2018 Life Jacket Wear Rate Observation Study

featuring

National Wear Rate Data from 1999 to 2018

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

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National Wear Rate Data from 1999 to 2018

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February, 2019

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I. INTRODUCTION

This report provides data and analysis on the 2018 National Life Jacket Wear Rate Observation Study with comparison information from the previous nineteen years' of studies (1999-2017). 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 2017 Recreational Boating Statistics report, published by the United States Coast Guard (USCG), shows that among the 438 drowning deaths in 2017 where life jacket use or nonuse was known, 84% (370) 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 2018 marked the twentieth 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.

The 2017 National Life Jacekt Wear Rate Observation Study report included a chapter that explored which boating conditions were associated with higher observed life jacket wear rates among adult boaters, by boat type. The analyses first looked at individual risk factors and their effect on adult wear rates, then investigated the effect of multiple risks on adult wear rates. This year, we have included a continuation of this analysis, with the goal of determining which risky conditions were most strongly associated with higher adult life jacket use in combination with other risky conditions. These analyses provide further insight 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 twenty 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 1999-2018 period of data collection.

II. NATIONAL CORE DATA RESULTS

Adult Life Jacket Wear Rates on Open Motorboats 2006 to 2018

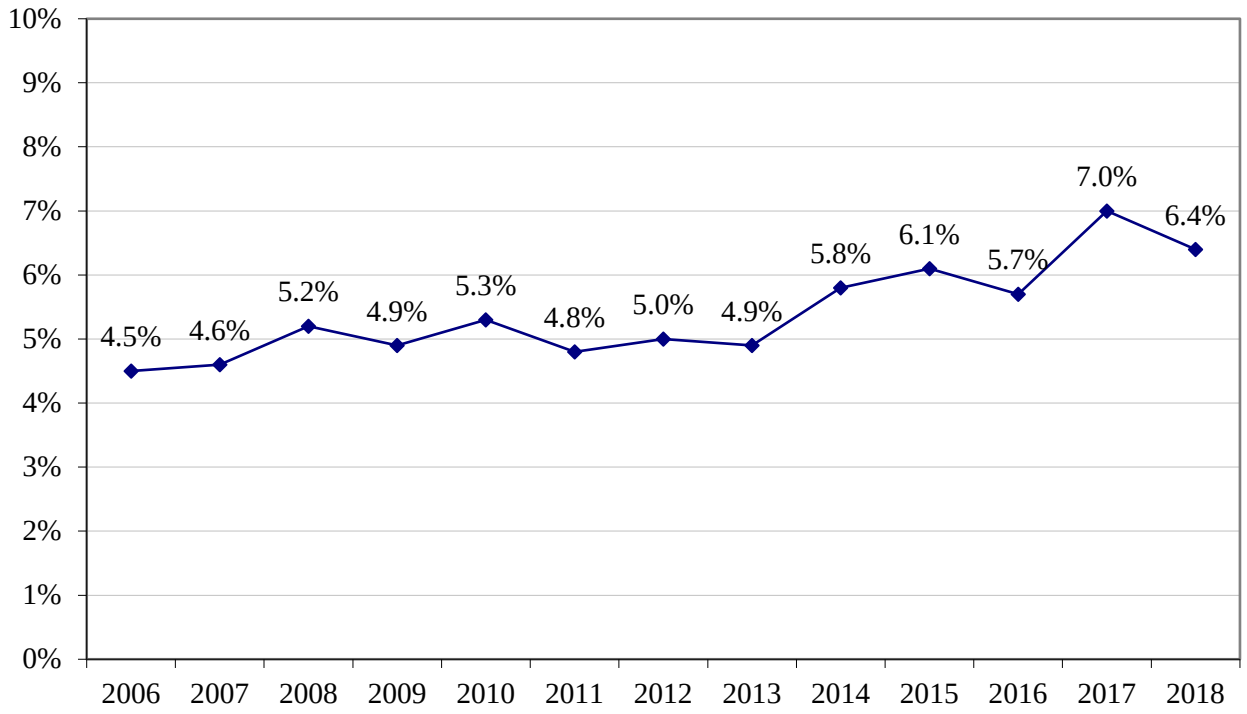
The National Boating Safety Advisory Council (NBSAC) recommended the creation of a strategic plan for the National Recreational Boating Safety Program in 2005. The goals, objectives, and strategies in this Plan can help all partners in boating safety work together to reduce the incidents of preventable 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 2018 is 6.4% and although this is a slight decrease from 2017, it still represents a generally improving trend since 2006. (See Figure A for a chart showing these trends and also Table 2.2 on page 14.) Since 2006 the wear rates for open motorboats have shown an increase by almost 42% since 2006 going from 4.5% to 6.4%.

Figure A – Adult Wear Rates on Open Motorboats* 2006-2018

(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.

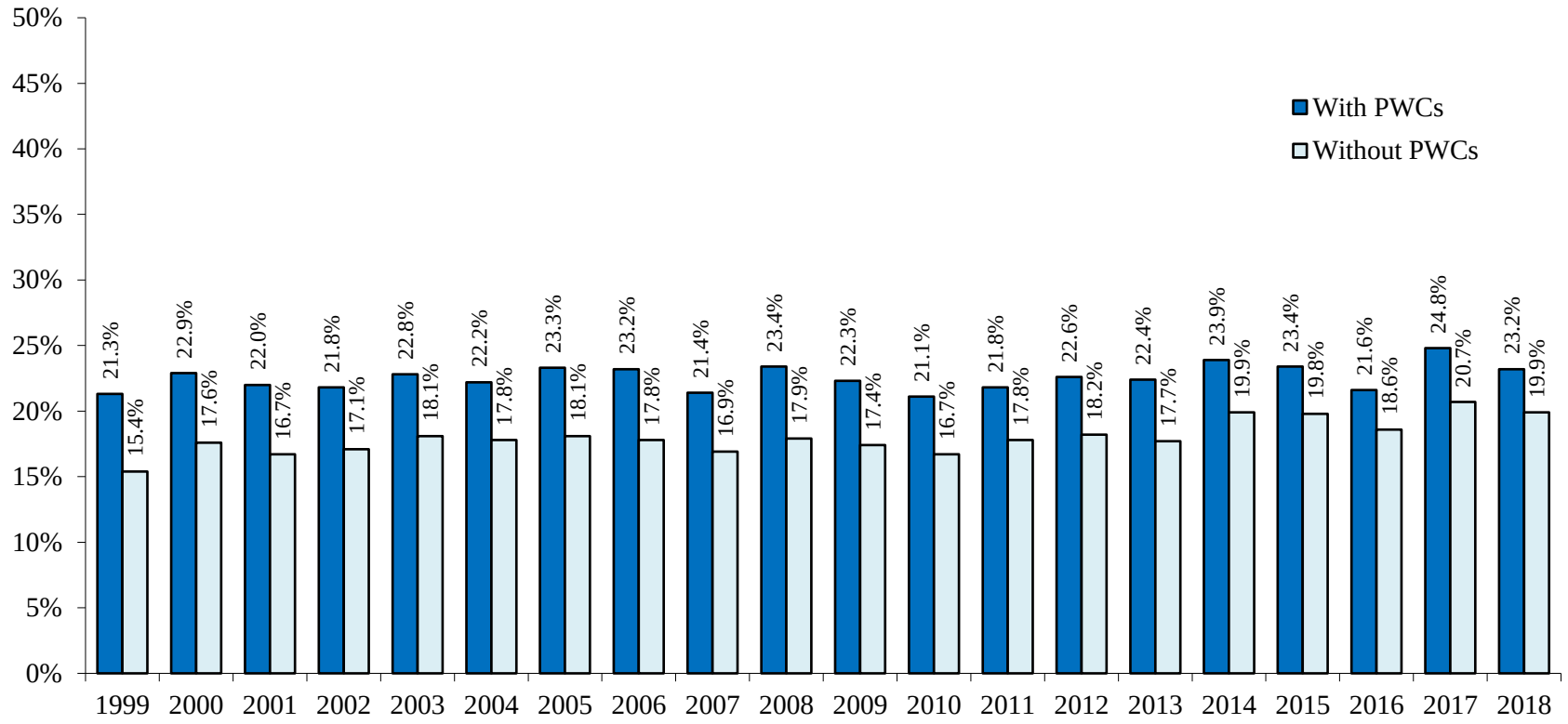
National Life Jacket Wear Rates for ALL Boaters 1999 to 2018

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 2018 was 23.2%. This is a relative decrease of 6% from 2017, and a relative increase of 9% since the beginning of the study.

The 2018 average wear rate excluding PWCs was 19.9%, which represents a relative increase of 29% since 1999 and only a slight decrease of 4% from the observed 2017 rate.

