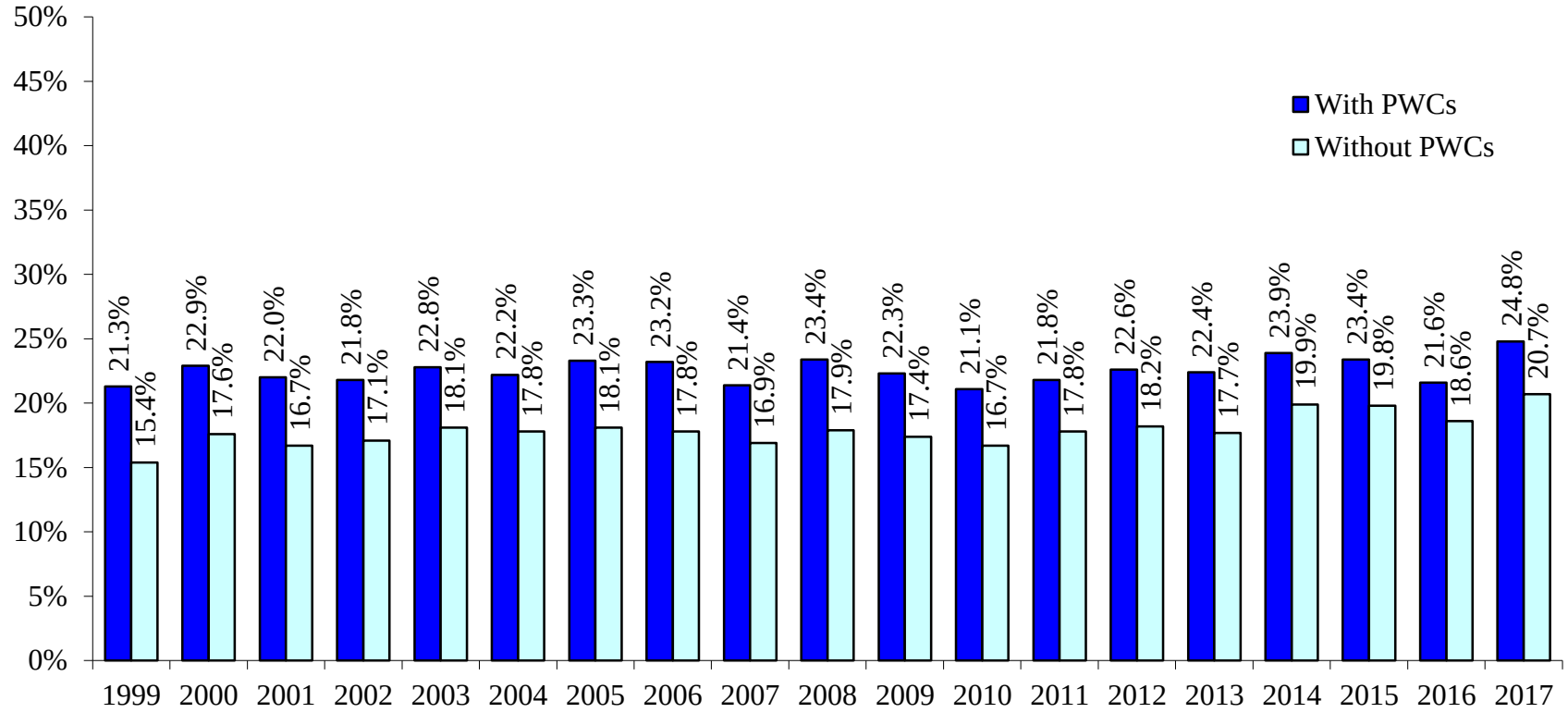
National Life Jacket Wear Rates for ALL Boaters 1999 to 2017

Figure B shows trends for national life jacket wear rates, including all groups of recreational boaters together (youth and adults) for two groups of boats - "all boats" and "all boats except PWCs". The two sets of data present a clear indication of the impact of PWCs (Personal Watercraft) on the overall average wear rates. In subsequent tables in this report we remove PWCs from the findings since this will provide a more valid representation of the trends in voluntary wear rates, because life jacket wear is mandated for operators and passengers of PWCs in almost all the states where observations occur (the exception is Alaska for adults).

The average life jacket wear rate for all boats and boaters combined for 2017 was 24.8%. This is the highest rate observed since the beginning of the study and represents an increase in the rate by 16%.

The 2017 average wear rate excluding PWCs was 20.7%, which represents a relative increase of 34% since 1999 and is the highest wear rate observed since 1999.

Figure B – Life Jacket Wear Rates for ALL Boaters



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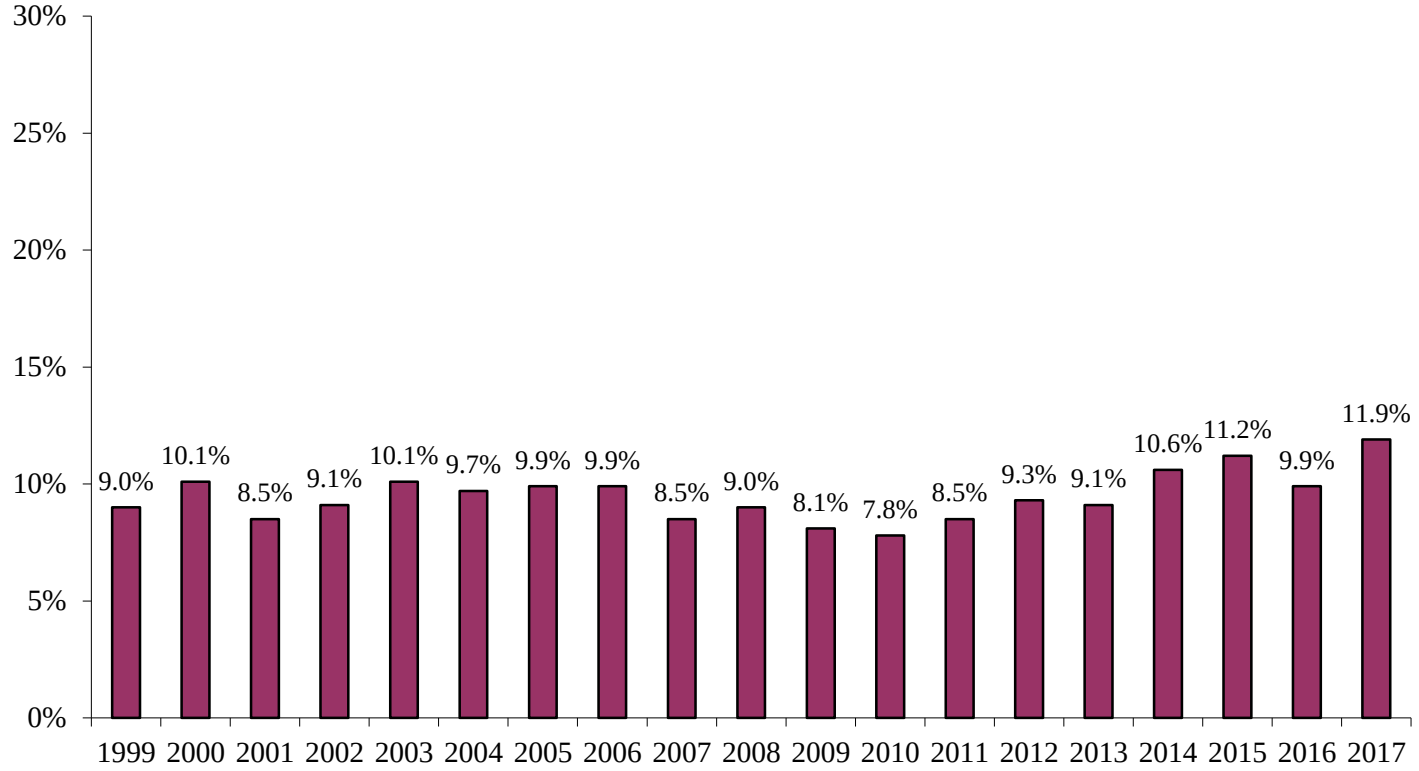
*Factors controlled for: Age & Boat Type.

National Life Jacket Wear Rates for ADULTS (18 years or older) 1999 to 2017

Figure C and Table 2.1 show the national wear rate trend for all adults on all boats excluding PWCs. The national average wear rate for all adults in 2017 was 11.9%. The 2017 rate is the highest rate recorded to date representing a 32% increase since 1999 and a 53% increase since 2010 that had the lowest rate observed at 7.8%.

Figure C – Life Jacket Wear Among Adult Boaters*

(All boats except PWCs)



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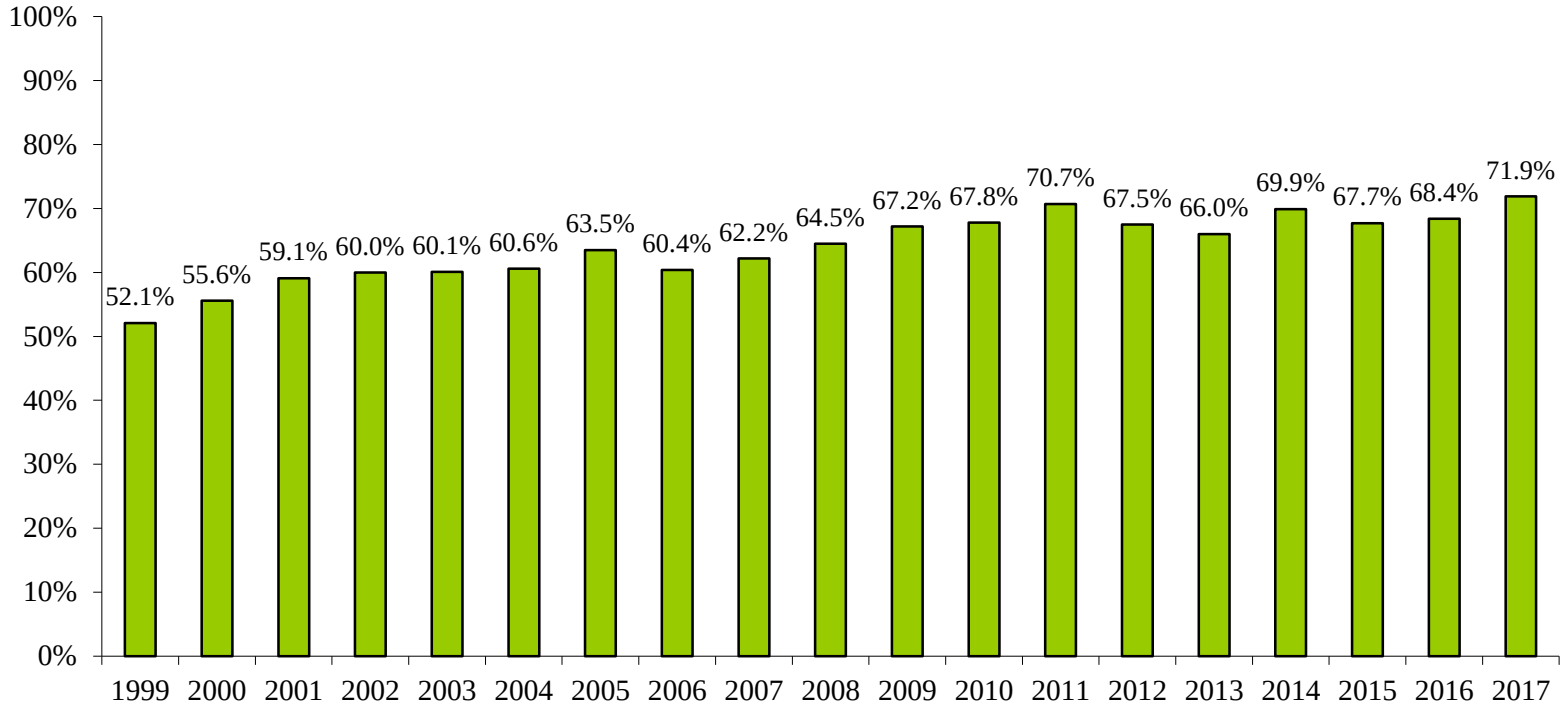
*Factors controlled for: Age & Boat Type.

National Life Jacket Wear Rates for YOUTH (17 years or younger) 1999 to 2017

Figure D and Table 2.1 show the national wear rate trend for all youth (17 years or younger) on all boats except PWCs. These rates are relatively high across the nineteen years of data shown, but still with a general upward trend. The rate for 2017 is 71.9%. This is the highest rate recorded to date, surpassing the previously reported high in 2011 and represents a 38% increase since 1999.

Figure D – Life Jacket Wear Among Youth Boaters*

(All boats except PWCs)



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*Factors controlled for: Age & Boat Type.

Life Jacket Wear Rates by Age Categories 1999 to 2017

Table 2.1 presents wear rates by the different age categories captured in the study.

The youth (0-17) wear rate for 2017 was 71.9%, an increase from last year and the highest reported to date; this represents a 38% increase in wear rates for youth since 1999. All youth age groups experienced an increase in wear rate compared to 2016 levels. Wear rates for youth under 6 years old were 94.1% in 2017; for those between 6 and 12 years of age rates were 87.3%; and for teens (ages 13 to 17) rates were 46.5%. The wear rate for teens was the highest ever observed and represents a 93% increase since 1999.

For adults ages 18 to 64, the 2017 wear rate is 11.9%, an increase from 2016 levels. This is the highest rate recorded to date and represents a 34% increase since 1999.

For adults 65 years of age and older, the 2017 data show a wear rate of 12.2% also an increase from 2016 rates.

As indicated in Figure C and in Table 2.1, for the combined adult group (18+ years), there has been an increase in wear rate from 7.8% in 2010 (a low point) to 11.9% in 2017 or a relative increase of 53%.

Table 2.1 – Life Jacket Wear Rates by Age Excluding Boaters on PWCs*

Age	Observation Year																		
	1999 % (N's)	2000 % (N's)	2001 % (N's)	2002 % (N's)	2003 % (N's)	2004 % (N's)	2005 % (N's)	2006 % (N's)	2007 % (N's)	2008 % (N's)	2009 % (N's)	2010 % (N's)	2011 % (N's)	2012 % (N's)	2013 % (N's)	2014 % (N's)	2015 % (N's)	2016 % (N's)	2017 % (N's)
0-5 yrs	80.6%	89.1%	91.7%	90.1%	90.3%	94.9%	93.1%	94.4%	92.2%	93.5%	93.6%	94.8%	96.6%	94.7%	93.5%	94.5%	92.1%	92.9%	94.1%
	(500)	(716)	(703)	(676)	(658)	(743)	(714)	(921)	(930)	(938)	(854)	(811)	(874)	(662)	(789)	(804)	(694)	(573)	(555)
6-12 yrs	69.1%	72.1%	76.6%	79.2%	79.7%	81.6%	80.6%	79.1%	84.1%	87.3%	86.5%	89.1%	90.7%	84.9%	85.4%	87.3%	87.2%	84.1%	87.3%
	(2104)	(2696)	(3122)	(2752)	(2627)	(27411)	(2487)	(2403)	(2819)	(2579)	(2812)	(2809)	(2381)	(2844)	(2494)	(2757)	(2227)	(2184)	(2131)
13-17 yrs	24.1%	30.5%	31.2%	32.4%	32.0%	29.8%	32.8%	33.5%	31.5%	33.2%	38.9%	35.1%	41.4%	37.6%	34.9%	41.6%	37.2%	41.5%	46.5%
	(2244)	(2725)	(2893)	(2575)	(2767)	(2572)	(2230)	(2403)	(2652)	(2507)	(2420)	(2127)	(1817)	(2163)	(1933)	(1837)	(1694)	(1675)	(2077)
0-17 yrs (all youth)	52.1%	55.6%	59.1%	60.0%	60.1%	60.6%	63.5%	60.4%	62.2%	64.5%	67.2%	67.8%	70.7%	67.5%	66.0%	69.9%	67.7%	68.4%	71.9%
	(4624)	(6094)	(6695)	(5924)	(5970)	(5955)	(5414)	(5713)	(6401)	(6024)	(6086)	(5747)	(5072)	(5669)	(5216)	(5398)	(4615)	(4432)	(4763)
18-64 yrs	8.8%	10.1%	8.5%	9.2%	10.1%	9.7%	9.9%	10.0%	8.4%	9.1%	8.1%	7.7%	8.5%	9.2%	9.1%	10.4%	11.1%	9.9%	11.9%
	(24321)	(27100)	(32528)	(31742)	(28551)	(33319)	(30176)	(29591)	(32108)	(30743)	(34632)	(36420)	(33267)	(32298)	(30843)	(33058)	(31012)	(30906)	(29760)
65+ yrs	12.9%	9.9%	6.9%	6.8%	9.4%	8.3%	11.0%	8.3%	11.7%	6.1%	7.0%	10.7%	7.2%	11.8%	6.9%	13.3%	12.3%	11.0%	12.2%
	(1147)	(1040)	(1276)	(922)	(1106)	(1331)	(823)	(803)	(881)	(1190)	(1129)	(763)	(951)	(1122)	(1091)	(1634)	(1232)	(1339)	(1134)
18+ yrs (all adults)	9.0%	10.1%	8.5%	9.1%	10.1%	9.7%	9.9%	9.9%	8.5%	9.0%	8.1%	7.8%	8.5%	9.3%	9.1%	10.6%	11.2%	9.9%	11.9%
	(25468)	(28140)	(33804)	(32664)	(29657)	(34650)	(30999)	(30394)	(32989)	(31933)	(35761)	(37003)	(34218)	(33420)	(31934)	(34692)	(32244)	(32245)	(30894)

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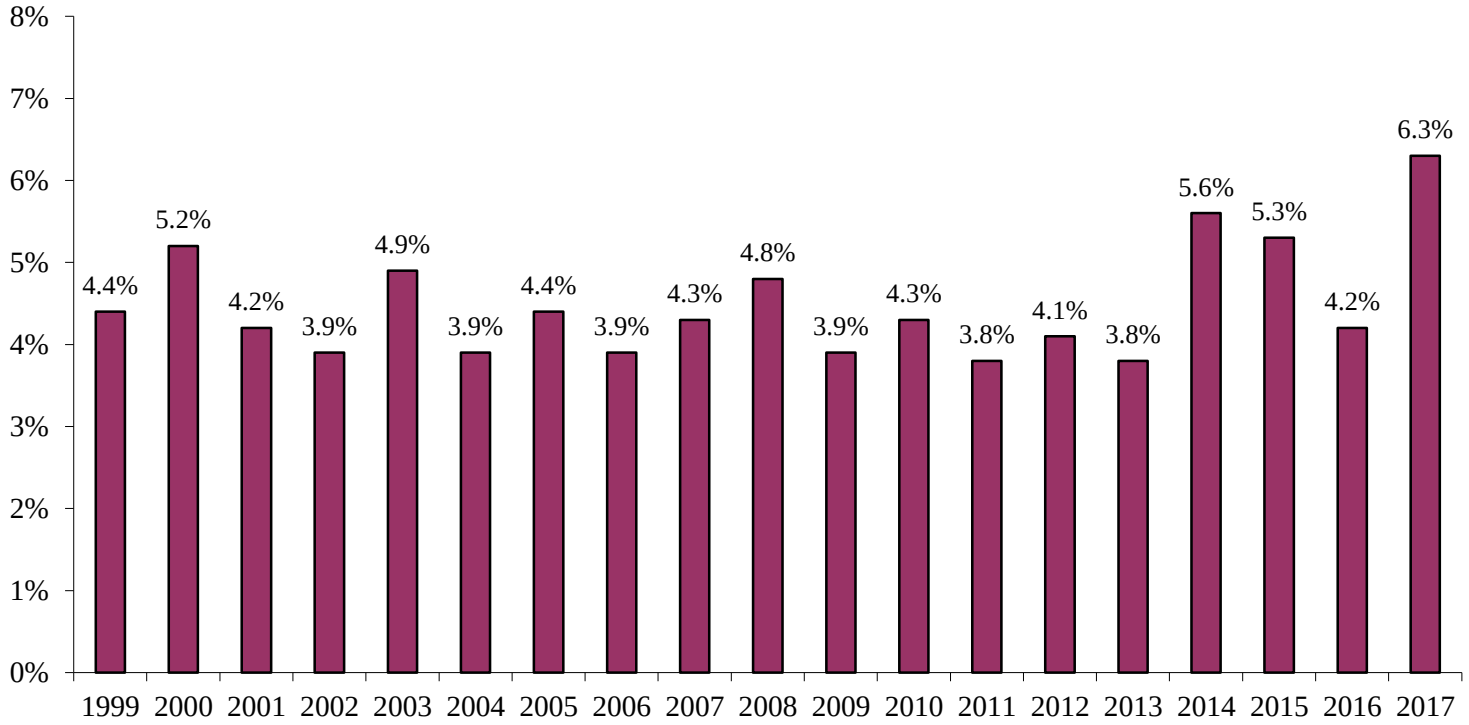
*Factors controlled for: Age & Boat Type.

Powerboats for Adults (18 years or older)

Figure E and Table 2.2 present information for all powerboats for adults. Almost all types of powerboats showed increases in wear rates over the 2016 data. The 2017 rate for all powerboats is 6.3%. This represents a 43% increase since 1999. Speedboats, the most popular type of powerboat, showed a wear rate of 4.6%, the highest rate observed since 2005. Open motorboats, which included a combination of skiffs and speedboats, showed a 2017 wear rate of 7.0%; the highest rate observed for open motor boats since 2006 when this boat type was first reported on.

Figure E – Adult Wear Rates for ALL Powerboats Except PWCs*



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*Factors controlled for: Age & Boat Type.

Table 2.2 - Life Jacket Wear Rates by Powerboats for Adults*

Boat Type	Observation Year																		
	1999 % (N's)	2000 % (N's)	2001 % (N's)	2002 % (N's)	2003 % (N's)	2004 % (N's)	2005 % (N's)	2006 % (N's)	2007 % (N's)	2008 % (N's)	2009 % (N's)	2010 % (N's)	2011 % (N's)	2012 % (N's)	2013 % (N's)	2014 % (N's)	2015 % (N's)	2016 % (N's)	2017 % (N's)
All Powerboats	4.4%	5.2%	4.2%	3.9%	4.9%	3.9%	4.4%	3.9%	4.3%	4.8%	3.9%	4.3%	3.8%	4.1%	3.8%	5.6%	5.3%	4.2%	6.3%
(no PWC's)	(19894)	(22448)	(27864)	(26304)	(24190)	(28285)	(25741)	(25412)	(27623)	(27315)	(29924)	(30894)	(28954)	(27890)	(26786)	(28766)	(26444)	(26774)	(25823)
Skiff/Utility	10.0%	10.3%	9.7%	5.9%	10.4%	7.9%	7.2%	7.3%	8.5%	9.2%	6.9%	9.7%	8.2%	7.8%	6.4%	13.1%	10.2%	7.4%	10.8%
	(1867)	(1903)	(2469)	(3177)	(4214)	(4429)	(5038)	(4091)	(5340)	(6633)	(7257)	(6634)	(6530)	(6936)	(7231)	(6776)	(6592)	(7338)	(7558)
Runabout/ Speedboat	4.2%	5.3%	4.5%	4.3%	4.6%	3.9%	4.7%	3.7%	3.6%	4.1%	3.5%	3.2%	3.0%	3.3%	3.5%	3.5%	4.1%	3.5%	4.6%
	(13195)	(14463)	(16985)	(14066)	(13057)	(16633)	(13643)	(14512)	(14414)	(13901)	(14635)	(15093)	(14381)	(13441)	(11686)	(13040)	(11853)	(11736)	(10192)
Runabout/ Speedboat	3.6%	4.6%	3.9%	3.6%	3.9%	3.2%	3.7%	2.8%	2.9%	3.1%	2.5%	2.2%	2.3%	2.3%	2.4%	2.6%	3.5%	2.7%	3.7%
(Excluding Towed Participants)	(13096)	(14364)	(16872)	(13969)	(12963)	(16477)	(13480)	14376)	(14313)	(13744)	(14481)	(14947)	(14279)	(13294)	(11554)	(12923)	(11766)	(11638)	(10101)
Open Motorboats**	5.5%	6.4%	5.6%	4.7%	5.9%	4.8%	5.3%	4.5%	4.6%	5.2%	4.9%	5.3%	4.8%	5.0%	4.9%	5.8%	6.1%	5.7%	7.0%
	(15062)	(16366)	(19454)	(17243)	(17271)	(21052)	(18681)	(18603)	(19754)	(20534)	(21892)	(21727)	(20911)	(20377)	(18917)	(19816)	(18445)	(19074)	(17750)
Cabin Cruiser	1.8%	1.6%	1.2%	1.9%	1.7%	1.0%	1.1%	1.7%	2.0%	1.4%	1.6%	1.5%	1.6%	1.6%	1.0%	2.2%	2.7%	1.4%	3.9%
	(3396)	(4391)	(6222)	(7111)	(5119)	(5242)	(5054)	(4280)	(5353)	(4430)	(5342)	(5900)	(5085)	(4611)	(4719)	(4669)	(4782)	(4418)	(4301)
Houseboat	0.0%	0.0%	0.6%	0.8%	0.0%	5.6%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%	0.8%	1.6%	0.0%	0.0%
	(151)	(216)	(162)	(124)	(328)	(216)	(219)	(112)	(43)	(51)	(31)	(140)	(309)	(18)	(51)	(131)	(64)	(93)	(32)
Pontoon	4.0%	6.2%	1.9%	2.7%	2.9%	2.9%	4.1%	2.4%	2.7%	1.1%	2.1%	1.5%	1.4%	2.3%	1.4%	2.4%	2.6%	1.5%	3.4%
	(1231)	(1458)	(1929)	(1796)	(1610)	(1770)	(1849)	(2276)	(2150)	(2051)	(2436)	(2922)	(2734)	(2624)	(2917)	(3966)	(2961)	(3080)	(3438)
PWC	94.2%	97.4%	96.0%	95.8%	94.7%	95.5%	95.3%	97.1%	96.1%	97.6%	97.4%	97.5%	97.7%	96.9%	96.3%	96.9%	97.6%	95.6%	97.9%
	(1899)	(1761)	(2091)	(1798)	(1589)	(1721)	(1858)	(1962)	(1736)	(2009)	(2093)	(1921)	(1524)	(1811)	(1905)	(1856)	(1501)	(1256)	(1625)
Powered Inflatable/ Raft	15.7%	22.3%	13.5%	27.2%	14.8%	9.0%	1.9%	11.0%	19.1%	17.6%	11.9%	16.7%	14.3%	14.1%	27.2%	22.9%	12.8%	23.8%	13.1%
	(205)	(233)	(259)	(154)	(190)	(211)	(157)	(253)	(366)	(228)	(254)	(345)	(224)	(278)	(233)	(315)	(256)	(223)	(334)