Figure B – Life Jacket Wear Rates for ALL Boaters



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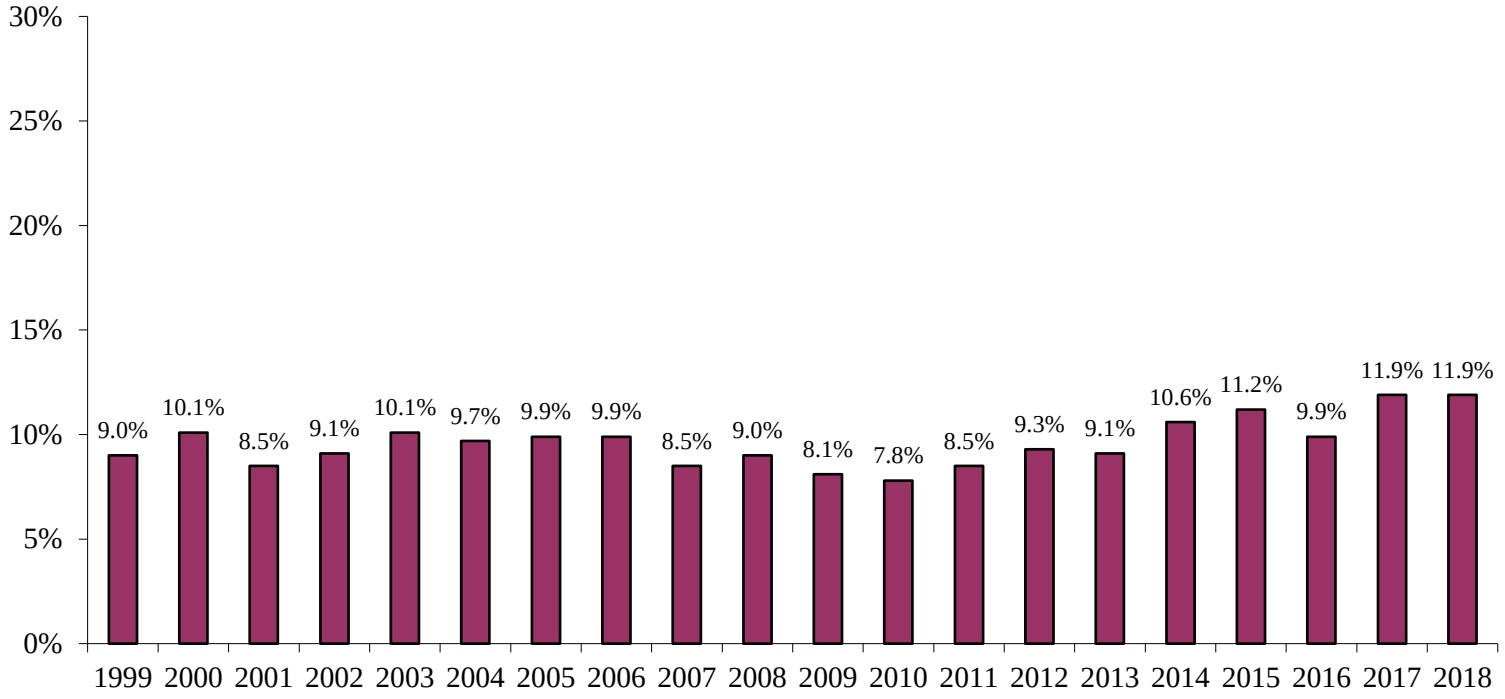
*Factors controlled for: Age & Boat Type.

National Life Jacket Wear Rates for ADULTS (18 years or older) 1999 to 2018

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 2018 was 11.9%, the same as in 2017. The 2017/2018 rate is the highest wear rate recorded, representing a 32% increase since 1999 and a 53% increase since 2010 (which had the lowest rate observed at 7.8%).

Figure C – Life Jacket Wear Among Adult Boaters*

(All boats except PWCs)



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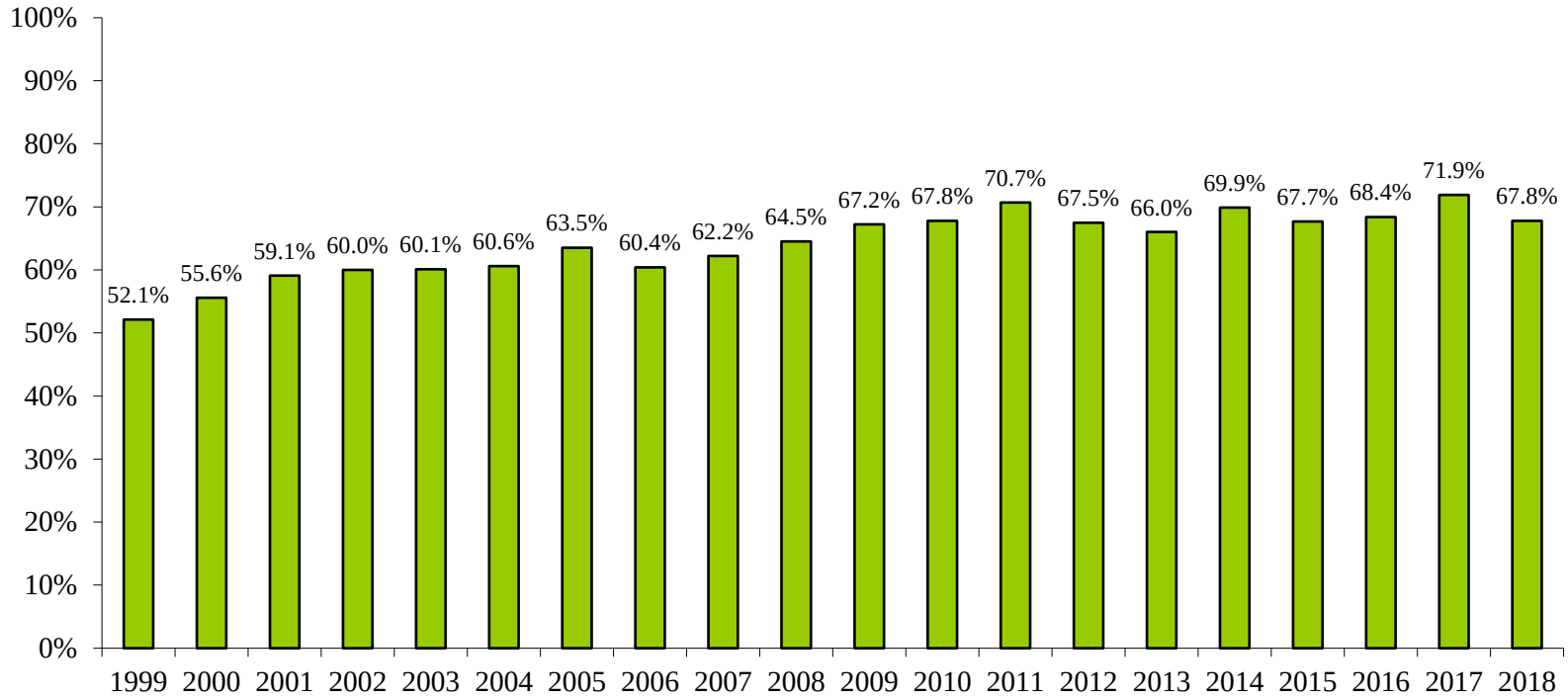
*Factors controlled for: Age & Boat Type.

National Life Jacket Wear Rates for YOUTH (17 years or younger) 1999 to 2018

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 twenty years of data shown, with a general upward trend. The wear rate for 2018 is 67.8%. This is a relative decrease of 6% compared to 2017, which was the highest recorded wear rate since 2011). However, the 2018 rate is approximately equal to both the 2016 and 2015 wear rates.

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 2018

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

The youth (0-17) wear rate for 2018 was 67.8%, a decrease from last year. All youth age groups experienced an decrease in wear rate compared to 2017 levels. Wear rates for youth under 6 years old were 90.4% in 2018 (a 4% relative decrease since 2017); for those between 6 and 12 years of age rates were 86.2% (a 1% relative decrease since 2017); and for teens (ages 13 to 17) rates were 38.3% (an 18% relative decrease since 2017).

For adults ages 18 to 64, the 2018 wear rate is 11.9%, the same as 2017 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 2018 data show a wear rate of 11.7%, a slight decrease of 4% from 2017 levels.

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 2018 or a relative increase of 53%.

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

Age	Observation Year															
	1999-2001 % (N's)	2002-2004 % (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)	2018 % (N's)
0-5 yrs	87.8%	91.9%	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%	90.4%
"blank"	(1919)	(2077)	(714)	(921)	(930)	(938)	(854)	(811)	(874)	(662)	(789)	(804)	(694)	(573)	(555)	(615)
6-12 yrs	73.1%	81.3%	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%	86.2%
"blank"	(7922)	(32790)	(2487)	(2403)	(2819)	(2579)	(2812)	(2809)	(2381)	(2844)	(2494)	(2757)	(2227)	(2184)	(2131)	(2575)
13-17 yrs	28.9%	31.4%	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%	38.3%
"blank"	(7862)	(7914)	(2230)	(2403)	(2652)	(2507)	(2420)	(2127)	(1817)	(2163)	(1933)	(1837)	(1694)	(1675)	(2077)	(2138)
0-17 yrs (all youth)	56.0%	60.2%	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%	67.8%
"blank"	(17413)	(17849)	(5414)	(5713)	(6401)	(6024)	(6086)	(5747)	(5072)	(5669)	(5216)	(5398)	(4615)	(4432)	(4763)	(5328)
18-64 yrs	9.1%	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%	11.9%
"blank"	(83949)	(93612)	(30176)	(29591)	(32108)	(30743)	(34632)	(36420)	(33267)	(32298)	(30843)	(33058)	(31012)	(30906)	(29760)	(34246)
65+ yrs	9.8%	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%	11.7%
"blank"	(3463)	(3359)	(823)	(803)	(881)	(1190)	(1129)	(763)	(951)	(1122)	(1091)	(1634)	(1232)	(1339)	(1134)	(975)
18+ yrs (all adults)	9.2%	9.6%	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%	11.9%
"blank"	(87412)	(96971)	(30999)	(30394)	(32989)	(31933)	(35761)	(37003)	(34218)	(33420)	(31934)	(34692)	(32244)	(32245)	(30894)	(35221)

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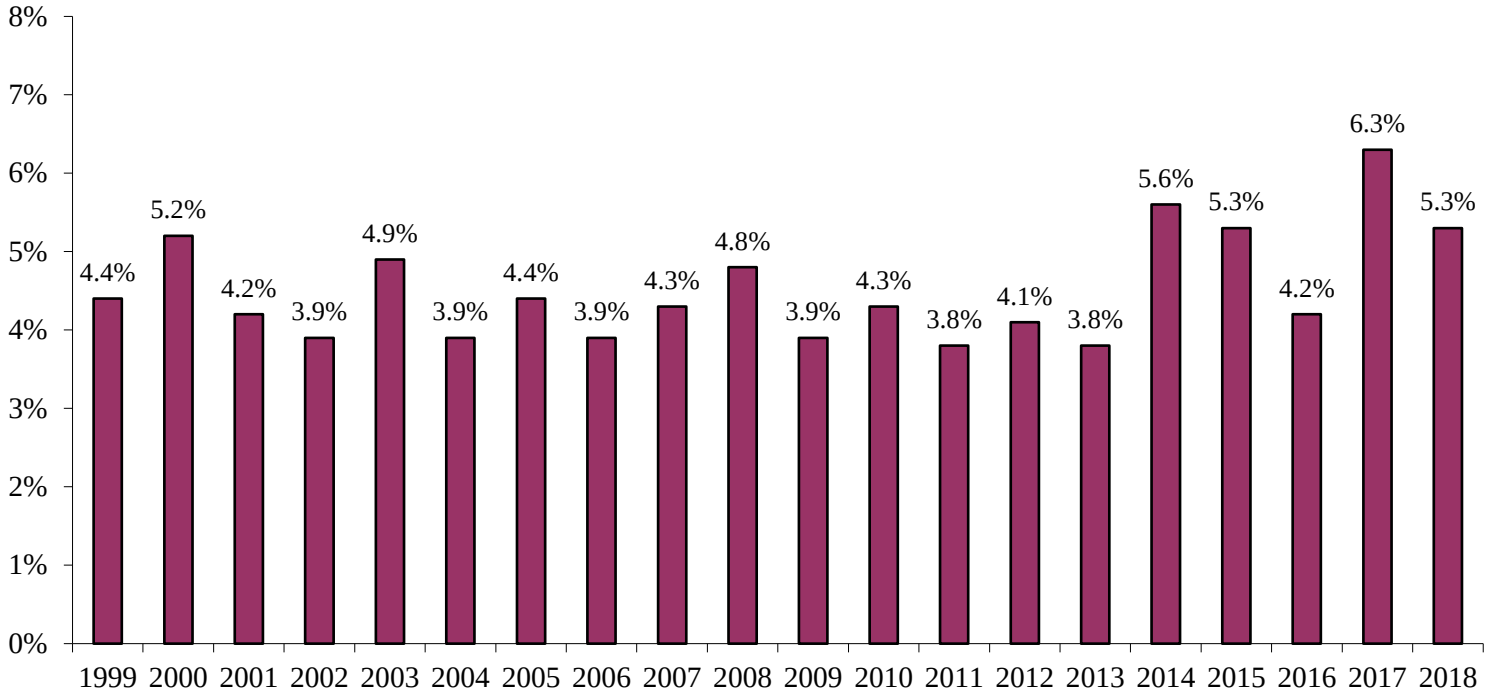
*Factors controlled for: Age & Boat Type.

Powerboats for Adults (18 years or older)

Figure E and Table 2.2 present information for all powerboats for adults. The 2018 rate for all powerboats is 5.3%, a relative decrease of 16% compared to 2017 rates. This represents a 20% increase since 1999 and a 39% increase since 2013, the lowest reported rate. Speedboats, the most popular type of powerboat, showed a wear rate of 3.4%, the lowest rate observed since 2012. Cabin cruisers showed a wear rate of 1.1%, a decrease of 72% since 2017 and the lowest rate observed since 2013. All other boat types showed similar wear rates to those reported in 2017. Open motorboats, which included a combination of skiffs and speedboats, showed a 2018 wear rate of 6.4%; a 9% decrease from that observed in 2017 but still a 42% increase 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	1999-2001 % (N's)	2002-2004 % (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)	2018 % (N's)
All Powerboats	4.6%	4.2%	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%	5.3%
(no PWC's)	(70206)	(78779)	(25741)	(25412)	(27623)	(27315)	(29924)	(30894)	(28954)	(27890)	(26786)	(28766)	(26444)	(26774)	(25823)	(29602)
Skiff/Utility	10.0%	8.3%	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%	10.8%
"blank"	(6239)	(11820)	(5038)	(4091)	(5340)	(6633)	(7257)	(6634)	(6530)	(6936)	(7231)	(6776)	(6592)	(7338)	(7558)	(8407)
Runabout/ Speedboat	4.7%	4.2%	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%	3.4%
"blank"	(44643)	(43756)	(13643)	(14512)	(14414)	(13901)	(14635)	(15093)	(14381)	(13441)	(11686)	(13040)	(11853)	(11736)	(10192)	(11277)
Runabout/ Speedboat	4.0%	3.5%	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%	3.0%
(excluding towed participants)	(44332)	(43409)	(13480)	14376)	(14313)	(13744)	(14481)	(14947)	(14279)	(13294)	(11554)	(12923)	(11766)	(11638)	(10101)	(11218)
Open Motorboats**	5.8%	5.1%	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%	6.4%
"blank"	(50882)	(55566)	(18681)	(18603)	(19754)	(20534)	(21892)	(21727)	(20911)	(20377)	(18917)	(19816)	(18445)	(19074)	(17750)	(19684)
Cabin Cruiser	1.5%	1.6%	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%	1.1%
"blank"	(14009)	(17472)	(5054)	(4280)	(5353)	(4430)	(5342)	(5900)	(5085)	(4611)	(4719)	(4669)	(4782)	(4418)	(4301)	(4920)
Houseboat	0.2%	2.0%	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%	0.0%
"blank"	(529)	(668)	(219)	(112)	(43)	(51)	(31)	(140)	(309)	(18)	(51)	(131)	(64)	(93)	(32)	(63)
Pontoon	3.8%	2.8%	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%	3.3%
"blank"	(4618)	(5176)	(1849)	(2276)	(2150)	(2051)	(2436)	(2922)	(2734)	(2624)	(2917)	(3966)	(2961)	(3080)	(3438)	(4695)
PWC	95.8%	95.4%	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%	97.4%
"blank"	(5751)	(5108)	(1858)	(1962)	(1736)	(2009)	(2093)	(1921)	(1524)	(1811)	(1905)	(1856)	(1501)	(1256)	(1625)	(1483)
Powered Inflatable/ Raft	17.1%	16.0%	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%	13.1%
"blank"	(697)	(555)	(157)	(253)	(366)	(228)	(254)	(345)	(224)	(278)	(233)	(315)	(256)	(223)	(334)	(303)