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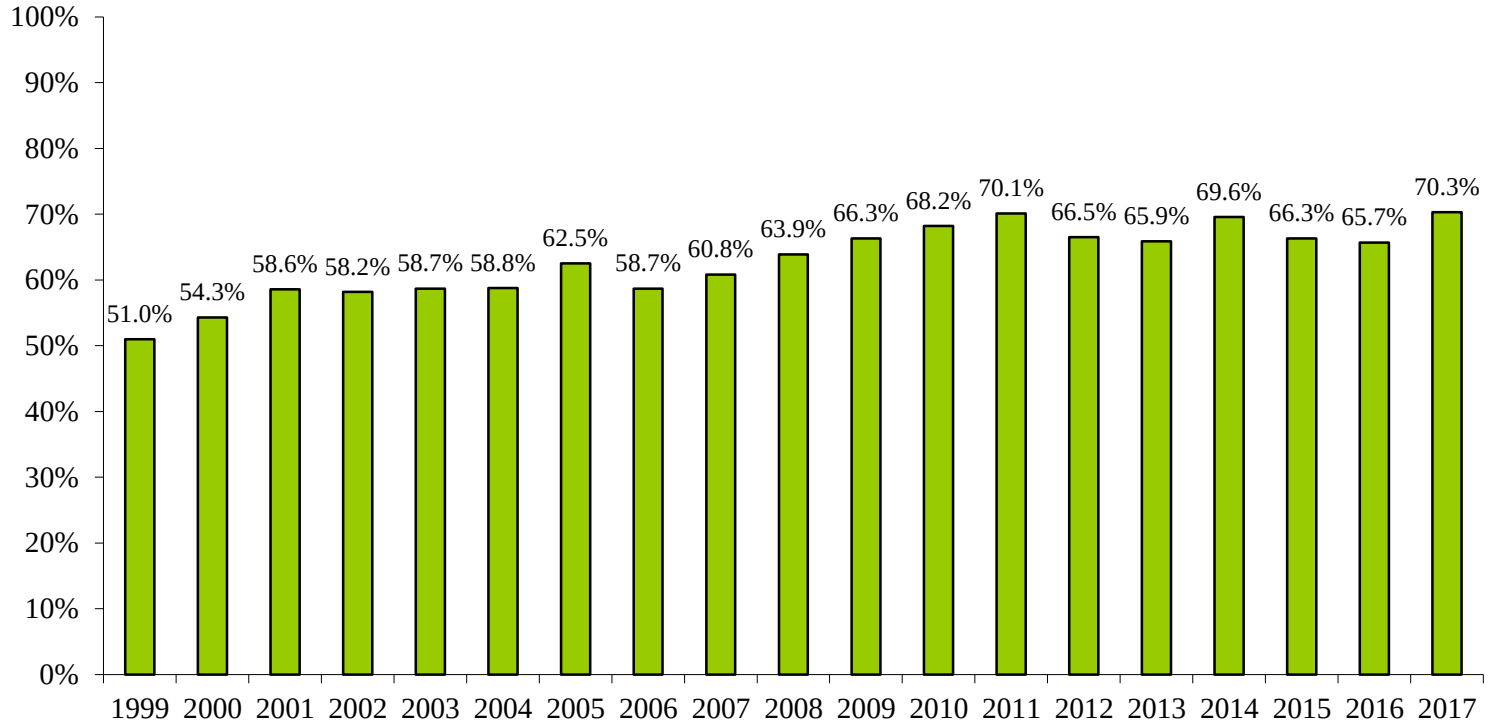
*Factors controlled for: Age & Boat Type.

** The Open Motorboat category is created by grouping "Skiffs" and "Speedboat/Runabouts" together. Factors controlled for in this line of the chart are Age (proportions of 18 to 64 and 65+ adults) and he proportion of Skiffs to Speedboat/Runabouts has been set in each year within each state to reflect the proportions observed in 2006, the year in which the Strategic Plan goals were first measured. In addition, each state's contribution to the national average is weighted to reflect the 2006 proportion.

Powerboats for Youth (17 years or younger)

Figure F and Table 2.3 present data for all powerboats for the three age groups of youth combined (17 years or younger). Wear rates for youth have been generally increasing over the years although they have leveled off since 2012. The 2017 wear rate is 70.3%, the highest rate recorded to date and represents a 38% increase since 1999.

Figure F – Youth Wear Rates for ALL Powerboats Except PWCs*



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*Factors controlled for: Age & Boat Type.

Table 2.3 – Life Jacket Wear Rates by Powerboats for Youth*

Boat Type	Observation Year																		
	1999 % (N's)	2000 % (N's)	2001 % (N's)	2002 % (N's)	2003 % (N's)	2004 % (N's)	2005 % (N's)	2006 % (N's)	2007 % (N's)	2008 % (N's)	2009 % (N's)	2010 % (N's)	2011 % (N's)	2012 % (N's)	2013 % (N's)	2014 % (N's)	2015 % (N's)	2016 % (N's)	2017 % (N's)
All Powerboats	51.0%	54.3%	58.6%	58.2%	58.7%	58.8%	62.5%	58.7%	60.8%	63.9%	66.3%	68.2%	70.1%	66.5%	65.9%	69.6%	66.3%	65.7%	70.3%
(no PWCs)	(3834)	(5179)	(5717)	(5162)	(5170)	(5191)	(4737)	(5043)	(5583)	(5257)	(5451)	(5090)	(4589)	(4846)	(4546)	(4798)	(4028)	(3750)	(4118)
Skiff/Utility	52.7%	49.5%	68.2%	54.9%	63.2%	60.7%	63.3%	58.4%	63.1%	68.4%	70.4%	68.1%	75.4%	65.1%	66.3%	70.8%	68.2%	65.6%	73.7%
	(338)	(369)	(441)	(557)	(768)	(641)	(781)	(661)	(947)	(988)	(1097)	(862)	(929)	(1022)	(936)	(901)	(948)	(871)	(980)
Runabout/ Speedboat	51.6%	55.2%	58.8%	59.4%	60.0%	60.0%	63.5%	60.9%	61.7%	64.6%	68.2%	69.7%	71.0%	69.9%	69.2%	70.5%	68.1%	66.3%	70.6%
	(2744)	(3776)	(3987)	(3479)	(3369)	(3574)	(2966)	(3348)	(3517)	(3256)	(3133)	(2943)	(2624)	(2744)	(2482)	(2696)	(2121)	(1934)	(2019)
Open Motorboats**	51.8%	54.3%	60.1%	58.7%	60.5%	60.1%	63.5%	60.5%	61.9%	65.2%	68.6%	69.5%	71.6%	69.1%	68.7%	70.6%	68.2%	66.6%	71.2%
(Skiff/Utility+ Runabout/ Speedboat)	(3082)	(4145)	(4428)	(4036)	(4137)	(4215)	(3747)	(4009)	(4464)	(4244)	(4230)	(3805)	(3553)	(3766)	(3418)	(3597)	(3069)	(2805)	(2019)
Cabin Cruiser	42.6%	48.2%	48.3%	50.7%	45.3%	49.6%	54.6%	50.7%	52.0%	51.0%	51.2%	58.8%	61.6%	50.6%	48.9%	56.6%	58.9%	58.7%	59.7%
	(418)	(587)	(774)	(690)	(659)	(529)	(528)	(501)	(639)	(581)	(644)	(524)	(507)	(465)	(505)	(364)	(430)	(409)	(473)
Houseboat	8.7%	12.7%	25.7%	30.3%	17.8%	24.7%	12.9%	28.2%	37.6%	0.0%	25.8%	19.1%	39.9%	6.9%	84.9%	0.0%	34.2%	43.0%	84.9%
	(46)	(64)	(44)	(30)	(63)	(35)	(38)	(40)	(5)	(1)	(4)	(18)	(19)	(3)	(1)	(2)	(10)	(8)	(1)
Pontoon	38.3%	46.3%	54.8%	55.6%	51.8%	48.5%	64.6%	50.3%	64.1%	65.9%	66.2%	68.4%	65.7%	67.3%	66.7%	71.9%	63.2%	65.5%	72.2%
	(272)	(379)	(455)	(399)	(338)	(394)	(440)	(505)	(414)	(392)	(530)	(716)	(494)	(580)	(598)	(787)	(511)	(508)	(606)
PWC	96.0%	99.1%	99.1%	98.8%	98.0%	98.5%	98.3%	99.2%	98.7%	99.4%	98.6%	99.4%	99.1%	98.7%	98.0%	99.7%	99.0%	98.7%	98.2%
	(551)	(649)	(691)	(502)	(562)	(543)	(652)	(580)	(522)	(664)	(572)	(427)	(376)	(401)	(371)	(365)	(292)	(154)	(275)
Powered Inflatable/Raft	59.3%	69.7%	79.5%	72.8%	66.8%	65.8%	71.2%	70.6%	71.1%	79.7%	70.3%	78.2%	73.1%	58.5%	65.4%	68.9%	69.5%	84.0%	68.9%
	(62)	(68)	(60)	(37)	(36)	(53)	(22)	(28)	(66)	(39)	(47)	(45)	(35)	(35)	(25)	(50)	(18)	(28)	(40)

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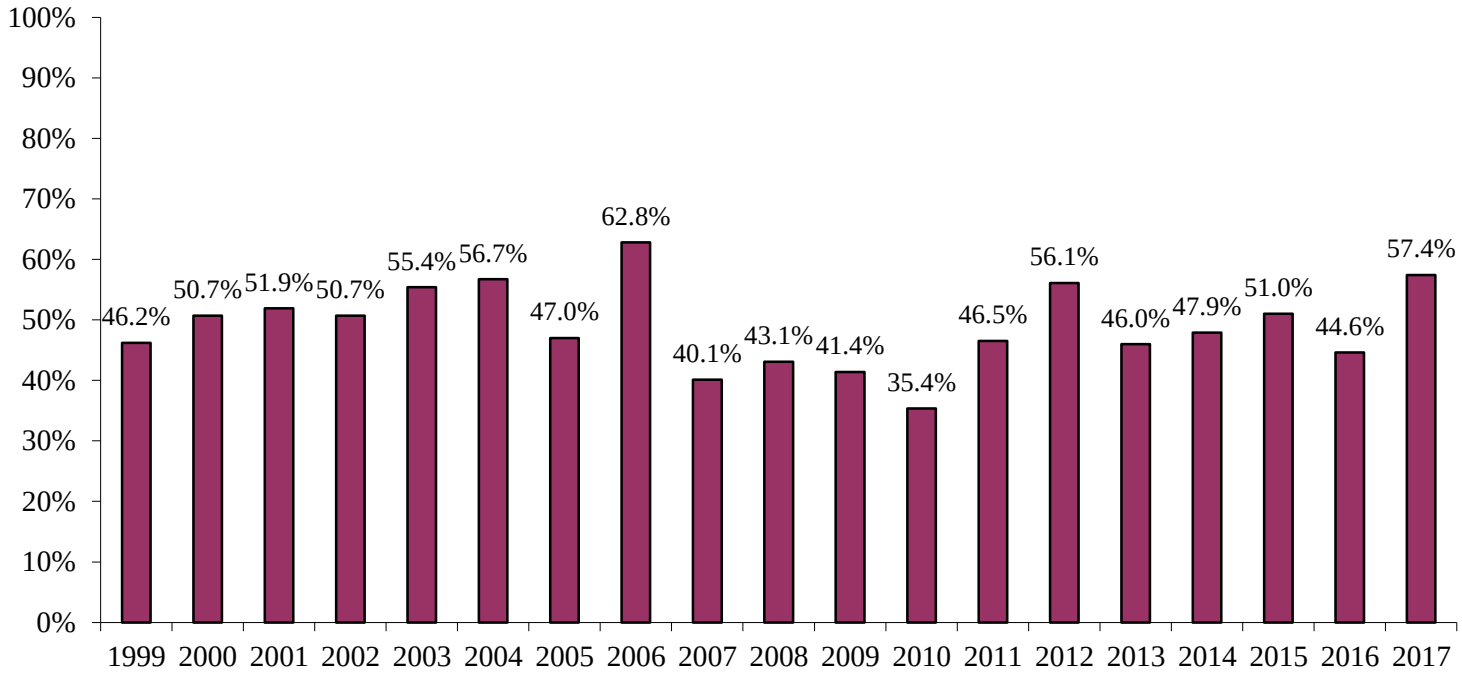
*Factors controlled for: Age & Boat Type.
** The Open Motorboat category is created by grouping "Skiffs" and "Speedboat/Runabouts" together. The proportion of Skiffs to Speedboat/Runabouts has been set to reflect the national proportions observed in 2006, the year in which the Strategic Plan goals were first measured. In addition, we control for age of youth as we do for the other boat types in this table.

Paddlecraft for Adults (18 years or older)

Table 2.4 presents results for adults in all types of paddlecraft and Figure G shows the trends for all paddlecraft excluding standup paddleboards (since this is a relatively new type of boat to be seen). The 2017 rates for all paddlecraft excluding standup paddleboards (57.4%) are the highest observed since 2006. These changes in rates should be viewed with caution, since paddlecraft activity is mostly observed at only a few sites; therefore, the overall averages can be highly influenced by local factors such as weather or special events at these sites.

In 2015 we added two rows of data to Table 2.4. One for standup paddleboards (first observed in 2010) and one for an all paddlecraft rate including standup paddleboards. The number of boaters observed has increased since 2010 and wear rates for standup paddleboards have exceeded 50% since 2012, despite showing a decrease from 2016 to 2017.

Figure G – Adult Wear Rates for ALL Paddlecraft (excluding Paddleboards)*



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*Factors controlled for: Age & Boat Type.

Table 2.4 – Life Jacket Wear Rates by Paddlecraft for Adults*

Boat Type	Observation Year																	
	1999 % (N's)	2000 % (N's)	2001 % (N's)	2002 % (N's)	2003 % (N's)	2004 % (N's)	2005 % (N's)	2006 % (N's)	2007 % (N's)	2008 % (N's)	2009 % (N's)	2010 % (N's)	2011 % (N's)	2012 % (N's)	2013 % (N's)	2014 % (N's)	2015 % (N's)	2016 % (N's)	2017 % (N's)
All Paddlecraft	46.2%	50.7%	51.9%	50.7%	55.4%	56.7%	47.0%	62.8%	40.1%	43.1%	41.4%	35.4%	46.5%	56.1%	46.0%	47.9%	51.0%	44.6%	57.4%
(excluding SUPs)	(1676)	(1676)	(1816)	(1864)	(1672)	(1637)	(1616)	(1456)	(2065)	(1523)	(1939)	(2551)	(1608)	(2015)	(1919)	(2555)	(2531)	(2391)	(2251)
Paddled Inflatable/ Raft	71.8%	13.0%	65.1%	65.6%	60.5%	57.8%	76.0%	77.8%	23.9%	38.4%	8.2%	6.9%	10.9%	39.4%	15.8%	18.2%	39.1%	28.2%	45.9%
	(174)	(198)	(250)	(307)	(290)	(283)	(225)	(308)	(526)	(311)	(340)	(813)	(324)	(485)	(271)	(337)	(455)	(371)	(354)
Rowboat/ Dinghy	24.4%	37.2%	18.7%	27.3%	22.8%	10.1%	59.2%	26.7%	15.0%	23.0%	35.3%	34.8%	34.3%	60.2%	17.8%	29.0%	22.1%	40.2%	43.0%
	(82)	(118)	(119)	(193)	(117)	(38)	(71)	(78)	(92)	(65)	(51)	(46)	(87)	(35)	(75)	(79)	(37)	(56)	(73)
Canoe	17.7%	33.8%	23.6%	15.4%	30.4%	26.7%	14.8%	29.2%	19.4%	19.7%	25.0%	19.1%	37.4%	32.7%	35.7%	24.9%	30.0%	14.6%	30.0%
	(809)	(714)	(750)	(701)	(607)	(622)	(679)	(364)	(764)	(481)	(758)	(994)	(386)	(438)	(569)	(744)	(716)	(605)	(532)
Kayak	82.7%	85.7%	84.4%	85.7%	81.4%	87.0%	74.1%	77.9%	72.0%	65.5%	72.6%	75.9%	68.6%	74.9%	67.9%	74.9%	70.7%	71.5%	71.3%
	(611)	(646)	(697)	(663)	(658)	(694)	(675)	(706)	(683)	(648)	(790)	(698)	(811)	(1056)	(1004)	(1395)	(1323)	(1359)	(1292)
Canoe/Kayak Combined	45.9%	58.6%	53.1%	49.7%	56.8%	58.6%	44.4%	61.2%	44.3%	46.0%	49.1%	47.3%	49.4%	52.8%	50.9%	51.9%	51.6%	47.3%	52.3%
	(1420)	(1360)	(1447)	(1364)	(1265)	(1316)	(1354)	(1070)	(1447)	(1129)	(1548)	(1692)	(1197)	(1494)	(1573)	(2139)	(2039)	(1964)	(1824)
Paddleboards (SUPs)												27.8%	41.7%	52.9%	58.7%	53.9%	52.0%	54.6%	50.9%
												(54)	(84)	(157)	(264)	(397)	(348)	(407)	(509)
All Paddlecraft**												35.5%	46.0%	55.0%	45.4%	48.7%	51.1%	46.0%	56.2%
(including SUPs)												(2605)	(1692)	(2171)	(2183)	(2952)	(2879)	(2798)	(2760)

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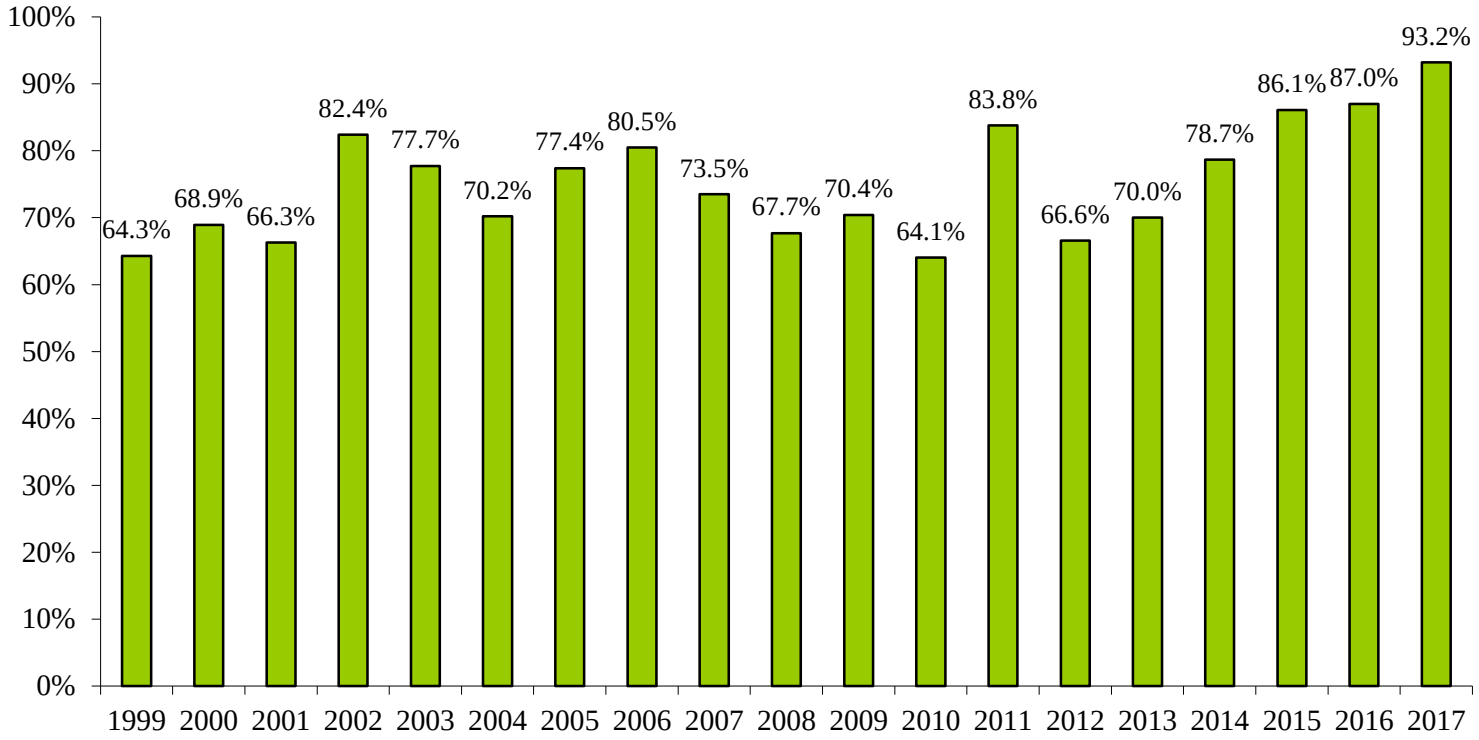
*Factors controlled for: Age & Boat Type.
**Data for this line in the table have been corrected on 5-21-2015 from the earlier published version

Paddlecraft for Youth (17 years or younger)

Figure H and Table 2.5 present results for youth in paddlecraft. Data in this table should be viewed with caution because of the relatively small number of youth who use these types of craft. For all paddlecraft combined excluding standup paddleboards, the wear rate in 2017 was 93.2% which continues the upward trend observed since 2012. In 2017, the wear rate for youth on standup paddleboards was 75.0%. However, this should be viewed with caution since relatively few youth were observed on standup paddleboards.

Figure H – Youth Wear Rates for ALL Paddlecraft*



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*Factors controlled for: Age & Boat Type.

Table 2.5 – Life Jacket Wear Rates by Paddlecraft for Youth*

Boat Type	Observation year																		
	1999 % (N's)	2000 % (N's)	2001 % (N's)	2002 % (N's)	2003 % (N's)	2004 % (N's)	2005 % (N's)	2006 % (N's)	2007 % (N's)	2008 % (N's)	2009 % (N's)	2010 % (N's)	2011 % (N's)	2012 % (N's)	2013 % (N's)	2014 % (N's)	2015 % (N's)	2016 % (N's)	2017 % (N's)
All Paddlecraft	64.3%	68.9%	66.3%	82.4%	77.7%	70.2%	77.4%	80.5%	73.5%	67.7%	70.4%	64.1%	83.8%	66.6%	70.0%	78.7%	86.1%	87.0%	93.2%
(excluding SUPs)	(317)	(457)	(457)	(312)	(372)	(360)	(281)	(225)	(520)	(487)	(319)	(419)	(231)	(476)	(371)	(337)	(340)	(389)	(414)
Paddled Inflatable/ Raft	62.4%	45.8%	52.3%	90.3%	68.9%	68.4%	77.5%	77.9%	58.4%	55.6%	59.0%	41.9%	68.5%	50.2%	55.1%	68.7%	83.5%	84.4%	85.0%
	(82)	(124)	(153)	(136)	(113)	(118)	(79)	(87)	(244)	(218)	(76)	(139)	(49)	(192)	(98)	(100)	(112)	(119)	(127)
Rowboat/ Dinghy	11.1%	47.1%	60.3%	54.7%	88.6%	58.0%	77.1%	67.3%	61.0%	77.8%	91.1%	98.0%	94.0%	88.0%	90.6%	74.2%	78.2%	99.3%	83.9%
	(9)	(15)	(32)	(31)	(21)	(11)	(17)	(26)	(21)	(25)	(9)	(14)	(15)	(10)	(10)	(23)	(4)	(15)	(3)
Canoe	57.7%	74.6%	62.4%	71.1%	75.0%	60.3%	69.4%	68.9%	81.0%	78.0%	70.6%	68.0%	95.2%	66.5%	78.0%	78.4%	82.1%	70.0%	92.6%
	(142)	(222)	(181)	(98)	(130)	(146)	(101)	(49)	(123)	(158)	(132)	(169)	(82)	(89)	(139)	(87)	(61)	(57)	(102)
Kayak	83.3%	89.2%	94.3%	83.7%	91.6%	91.2%	88.7%	89.0%	90.1%	83.5%	85.3%	85.4%	89.3%	84.8%	77.0%	90.7%	91.9%	85.4%	94.5%
	(84)	(96)	(91)	(47)	(108)	(85)	(94)	(63)	(132)	(86)	(102)	(97)	(85)	(185)	(124)	(127)	(163)	(198)	(182)
Canoe/Kayak Combined	67.3%	78.9%	73.1%	74.5%	82.9%	71.3%	79.6%	82.2%	85.7%	80.0%	76.0%	75.1%	88.8%	74.6%	77.2%	83.3%	85.6%	78.3%	92.0%
	(226)	(318)	(272)	(145)	(238)	(231)	(195)	(112)	(255)	(244)	(234)	(266)	(167)	(274)	(263)	(214)	(224)	(255)	(284)
Paddleboards (SUPs)										0.0%	100%	33.3%	100%	92.3%	51.9%	75.0%	77.5%	73.4%	75.0%
										(3)	(1)	(9)	(5)	(13)	(52)	(44)	(40)	(84)	(80)
All Paddlecraft**										67.3%	70.5%	63.5%	84.1%	67.3%	63.8%	78.3%	85.2%	84.6%	90.3%
(including SUPs)										(490)	(320)	(428)	(236)	(489)	(423)	(381)	(380)	(473)	(494)

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*Factors controlled for: Age & Boat Type.
**Data for this line in the table have been corrected on 5-21-2015 from the earlier published version.

Sailboats for Adults (18 years or older)

Figure I and Table 2.6 document observations of adults in sailboats. For all sailboats combined, the wear rate of 28.0% is the second highest wear rate observed since 1999 and represents a 106% increase over this time period. The 2017 rate is a drop from the all time high of 31.1% in 2015 but a slight increase from that reported in 2016. Even though 2017 rates for both day sailors and cabin sailboats are somewhat lower than the highest rates, the 2017 rates represent dramatic changes since 1999-- Day Sailors (102% increase) and Cabin Sailboats (107% increase)

Figure I – Adult Wear Rates for ALL Sailboats*

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*Factors controlled for: Age & Boat Type.

Table 2.6 – Life Jacket Wear Rates by Sailboats for Adults*

Boat Type	Observation Year																		
	1999 % (N's)	2000 % (N's)	2001 % (N's)	2002 % (N's)	2003 % (N's)	2004 % (N's)	2005 % (N's)	2006 % (N's)	2007 % (N's)	2008 % (N's)	2009 % (N's)	2010 % (N's)	2011 % (N's)	2012 % (N's)	2013 % (N's)	2014 % (N's)	2015 % (N's)	2016 % (N's)	2017 % (N's)
All Sailboats	13.6%	17.1%	17.0%	18.4%	16.7%	19.5%	24.8%	28.0%	24.7%	20.0%	23.2%	22.0%	24.3%	22.1%	27.6%	26.5%	31.1%	27.1%	28.0%
	(3420)	(3565)	(3843)	(4087)	(3149)	(4149)	(3084)	(3279)	(3217)	(3079)	(3733)	(3336)	(3231)	(3297)	(2840)	(2786)	(2800)	(2557)	(2269)
Sailboard	16.4%	94.0%	80.6%	83.2%	96.7%	92.9%	53.0%	92.1%	83.7%	94.6%	71.9%	83.2%	100%	93.3%	100%	100%	94.5%	90.4%	100%
	(46)	(30)	(15)	(55)	(27)	(40)	(20)	(12)	(18)	(17)	(7)	(29)	(9)	(14)	(10)	(3)	(17)	(10)	(10)
Day Sailor	30.7%	35.6%	37.9%	46.7%	38.4%	49.7%	56.4%	59.1%	50.4%	48.3%	61.7%	57.5%	61.3%	54.0%	67.1%	55.1%	69.6%	62.4%	61.9%
	(739)	(791)	(604)	(1124)	(815)	(984)	(736)	(607)	(397)	(649)	(652)	(731)	(736)	(682)	(469)	(630)	(565)	(532)	(365)
Cabin Sailboat	9.1%	11.3%	10.2%	9.5%	10.2%	10.1%	15.4%	19.1%	17.1%	12.0%	13.0%	11.7%	13.4%	12.9%	17.3%	18.3%	20.5%	17.2%	18.8%
	(2635)	(2744)	(3224)	(2908)	(2307)	(3125)	(2328)	(2660)	(2802)	(2413)	(3074)	(2576)	(2486)	(2601)	(2361)	(2153)	(2218)	(2015)	(1894)

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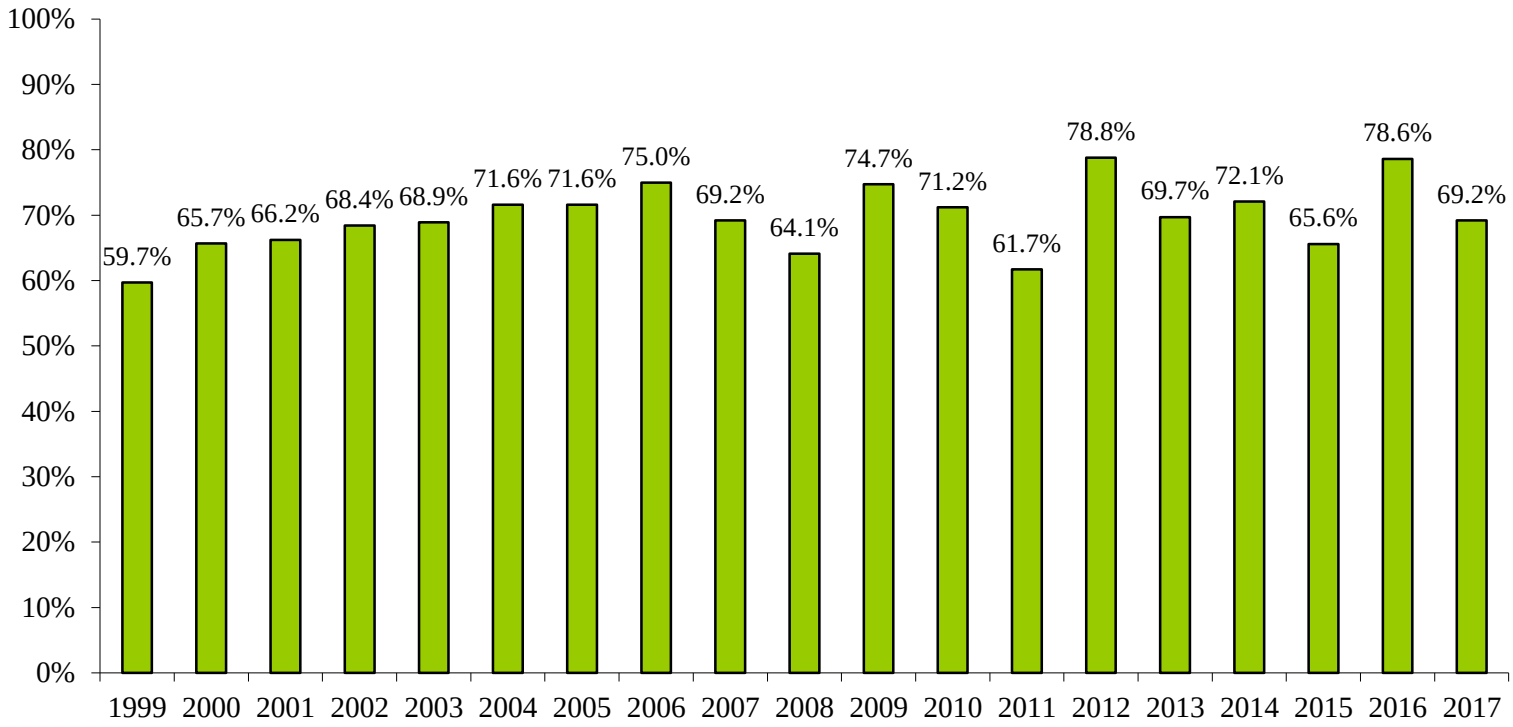
2017 National Observational Life Jacket Wear Rate Study
*Factors controlled for: Age & Boat Type.

Sailboats for Youth (17 years or younger)

Figure J and Table 2.7 show that the national average wear rate on all sailboats for all youth decreased from last year (from 78.6% in 2016 to 69.2% in 2017). However, relatively few youth are found on any type of sailboats and, therefore, fluctuations in rates should be interpreted with caution. Since 1999 rates for youth on sailboats has remained relatively high.

Figure J – Youth Wear Rates for ALL Sailboats*



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*Factors controlled for: Age & Boat Type.

Table 2.7 – Life Jacket Wear Rates by Sailboats for Youth*

Boat Type	Observation Year																		
	1999 % (N's)	2000 % (N's)	2001 % (N's)	2002 % (N's)	2003 % (N's)	2004 % (N's)	2005 % (N's)	2006 % (N's)	2007 % (N's)	2008 % (N's)	2009 % (N's)	2010 % (N's)	2011 % (N's)	2012 % (N's)	2013 % (N's)	2014 % (N's)	2015 % (N's)	2016 % (N's)	2017 % (N's)
All Sailboats	59.7%	65.7%	66.2%	68.4%	68.9%	71.6%	71.6%	75.0%	69.2%	64.1%	74.7%	71.2%	61.7%	78.8%	69.7%	72.1%	65.6%	78.6%	69.2%
	(347)	(329)	(424)	(381)	(323)	(323)	(327)	(371)	(270)	(274)	(305)	(202)	(219)	(313)	(220)	(206)	(170)	(200)	(147)
Sailboard	0.0%	100%	66.7%	75.0%	--	92.1%	100%	100%	82.2%	--	--	100%	--	100%	--	100%	--	100%	--
	(3)	(7)	(6)	(4)	(0)	(48)	(1)	(4)	(8)	(0)	(0)	(1)	(0)	(1)	(0)	(1)	(0)	(1)	(0)
Day Sailor	71.1%	81.6%	92.0%	82.1%	84.3%	87.5%	73.4%	93.2%	86.5%	88.0%	92.5%	85.2%	80.2%	98.2%	91.5%	97.2%	87.7%	96.4%	90.7%
	(114)	(81)	(85)	(113)	(107)	(83)	(67)	(122)	(54)	(75)	(80)	(86)	(57)	(166)	(36)	(54)	(27)	(103)	(25)
Cabin Sailboat	58.3%	61.5%	58.2%	63.5%	60.6%	68.3%	69.4%	65.7%	62.4%	56.4%	66.4%	65.9%	54.9%	60.3%	61.7%	61.0%	58.6%	66.7%	66.2%
	(230)	(241)	(333)	(264)	(216)	(192)	(259)	(245)	(208)	(196)	(225)	(115)	(162)	(146)	(184)	(152)	(143)	(97)	(122)

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*Factors controlled for: Age & Boat Type.

Boat Type and Size for Adults (18 years or older)

Table 2.8 shows the breakdown of adult wear rates by boat size for three general categories of boat types: powerboats, sailboats, and paddlecraft. Data are presented only for 2004 to 2017, since 2004 was the first year that observations were divided into two size categories of 16 to 21 feet and 21 to 26 feet, from one category (16 to 26 feet that was used in prior years.)

Wear rates and boat size show a dependent relationship: wear rates decrease as the size of the boat increases. However, the general level of wear is also highly influenced by the type of boat. The 14 year averages for powerboats range from 8.7% for boats less than 16 feet to 1.8% for boats over 26 feet in length. For sailboats, the 14 year average ranges from 75.4% for sailboats less than 16 feet to 12.1% for sailboats over 26 feet in length. For paddlecraft, the 14 year average for boats less than 16 feet is 53.1% and for boats in the 16 to 21 foot category it is 42.0%.

Table 2.8 – Life Jacket Wear Rates by Boat Type and Size for Adults*
2004 to 2017

Boat Type and Size	Observation Year														
	2004 % (N's)	2005 % (N's)	2006 % (N's)	2007 % (N's)	2008 % (N's)	2009 % (N's)	2010 % (N's)	2011 % (N's)	2012 % (N's)	2013 % (N's)	2014 % (N's)	2015 % (N's)	2016 % (N's)	2017 % (N's)	Total % (N's)
Powerboats (no PWCs)															
<16 ft.	8.2%	7.6%	7.1%	8.7%	7.6%	8.5%	11.5%	8.4%	9.3%	9.3%	12.4%	6.6%	6.5%	9.4%	8.7%
	(2320)	(2734)	(3395)	(2173)	(1862)	(1824)	(2764)	(2183)	(1599)	(2119)	(2951)	(2174)	(2008)	(1483)	(30977)
16-20.9 ft.	4.7%	5.1%	4.4%	4.9%	6.1%	5.0%	5.0%	5.2%	5.1%	4.3%	7.2%	6.9%	6.3%	8.3%	5.6%
	(16298)	(14629)	(11778)	(13034)	(12586)	(13125)	(13944)	(13255)	(12898)	(11424)	(12217)	(11763)	(11340)	(11416)	(179654)
21-25.9 ft.	2.4%	3.2%	2.4%	3.7%	3.4%	2.3%	2.4%	2.0%	2.7%	2.5%	3.4%	4.2%%	2.2%	4.2%	2.9%
	(6218)	(5503)	(6957)	(8634)	(9127)	(10420)	(9713)	(8718)	(9389)	(9364)	(9533)	(8270)	(9048)	(8467)	(119361)
26+ ft.	0.8%	1.4%	1.6%	1.5%	1.5%	1.8%	1.3%	1.3%	2.0%	2.1%	1.4%	2.5%	1.8%	3.5%	1.8%
	(3407)	(2865)	(3268)	(3782)	(3650)	(4546)	(4473)	(4798)	(4004)	(3874)	(4065)	(4234)	(4393)	(4442)	(56073)
Sailboats															
<16 ft.	75.0%	74.0%	79.7%	67.6%	73.2%	70.2%	65.5%	74.6%	74.2%	78.7%	70.3%	89.6%	89.0%	81.5%	75.4%
	(481)	(376)	(265)	(77)	(163)	(247)	(299)	(160)	(194)	(136)	(265)	(200)	(197)	(136)	(3196)
16-20.9 ft.	34.2%	41.9%	57.7%	51.8%	46.8%	58.0%	57.4%	63.8%	48.6%	66.3%	43.6%	63.1%	47.8%	51.25	52.9%
	(357)	(312)	(609)	(193)	(370)	(157)	(346)	(390)	(379)	(314)	(248)	(225)	(339)	(239)	(4514)
21-25.9 ft.	12.2%	24.1%	21.0%	25.5%	14.0%	21.5%	16.7%	27.5%	24.3%	27.6%	23.8%	41.1%	29.4%	39.1%	23.3%
	(1428)	(1527)	(793)	(797)	(911)	(949)	(766)	(846)	(989)	(736)	(593)	(654)	(559)	(541)	(12089)
26+ ft.	9.9%	3.2%	11.5%	15.2%	11.6%	13.1%	11.0%	9.6%	8.3%	13.4%	17.7%	15.1%	13.3%	11.6%	12.1%
	(1864)	(875)	(1614)	(2148)	(1629)	(2380)	(1925)	(1835)	(1735)	(1654)	(1644)	(1721)	(1453)	(1353)	(23830)
Paddlecraft (excluding SUP)															
<16 ft.	60.4%	68.4%	70.6%	44.8%	38.2%	42.7%	38.0%	42.6%	57.2%	43.0%	55.3%	52.5%	49.8%	61.9	53.1%
	(1056)	(1012)	(1147)	(1306)	(1319)	(1296)	(1953)	(1021)	(1647)	(1532)	(1760)	(2126)	(2079)	(1694)	(19737)
16-20.9 ft.	49.4%	11.1%	53.0%	35.7%	67.9%	64.4%	42.0%	53.2%	47.3%	56.2%	32.2%	44.0%	38.2%	41.3%	42.0%
	(531)	(488)	(171)	(672)	(180)	(347)	(331)	(587)	(367)	(383)	(795)	(395)	(312)	(541)	(6025)

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*Factors controlled for: Age & Boat Type.

III. How "Risky" Boating Conditions Influence Wear Rates by Boat Type

Section 3.1: General Boating Risks

The United States Coast Guard (USCG) reports that hazardous weather, water, and waves were among the top ten known contributing factors of boating accidents in 2016.[1] Several environmental factors may place boaters at a heightened risk for drowning. In the event that a boater falls overboard, cold water and air temperatures can place severe strain on the body, leading to possible hyperventilation, swim fatigue, loss of function, or hypothermia.[2-7] Environmental conditions such as restricted visibility and poor weather increase the difficulty of navigating and operating boats, which may lead to capsizing, falling overboard, and difficulty searching for and rescuing boaters who have entered the water.[8-13] Strong winds that create large waves and harsh or quick-changing weather patterns can also increase the possibility of entering the water unexpectedly.[14-16] Even a moderate current can exert a force of several tons against a boat and cause its operator to lose control and capsize.[17-19]

There are also many situational factors associated with boaters and boat type that may contribute to higher drowning risk. Boater inattention or improper lookout places boaters at a heightened risk for entering the water and drowning. In situations where children are on board, adult boaters are more likely to quickly enter the water in the attempt to rescue a child who has fallen overboard.[20-25] Passengers on board may be more likely than operators to fall overboard, as passengers are often less attentive/responsive to unexpected hazards or their physical position in the boat does not allow them the same awareness to possible risks as operators.[26] Boaters who are participating in more hazardous activities (such as fishing, high speed/racing, or white water) are more likely to stand, lose their balance, or be in conditions that decrease boat stability and cause capsizing or falling overboard.[27-29] If there is a capsizing or falling overboard event, boaters who are alone on board are at an increased risk for drowning, as it is less likely that someone will be able to throw them flotation, find and rescue them, or report an accident.[30-34] Smaller boats are often less stable and more likely to capsize in the event of improper loading or inclement weather.[35-37] Lastly, boaters in a moving boat are more likely to experience injury, collision, falling overboard, or capsizing. Unpredictable swiveling booms, broken masts, faulty sail or motor equipment, uncontrollable speeds or steering practices, less stable balance during movement, and increased chances of operator error place moving boaters at a greater risk for drowning than boaters who are drifting or anchored.[38-42]

This chapter of the report looks at influences of environmental and situational factors on adult life jacket wear rates by specific boat type under three general types of boats—powerboats, paddlecraft and sailboats. The analyses look at each risk factor individually as well as evaluating the impact of multiple risks on life jacket wear rate for the following boat types:

Section 3.2: Powerboats: skiffs/utility vessels, speedboats/runabouts, cabin cruisers, pontoons, and powered inflatables/rafts
Section 3.3: Paddlecraft: canoes, kayaks, rowboats, paddleboards (SUPs), and paddled inflatables/rafts
Section 3.4: Sailboats: cabin sailboats, day sailors, and sailboards

In this section, environmental and situational boating conditions were re-categorized into binary forms and classified as either "risky" or "non-risky" conditions based on expert literature and USCG boating safety findings. **Table 3.1** is a representation of how risk conditions were defined in general across all boating types. Environmental conditions that were considered "risky" were water temperatures less than 65°F (compared to warmer water), air temperatures less than 70°F (compared to warmer air), poor visibility (compared to good or fair visibility), choppy or rough waves (compared to calm waves), raining or stormy weather (compared to sunny or cloudy weather), strong current (compared to weak or moderate strength), and high wind speeds (compared to low wind). "Risky" situational boating conditions were having a child on board (compared to no child on board), small boat size (compared to large boat size), boater activity as fishing, racing, high speed, or white water (compared to "pleasure"), boat movement as motoring, paddling, or sailing (compared to drifting or anchored), having only one boater on board (compared to having 2 or more on board), and boater position as passenger (compared to the operator position).

Table 3.1 – Risk Variable Classifications

Condition	"RISKY" vs. "NON-RISKY" Classification**	Justification
Water Temperature	**COLD WATER (<65°F)** vs. **WARM WATER (≥65°F)**	Increased chances of hyperventilation, swimming fatigue, loss of function, hypothermia
Air Temperature	**COLD AIR (<70°F)** vs. **WARM AIR (≥70°F)**	Risks similar to cold water, particularly hypothermia
Visibility	**POOR** vs. **GOOD/FAIR**	Difficulty navigating and operating boats, responding to obstacles or other boats, finding boaters who have fallen overboard
Wave Height	**CHOPPY/ROUGH** vs. **CALM**	Increased chances of capsizing, falling overboard, swimming fatigue
General Weather	**RAINING/STORMY** vs. **SUNNY/CLOUDY**	Risks related to visibility and wave height.
Strength of Current	**STRONG** vs. **WEAK/MODERATE**	Increased chances of loss of control, capsizing, falling overboard, boater/swimming fatigue
Wind Speed	**HIGH WIND** vs **LOW WIND**	Increased chances of unpredictable weather changes, capsizing, falling overboard
Children on Board	**CHILD PRESENT** vs. **NO CHILD**	Increased chances of entering water (to rescue child), boater distraction, unpredictable movements that contribute to capsizes or falls overboard
Size of Boat	**SMALL** vs. **LARGE**	Reduced stability, increased chances of capsizing and falling overboard
Boater Activity	**FISHING/RACING/WHITE WATER** vs. **OTHER (pleasure)**	Increased chances of standing, loss of balance, entering water, capsizing, falling overboard
Boat Movement	**MOTORING/PADDLING/SAILING** vs. **OTHER (drifting/anchored)**	Increased chances of loss of control, capsizing, falling overboard
Number of Boaters	**SINGLE** vs. **2+ BOATERS**	Less likely to be rescued if falling overboard (no one to throw flotation, search and rescue, report accident)
Boater Position	**PASSENGER** vs. **OPERATOR**	Passengers less aware of boating hazards

**While many environmental or boating factors present risk of drowning for all boaters, some may vary across type of craft or specific boat type. In these instances, risk classifications are adjusted and discussed in later sections.

In **Sections 3.2, 3.3,** and **3.4**, the association between the presence of boating risk conditions and adult life jacket wear rates was compared by each dichotomized boating "risk" factor with every boat type observed. Comparisons were made using Chi-square tests for equality of proportion and using an alpha level of 0.05. **Tables 3.2b**, **3.3b**, and **3.4b** summarize the results of these analyses for each type of boat by powerboats, paddlecraft, and sailboats types, respectively. Statistically significant differences between life jacket wear rate and the presence of risk are identified and discussed.

For each boat type, the cumulative count of risks present was tested to determine the association with life jacket wear rate. Cochran-Armitage tests were applied for each boat type to test for linear trends in life jacket wear rate by cumulative risk count in order to describe the additive impact of multiple risks on life jacket wear rate. **Tables 3.2c**, **3.3c**, and **3.4c** and **Figures K, L,** and **M** summarize the results of these analyses by powered boats, paddlecraft, and sailboats types, respectively.

The purpose of these analyses is to understand if adult boaters change their wear behaviors in the presence of "risky" conditions. For example, if adult boaters in a "risky" situation show higher life jacket wear rate than boaters in the corresponding "non-risky" situation, we can surmise that boaters are aware of the risk and try to reduce that risk by wearing a life jacket.

Section 3.2a: Definitions of "Risky" Conditions for Powerboats

Table 3.2a defines the environmental and situational boating factors that were considered to be "risky" for each powerboat type. Cells with bolded text indicate risk classifications that deviate from those outlined previously in **Section 3.1** and have been adjusted in favor of a more accurate risk representation specific to that boat type. Justifications for these changes are also included.

Table 3.2a – Risk Variable Classifications – Powerboats

Condition		Risky Circumstances for each Boat Type				
		1. Skiff/Utility	2. Runabout	3. Cabin Cruiser	4. Pontoon	5. Inflatable/Raft
A.	Water Temperature	<65°F	<65°F	<65°F	<65°F	<65°F
B.	Air Temperature	<70°F	<70°F	<70°F	<70°F	<70°F
C.	Visibility	Poor	Poor	Poor	Poor	Poor
D.	Wave Height	Choppy/Rough	Choppy/Rough	Choppy/Rough	Choppy/Rough	Choppy/Rough
E.	General Weather	Rainy/Stormy	Rainy/Stormy	Rainy/Stormy	Rainy/Stormy	Rainy/Stormy
F.	Strength of Current	Strong	Strong	Strong	Strong	Strong
G.	Wind Speed	High (≥6 knots)	High (≥6 knots)	High (≥6 knots)	High (≥6 knots)	High (≥6 knots)
H.	Child (<13 years old) on Board*	Child Present	Child Present	Child Present	Child Present	Child Present
I.	Boat Size (feet)	Small (<16 feet)	Small (<16 feet)	**Small (<26 feet)**	**Small (<21 feet)**	**Large (≥16 feet)**
J.	Activity	**Fishing/Racing**	Fishing/Racing/ White Water	**Fishing/Racing**	Fishing/Racing/ White Water	Fishing/Racing/ White Water
K.	Boat movement	**Motoring**	**Motoring**	**Motoring**	**Motoring**	**Motoring**
L.	Number of boaters	Single	Single	Single	Single	Single
M.	Boater position*	Passenger	Passenger	Passenger	Passenger	Passenger

All conditions classified into binary form. Forms distinguished on table considered to be "risky"
Forms not indicated in the table considered to be "non-risky"
Forms in **bold** deviate from previously categorized risk definitions
*For boats with more than one boater on board

I.3. and **I.4.**: Small size reclassified to <26 feet for cabin cruisers and <21 feet for pontoons in order to create comparison groups better reflecting their respective size distributions (cabin cruisers and pontoons are generally larger than 16 feet and these risk categorizations provide more meaningful comparisons)
I.5.: Large rafts are more likely to flip from changes in weather or water conditions, especially if the overall boat weight is too light or not properly distributed (from improper loading, not enough passengers, unpredictable passenger movements, etc.)[43]
J.1. and **J.3.**: White water activity not included in risk classification because no boaters were observed participating in this activity for these boat types.
K.1-5: Sailing and paddling movement not included in risk classification because no powerboats were observed using these modes of movement.

Section 3.2b: Adult Life Jacket Wear Rates by Dichotomized Risk Variables for Each Type of Powerboat

In general, adult life jacket wear rates were significantly higher in "risky" boating conditions when compared to "non-risky" conditions, suggesting that adult boaters seem to understand the connection between wearing life jackets and drowning prevention and respond to their specific boating conditions accordingly. Below is a summary of results for each boat type. **Table 3.2b** provides results of significance tests.

Skiff/Utility Boats: The following ten "risky" conditions were significantly related to higher life jacket wear rates among adult boaters:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Choppy/rough waves
4. Raining/stormy weather
5. Strong current
6. Child on board
7. Small boat size < 16 feet long
8. Fishing/racing activities
9. Motoring movement
10. Boating alone

Although a larger proportion of boaters in poor visibility conditions were observed wearing life jackets than boaters in good or fair visibility, there was not enough evidence to suggest a statistically significant difference. This is likely due to the small sample size among boaters in poor visibility conditions. Two "non-risky" conditions were related to higher life jacket wear rates among adult boaters, low wind speed less than 6 knots and boater position as operator. The presence of other "risky" conditions associated with higher life jacket concurrently with these less "risky" conditions might explain these reversals.