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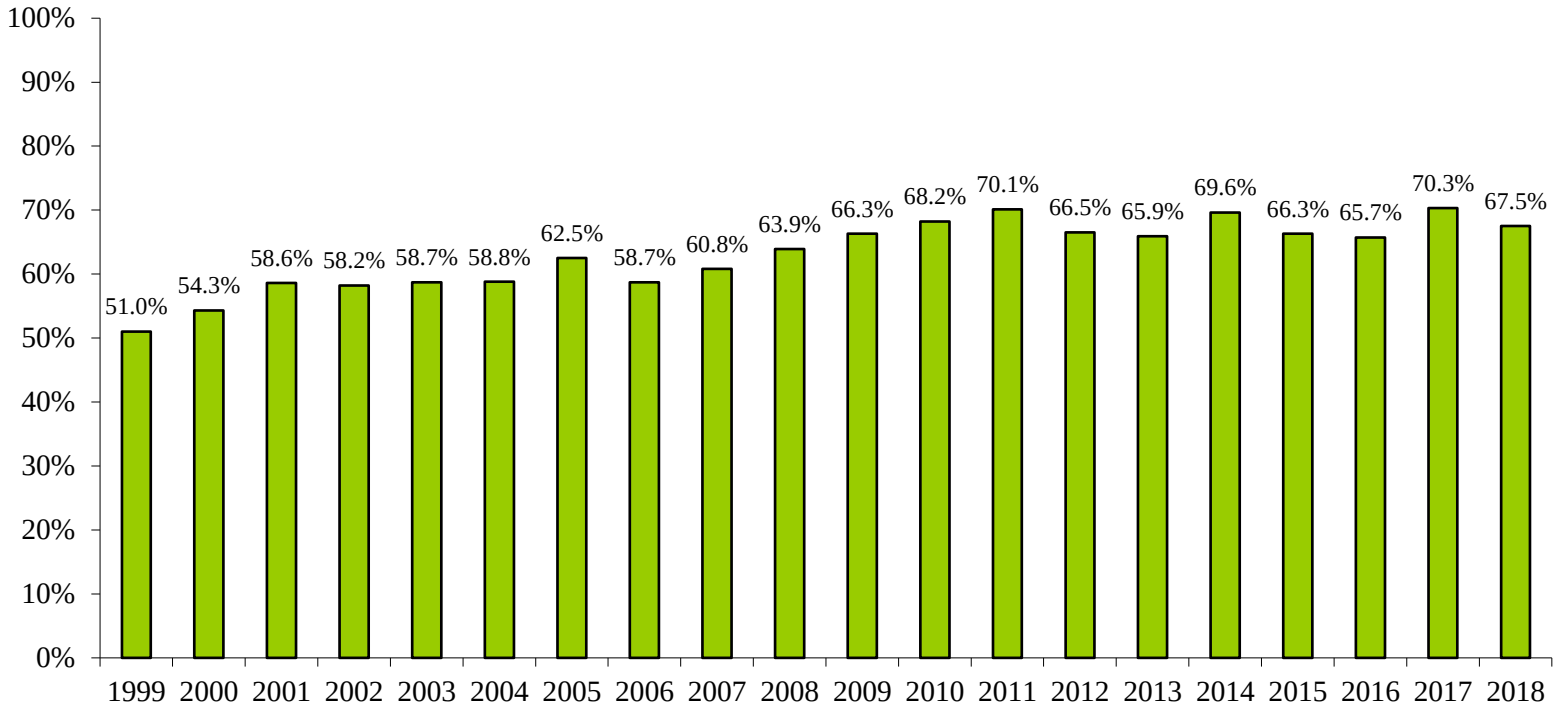
*Factors controlled for: Age & Boat Type.
** The Open Motorboat category is created by grouping "Skiffs" and "Speedboat/Runabouts" together. Factors controlled for in this line of the chart are Age (proportions of 18 to 64 and 65+ adults) and he proportion of Skiffs to Speedboat/Runabouts has been set 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 2018 wear rate is 67.5%, a relative decrease of 4% from 2017 and represents a 32% 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															
	1999-2001 % (N's)	2002-2004 % (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)	2018 % (N's)
All Powerboats	55.1%	58.6%	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%	67.5%
(no PWCs)	(14730)	(15523)	(4737)	(5043)	(5583)	(5257)	(5451)	(5090)	(4589)	(4846)	(4546)	(4798)	(4028)	(3750)	(4118)	(4762)
Skiff/Utility	57.6%	60.0%	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%	68.4%
"blank"	(1148)	(1966)	(781)	(661)	(947)	(988)	(1097)	(862)	(929)	(1022)	(936)	(901)	(948)	(871)	(980)	(1116)
Runabout/ Speedboat	55.6%	59.8%	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%	67.9%
"blank"	(10507)	(10422)	(2966)	(3348)	(3517)	(3256)	(3133)	(2943)	(2624)	(2744)	(2482)	(2696)	(2121)	(1934)	(2019)	(2229)
Open Motorboats**	55.8%	59.8%	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%	68.0%
(Skiff/Utility+ Runabout/ Speedboat)	(11655)	(12388)	(3747)	(4009)	(4464)	(4244)	(4230)	(3805)	(3553)	(3766)	(3418)	(3597)	(3069)	(2805)	(2019)	(3345)
Cabin Cruiser	46.9%	48.5%	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%	49.1%
"blank"	(1106)	(1878)	(528)	(501)	(639)	(581)	(644)	(524)	(507)	(465)	(505)	(364)	(430)	(409)	(473)	(459)
Houseboat	15.2%	22.6%	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%	67.1%
"blank"	(154)	(128)	(38)	(40)	(5)	(1)	(4)	(18)	(19)	(3)	(1)	(2)	(10)	(8)	(1)	(4)
Pontoon	47.8%	52.0%	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%	75.0%
"blank"	(1106)	(1131)	(440)	(505)	(414)	(392)	(530)	(716)	(494)	(580)	(598)	(787)	(511)	(508)	(606)	(908)
PWC	98.2%	98.4%	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%	99.3%
"blank"	(1891)	(1607)	(652)	(580)	(522)	(664)	(572)	(427)	(376)	(401)	(371)	(365)	(292)	(154)	(275)	(269)
Powered Inflatable/ Raft	69.4%	68.1%	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%	71.4%
"blank"	(190)	(126)	(22)	(28)	(66)	(39)	(47)	(45)	(35)	(35)	(25)	(50)	(18)	(28)	(40)	(50)

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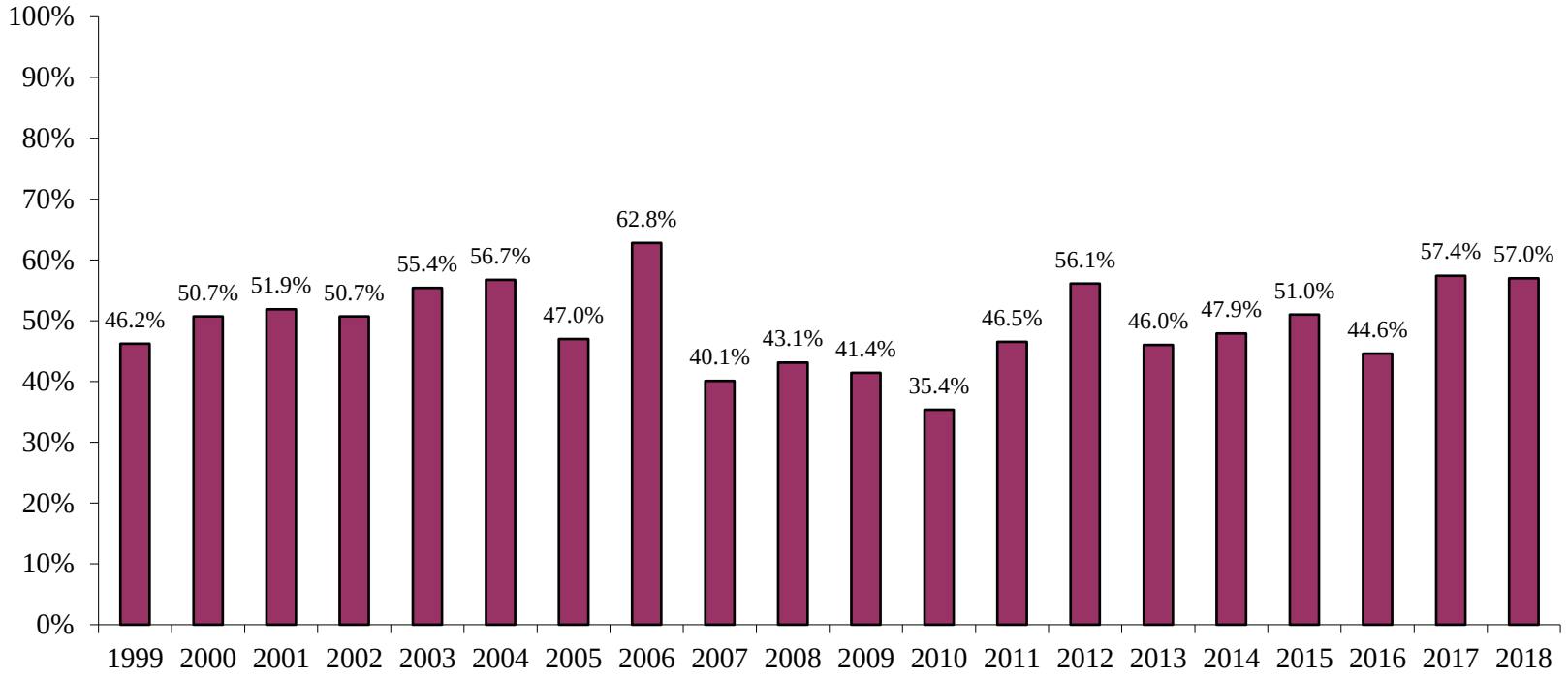
*Factors controlled for: Age & Boat Type.
** The Open Motorboat category is created by grouping "Skiffs" and "Speedboat/Runabouts" together. The proportion of Skiffs to Speedboat/Runabouts has been set to reflect the national proportions observed in 2006, the year in which the Strategic Plan goals were 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 2018 rates for all paddlecraft excluding standup paddleboards (57.0%) are approximately equal to the 2017 rates, and represents a relative increase of 28% from 2016 rates. 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, and increased 9% from 2017 to 2018.