The proportion of boaters observed with children on board, in small boats, participating in fishing or racing activities, boating alone, boating in poor visibility, and boating in cold water and air temperatures is higher among boaters observed in low wind compared to boaters observed in high wind. These "risky" conditions are also significantly associated with higher life jacket wear rates (except poor visibility, which did not have enough evidence to support a positive relationship). Thus, the observed high life jacket wear rate among boaters in low wind conditions can be partially attributed to the confounding "risky" conditions that are related to both wind and wear rates.

The proportion of boaters observed with children on board, in small boats, participating in fishing or racing activities, and boating in poor visibility is higher among operators compared to passengers. These "risky" conditions are also significantly associated with higher life jakcet wear rates (except poor visibility, which did not have enough evidence to support a positive relationship). Thus, the observed high life jacket rate among operators can be partially attributed to the confounding "risky" conditions that are related to both boater position and wear rates.

Runabouts: The following eleven "risky" conditions were significantly related to higher life jacket wear rates among adult boaters:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Poor visibility
4. Raining/stormy weather
5. Strong current
6. High wind speeds of 6 or more knots
7. Child on board
8. Small boat size < 16 feet long
9. Fishing/racing/white water activities
10. Single boater on board (boating alone)
11. Boater position as passenger

Wave height and boat movement were not significantly related to life jacket wear rate.

Cabin Cruisers: The following eleven "risky" conditions were significantly related to higher life jacket wear rates among adult boaters:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Poor visibility
4. Raining/stormy weather
5. Strong current
6. High wind speeds of 6 or more knots
7. Child on board
8. Small boat size < 26 feet long
9. Fishing/racing activities
10. Single boater on board (boating alone)
11. Boater position as passenger

Wave height and boat movement were not significantly related to life jacket wear rate.

Pontoons: The following ten "risky" conditions were significantly related to higher life jacket wear rates among adult boaters:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Choppy/rough waves
4. Raining/stormy weather
5. Strong current
6. High wind speeds of 6 or more knots
7. Child on board
8. Small boat size < 21 feet long
9. Single boater on board (boating alone)
10. Boater position as passenger

Visibility, boater activity, and boat movement were not significantly related to life jacket wear rate.

Powered Inflatables: The following seven "risky" conditions were significantly related to higher life jacket wear rates among adult boaters:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Raining/stormy weather
4. Strong current
5. Child on board
6. Large boat size ≥ 16 feet long
7. Fishing/racing/white water activities

Although a larger proportion of boaters in choppy/rough waves, boating alone, or position as passeneger were observed wearing life jackets as compared to calm waves, boating with at leat one other person, or position as operator (respectively), there was not enough evidence to suggest statistically significant differences in use. Visibility, and high wind speeds were not statistically significantly related to higher life jacket wear rates. The "non-risky" condition of drifting or anchoring was associated with significantly higher life jacket wear rate. The presence of other "risky" conditions associated with higher life jacket wear rates concurrently with this less "risky" condition might explain the reversal.

Table 3.2b – Adult life jacket wear rates, by dichotomized risk variables – for Powerboats

Condition	Boat Type									
	1. Skiff/Utility		2. Runabout		4. Cabin Cruiser		5. Pontoon		6. Inflatable/Raft	
	N (% PFD)	p	N (% PFD)	p	N (% PFD)	p	N (% PFD)	p	N (% PFD)	p
Life Jacket Wear Rate	**101766 (8.7)**		**257896 (3.2)**		**94551 (1.7)**		**44888 (2.2)**		**4899 (16.6)**	
COLD WATER temperature *(<65°F)* (R)	15188 (15.7)	****	10051 (8.9)	****	9836 (5.7)	****	2470 (4.7)	****	710 (36.6)	****
WARM WATER temperature *(≥65°F)*	84126 (7.4)		243738 (2.9)		82494 (1.2)		42135 (2.1)		4082 (13.4)	
COLD AIR temperature *(<70°F)* (R)	15824 (14.9)	****	22414 (5.6)	****	14105 (4.3)	****	2962 (3.0)	**	685 (31.2)	****
WARM AIR temperature *(≥70°F)*	85670 (7.5)		234577 (2.9)		79986 (1.2)		41843 (2.1)		4182 (14.3)	
POOR VISIBILITY (R)	778 (9.5)	ns	150 (4.7)	**	880 (5.6)	****	178 (3.9)	ns	24 (4.2)	ns†
GOOD/FAIR VISIBILITY	100160 (8.7)		255317 (3.1)		93083 (1.6)		44395 (2.2)		4823 (16.8)	
CHOPPY/ROUGH WAVES *(≥0.5 feet)* (R)	21071 (9.4)	****	55729 (3.1)	ns	26534 (1.6)	ns	7164 (2.5)	*	1117 (18.2)	ns
CALM WAVES *(<0.5 feet)*	80324 (8.5)		201320 (3.2)		67621 (1.7)		37486 (2.1)		3719 (16.2)	
RAINING/STORMING weather (R)	3816 (14.1)	****	4828 (4.3)	****	3341 (3.2)	****	1125 (4.4)	****	90 (35.6)	****
SUNNY/CLOUDY weather	97383 (8.5)		251915 (3.1)		90766 (1.6)		43403 (2.2)		4762 (16.4)	
STRONG CURRENT (R)	8607 (10.9)	****	6090 (4.7)	****	2889 (2.5)	***	589 (3.6)	*	143 (31.5)	****
WEAK/MODERATE CURRENT	92703 (8.5)		250455 (3.1)		90925 (1.6)		44162 (2.2)		4743 (16.2)	
HIGH WIND *(≥6 knots)* (R)	21985 (7.8)	****	52839 (3.3)	*	24610 (1.9)	***	7162 (3.6)	****	1280 (15.1)	ns
LOW WIND *(6 knots)*	79053 (8.8)		202860 (3.1)		68605 (1.6)		37437 (1.9)		3591 (17.2)	
CHILD present *(<13 years old, 2+ boaters)* (R)	12880 (10.4)	****	48733 (4.4)	****	11115 (2.5)	****	11143 (3.6)	****	467 (22.5)	***
NO CHILD present	80419 (8.1)		199133 (2.7)		79346 (1.5)		32817 (1.7)		3679 (15.9)	
SMALL BOAT size (R for all *except* rafts) *(<26 feet (3); <16 feet (1,2,5); <21 feet (4))*	30192 (9.1)	**	18064 (5.6)	****	38022 (2.2)	****	10470 (2.7)	****	4271 (16.1)	*
LARGE BOAT size (R for rafts) *(≥26 feet (3); ≥16 feet (1,2,5); ≥ 21 feet (4))*	71528 (8.5)		239614 (3.0)		56467 (1.3)		26448 (1.7)		604 (19.7)	
DANGEROUS ACTIVITY (R) *(fish/race/white water (2,4,5), fish/race (1,3))*	38881 (10.8)	****	22748 (5.5)	****	8302 (3.3)	****	2637 (2.0)	ns	351 (34.2)	****
OTHER ACTIVITY *(pleasure)*	62885 (7.4)		235148 (2.9)		86249 (1.5)		42251 (2.2)		4548 (15.3)	
DANGEROUS MOVEMENT *(motoring)* (R)	94617 (8.7)	*	251221 (3.1)	ns	93223 (1.7)	ns	43419 (2.2)	ns	4608 (16.1)	*
OTHER MOVEMENT *(drifting/anchored)*	6926 (7.8)		5804 (3.6)		1046 (1.9)		1311 (2.7)		258 (22.1)	
SINGLE BOATER (R)	8467 (11.7)	****	10030 (5.2)	****	4090 (2.5)	****	928 (3.4)	**	753 (16.9)	ns
2+ BOATERS	93299 (8.4)		247866 (3.1)		90461 (1.6)		43960 (2.2)		4146 (16.6)	
PASSENGER position *(2+ boaters)* (R)	57492 (8.1)	***	164217 (3.2)	****	61612 (1.7)	**	32184 (2.3)	**	2366 (17.2)	ns
OPERATOR position	35807 (8.8)		83649 (2.8)		28849 (1.4)		11776 (1.8)		1780 (15.7)	

P-values derived from Chi-Square test with 1 degree of freedom; * = p<0.05; ** = p<0.01; *** = p<0.001; **** = p≤0.0001; ns = not significant;
† Fisher's Exact Tess used instead of Chi-Square test
(**R**) denotes a risky condition; in cases where risky conditions differ by boat type, the risk condition is distinguished in the variable definition in col. 1;

Section 3.2c: Adult Life Jacket Wear Rates by Cumulative Risk Count on Powerboats

For all types of powerboats, reported life jacket wear rate increases as the number of "risky" conditions present increases. Statistically significant results of Cochran-Armitage tests indicate strong evidence that life jacket wear rate increases linearly with the number of risks present. See **Table 3.2c** and **Figure K** for life jacket wear rates, cumulative risk count, and statistical test results presented graphically. These results suggest that adult boaters are aware of the increased risk of drowning in boating situations in which multiple risky conditions are present and are adjusting their life jacket wearing behaviors accordingly.

The highest number of risky conditions shown varies somewhat across the boat types since for higher number of risks, relatively few boaters were observed.

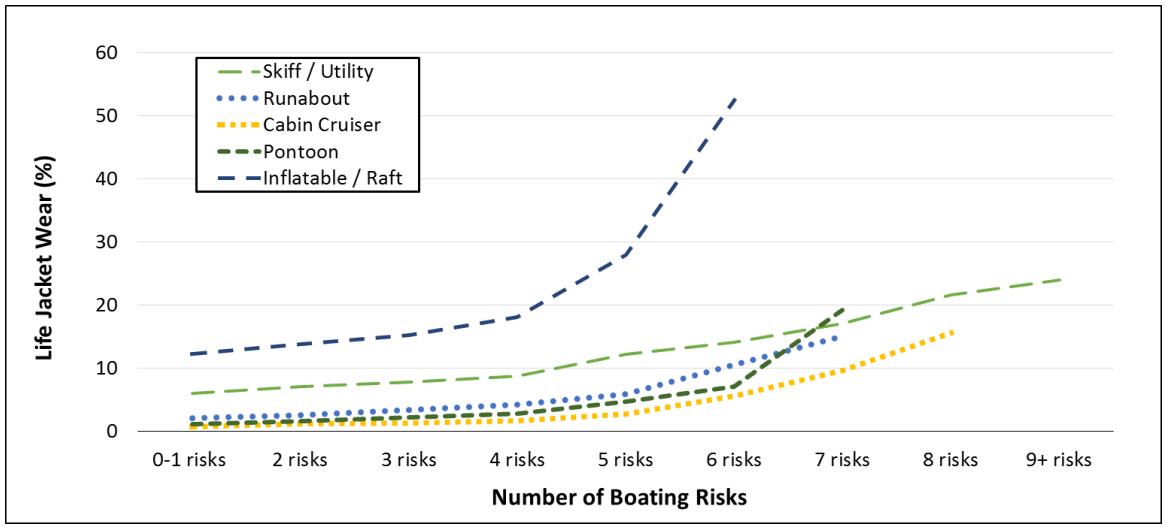
Skiff/Utility boats wear rates ranged from a low of 6.0% with 0-1 risk encountered to 24.0% with nine or more encountered risks.
Runabout/speedboat wear rates ranged from 2.0% with 0-1 encountered risk to a high of 15.0% with seven or more encountered risks.
Cabin Cruiser wear rates ranged from 0.7% with 0-1 encountered risks to a high of 15.5% with eight or more encountered risks.
Pontoon boat wear rates ranged from 1.1% with 0-1 encountered risks to a high of 19.2% with seven or more encountered risks.
Powered Inflatable Raft wear rates ranged from 12.2% with 0-1 encountered risks to a high of 52.5% with six or more encountered risks.

Table 3.2c – Adult life jacket wear rate, by cumulative risk count – Powerboats

Number of Risks Present	Boat Type														
	1. Skiff/Utility			2. Runabout			3. Cabin Cruiser			4. Pontoon			5. Inflatable/Raft		
	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD
Average Wear Rate	101766	8804	**8.7%**	257896	8131	**3.2%**	94551	1575	**1.7%**	44888	**987**	**2.2%**	4899	**815**	**16.6%**
0-1 risks	7319	437	6.0%	34098	692	2.0%	7053	52	0.7%	4347	49	1.1%	713	87	12.2%
2 risks	26616	1859	7.0%	102036	2570	2.5%	25633	273	1.1%	16329	264	1.6%	1834	254	13.8%
3 risks	31224	2440	7.8%	73912	2473	3.3%	28544	355	1.2%	14779	332	2.2%	1231	187	15.2%
4 risks	18931	1648	8.7%	33896	1425	4.2%	18362	288	1.6%	6692	186	2.8%	656	118	18.0%
5 risks	10002	1207	12.1%	11166	654	5.9%	9997	270	2.7%	2171	100	4.6%	307	86	28.0%
6 risks *(6+ for raft)*	4713	666	14.1%	2290	241	10.5%	3807	209	5.5%	440	31	7.0%	158	83	52.5%
7 risks *(7+ for runabout; pontoon)*	2076	354	17.1%	508	76	15.0%	871	84	9.6%	130	25	19.2%	-	-	-
8 risks *(8+ for cabin cruiser)*	810	175	21.6%	-	-	-	284	44	15.5%	-	-	-	-	-	-
9+ risks	75	18	24.0%	-	-	-	-	-	-	-	-	-	-	-	-
Linear Trend Test (Z-score)	**28.1******			**32.4******			**26.6******			**14.0******			**11.2******		

P-values derived from Cochran-Artmitage Linear Trend one-sided test; **** = p≤0.0001

Figure K – Adult life jacket wear rate, by cumulative risk count – Powerboats



Section 3.3a: Definitions of "Risky" Conditions for Paddlecraft

Table 3.3a defines the environmental and situational boating factors that were considered to be "risky" for each paddlecraft type. Cells with bolded text indicate risk classifications that deviate from those outlined previously in **Section 3.1** and have been adjusted in favor of a more accurate risk representation specific to that boat type. Justifications for these changes are also included in the footnotes of the table.

Table 3.3a – Risk Variable Classifications – Paddlecraft

Condition		Risky Circumstances for each Boat Type				
		1. Inflatable/Raft	2. Rowboat	3. Canoe	4. Kayak	5. Paddleboard
A.	Water Temperature	<65°F	<65°F	<65°F	<65°F	<65°F
B.	Air Temperature	<70°F	<70°F	<70°F	<70°F	<70°F
C.	Visibility	Poor	Poor	Poor	Poor	-
D.	Wave Height	Choppy/Rough	Choppy/Rough	Choppy/Rough	Choppy/Rough	Choppy/Rough
E.	General Weather	Rainy/Stormy	Rainy/Stormy	Rainy/Stormy	Rainy/Stormy	Rainy/Stormy
F.	Strength of Current	Strong	Strong	Strong	Strong	Strong
G.	Wind Speed	≥4 knots	≥4 knots	≥4 knots	≥4 knots	≥4 knots
H.	Child (<13 years old) on Board*	Yes	Yes	Yes	Yes	Yes
I.	Boat Size (feet)	**Large (≥16 feet)**	Small (<16 feet)	Small (<16 feet)	**Large (≥16 feet)**	Small (<16 feet)
J.	Activity	**Fishing/ White Water**	Fishing/Racing /White Water	**Fishing/ White Water**	Fishing/Racing /White Water	**Fishing/ White Water**
K.	Number of boaters	1 only	1 only	1 only	**2+ boaters**	**2+ boaters**
L.	Boater position*	Passenger	Passenger	Passenger	Passenger	Passenger
M.	Boat movement	**Paddling**	**Paddling/ Motoring**	**Paddling/ Motoring**	**Paddling/ Motoring**	**Paddling**

All conditions classified into binary form. Forms distinguished on table considered to be "risky"
Forms not indicated in the table considered to be "non-risky"
Forms in **bold** deviate from previously categorized risk definitions
Blank cells indicate conditions not categorized into binary risks for that boat type (due to no observations recorded in "risky" category)
*For boats with more than one boater on board

C.5.: There were no recorded observations in which an adult was observed on a paddleboard in poor visibility conditions
I.1.: Large rafts are more likely to flip from changes in weather or water conditions, especially if the overall boat weight is too light or not properly distributed (from improper loading, not enough passengers, etc.)[43]
I.4. and **K.4.**: Large kayaks or kayaks with more than 1 boater are more likely to flip due to decreased stability from larger frames or multiple boater loss of balance or sudden movements. These boats are also less responsive to oncoming risks due to decreased maneuverability of boat frame and multiple boaters paddling.[44-46]
J.1., J.3., and **J.5.**: Racing activity not included in risk classification because no boaters were observed participating in this activity.
M.1. and **M.5.**: Sailing and/or motoring not included in risk classification because no rafts or paddleboards were observed using these modes of movement.
M.2-4.: Sailing not included in risk classification because no rowboats, canoes, or kayaks were observed using this mode of movement.
K.5. Paddleboards with more than one boater on board determined to be more likely to flip due to passenger instability or sudden movement/loss of balance.[47]

Section 3.3b: Adult Life Jacket Wear Rates by Dichotomized Risk Variables on Paddlecraft

In general, adult life jacket wear rates were significantly higher in "risky" boating conditions when compared to "non-risky" conditions, suggesting that adult boaters seem to understand the connection between wearing life jackets and drowning prevention and respond to their specific boating conditions accordingly. Below is a summary of results for each boat type. **Table 3.3b** shows results of significance tests.

Paddled Inflatables: The following eleven "risky" conditions were significantly related to higher life jacket wear rates among adult boaters on paddled inflatables:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Choppy/rough waves
4. Raining/stormy weather
5. Strong current
6. High wind speeds of 4 or more knots
7. Child on board
8. Large boat size ≥ 16 feet long
9. Fishing/white water activities
10. Paddling movement
11. Single boater on board (boating alone)

There was not enough evidence to suggest a statistically significant difference in life jacket wear rates by visibility conditions due to the small sample size among paddlers in poor visibility conditions. Boater position was not significantly related to a higher life jacket wear rate.

Rowboats: The following six "risky" conditions were significantly related to higher life jacket wear rates among adult boaters on rowboats:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Choppy/rough waves
4. Child on board
5. Small boat size < 16 feet long
6. Paddling or motoring movement

There was not enough evidence to suggest statistically significant higher life jacket wear rates among the following "risky" situations: poor visibility, raining or stormy weather, strong current and high wind speed. Although a larger proportion of boaters in these "risky" situations appear to be wearing life jackets compared to boaters in less "risky" conditions, statistical comparison tests could not confirm significance of these differences, due to smaller sample sizes observed for this boat type. Boater position was not significantly related to a higher life jacket wear rate. Two "non-risky" conditions were related to higher life jacket wear rates among adult boaters, including less dangerous

boating activities (not fishing/racing/white water activities) and two or more boaters on board. The presence of other "risky" conditions associated with higher life jacket wear rates that occur concurrently with these less "risky" conditions might explain these reversals.

Canoes: The following twelve "risky" conditions were significantly related to higher life jacket wear rates among adult boaters on canoes:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Poor visibility
4. Choppy/rough waves
5. Raining/stormy weather
6. Strong current
7. High wind speeds of 4 or more knots
8. Child on board
9. Small boat size < 16 feet long
10. Fishing/white water activities
11. Paddling or motoring movement
12. Single boater on board (boating alone)

Boater position was not significantly related to a higher life jacket wear rate.

Kayaks: The following eleven "risky" conditions were significantly related to higher life jacket wear rates among adult boaters:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Poor visibility
4. Choppy/rough waves
5. Raining/stormy weather
6. Strong current
7. High wind speeds of 4 or more knots
8. Large boat size ≥ 16 feet long
9. Fishing/racing/white water activities
10. Paddling or motoring movement
11. 2 or more boaters on board

Boater position and child presence were not significantly related to higher life jacket wear rates.

Paddleboards: The following four "risky" conditions were significantly related to higher life jacket wear rates among adult boaters on kayaks:

1. Cold water temperatures below 65°F
2. Choppy/rough waves
3. Strong current
4. Paddling movement

There was not enough evidence to suggest statistically significant higher life jacket wear rates among the following risky situations: cold air temperature, raining/stormy weather, or child on board. Although a larger proportion of boaters in these "risky" situations appear to be wearing life jackets compared to boaters in less "risky" conditions, statistical comparison tests could not confirm significance of these differences, likely due to smaller sample sizes observed for this boat type. Small boat size, fishing or white water activities, and boater position as passenger were not significantly related to higher life jacket wear rates. Two "non-risky" conditions were related to higher life jacket wear rates among adult boaters, low wind speeds below 4 knots and boating alone on board. The presence of other risky conditions associated with higher life jacket wear rates concurrently with these less risky conditions might explain these reversals.

Table 3.3b – Adult life jacket wear rate, by dichotomized risk variables – Paddlecraft

Condition	Boat Type									
	1. Inflatable/Raft		2. Rowboat		3. Canoe		4. Kayak		5. Paddleboard	
	N (% PFD)	p	N (% PFD)	p	N (% PFD)	p	N (% PFD)	p	N (% PFD)	p
Life Jacket Wear Rate	**6199 (35.6)**		**1477 (28.0)**		**10971 (26.7)**		**16390 (75.1)**		**1637 (53.3)**	
COLD WATER temperature *(<65°F)* (R)	2443 (76.2)	****	460 (40.4)	****	957 (42.8)	****	2301 (90.4)	****	134 (64.9)	**
WARM WATER temperature *(≥65°F)*	3623 (9.5)		992 (22.0)		9817 (25.1)		13881 (72.5)		1502 (52.2)	
COLD AIR temperature *(<70°F)* (R)	561 (74.1)	****	353 (34.3)	**	2054 (30.8)	****	2536 (86.1)	****	200 (57.5)	ns
WARM AIR temperature *(≥70°F)*	5635 (31.8)		1121 (26.1)		8882 (25.6)		13799 (73.1)		1437 (52.7)	
POOR VISIBILITY (R)	2 (50.0)	ns†	13 (23.1)	ns†	52 (44.2)	**	144 (96.5)	****		
GOOD/FAIR VISIBILITY	6196 (35.6)		1455 (28.2)		10885 (26.7)		16010 (74.9)			
CHOPPY/ROUGH WAVES *(≥0.5 feet)* (R)	1396 (87.7)	****	329 (35.0)	**	982 (57.6)	****	4390 (87.7)	****	296 (59.1)	*
CALM WAVES *(<0.5 feet)*	4790 (20.4)		1139 (26.2)		9945 (23.7)		11831 (70.3)		1341 (52.0)	
RAINING/STORMING weather (R)	78 (62.8)	****	50 (30.0)	ns	217 (47.9)	****	434 (86.2)	****	17 (58.8)	ns
SUNNY/CLOUDY weather	6120 (35.2)		1418 (28.1)		10720 (26.3)		15798 (74.7)		1620 (53.2)	
STRONG CURRENT (R)	1725 (79.1)	****	340 (30.9)	ns	1049 (30.7)	**	1854 (92.1)	****	61 (80.3)	****
WEAK/MODERATE CURRENT	4474 (18.8)		1136 (27.1)		9918 (26.3)		14429 (72.8)		1571 (52.1)	
HIGH WIND *(≥4 knots)* (R)	1220 (51.7)	****	513 (28.3)	ns	2725 (41.2)	****	5992 (76.5)	**	537 (44.7)	****
LOW WIND *(<4 knots)*	4969 (31.6)		958 (27.9)		8206 (22.0)		10273 (74.3)		1100 (57.5)	
CHILD present *(<13 years old, 2+ boaters)* (R)	1247 (54.2)	****	156 (59.0)	****	1186 (51.6)	****	675 (79.4)	ns	38 (50.0)	ns
NO CHILD present	4586 (29.8)		1099 (26.6)		9104 (23.2)		5015 (80.8)		69 (36.2)	
SMALL BOAT size *(<16 feet)* (R for canoe/rowboat/paddleboard)	5928 (34.3)	****	1264 (29.2)	*	4601 (35.3)	****	13989 (74.6)	****	1631 (53.2)	ns†
LARGE BOAT size *(≥16 feet)* (R for kayak/raft)	268 (64.2)		202 (22.3)		6301 (20.6)		2360 (78.3)		6 (66.7)	
DANGEROUS ACTIVITY (R) *(fish/white water (1,3,5); fish/race/white water (2,4))*	1105 (78.1)	****	460 (24.6)	*	710 (55.9)	****	1489 (87.1)	****	5 (40.0)	ns†
OTHER activity *(pleasure)*	5094 (26.3)		1017 (29.6)		10261 (24.7)		14901 (73.9)		1632 (53.3)	
DANGEROUS MOVEMENT (R) *(paddle (1,5); paddle/motor (2,3,4)*	5432 (36.7)	****	1283 (29.2)	**	10372 (27.7)	****	16093 (75.5)	****	1625 (53.5)	*
OTHER MOVEMENT *(drift/anchor)*	730 (24.9)		186 (19.4)		556 (10.6)		239 (51.0)		12 (16.7)	
SINGLE BOATER (R for canoe/rowboat/raft)	366 (44.8)	***	222 (13.5)	****	681 (30.1)	*	10700 (72.2)	****	1530 (54.1)	**
2+ BOATERS (R for kayak/paddleboard)	5833 (35.0)		1255 (30.6)		10290 (26.5)		5690 (80.7)		107 (41.1)	
PASSENGER position (R)	3831 (34.9)	ns	721 (30.7)	ns	5250 (26.6)	ns	2556 (81.4)	ns	35 (37.1)	ns
OPERATOR position	2002 (35.2)		534 (30.5)		5040 (26.3)		3134 (80.1)		72 (43.1)	

P-values derived from Chi-Square test with 1 degree of freedom; * = p<0.05; ** = p<0.01; *** = p<0.001; **** = p≤0.0001; ns = not significant;
† Fisher's Exact Tess used instead of Chi-Square test
(**R**) denotes a risky condition; in cases where risky conditions differ by boat type, the risk condition is distinguished in the variable definition in col. 1;

Section 3.3c: Adult Life Jacket Wear Rates by Cumulative Risk Count on Paddlecraft

For paddled rafts, rowboats, canoes, and kayaks, life jacket wear rate increases as the number of risks present increases. Statistically significant results of Cochran-Armitage tests indicate strong evidence that life jacket wear rate increases linearly with the number of risks present for these boat types. The Cochran-Armitage test results do not indicate a positive linear relationship for paddleboards, although the general trend appears to increase with the number of risks. A larger sample size might provide more evidence. See **Table 3.3c** and **Figure L** for life jacket wear rates, cumulative risk count, and statistical test results presented graphically.