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 Adult*

Boat Type	Observation Year															
	1999-2001 % (N's)	2002-2004 % (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)	2018 % (N's)
All Paddlecraft	49.7%	54.1%	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%	57.0%
(excluding SUPs)	(5168)	(5173)	(1616)	(1456)	(2065)	(1523)	(1939)	(2551)	(1608)	(2015)	(1919)	(2555)	(2531)	(2391)	(2251)	(2353)
Paddled Inflatable/ Raft	50.4%	61.4%	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%	41.7%
"blank"	(622)	(880)	(225)	(308)	(526)	(311)	(340)	(813)	(324)	(485)	(271)	(337)	(455)	(371)	(354)	(247)
Rowboat/ Dinghy	27.0%	23.9%	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%	32.3%
"blank"	(319)	(348)	(71)	(78)	(92)	(65)	(51)	(46)	(87)	(35)	(75)	(79)	(37)	(56)	(73)	(64)
Canoe	24.7%	23.8%	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%	28.1%
"blank"	(2273)	(1930)	(679)	(364)	(764)	(481)	(758)	(994)	(386)	(438)	(569)	(744)	(716)	(605)	(532)	(677)
Kayak	84.3%	84.7%	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%	75.6%
"blank"	(1954)	(2015)	(675)	(706)	(683)	(648)	(790)	(698)	(811)	(1056)	(1004)	(1395)	(1323)	(1359)	(1292)	(1365)
Canoe/Kayak Combined	52.5%	55.0%	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%	55.4%
"blank"	(4227)	(3945)	(1354)	(1070)	(1447)	(1129)	(1548)	(1692)	(1197)	(1494)	(1573)	(2139)	(2039)	(1964)	(1824)	(2042)
Paddleboards (SUPs)								27.8%	41.7%	52.9%	58.7%	53.9%	52.0%	54.6%	50.9%	55.3%
"blank"	"blank"	"blank"	"blank"	"blank"	"blank"	"blank"	"blank"	(54)	(84)	(157)	(264)	(397)	(348)	(407)	(509)	(492)
All Paddlecraft**								35.5%	46.0%	55.0%	45.4%	48.7%	51.1%	46.0%	56.2%	56.7%
(including SUPs)	"blank"	"blank"	"blank"	"blank"	"blank"	"blank"	"blank"	(2605)	(1692)	(2171)	(2183)	(2952)	(2879)	(2798)	(2760)	(2845)

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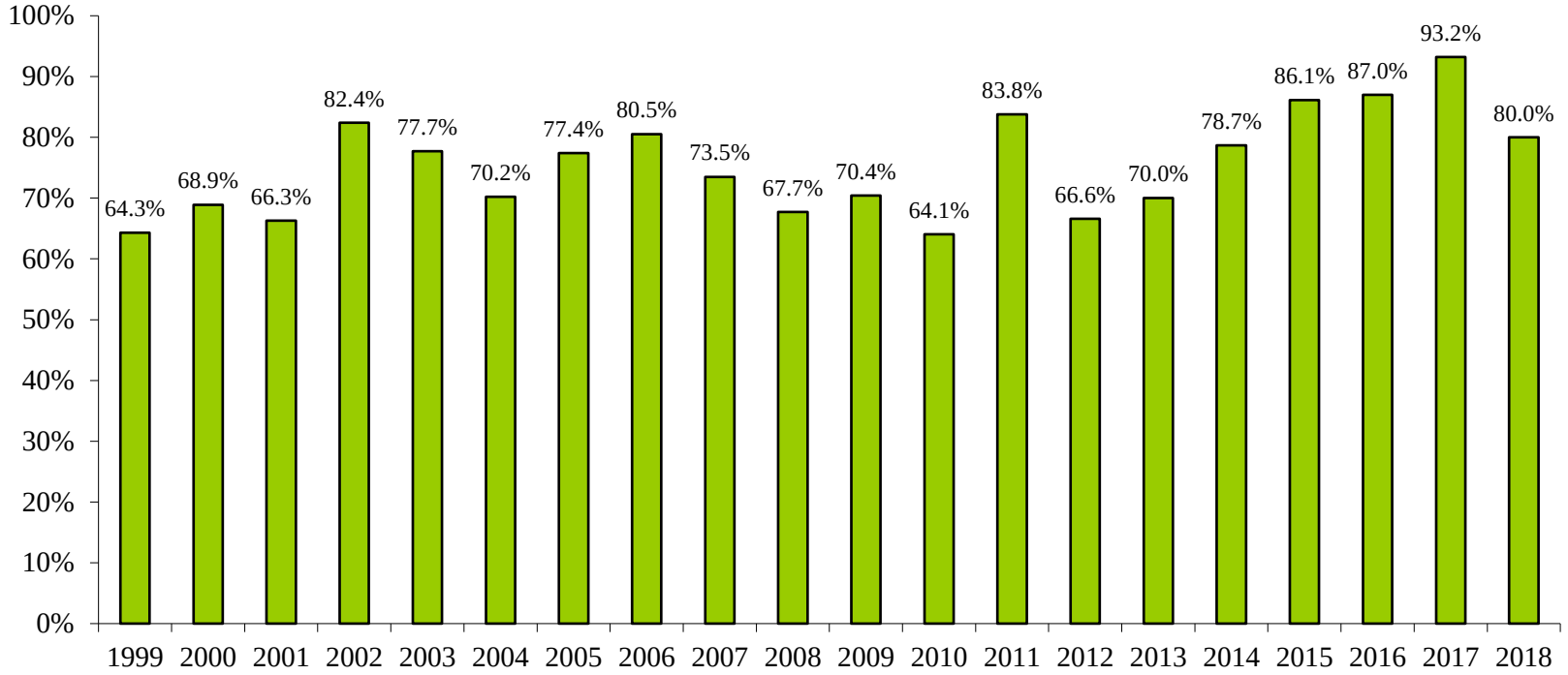
*Factors controlled for: Age & Boat Type.
**Data for this line in the table have been corrected on 5-21-2015 from the earlier published version

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 2018 was 80.0% the lowest rate recorded since 2015 and a break in the upward trend observed since 2012. In 2018, the wear rate for youth on standup paddleboards was 77.1%. 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															
	1999-2001 % (N's)	2002-2004 % (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)	2018 % (N's)
All Paddlecraft	66.8%	76.5%	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%	80.0%
(excluding SUPs)	(1231)	(1044)	(281)	(225)	(520)	(487)	(319)	(419)	(231)	(476)	(371)	(337)	(340)	(389)	(414)	(327)
Paddled Inflatable/ Raft	52.4%	76.7%	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%	69.7%
"blank"	(359)	(367)	(79)	(87)	(244)	(218)	(76)	(139)	(49)	(192)	(98)	(100)	(112)	(119)	(127)	(88)
Rowboat/ Dinghy	48.9%	66.6%	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%	75.0%
"blank"	(56)	(63)	(17)	(26)	(21)	(25)	(9)	(14)	(15)	(10)	(10)	(23)	(4)	(15)	(3)	(6)
Canoe	66.1%	68.2%	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%	71.5%
"blank"	(545)	(374)	(101)	(49)	(123)	(158)	(132)	(169)	(82)	(89)	(139)	(87)	(61)	(57)	(102)	(105)
Kayak	89.1%	89.9%	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%	90.6%
"blank"	(271)	(240)	(94)	(63)	(132)	(86)	(102)	(97)	(85)	(185)	(124)	(127)	(163)	(198)	(182)	(128)
Canoe/Kayak Combined	73.8%	76.6%	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%	81.0%
"blank"	(816)	(614)	(195)	(112)	(255)	(244)	(234)	(266)	(167)	(274)	(263)	(214)	(224)	(255)	(284)	(233)
Paddleboards (SUPs)						0.0%	100%	33.3%	100%	92.3%	51.9%	75.0%	77.5%	73.4%	75.0%	77.1%
"blank"	"blank"	"blank"	"blank"	"blank"	"blank"	(3)	(1)	(9)	(5)	(13)	(52)	(44)	(40)	(84)	(80)	(61)
All Paddlecraft**						67.3%	70.5%	63.5%	84.1%	67.3%	63.8%	78.3%	85.2%	84.6%	90.3%	79.6%
(including SUPs)	"blank"	"blank"	"blank"	"blank"	"blank"	(490)	(320)	(428)	(236)	(489)	(423)	(381)	(380)	(473)	(494)	(388)