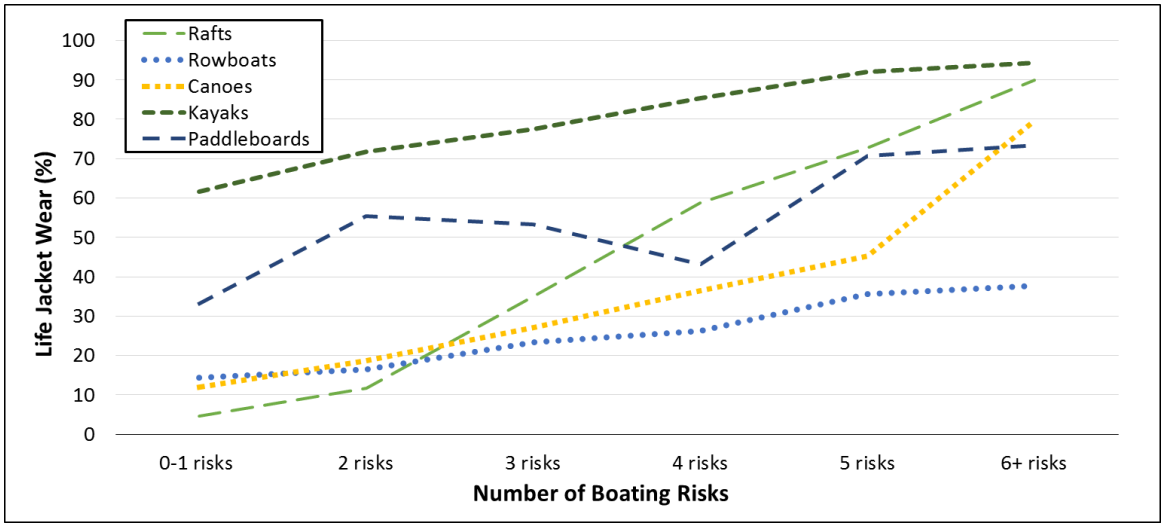
Paddled inflatable rafts showed wear rate ranges from 4.2% in the lowest risk situation to 89.0% in the highest risk situations.
Rowboat wear rates ranged from 14.3% under lowest risks to 37.7% in highest risk situations.
Canoe wear rates ranged from 11.9% under lowest risks to 79.7% under the highest risk situations
Kayak wear rates ranged from 61.4% under lowest risks to 92.4% under the highest risk situations.
Paddleboards wear rates ranged from 33.3% under the lowest risks to 73.3% under the highest risk situations.

Table 3.3c – Adult life jacket wear rate, by cumulative risk count – Paddlecraft

Number of Risks Present	Boat Type														
	1. Rafts			2. Rowboats			3. Canoes			4. Kayaks			5. Paddleboards		
	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD
Life Jacket Wear Rate	6199	**2205**	**35.6%**	1477	**414**	**28.0%**	10971	**2931**	**26.7%**	16390	**12313**	**75.1%**	1637	**872**	**53.2%**
0-1 risks	1009	42	4.2%	21	3	14.3%	1664	198	11.9%	3732	2291	61.4%	9	3	33.3%
2 risks	2085	228	10.9%	171	28	16.4%	3376	628	18.6%	4081	2878	70.5%	715	396	55.4%
3 risks	1107	378	34.1%	381	89	23.4%	3002	815	27.1%	3293	2531	76.9%	519	276	53.2%
4 risks	511	304	59.5%	363	95	26.2%	1871	683	36.5%	2836	2402	84.7%	297	128	43.1%
5 risks	443	324	73.1%	225	80	35.6%	684	309	45.2%	1579	1408	89.2%	82	58	70.7%
6+ risks	1044	929	89.0%	316	119	37.7%	374	298	79.7%	869	803	92.4%	15	11	73.3%
Linear Trend Test (Z-score)	**51.3******			**6.1******			**30.7******			**29.2******			**0.2 (ns)**		

P-values derived from Cochran-Artmitage Linear Trend one-sided test; **** = p≤0.0001, ns = not significant at p<0.05

Figure L – Adult life jacket wear rate, by cumulative risk count – Paddlecraft



Section 3.4a: Definitions of "Risky" Conditions for Sailboats

SailboatsTable 3.4a defines the environmental and situational boating factors that were considered to be "risky" for each sail craft type. Cells with bolded text indicate risk classifications that deviate from those outlined previously in **Section 3.1** and have been adjusted in favor of a more accurate risk representation specific to that boat type. Justifications for these changes are also included.

Table 3.4a – Risk Variable Classifications – Sailboats

Condition		Risky Circumstances for each Boat Type		
		1. Sailboard	2. Day Sailors	3. Cabin Sailboats
A.	Water Temperature	<65°F	<65°F	<65°F
B.	Air Temperature	<70°F	<70°F	<70°F
C.	Visibility	Poor	Poor	Poor
D.	Wave Height	Choppy/Rough	Choppy/Rough	Choppy/Rough
E.	General Weather	Rainy/Stormy	Rainy/Stormy	Rainy/Stormy
F.	Strength of Current	Strong	Strong	Strong
G.	Wind Speed	≥6 knots	≥6 knots	≥6 knots
H.	Child (<13 years old) on Board*	**-**	Yes	Yes
I.	Boat Size (feet)	**-**	Small (<16 feet)	**Small (<26 feet)**
J.	Activity	**Fishing/Racing**	**Fishing/Racing**	**Fishing/Racing**
K.	Number of boaters	**2+ Boaters**	1 only	1 only
L.	Boater position*	Passenger	Passenger	Passenger
M.	Boat movement	**Sailing**	**Sailing/Motoring**	**Sailing/Motoring**

All conditions classified into binary form. Forms distinguished on table considered to be "risky"
Forms not indicated in the table considered to be "non-risky"
Forms in **bold** deviate from previously categorized risk definitions
Blank cells indicate conditions not categorized into binary risks for that boat type.
*For boats with more than one boater on board

H.1.: There were no recorded observations in which an adult was observed on a sailboard with a child present
I.1.: There were no recorded observations in which an adult was observed on a sailboard greater than 16 feet
J.1-3.: White water activity not included in risk classification because no boaters were observed participating in this activity (for all types of sail boats).
K.1.: Sailboards with more than one boater on board determined to be more likely to flip due to passenger instability or sudden movement/loss of balance.[48]
M.1.: There were no recorded observations in which an adult was observed paddling or motoring on a sailboard
M.2-3.: There were no recorded observations in which an adult was observed paddling on a day sailor or cabin sailboat.
I.3.: Small size reclassified to <26 feet in order to create comparison groups better reflecting cabin sailboat size distribution (cabin sailboats are generally larger than 16 feet and this risk categorization provides a more meaningful comparison)

Section 3.4b: Adult Life Jacket Wear Rates by Dichotomized Risk Variables on Sailboats

In general, adult life jacket wear rates on sail craft was significantly higher in "risky" boating conditions when compared to "non-risky" conditions, suggesting that adult boaters seem to understand the connection between wearing life jackets and drowning prevention and respond to their specific boating conditions accordingly. Below is a summary of results for each boat type. **Table 3.4b** provides results of significance tests.

Sailboards: Cold air temperature below 65°F was the only "risky" factor significantly related to higher life jacket wear rates among adult boaters. There was not enough evidence to suggest statistically significant higher life jacket wear rates among the following "risky" situations: cold water temperatures, poor visibility, raining or stormy weather, or dangerous activity. Although a larger proportion of boaters in these "risky" situations appear to be wearing life jackets compared to boaters in less "risky" conditions, statistical comparison tests could not confirm significance of these differences, likely due to very small sample sizes observed for this boat type. Strong current, sailing boat movement, and boating alone were not significantly related to highter life jacket wear rates. Two "non-risky" conditions were related to higher life jacket wear rates among adult boaters, including calm waves and low wind speeds. These results may be due to unmeasured factors, such as boater experience, or the presence of other "risky" conditions associated with higher life jacket wear rates.

Day Sailors: The following six "risky" conditions were significantly related to higher life jacket wear rates use among adult boaters:

1. Cold water temperatures below 65°F
2. Choppy/rough waves
3. High wind speeds of 6 or more knots
4. Small boat size < 16 feet long
5. Fishing/racing activities
6. Single boater on board (boating alone)

There was not enough evidence to suggest statistically significant higher life jacket wear rates among the following "risky" situations: poor visibility, raining or stormy weather, and sailing or motoring movement. Although a larger proportion of boaters in these "risky" situations appear to be wearing life jackets compared to boaters in less "risky" conditions, statistical comparison tests could not confirm significance of these differences, likely due to smaller sample sizes observed for this boat type. Cold air temperature was not significantly related to a higher life jacket wear rate. Three "non-risky" conditions were related to higher life jacket wear rates among adult boaters, including weak or moderate current, no child on board, and boater position as operator. The presence of other "risky" conditions associated with higher life jacket wear rates concurrently with these less "risky" conditions might explain these reversals.

Cabin Sailboats: The following eight "risky" conditions were significantly related to higher life jacket wear rates among adult boaters:

1. Cold water temperatures below 65°F
2. Cold air temperatures below 70°F
3. Choppy/rough waves
4. Raining/storming weather
5. High wind speeds of 6 or more knots
6. Small boat size < 26 feet long
7. Fishing/racing activities
8. Sailing/motoring movement

Although the life jacket wear rate was noticeably higher among sailors boating alone compared to sailors with at least one other boater, there was not enough evidence to suggest that this difference was statistically significant. Poor visibility, child on board, and boater position as passenger were not significantly related to higher life jacket wear rates. The "non-risky" condition of strong current was related to a higher life jacket wear rate among adult boaters. The presence of other "risky" conditions associated with higher life jacket wear rates concurrently with weak or moderate current might explain this reversal.

Table 3.4b – Adult life jacket wear rate, by dichotomized risk variables – Sailboats

Condition	Boat Type					
	1. Sailboard		2. Day Sailor		3. Cabin Sailboat	
	N (% PFD)	p	N (% PFD)	p	N(% PFD)	p
Life Jacket Wear Rate	**378 (80.2)**		**12804 (51.6)**		**48509 (13.8)**	
COLD WATER temperature *(<65°F)* (R)	18 (94.4)	ns†	956 (60.6)	****	4978 (23.1)	****
WARM WATER temperature *(≥65°F)*	331 (78.3)		11146 (50.1)		41755 (12.6)	
COLD AIR temperature *(<70°F)* (R)	26 (96.2)	*	1241 (50.6)	ns	6446 (29.1)	****
WARM AIR temperature *(≥70°F)*	339 (78.2)		11305 (51.1)		41810 (11.4)	
POOR VISIBILITY (R)	10 (100.0)	ns†	52 (63.5)	ns	253 (13.0)	ns
GOOD/FAIR VISIBILITY	364 (79.4)		12639 (51.6)		47934 (13.8)	
CHOPPY/ROUGH WAVES *(≥0.5 feet tall)* (R)	171 (74.3)	*	4802 (55.3)	****	15765 (15.8)	****
CALM WAVES *(<0.5 feet tall)*	204 (84.8)		7968 (49.5)		32499 (12.8)	
RAINING/STORMING weather (R)	16 (93.8)	ns†	284 (57.0)	ns	1233 (16.4)	**
SUNNY/CLOUDY weather	361 (79.6)		12490 (51.5)		47032 (13.7)	
STRONG CURRENT (R)	10 (70.0)	ns†	435 (38.9)	****	1841 (10.3)	****
WEAK/MODERATE CURRENT	367 (80.4)		12356 (52.0)		46534 (13.9)	
HIGH WIND *(≥6 knots)* (R)	155 (73.6)	*	4704 (56.6)	****	18167 (15.4)	****
LOW WIND *(<6 knots)*	216 (84.3)		7950 (48.5)		29888 (12.8)	
CHILD present *(<13 years old, 2+ boaters)* (R)			676 (44.4)	*	3912 (13.8)	ns
NO CHILD present			10586 (49.4)		42519 (13.7)	
SMALL BOAT size *(<16 feet (2); <26 feet (3))* (R)			4344 (67.3)	****	15973 (19.7)	****
LARGE BOAT size *(≥16 feet (2); ≥26 feet (3))*			8418 (43.6)		32446 (10.9)	
DANGEROUS ACTIVITY *(fish/race)* (R)	2 (100.0)	ns†	107 (96.3)	****	259 (28.6)	****
OTHER ACTIVITY *(pleasure)*	376 (80.1)		12697 (51.2)		48250 (13.7)	
DANGEROUS MOVEMENT (R) *(sailing (1); sailing/motoring (2,3))*	368 (79.6)	ns†	12645 (51.7)	ns	47879 (13.8)	**
OTHER MOVEMENT *(drifting/anchored)*	4 (100.0)		113 (45.1)		553 (9.2)	
SINGLE BOATER (R for day sailor and cabin sailboat)	376 (80.1)	ns†	1542 (70.0)	****	2078 (14.5)	ns
2+ BOATERS (R for sailboard)	2 (100.0)		11262 (49.1)		46431 (13.7)	
PASSENGER position (R)	1 (100.0)	no test	6904 (47.6)	****	31999 (13.8)	ns
OPERATOR position	1 (100.0)		4358 (51.4)		14432 (13.6)	

P values derived from Chi-Square test with 1 degree of freedom; * = p<0.05; ** = p<0.01; *** = p<0.001; **** = p≤0.0001; ns = not significant
† Fisher's Exact Tess used instead of chi-square test
(**R**) denotes a risky condition; in cases where risky conditions differ by boat type, risk condition is distinguished in the variable definition in column 1

Section 3.4c: Adult Life Jacket Wear Rates by Cumulative Risk Count on Sailboats

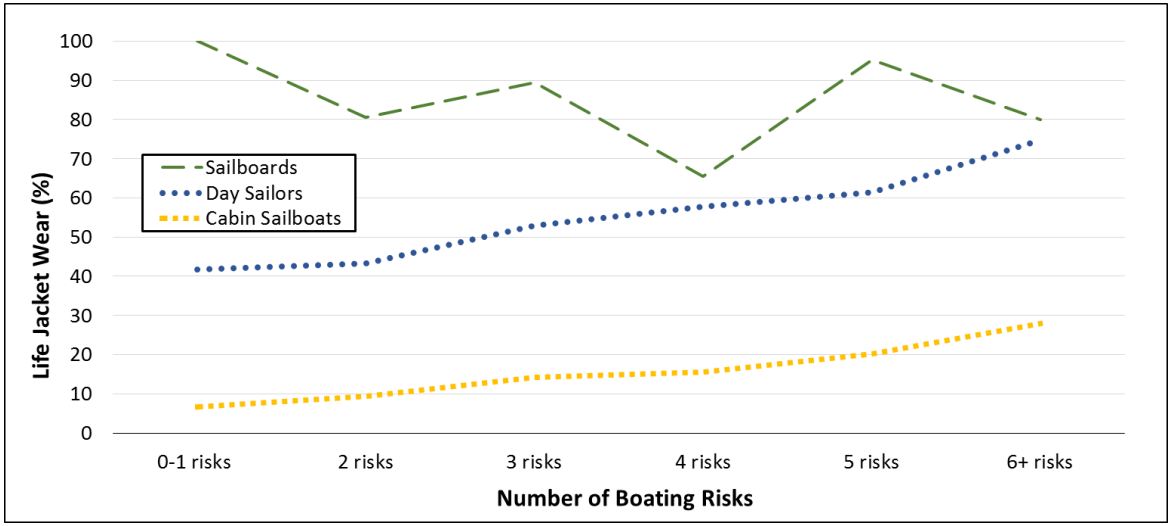
For both cabin sailboat and day sailor boaters, reported life jacket wear rate increases as the number of risks present increases. Day sailor wear rates range from 41.7% under low risks to 74.7% under highest risks. Cabin sailboat wear rates range from 6.6% under low risks to 28.0% under highest risks. Statistically significant results of Cochran-Armitage tests indicate strong evidence that life jacket wear rate increases linearly with the number of risks present. However, this trend is not true for sailboards, and is likely a result of small sample sizes. See **Table 3.4c** and **Figure M** for life jacket wear rates, cumulative risk count, and statistical test results presented graphically.

Table 3.4c – Adult life jacket wear rate, by cumulative risk count – Sailboats

Number of Risks Present	Boat Type								
	1. Sailboards			2. Day Sailors			3. Cabin Sailboats		
	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD
Overall Life Jacket Wear Rate	378	**303**	**80.2%**	12804	**6604**	**51.6%**	48509	**6675**	**13.8%**
0-1 risks	5	5	100.0%	1145	478	41.7%	3840	252	6.6%
2 risks	129	104	80.6%	3550	1533	43.2%	13443	1257	9.4%
3 risks	114	102	89.5%	3826	2025	52.9%	14628	2075	14.2%
4 risks	104	68	65.4%	2761	1592	57.7%	9499	1484	15.6%
5 risks	21	20	95.2%	1214	746	61.4%	4836	974	20.1%
6+ risks	5	4	80.0%	308	230	74.7%	2263	633	28.0%
Linear Trend Test (Z-score)	**1.5 (ns)**			**16.8******			**30.3******		

P-values derived from Cochran-Artmitage Linear Trend one-sided test; **** = p≤0.0001, ns = not significant at p<0.05

Figure M – Adult life jacket wear rate, by cumulative risk count – Sailboats



Section 3.5: How "Risky" Conditions Influence Life Jacket Wear Rates – CONCLUSIONS

The results of this analysis suggest that patterns of life jacket wear rate among adult boaters are likely not due to random behavior and are instead associated with specific boat type as well as situational and environmental characteristics. A summary of key findings are:

1. In general, adult boaters were more likely to wear life jackets when boating in conditions categorized as "risky", a response which suggests that boaters are aware of the connection between wearing life jacket and drowning prevention.

2. Several "risky" conditions show no significant changes in adult life jacket wear rate when compared to their less "risky" alternatives. These "unrecognized" risks vary by boat type, although many are likely due to small sample sizes impacting the power of statistical tests.

3. Several comparisons reveal a "risky" condition as significantly related to *lower* rates of life jacket wear. These situations are likely due to concurrent risks that are *confounding* the relationship. For example, boaters in powered inflatable rafts recorded as drifting or anchored (a "non-risky" situation) were more likely to be wearing life jackets than boaters who were motoring (the "risky" situation). However at the same time, boaters who were drifting or anchored were *also* more likely to be fishing (a different "risky" condition that is significantly related to higher life jacket wear rates). In this case, fishing is *confounding* the relationship between boat movement and life jacket wear rate and partially explains why boaters who are drifting or anchored are more likely to be wearing life jackets.

4. Although response to "risky" conditions differs by boat type, many of the same "risky" conditions are related to higher life jacket wear rates across boat type categories. Cold water temperatures, cold air temperatures, raining or stormy weather, strong current, children on board, and boat size were significant predictors of life jacket wear rate for every type of powerboat. Cold water temperatures, choppy or rough waves, and dangerous boat movement were significant predictors of higher life jacket wear rates for every type of paddlecraft. Cold water temperatures, choppy/rough waves, high wind speed, small boat sizes, and fishing/racing boating activities were significant predictors of higher life jacket wear rates for both day sailors and cabin sailboats.

5. Highly statistically significant linear trend tests for all boats *except* paddleboards and sailboards indicated that life jacket wear rates increased with the cumulative number of "risky" conditions present, suggesting that adult boaters are modifying their life jacket wearing behaviors dependent on how risky they perceive their boating situation to be. Paddleboards and sailboards did not show these same consistent associations but this may be due to the relatively small number of these types of craft observed. When a larger sample size is available in the future we would expect to see similar trends.

6. While it is encouraging that adult boaters in every boat type category seem to be considering environmental, situational, or compounded risks when choosing to wear life jackets, a perceived lack of risky conditions does not mean that there is no risk for drowning. Even though boaters may not expect to enter the water, capsizing and falling overboard occurs in less-risky conditions as well. Thus, life jackets should be worn at all times.

IV. CONCLUSIONS FOR LIFE JACKET WEAR RATES - NATIONAL TREND DATA 1999 TO 2017

This report includes observational data collected from 1999 to 2017. The 2017 report represents 19 years of trend data.

1. For many different age groups of boaters on all types of craft, wear rates in 2017 are the highest they have ever been and mark substantial improving trends since the 1999 baseline year. Here we list the types of boaters and cumulative increases since 1999.

    a. All boaters on all types of boats excluding PWCs: 34% increase
    b. All adults (18+) on all types of boats excluding PWCs: 32% increase
    c. All youth (0-17) on all types of boats excluding PWCs: 38% increase
    d. Children (0-5) on all types of boats excluding PWCs: 17% increase
    e. Children (6-12) on all types of boats excluding PWCs: 26% increase
    f. Teenagers (13-17) on all types of boats excluding PWCs: 93% increase

2. Adult wear rates on powerboats have shown increases over this 19 year period with the average rate of life jacket wear for all powerboats (excluding PWCs) showing increases from 1999 to 2017 by 43%.

3. Open motor boats have increased in wear rates with 2017 being highest ever observed at 7.0% and representing a 52% increase since 2006 (4.6%) when the first strategic plan identified open motorboat wear rates as a target.

4. Cabin sail boat wear rates were at 18.8%, a drop from the highest ever observed rate (20.5%) in 2015, but an increase since 2016 (17.2%). This rate is over two times higher than wear rates reported in 1999 (9.1%).

5. Day sailor rates have also climbed dramatically since 1999 when wear rates were 30.7%. The 2017 wear rate was 61.9% and this represents a 102% relative increase over the 19 years.

6. The number of adult standup paddleboarders has increased each year since 2010 and wear rates have been in excess of 50% since 2012. In 2017 the wear rate was 50.9%.

7. Wear rates on PWCs for both adults and children are almost universal with the 2017 adult wear rate 97.9% the highest ever.

8. For each type of powerboat, cold water temperatures, cold air temperatures, raining or stormy weather, strong current, children on board, and small boat size are significantly related to higher life jacket wear rates.

9. For each type of paddlecraft, cold water temperatures, choppy or rough waves, boat movement, and number of boaters are significantly related to higher life jacket wear rates.

10. For each type of sailboat (day sailors or cabin sailboats), choppy or rough waves, high wind speed, and small boat sizes are significantly related to higher life jacket wear rates.

11. Life jacket wear rates increase with the cumulative number of risky conditions encountered for adult boaters in skiffs, runabouts, cabin cruisers, pontoons, powered inflatable/rafts, paddled inflatables/rafts, rowboats, canoes, kayaks, day sailors, and cabin sailboats. This suggests that adult boaters are modifying their life jacket wearing behaviors dependent on how risky they perceive their boating situation to be.

V. APPENDIX: METHODS & DESCRIPTIVE INFORMATION

To provide reliable and valid indicators of changes in life jacket wear rates, it was essential for observation procedures to remain as close as possible to those used in previous years. The same states were observed for each of the years of data collection efforts, during the same period of time (July and August). The vast majority of the sites in each of 30 states observed have remained the same for all years. The following is a detailing of the methods used in all years of data collection.

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 (20 out of 26 states) were chosen, and approximately 40% of the inland states (10 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 U.S. Power Squadrons, and state boating or fishing law enforcement agencies. Sites were selected to roughly represent a variety of available boating venues in the state, as well as their proximity to one another to allow for relatively short travel time between sites. In addition, sites needed to have suitable shore-based viewing locations from which observations of life jacket wear could be made using 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 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 life jacket 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 an experienced 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 about 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 conditions. The forms have remained the same from year to year, with the exception of two changes made in 1999, one change made in 2004, one change made in 2007, and three changes made in 2016. These changes are discussed in detail below.

A) Boat Forms - Observers recorded the observation **time period** in two hour blocks of time (7:59 or earlier, 8am – 9:59am, 10am – 11:59pm, 12pm – 1:59pm, 2pm – 3:59pm, 4pm – 5:59pm, 6pm or later); the **type of boat** observed (skiff, speedboat/runabout, cabin cruiser, personal watercraft (PWC), pontoon boat, houseboat, sailboard, day sailor, cabin sailboat, rowboat, inflatable, canoe, kayak, and other); **length of boat** (less than 16 feet, 16-20.9 feet, 21-25.9 feet, 26-45.9, and 46+ feet); **type of operation** (motoring, sailing, paddling, drifting, or at anchor); and **activity** engaged in (fishing, intent to fish, water-skiing, white-water, high speed racing, swimming, pleasure boating, and other). Observers also recorded **operator/passenger status**; **gender** (male, female, or unknown); **age** (less than six, 6 - 12, 13 - 17, 18 - 64, 65 or older); **life jacket wear** and **life jacket type** (buoyant/traditional, inflatable suspender or belt pack, or not wearing). In addition, if the boat was involved in water-skiing or a towing sport, observers indicated which **boaters were skiing** (or being towed) at the time.

B) Site Forms - 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 19 years of observations five categories of information have changed. In 1999, the original 6 to 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. In 2004 the USCG requested that JSI breakout the boat size categories from three (less than 16 feet, 16-25 feet and over 26 feet) to four categories (less than 16 feet, 16-20 feet, 21-25 feet and over 26 feet). Observations made in 2004 to 2011 are the only years to record observations using the expanded boat size categories. In 2007, we added an "intent to fish" category distinct from "pleasure". Intent to fish was indicated when a boat could be observed with obvious fishing gear (fishing rods, trolling motors, etc.) even though at the moment of observation, the boaters were not fishing. In 2016 we removed the type of propulsion category from the form because it was not adding value to our analysis. Instead we added separate boat type categories for "powered" inflatables and "paddled" inflatable the only ambiguous category. Finally, we updated the life jacket wear and type categories for the first time. Until 2016, options read "Old," meaning inherently buoyant, "New," meaning inflatable and "No," for not weariing. In order to prevent confusion about these categories, they were renamed more explicitely to "Bouyant (Trad)," "Inflatable" "Susp" (suspender) and "Belt," and "Not Wear."