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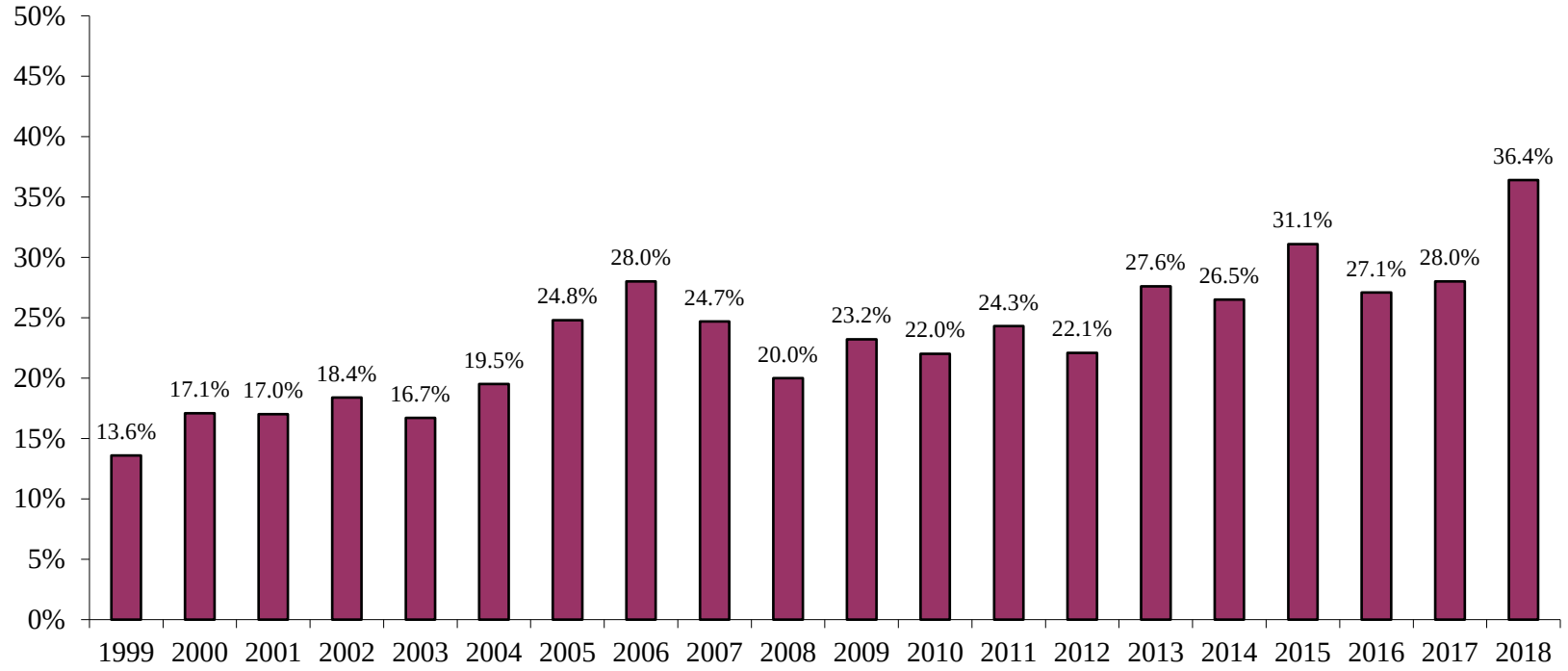
*Factors controlled for: Age & Boat Type.
**Data for this line in the table have been corrected on 5-21-2015 from the earlier published version.

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 36.4% is the highest wear rate observed since the beginning of the study, representing almost triple the rate observed in 1999. The 2018 rate is an increase of 17% from the all time high of 31.1% in 2015. The day sailor wear rates of 70.4% represented a relative increase of 14% since 2017, while the cabin sailboat rate of 27.1 represented a relative increase of 44%. Both day sailor and cabin sailboat wear rates are the highest reported since the beginning of the study.

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*

						Observation Year										
Boat Type	**1999-2001 % (N's)**	**2002-2004 % (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)**	**2018 % (N's)**
All Sailboats	16.0%	18.3%	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%	36.4%
"blank"	(10828)	(11385)	(3084)	(3279)	(3217)	(3079)	(3733)	(3336)	(3231)	(3297)	(2840)	(2786)	(2800)	(2557)	(2269)	(2766)
Sailboard	52.6%	89.4%	53.0%	92.1%	83.7%	94.6%	71.9%	83.2%	100%	93.3%	100%	100%	94.5%	90.4%	100%	92.0%
"blank"	(91)	(122)	(20)	(12)	(18)	(17)	(7)	(29)	(9)	(14)	(10)	(3)	(17)	(10)	(10)	(36)
Day Sailor	34.6%	45.4%	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%	70.4%
"blank"	(2134)	(2923)	(736)	(607)	(397)	(649)	(652)	(731)	(736)	(682)	(469)	(630)	(565)	(532)	(365)	(560)
Cabin Sailboat	10.2%	9.9%	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%	27.1%
"blank"	(8603)	(8340)	(2328)	(2660)	(2802)	(2413)	(3074)	(2576)	(2486)	(2601)	(2361)	(2153)	(2218)	(2015)	(1894)	(2170)

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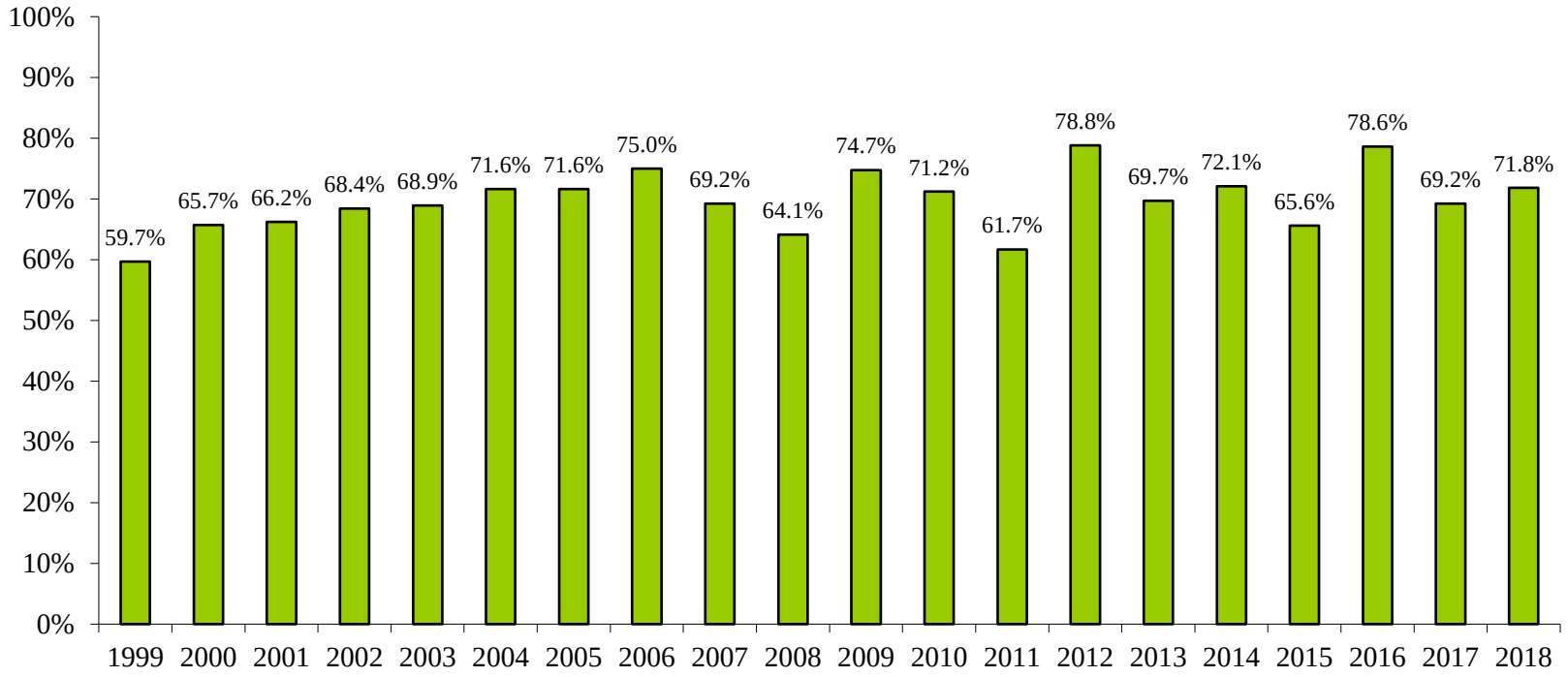
*Factors controlled for: Age & Boat Type.

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 increased from last year (from 69.2% in 2017 to 71.8% in 2018). 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															
	1999-2001 % (N's)	2002-2004 % (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)	2018 % (N's)
All Sailboats	64.0%	69.6%	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%	71.8%
"blank"	(1100)	(1027)	(327)	(371)	(270)	(274)	(305)	(202)	(219)	(313)	(220)	(206)	(170)	(200)	(147)	(174)
Sailboard	68.8%	90.8%	100%	100%	82.2%	--	--	100%	--	100%	--	100%	--	100%	--	100%
"blank"	(16)	(52)	(1)	(4)	(8)	(0)	(0)	(1)	(0)	(1)	(0)	(1)	(0)	(1)	(0)	(1)
Day Sailor	80.5%	84.4%	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%	95.2%
"blank"	(280)	(303)	(67)	(122)	(54)	(75)	(80)	(86)	(57)	(166)	(36)	(54)	(27)	(103)	(25)	(39)
Cabin Sailboat	59.2%	63.9%	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%	61.5%
"blank"	(804)	(672)	(259)	(245)	(208)	(196)	(225)	(115)	(162)	(146)	(184)	(152)	(143)	(97)	(122)	(134)

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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 2018, 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 15 year averages for powerboats range from 8.9% for boats less than 16 feet to 1.9% for boats over 26 feet in length. For sailboats, the 15 year average ranges from 63.4% for sailboats less than 16 feet to 15.4% for sailboats over 26 feet in length. For paddlecraft, the 15 year average for boats less than 16 feet is 55.6% and for boats in the 16 to 21 foot category it is 37.3%.