JSI Data Collection Form: 2017 Boat Form

TIME: ○ 7:59 or earlier ○ 8:00 - 9:59 am ○ 10:00 - 11:59 am ○ 12:00 - 1:59 pm ○ 2:00 - 3:59 pm ○ 4:00 - 5:59 pm ○ 6:00 or later

9795

POWER BOAT:		SAIL:	PADDLE:		
○ Skiff/Utility	○ Pontoon	○ Day sailor	○ Kayak	○ Paddle board	
○ Runabout	○ Inflatable/Raft	○ Cabin sailboat	○ Canoe	○ Inflatable	
○ Cabin cruiser	○ Houseboat	○ Sailboard	○ Rowboat		
○ PWC					

SIZE:	OPERATION:	ACTIVITY:	
○ Under 16	○ Cruising/Motoring	○ Pleasure	○ Fishing
○ 16 - 20.9	○ Sailing	○ Water skiing	○ Intent to Fish
○ 21 - 25.9	○ Rowing/Paddling	○ White water	○ Swimming
○ 26 - 45.9	○ Drifting	○ High Speed	○ Other
○ 46 +	○ Anchored		

	GENDER			AGE(years)					PFD			WS SW
	M	F	?	0-5	6-12	13-17	18-64	65+	Buoyant (Trad)	Inflatable Susp	Inflatable Belt	Not Wear	Yes
OP	○	○	○	○	○	○	○	○	○	○	○	○	
P1	○	○	○	○	○	○	○	○	○	○	○	○	○
P2	○	○	○	○	○	○	○	○	○	○	○	○	○
P3	○	○	○	○	○	○	○	○	○	○	○	○	○
P4	○	○	○	○	○	○	○	○	○	○	○	○	○
P5	○	○	○	○	○	○	○	○	○	○	○	○	○
P6	○	○	○	○	○	○	○	○	○	○	○	○	○
P7	○	○	○	○	○	○	○	○	○	○	○	○	○
P8	○	○	○	○	○	○	○	○	○	○	○	○	○

POWER BOAT:		SAIL:	PADDLE:		
○ Skiff/Utility	○ Pontoon	○ Day sailor	○ Kayak	○ Paddle board	
○ Runabout	○ Inflatable/Raft	○ Cabin sailboat	○ Canoe	○ Inflatable	
○ Cabin cruiser	○ Houseboat	○ Sailboard	○ Rowboat		
○ PWC					

SIZE:	OPERATION:	ACTIVITY:	
○ Under 16	○ Cruising/Motoring	○ Pleasure	○ Fishing
○ 16 - 20.9	○ Sailing	○ Water skiing	○ Intent to Fish
○ 21 - 25.9	○ Rowing/Paddling	○ White water	○ Swimming
○ 26 - 45.9	○ Drifting	○ High Speed	○ Other
○ 46 +	○ Anchored		

	GENDER			AGE(years)					PFD			WS SW
	M	F	?	0-5	6-12	13-17	18-64	65+	Buoyant (Trad)	Inflatable Susp	Inflatable Belt	Not Wear	Yes
OP	○	○	○	○	○	○	○	○	○	○	○	○	
P1	○	○	○	○	○	○	○	○	○	○	○	○	○
P2	○	○	○	○	○	○	○	○	○	○	○	○	○
P3	○	○	○	○	○	○	○	○	○	○	○	○	○
P4	○	○	○	○	○	○	○	○	○	○	○	○	○
P5	○	○	○	○	○	○	○	○	○	○	○	○	○
P6	○	○	○	○	○	○	○	○	○	○	○	○	○
P7	○	○	○	○	○	○	○	○	○	○	○	○	○
P8	○	○	○	○	○	○	○	○	○	○	○	○	○

POWER BOAT:		SAIL:	PADDLE:		
○ Skiff/Utility	○ Pontoon	○ Day sailor	○ Kayak	○ Paddle board	
○ Runabout	○ Inflatable/Raft	○ Cabin sailboat	○ Canoe	○ Inflatable	
○ Cabin cruiser	○ Houseboat	○ Sailboard	○ Rowboat		
○ PWC					

SIZE:	OPERATION:	ACTIVITY:	
○ Under 16	○ Cruising/Motoring	○ Pleasure	○ Fishing
○ 16 - 20.9	○ Sailing	○ Water skiing	○ Intent to Fish
○ 21 - 25.9	○ Rowing/Paddling	○ White water	○ Swimming
○ 26 - 45.9	○ Drifting	○ High Speed	○ Other
○ 46 +	○ Anchored		

	GENDER			AGE(years)					PFD			WS SW
	M	F	?	0-5	6-12	13-17	18-64	65+	Buoyant (Trad)	Inflatable Susp	Inflatable Belt	Not Wear	Yes
OP	○	○	○	○	○	○	○	○	○	○	○	○	
P1	○	○	○	○	○	○	○	○	○	○	○	○	○
P2	○	○	○	○	○	○	○	○	○	○	○	○	○
P3	○	○	○	○	○	○	○	○	○	○	○	○	○
P4	○	○	○	○	○	○	○	○	○	○	○	○	○
P5	○	○	○	○	○	○	○	○	○	○	○	○	○
P6	○	○	○	○	○	○	○	○	○	○	○	○	○
P7	○	○	○	○	○	○	○	○	○	○	○	○	○
P8	○	○	○	○	○	○	○	○	○	○	○	○	○

PFD Study 2016

CODE State | Site | Block | Group | Phase | Page Number

JSI Data Collection Form: 2017 Site Form

PFD Study 2017

# of Boats Observed | **ID** | State | Site | Block | Group | Phase

1. Site Information

Observer Names: _____ City: _____

Site Name: _____ Water: _____

Date of Observation: ☐☐ / ☐☐ / ☐☐ Day of the week: ○ Sat. ○ Sun.

Observation start time: ☐☐ : ☐☐ ○ AM ○ PM Observation end time: ☐☐ : ☐☐ ○ AM ○ PM

Loan Board: → ○ Yes (COMPLETE 'Loan Board' section on back of page.) ○ No ○ Not near launch area

2. Type of Body of Water

○ Bay, inlet or sound ○ River, stream, creek or canal ○ Other: _____

○ Harbor ○ Lake, pond, or reservoir (not Great Lakes)

○ Intracoastal waterway ○ Great lake (not including tributaries)

3. Site Conditions

Water temperature: ☐☐ degrees F

A. First Weather Observation (to be completed during 1st time block of boat observations)

Time:

○ 7:59 or before ○ 8-9:59 AM ○ 10-11:59 AM ○ 12-1:59 PM ○ 2-3:59 PM ○ 4-5:59 PM ○ 6 PM or later

Air Temp. ☐☐☐ F	Water Conditions	Current	Visibility	Weather Conditions
Wind Speed ☐☐ knots	○ Calm (less than 6")	○ Strong	○ Good	○ Sunny ○ Raining
	○ Choppy (6" to 2')	○ Moderate	○ Fair	○ Partly Cloudy ○ Stormy
	○ Rough (over 2')	○ Weak/None	○ Poor	○ Cloudy

*Actual form provides 3 blocks to record Weather Observations across the 4 hours of data collection

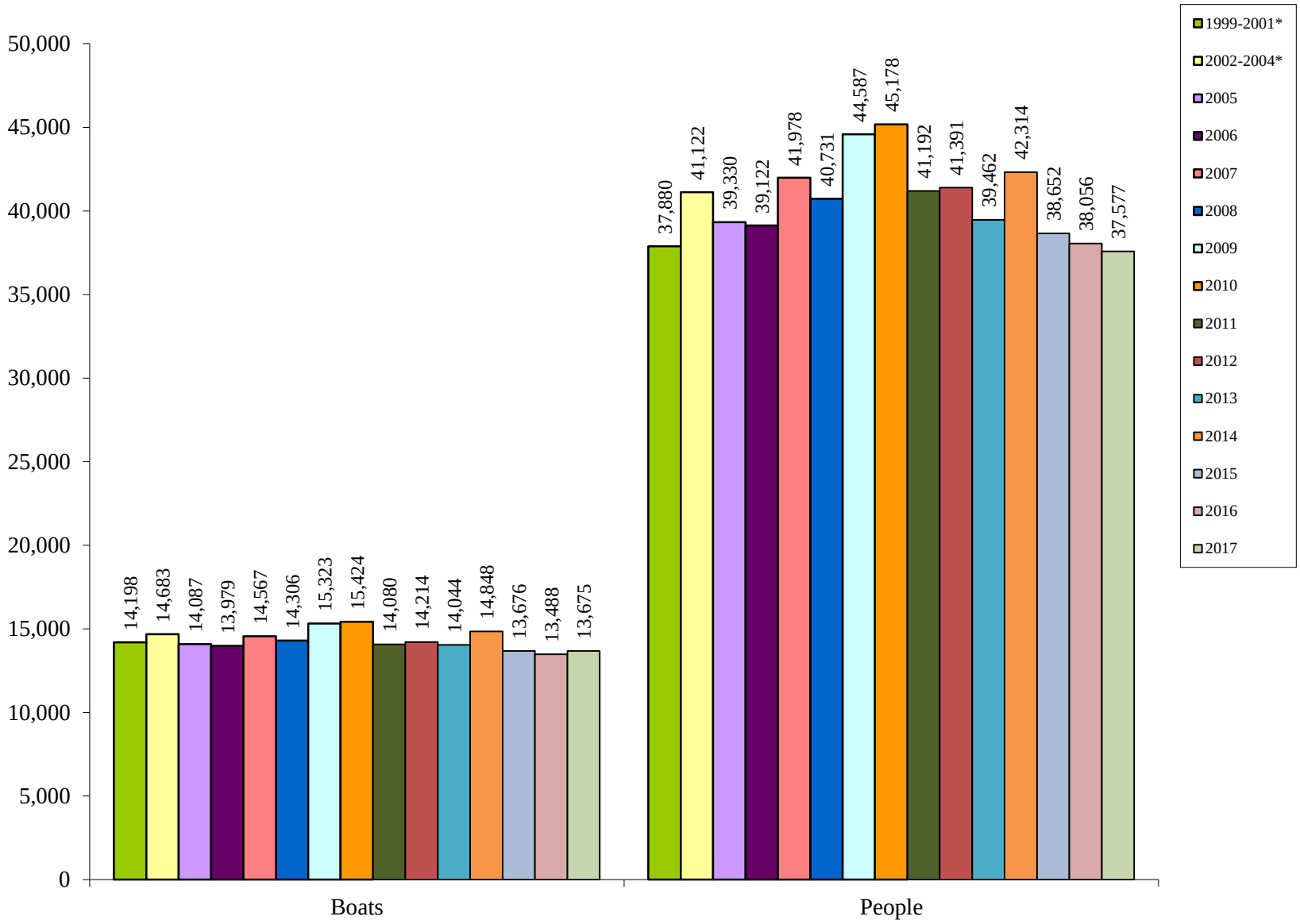
VI. INFORMATION ON BOATS & PEOPLE OBSERVED

From 1999 to 2017, JSI has observed a total of 272,354 boats and 766,576 boaters (Figure N). This year, 2017, 13,675 boats carrying 37,577 boaters were observed. The proportions of the different types of boats, length of boat, operation and activity of boats, as well as the age and gender of the boaters observed has remained fairly consistent (see Figures O through U2). This indicates not only that the sites chosen yielded diversity in the boats and boaters observed each year, but also that diversity has remained relatively consistent across the years. These figures demonstrate that the degree of representativeness of the sample of recreational boaters and their boating habits remained relatively constant across this nineteen year span.

Figures V through AB 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 remained fairly constant over the years. Therefore, any overall changes reported in life jacket 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 conditions across the sites. Of course, at individual site locations changes in these factors from year to year could account for sizable fluctuations in wear rates at individual sites.

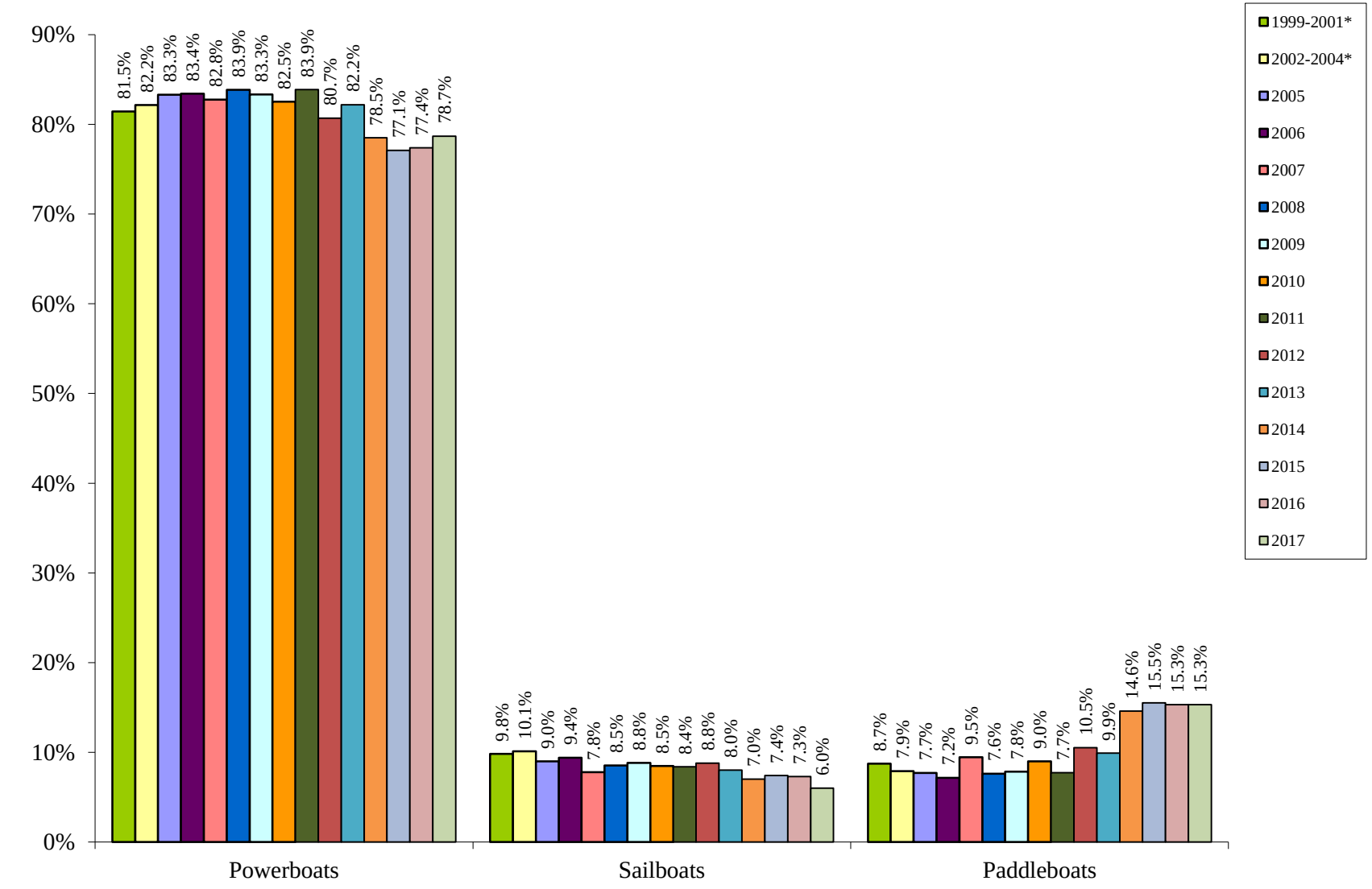
All figures in this section have been modified slightly from reports prior to 2011. The percentages now exclude (like the 2011 report) any missing observations on a particular characteristic. Since missing observations are relatively rare, this switch in presentation does not result in any major shifts in proportions shown in previous reports (before 2011).

Figure N – Number of Boats and People



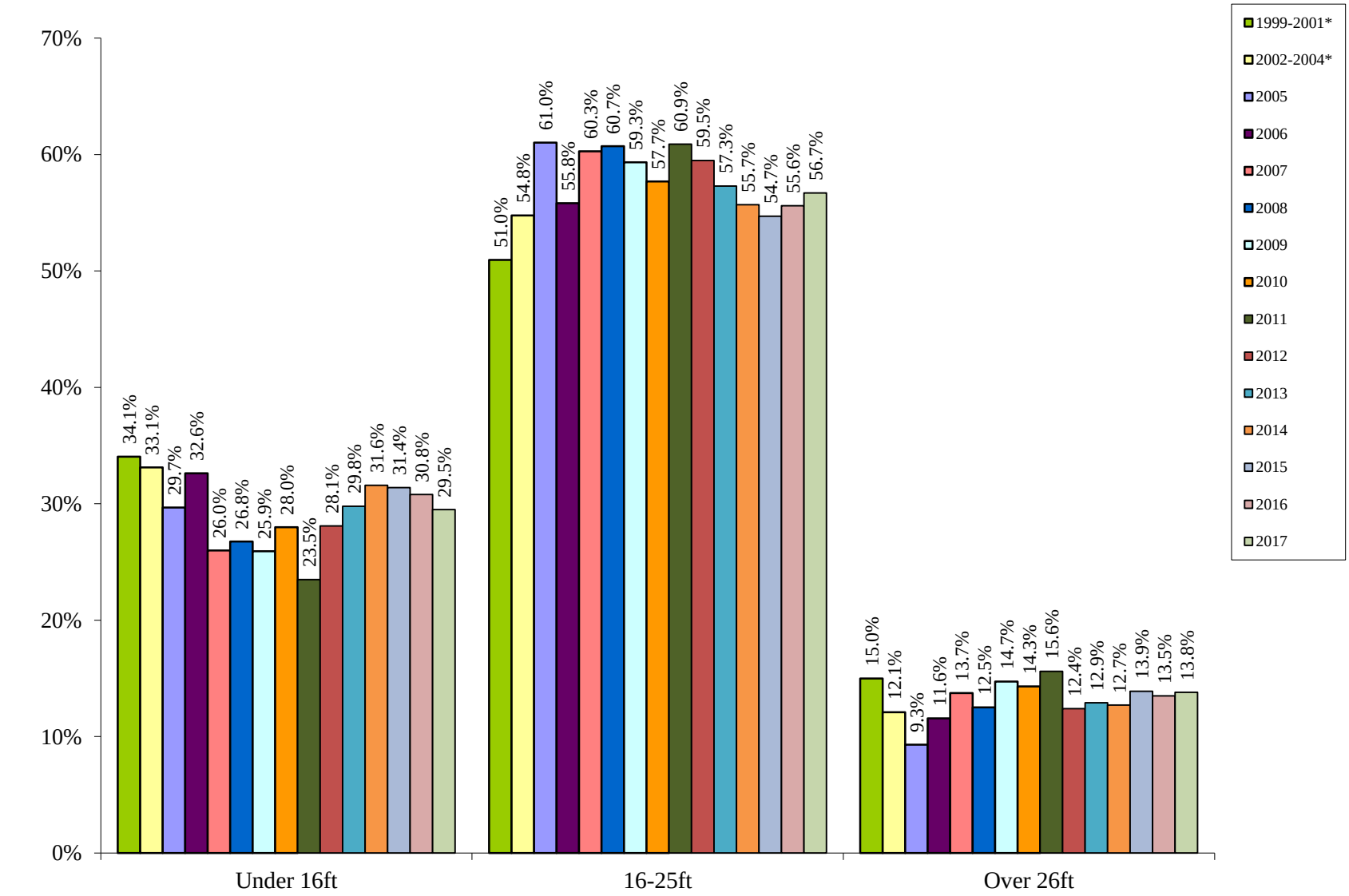
*Three-year average

Figure O – Types of Boats



*Three-year average

Figure P – Length of Boats



*Three-year average

Figure Q – Length of Boats 2004-2017 Data Only

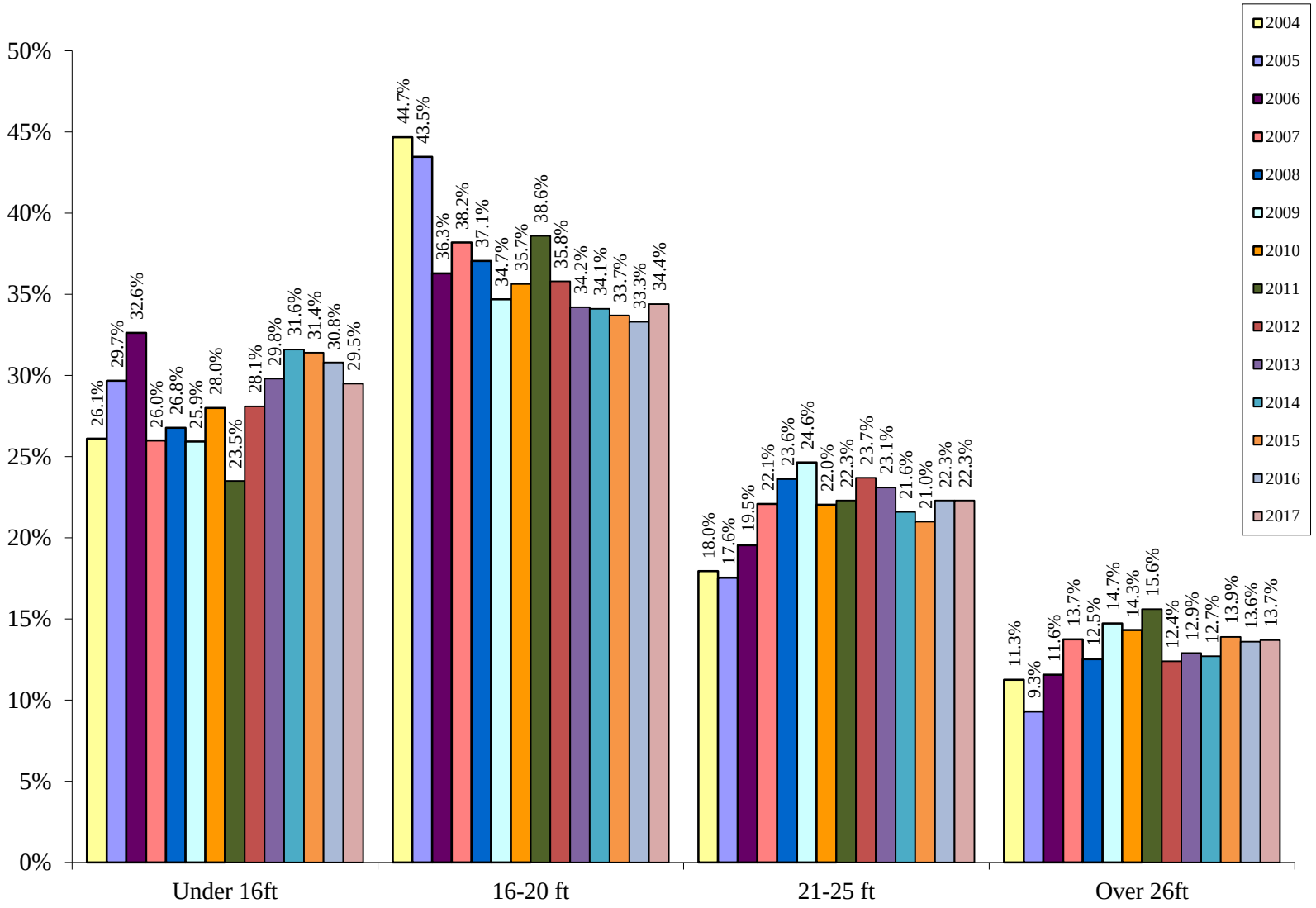
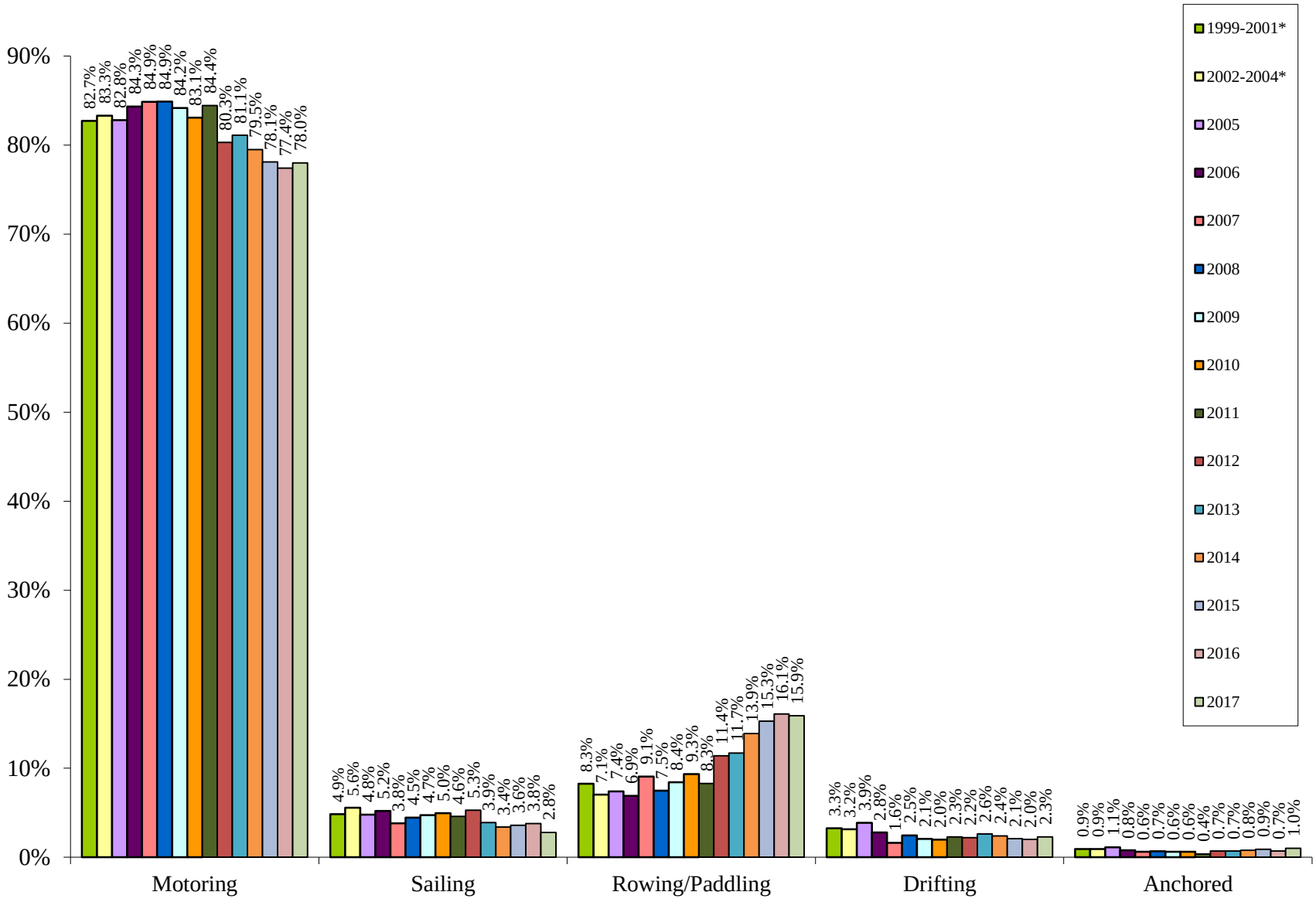
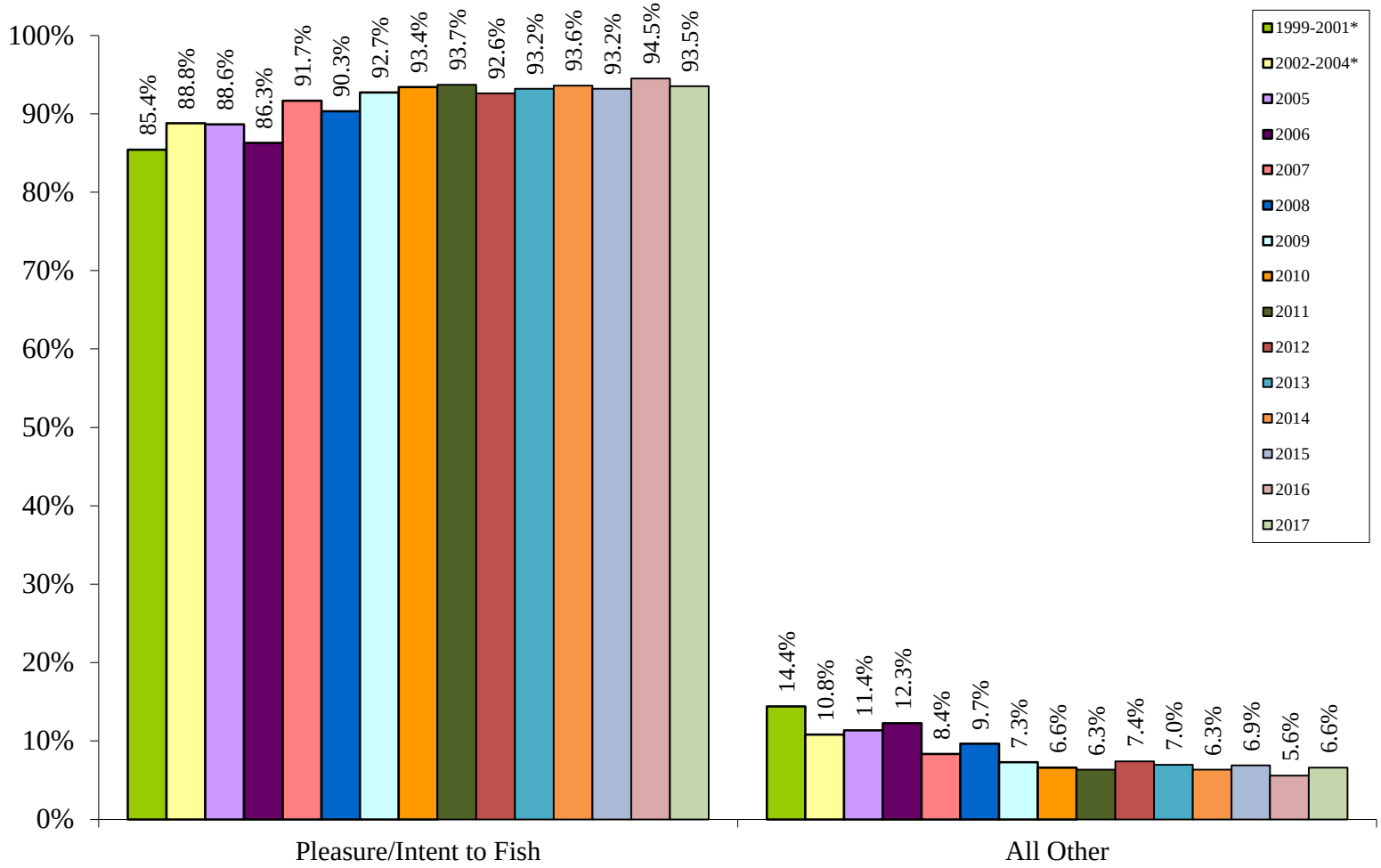