Table 2.8 – Life Jacket Wear Rates by Boat Type and Size for Adults*
2004 to 2018

							Observation Year									
Boat Type and Size	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)	2018 % (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%	13.0%	8.9%
"blank"	(2320)	(2734)	(3395)	(2173)	(1862)	(1824)	(2764)	(2183)	(1599)	(2119)	(2951)	(2174)	(2008)	(1483)	(1691)	(32668)
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%	7.8%	5.6%
"blank"	(16298)	(14629)	(11778)	(13034)	(12586)	(13125)	(13944)	(13255)	(12898)	(11424)	(12217)	(11763)	(11340)	(11416)	(11696)	(191350)
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%	3.0%	3.0%
"blank"	(6218)	(5503)	(6957)	(8634)	(9127)	(10420)	(9713)	(8718)	(9389)	(9364)	(9533)	(8270)	(9048)	(8467)	(11050)	(130411)
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%	1.7%	1.9%
"blank"	(3407)	(2865)	(3268)	(3782)	(3650)	(4546)	(4473)	(4798)	(4004)	(3874)	(4065)	(4234)	(4393)	(4442)	(5153)	(61226)
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%	70.5%	63.4%
"blank"	(481)	(376)	(265)	(77)	(163)	(247)	(299)	(160)	(194)	(136)	(265)	(200)	(197)	(136)	(198)	(3394)
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%	51.3%	70.4%	44.1%
"blank"	(357)	(312)	(609)	(193)	(370)	(157)	(346)	(390)	(379)	(314)	(248)	(225)	(339)	(239)	(398)	(4912)
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%	37.9%	25.8%
"blank"	(1428)	(1527)	(793)	(797)	(911)	(949)	(766)	(846)	(989)	(736)	(593)	(654)	(559)	(541)	(685)	(12774)
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%	23.1%	15.4%
"blank"	(1864)	(875)	(1614)	(2148)	(1629)	(2380)	(1925)	(1835)	(1735)	(1654)	(1644)	(1721)	(1453)	(1353)	(1485)	(25315)
Paddlecraft (excluding SUPs)																
<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%	64.1%	55.6%
"blank"	(1056)	(1012)	(1147)	(1306)	(1319)	(1296)	(1953)	(1021)	(1647)	(1532)	(1760)	(2126)	(2079)	(1694)	(1671)	(21408)
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%	36.6%	37.3%
"blank"	(531)	(488)	(171)	(672)	(180)	(347)	(331)	(587)	(367)	(383)	(795)	(395)	(312)	(541)	(674)	(6699)

JSI Research & Training Institute, Inc.
2018 National Observational Life Jacket Wear Rate Study
*Factors controlled for: Age & Boat Type.

III. How Situational Awareness Factors Contribute to Decisions to Wear Life Jackets While Boating

In the 2017 Life Jacket Wear Rate Observation Study, we explored to what extent different risk factors and boat types influenced adult life jacket wear rates. In general and across a majority of boat types, 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 connections between risk factors and wearing life jackets for drowning prevention. However, several "risky" conditions showed no significant association with adult life jacket wear rates when comparing presence or absence of that condition. These "unrecognized" risks varied by boat type. This year, we will use statistical procedures to explore which risk factors have the strongest association with adult life jacket wear rates, and how the strongest risk factors vary by boat type. In an effort to understand boater decision-making about life jackets, we will descibe a model of how situational awareness factors may influence boaters' decisions to wear life jackets.

Section 3.1: Identifying General Boating Risks

Entering the water unexpectedly and unintentionally while boating is highly correlated with drowning.[1, 2] Most people gasp suddenly and involuntarily when entering water unexpectedly, followed by rigorous swimming and thrashing.[5, 6] This reaction can be fatal: the involuntary gasp reflex increases the chances of water entering the lungs, while the natural instinct to swim and thrash (rather than float) increases swimming fatigue and releases air contained in clothing much faster, reducing buoyancy. Adjusting to entering the water unexpectedly takes time, but the average adult drowns in 60 seconds without a flotation device.[7]

Unexpectedly entering the water may happen by falling or slipping overboard, being thrown overboard by a collision, rough weather or sharp turns, being knocked overboard by another passenger or boating equipment, or boats tipping, capsizing, or sinking due to weather, harsh waters, equipment or passenger destabilization, or sharp turns.[3, 4] There are many environmental and situational factors that increase the chance of boaters unexpectedly entering the water. Below, we have classified several environmental and situational factors measured during boating observations that are associated with a heightened risk of entering the water unexpectedly and/or drowning.

The United States Coast Guard (USCG) reports that hazardous water, weather, and forceful waves were among the top ten known contributing factors of boating accidents in 2017.[8] 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.[9-14] 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.[14-20] Strong winds that create large waves and harsh or quick-changing weather patterns can also increase the possibility of entering the water unexpectedly or difficulty keeping their head above water. [21-23] Even a moderate current can exert a force of several tons against a boat and cause its operator to lose control and capsize.[24-26]

There are also many situational factors associated with boaters and boat type that may contribute to higher drowning risk. Boater inattention or improper lookout place 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.[27-32] 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, which does not allow them the same awareness to possible risks as operators.[33] 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.[34-36] 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.[37-41] Smaller boats are often less stable and more likely to capsize in the event of improper loading or inclement weather.[42-44] Lastly, boaters in a moving boat are more likely to experience injury, collision, falling overboard, or capsizing. Unpredictable swiveling booms, broken masts, faulty sails or motor equipment, uncontrollable speeds or steering practices, less stable balance during movement, and increased chances of operator error place moving boaters at a heightened risk for entering the water unexpectedly than boaters who are drifting or anchored.[45-48]

Section 3.2: Introducing Situational Awareness in Recreational Boating

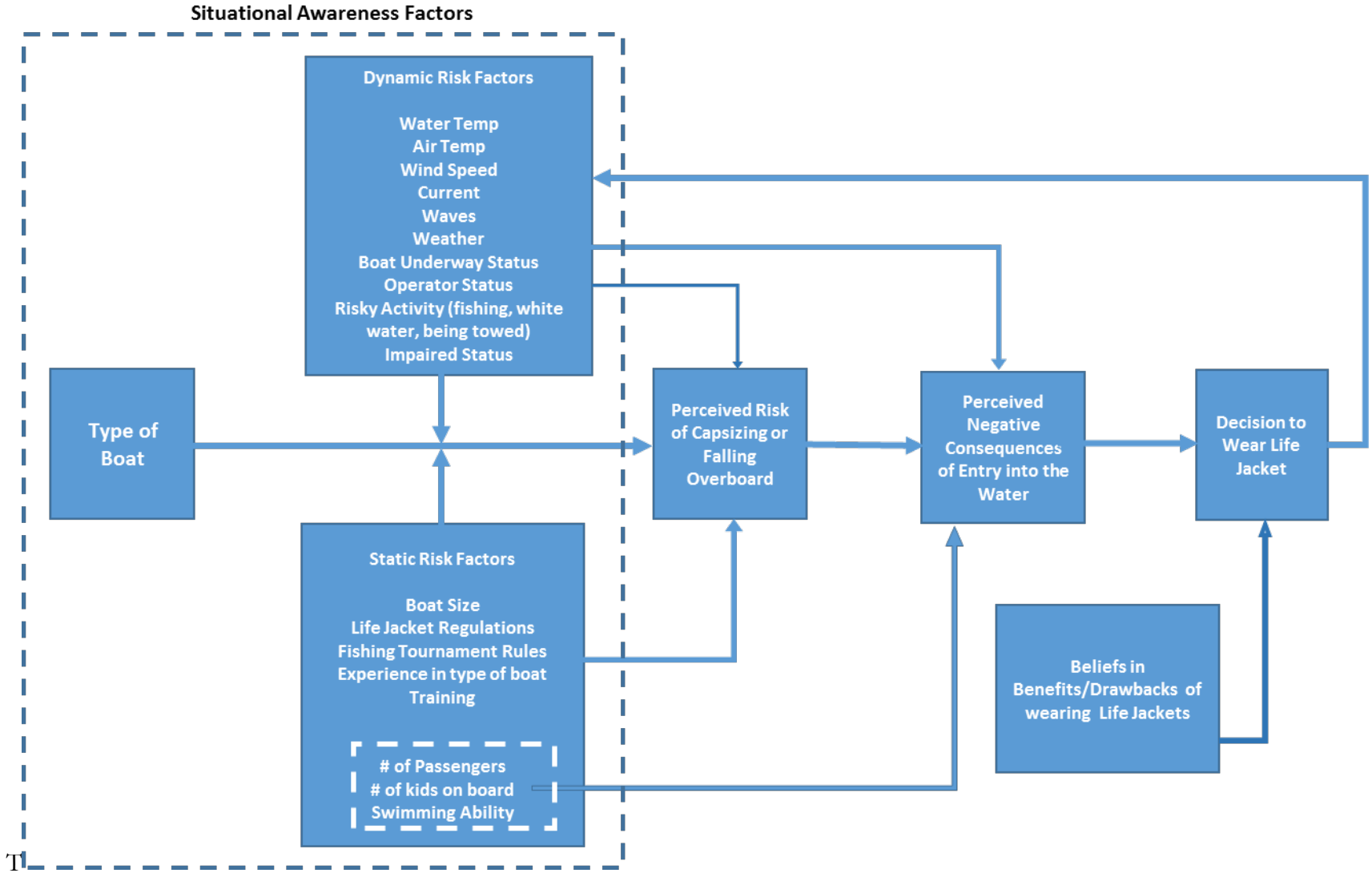
Situational Awareness (SA) is the perception and awareness of individual, task, and environmental factors within one's environment, as well as the understanding of its meaning and future implications.[49, 50] Dr. Mica Endsley provides a theoretical framework describing three stages of SA formation, which includes perception (awareness of the status, attributes, and dynamics of a situation), comprehension (synthesis of all perceived elements and how they impact one's status), and projection (the ability to extrapolate how perceived elements may or may not change over time and how those changes impact one's status). Boaters with good SA thus should be able to continuously monitor different environmental and boating factors and have a knowledgeable and accurate understanding of how these factors influence the likelihood of experiencing an adverse boating event, such as unexpected entry into the water through capsizing or falling overboard.