Figure R – Operation of Boats



*Three-year average

Figure S1 – Activity of Boaters—ALL YEARS*



*Three-year average

Figure S2 – Activity of Boaters 2007-2017 Data

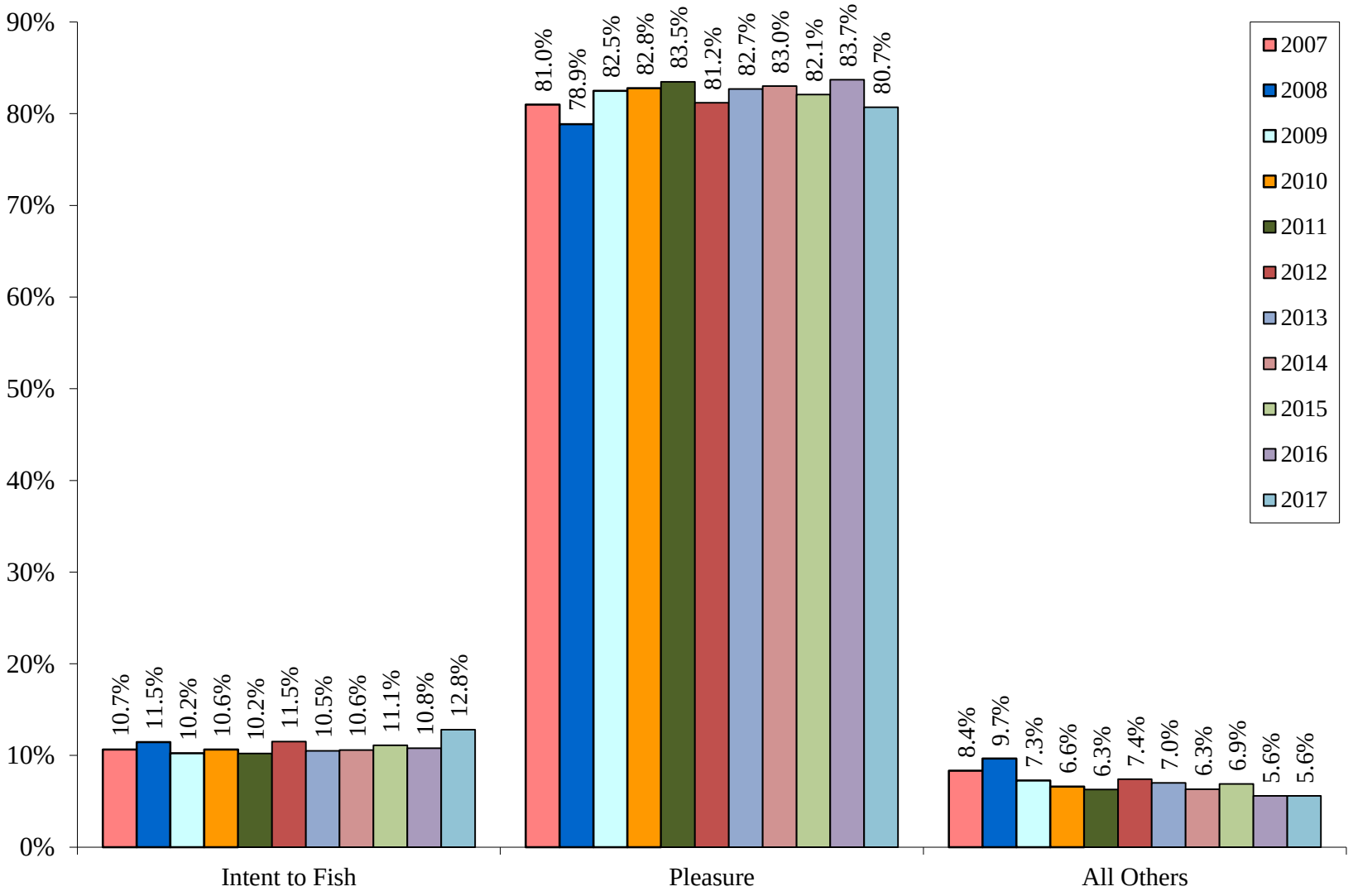
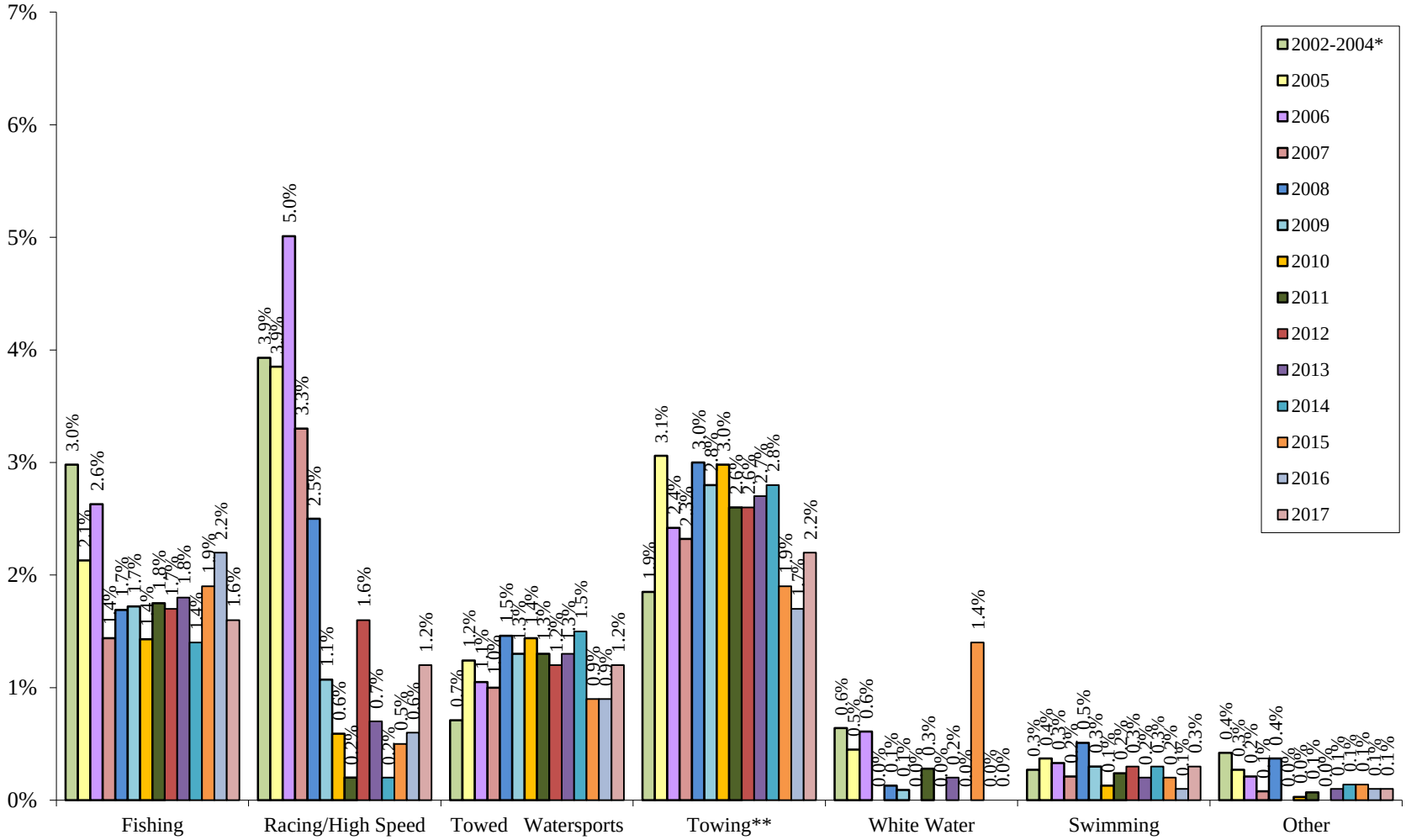


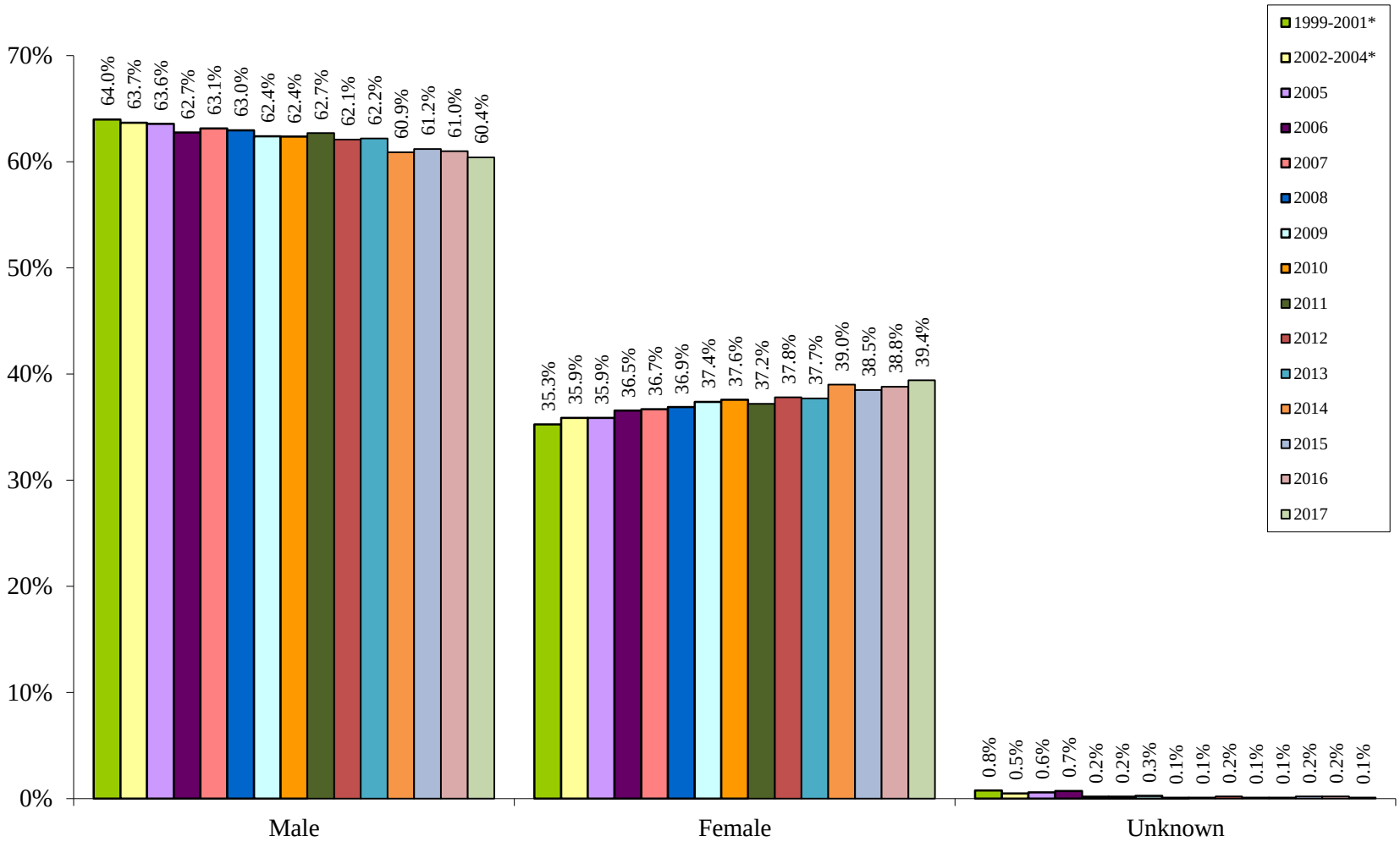
Figure S3 – Activity of Boaters 2002-2017
Detailed Breakdown of ALL OTHER Category from Figure P1



*Three-year average

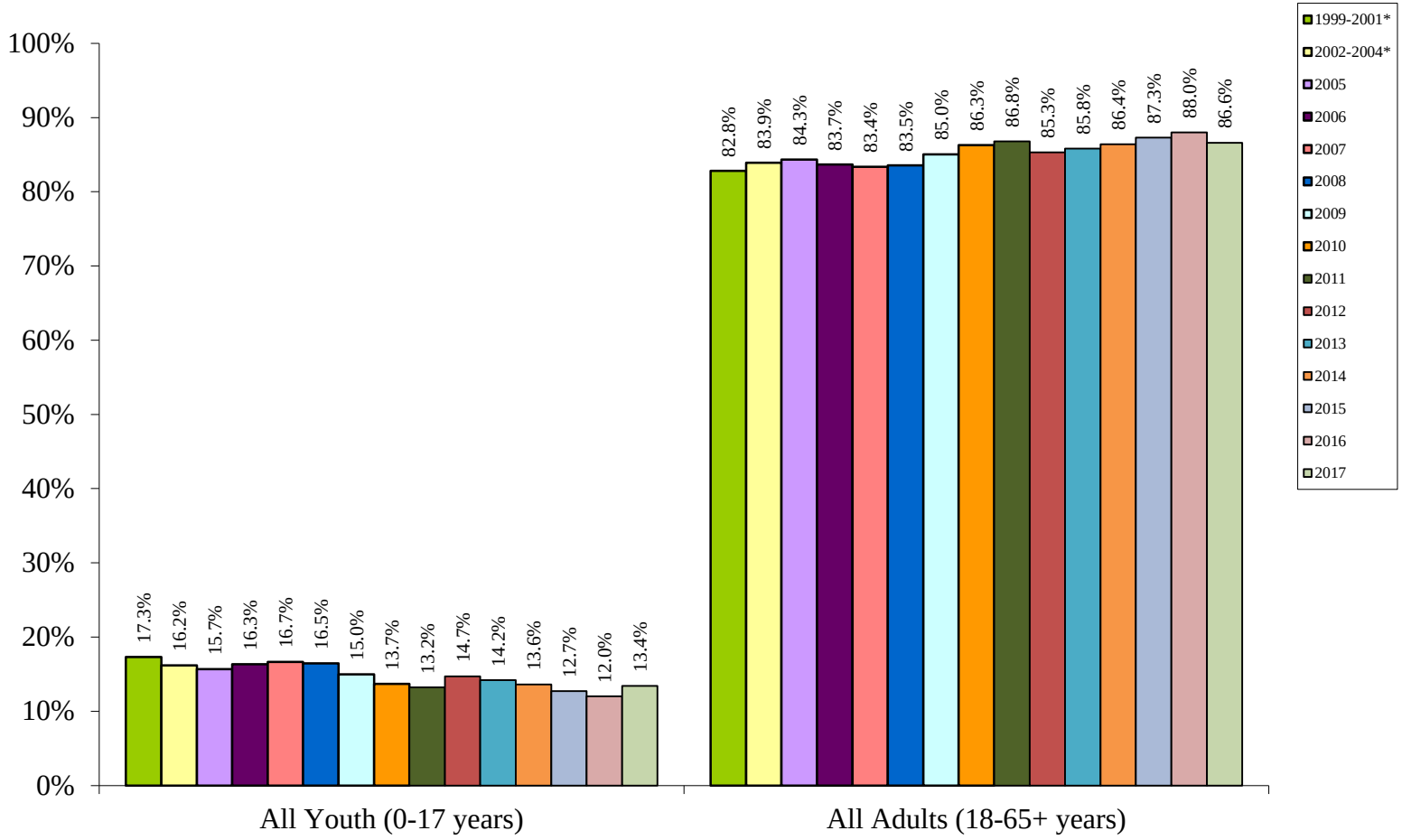
**The activity "Towing" indicates that these boaters were passengers in a boat towing water-skiers or other towing activities. Likewise, "Towed Watersports" includes all towing sports and is reserved for the boaters in the water being towed. The label was changed in April 2010.

Figure T – Gender of Boaters



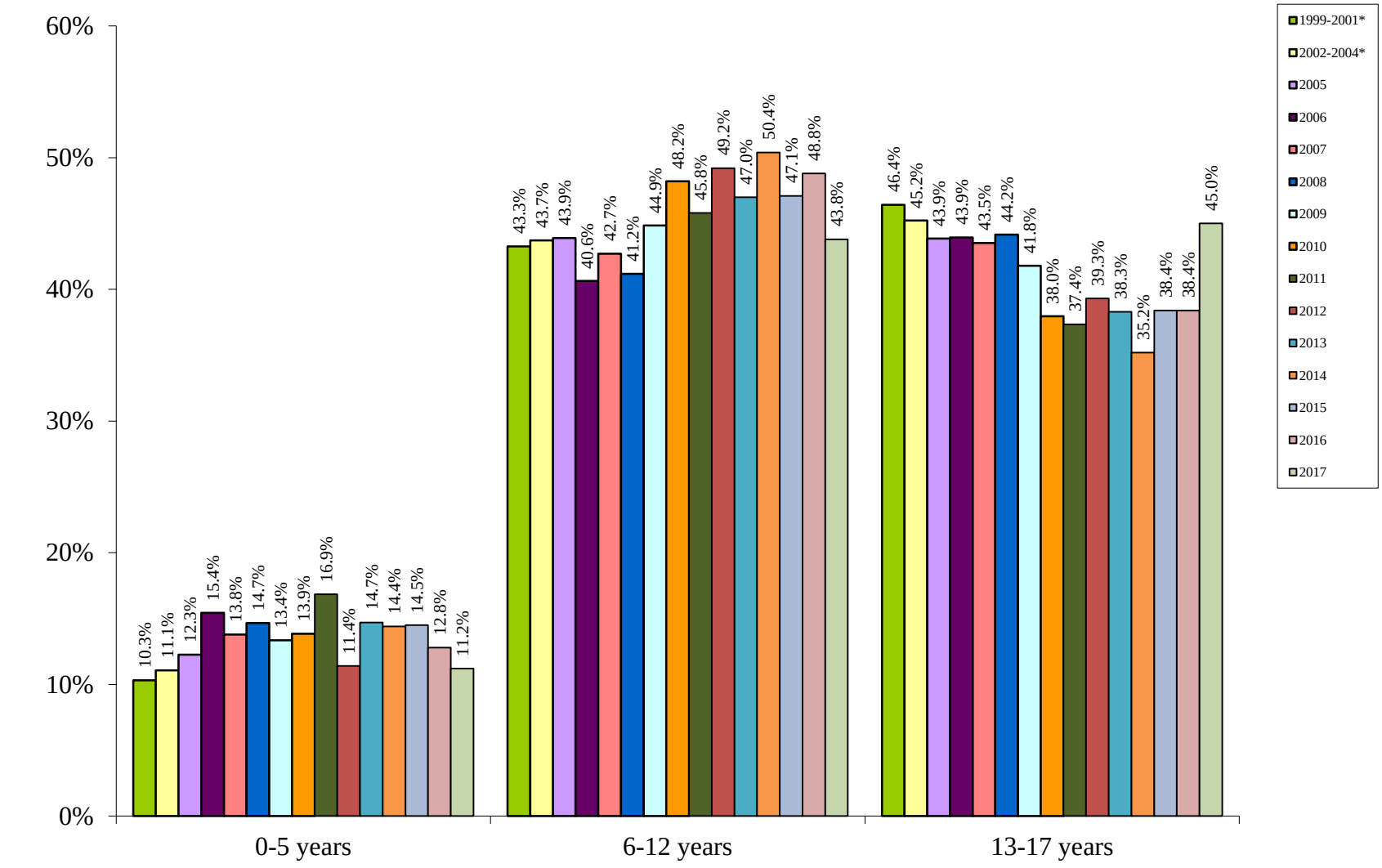
*Three-year average

Figure U1 – Age of Boaters



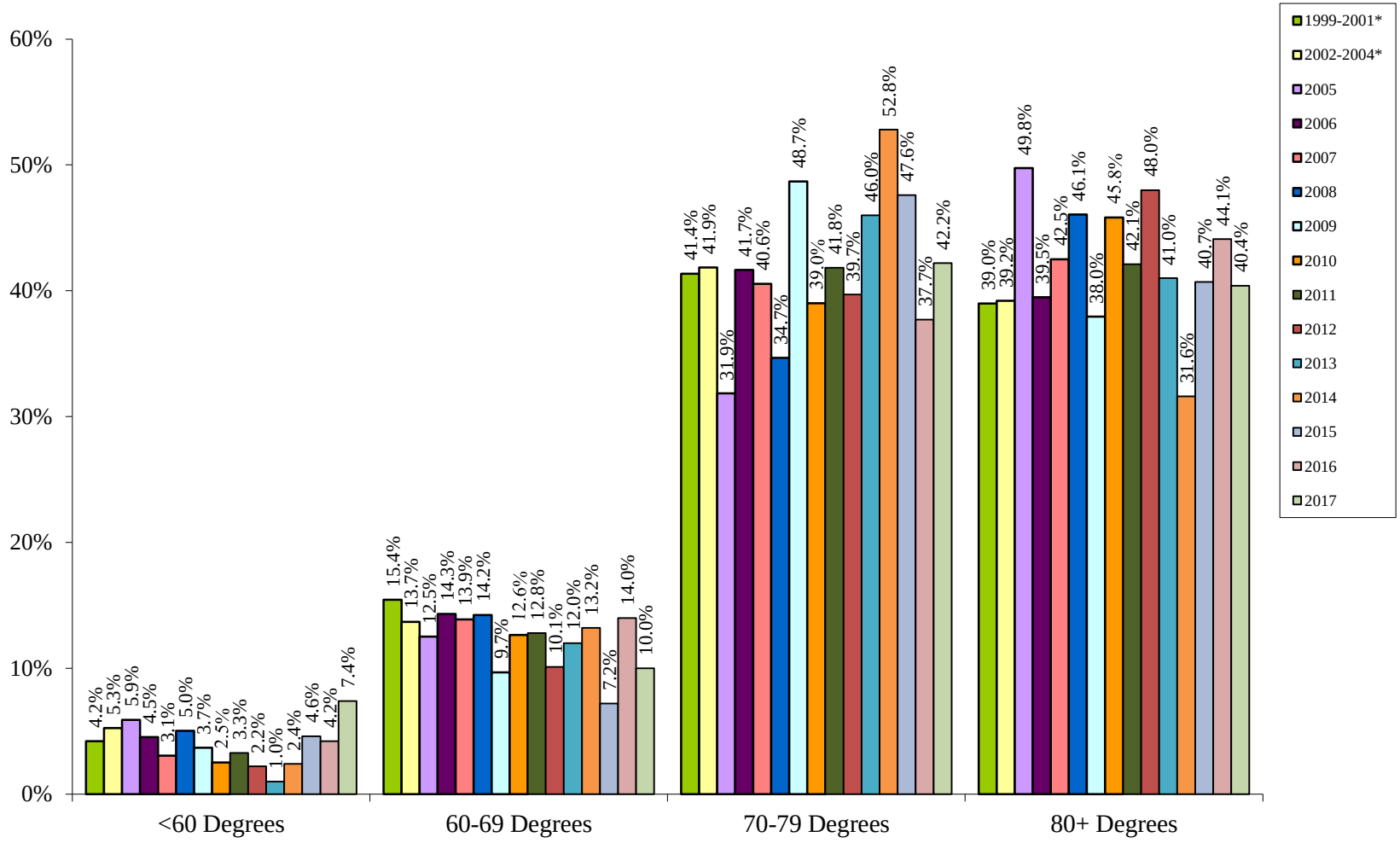
*Three-year average

Figure U2 – Age of Youth Boaters



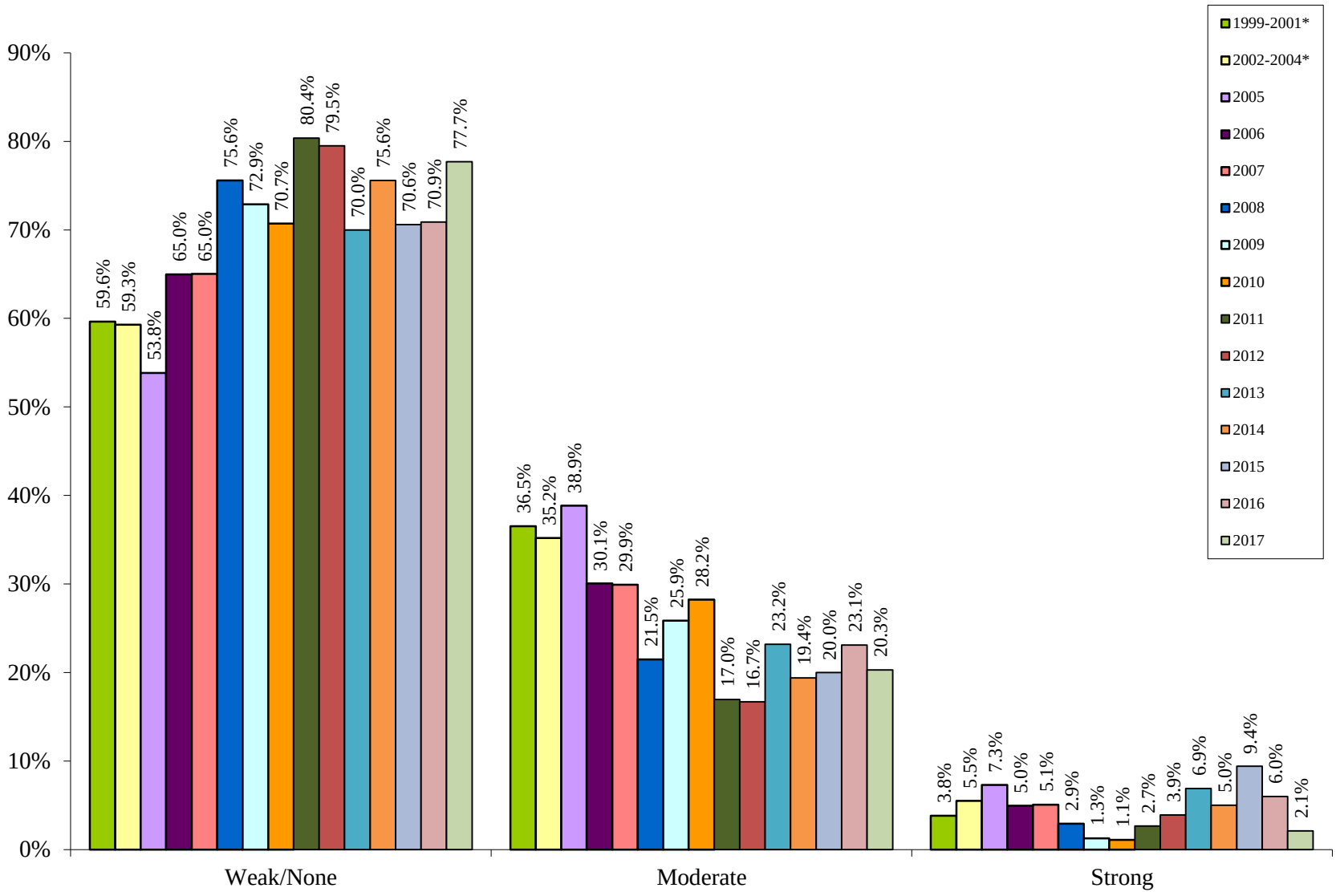
*Three-year average

Figure V – Water Temperature in which ALL Boaters were Observed



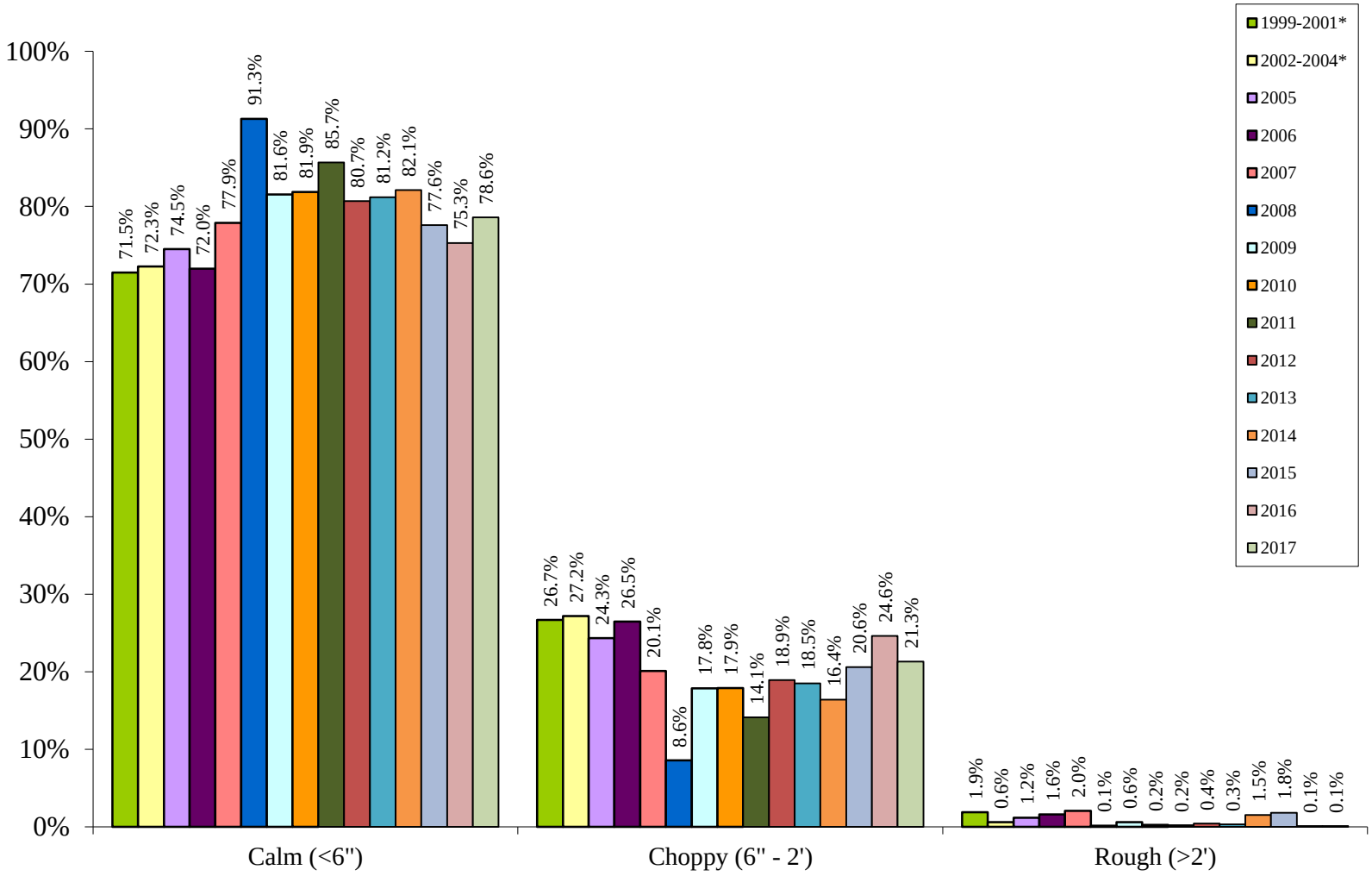
*Three-year average

Figure W – Water Current in which ALL Boaters were Observed



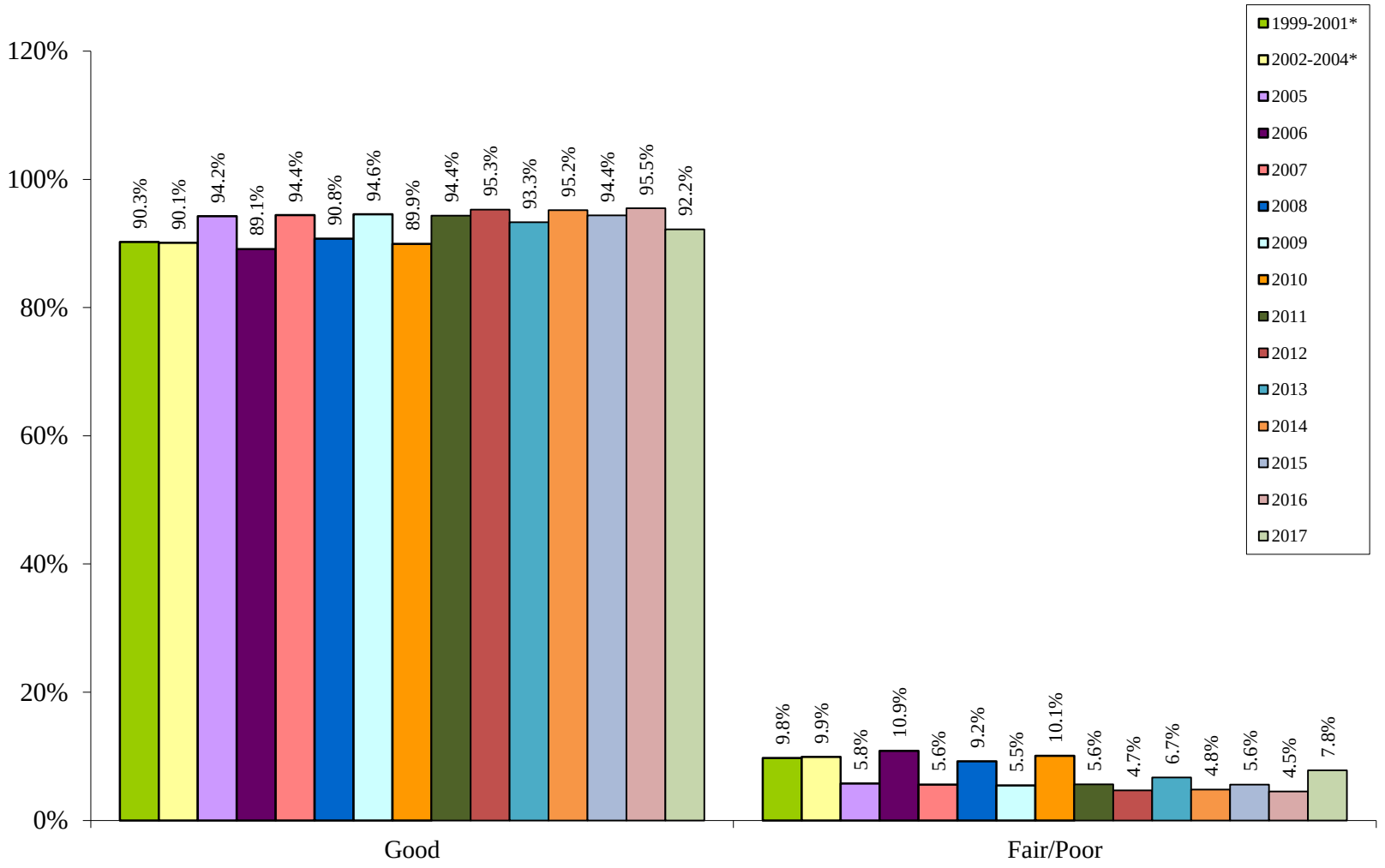
*Three-year average

Figure X – Wave Height in which ALL Boaters were Observed



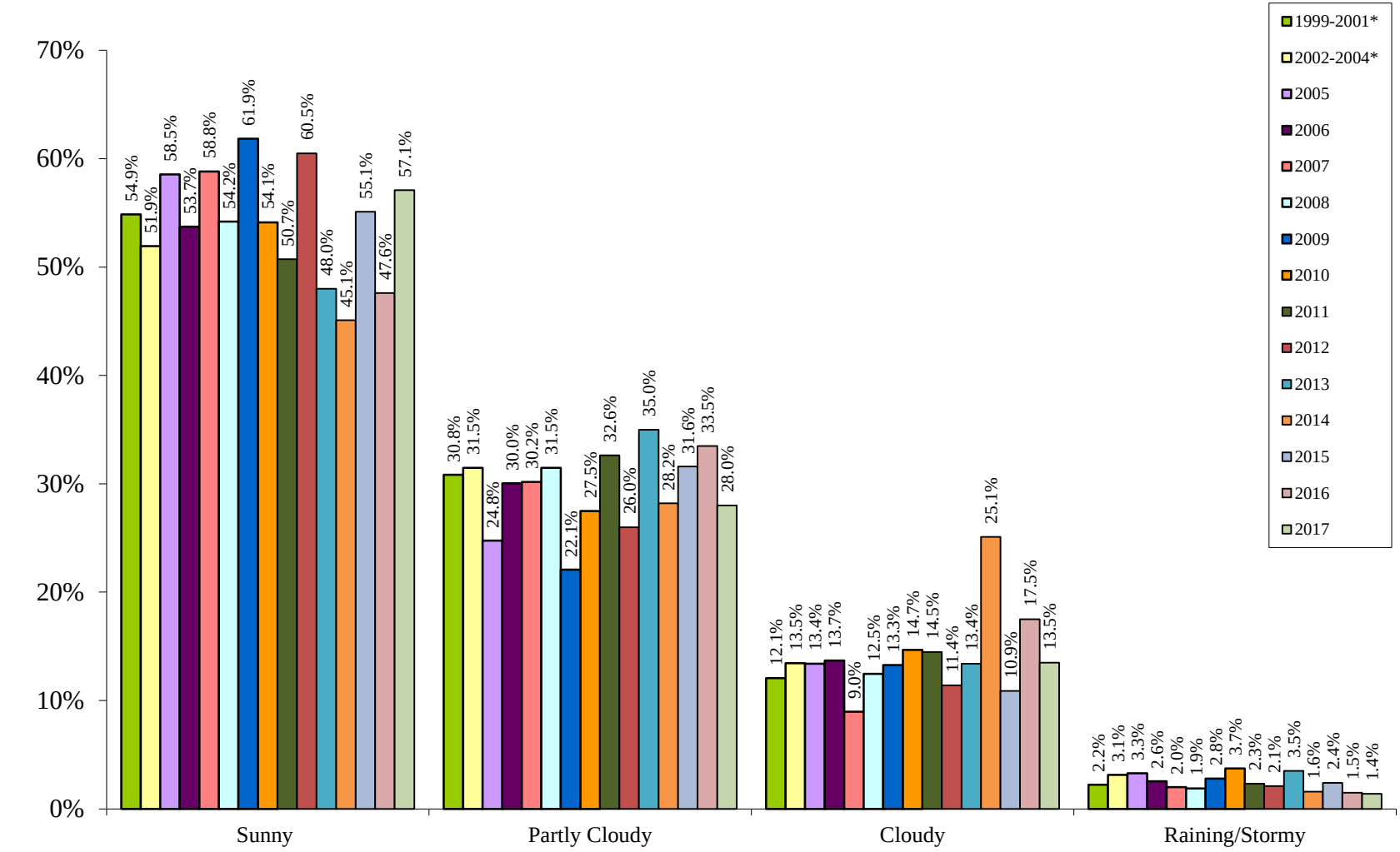
*Three-year average

Figure Y – Visibility in which ALL Boaters were Observed



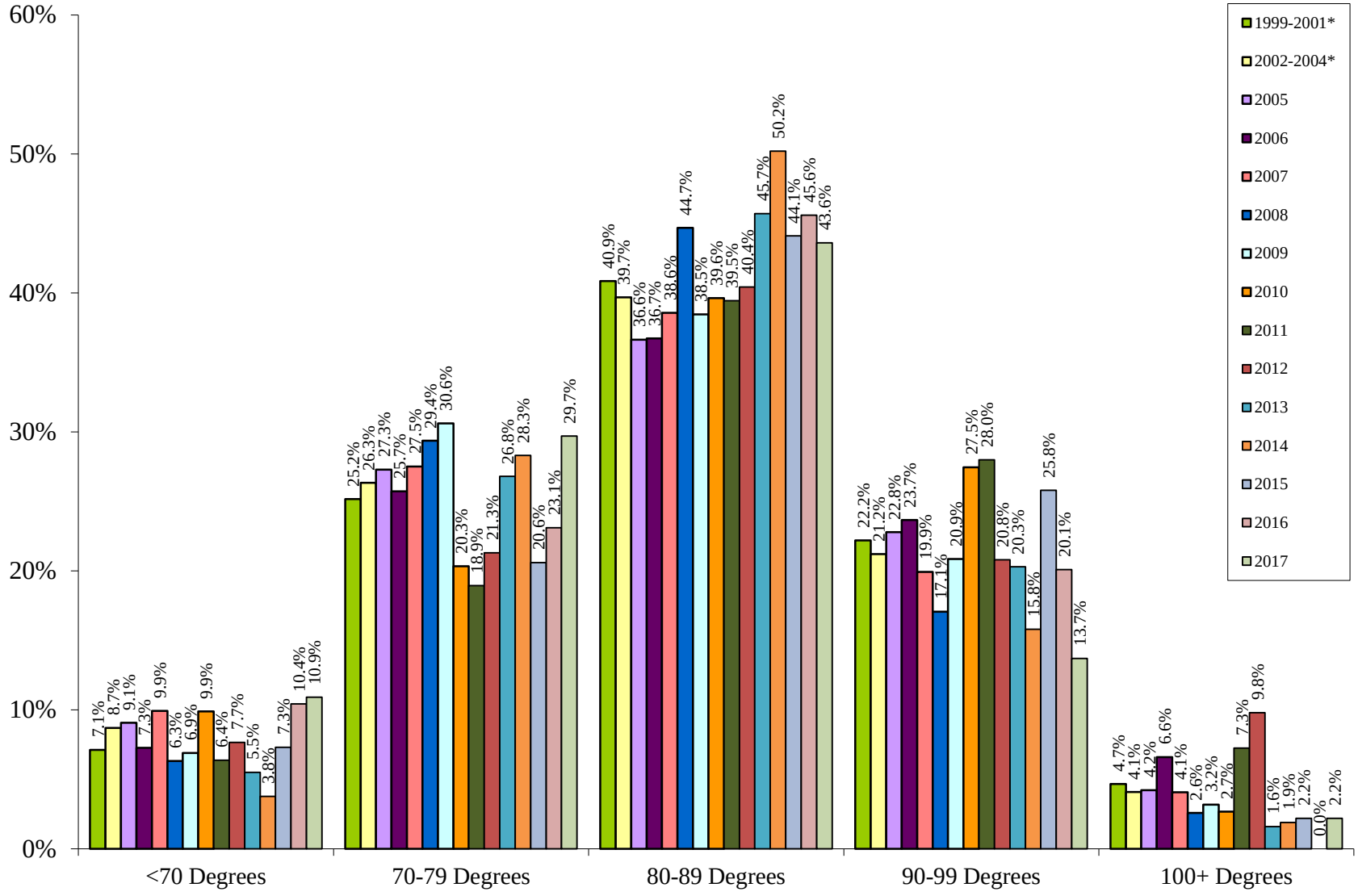
*Three-year average

Figure Z – Weather in which ALL Boaters were Observed



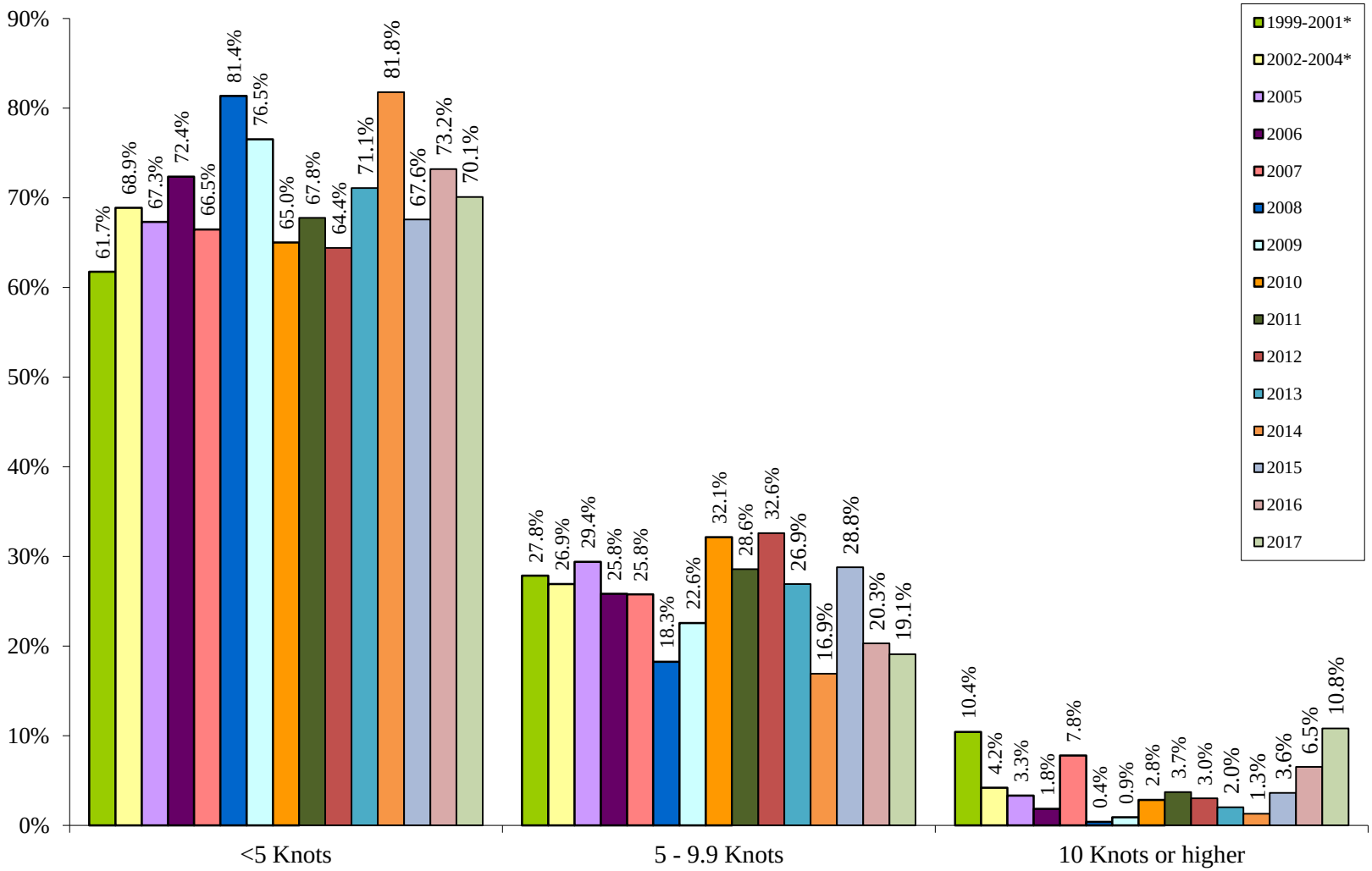
*Three-year average

Figure AA – Air Temperature in which ALL Boaters were Observed



*Three-year average

Figure AB – Wind Speed in which ALL Boaters were Observed



*Three-year average

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