The model below provides our framework for understanding how awareness of the situation leads to forming a perception about the likelihood of unexpected entry into the water and in turn creates a perception of resulting negative consequences that might arise with entry into the water. This perception along with a boater's beliefs about the benefits and drawbacks of wearing a life jacket influence the decision to wear (or not wear) a life jacket. We also expect that the formulation of perceptions about risk of water entry will be highly influenced by the type of boat being used. For instance, moderate wind speeds may not make much impact on decision making if one is on a large cabin cruiser but it may make a big impact if one is boating on a canoe. As discussed in Section 3.1 above, there are several risk factors observed by our study that may be associated with a perceived risk of entering the water unexpectedly and/or drowning. In the 2017 Life Jacket Wear Rate Observation Study, we demonstrated that these risks were associated with life jacket wear rates and that the amount of influence varied by boat type. We also demonstrated that the presence of multiple risks made even larger impacts on wear rates. Thus, the SA model below incorporates a wide range of situational awareness factors. These factors have been divided into "dynamic" (changing) versus "static" (fixed) to account for the fact that some risk factors will stay constant for the boat trip while others may change during the trip. The model below also incorporates factors that we did not measure by observation in our study, such as impairment status (through drug or alcohol use), boater training or amount of experience in that type of boat, as well as swimming ability, or what type of mandatory life jacket rules might be in place at the time of observation (such as a fishing tournament requirement).

Overall, the model below demonstrates how boat type and awareness of different static and dynamic factors lead to a perceived sense of unexpectedly entering the water which in turn leads to a perception of the negative consequences of entering the water unexpectedly. This perception along with a boater's beliefs of the benefits of wearing a life jacket influence the decision to wear a life jacket.

Figure K

Model of How Situational Awareness Factors Play a Role in Decisions to Wear Life Jackets While Boating



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Section 3.3: Purpose of this Analysis

In this chapter, we focus on the nine risk factors that we measure in our observational study and assess the extent to which the presence of these risk factors taken together influence wear behavior. We conduct these analyses separately for each boat type. The statistical procedure we use will order the risk factors from most important to least important as an influence of life jacket wear behavior. When interpreting and discussing the results for each boat type, we focus on the four strongest associations and discuss similarities and differences across boat types. We also identify, for each boat type, risk factors that do not seem to have much influence on wear behaviors. It should be pointed out that there are several reasons why a risk factor may seem to have little influence. First, boaters may not notice or be aware of the actual presence of the risk condition. Second, even though a boater is aware of that risk factor, the condition may be highly overlapping with another risk factor that has even a stronger association with life jacket wearing behavior and the statistical program can only address the factors influence above and beyond what the stronger risk factor captures. And finally, third, boaters may not recognize this factor as risky. Our discussion and interpretation assumes this later circumstance. Additionally, this chapter will explore the influence of multiple risk factors at a time on boaters' decisions to wear life jackets. We will create a count of how many of the four most important risk factors are present for boaters in each type of boat. We will describe average wear rates for zero, one, two, three and four of the most important risk factors are present for each boat type and what are the resulting wear rates.

This chapter looks at influences of multiple situational risk factors on adult life jacket wear rates among three general types of boats – powerboats, paddlecraft, and sailboats and within those general types for the following specific boat types:

Powerboats: skiffs/utility vessels, speedboats/runabouts, cabin cruisers, and pontoons
Paddlecraft: canoes and kayaks
Sailboats: cabin sailboats and day sailors

In **Section 3.4**, boating conditions and boater situations were re-categorized into binary forms and classified as either "risky" or "non-risky" conditions based on expert literature and USCG data on factors present for boating fatalities by boat type. **Table 3.4a** is a representation of how risk conditions were defined in general across all boating types. **Table 3.4b** summarizes all risky conditions by specific boat type and provides justification for why risk definitions deviated from the general risk definitions in **Section 3.4a**.

In **Section 3.5**, stepwise logistic regression model selection procedures were applied to identify the four risky conditions that are most strongly associated with adult life jacket wear rates for each boat type. **Table 3.5** presents the list of risky conditions ordered by strength of association and designating the top four conditionas as well as the weaker associated conditions.

In **Section 3.6**, the wear rates within each boat type are presented for boaters experiencing zero to four of the strongest risk factors. 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 3.6a**, **3.6b**, and **3.6c** and **Figures L, M,** and **N** summarize the results of these analyses for power boats, paddlecraft, and sailboats, respectively.

Results are summarized in **Section 3.7** and recommendations given to inform future efforts to increase adult life jacket wear rates.

Section 3.4a: Defining "Risky" Conditions

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, partly cloudy, 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 3.4a – 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.

Section 3.4b: Defining "Risky" Conditions for specific boat types

While many environmental or boating factors present risk of drowning for all boaters, some may vary across type of craft or specific boat type. **Table 3.4b** defines the environmental and situational boating factors that were considered to be "risky" for each boat type. Cells with bolded text indicate risk classifications that deviate from those outlined previously in **Section 3.4a** and have been adjusted in favor of a more accurate risk representation specific to that boat type. Justifications for these changes are also included below.

Wind speed deviations: A lower threshold of wind speed (high wind speed: ≥4 knots) was used for canoes and kayaks in order to create comparison groups better reflecting the wind disributions observed among these boat types.

Boat size deviations: Small boat size was reclassified to <26 feet for cabin cruisers and cabin sailboats, and <21 feet for pontoons in order to create comparison groups better reflecting their respective size distributions (these boats are generally larger than 16 feet and these risk categorizations provide more meaningful comparisons). Large kayaks are more likely to flip due to decreased stability from larger frames. Kayaks are also less responsive to oncoming risks due to decreased maneuverability of boat frame.[51-53]

Boater activity deviations: For cabin cruisers, skiffs, day sailors, and cabin sailboats, white water activity was not included in risk classification because there were no boaters observed participating in this activity. For canoes, racing activity was not included in risk classification because there were no boaters observed participating in this activity.

Boat movement deviations: For all powerboats, sailing and paddling movement were not included in risk classification because there were no powerboats observed using these modes of movement. For all paddlecraft, sailing movement was not included in risk classification because there were no paddlecraft observed using this mode of movement. For all sailboats, paddling movement was not included in risk classification because there were no sailboats observed using this mode of movement.

Number of boater deviations: 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.[51-53]

Table 3.4b– Risk Variable Classifications – All Boats

Condition	Risky Circumstances for each Boat Type							
	Runabout	**Cabin Cruiser**	**Pontoon**	**Skiff / Utility**	**Canoe**	**Kayak**	**Day Sailor**	**Cabin Sailboat**
Water Temperature	<65°F	<65°F	<65°F	<65°F	<65°F	<65°F	<65°F	<65°F
Air Temperature	<70°F	<70°F	<70°F	<70°F	<70°F	<70°F	<70°F	<70°F
Visibility	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Wave Height	Choppy or rough	Choppy or rough	Choppy or rough	Choppy or rough	Choppy or rough	Choppy or rough	Choppy or rough	Choppy or rough
General Weather	Rainy or stormy	Rainy or stormy	Rainy or stormy	Rainy or stormy	Rainy or stormy	Rainy or stormy	Rainy or stormy	Rainy or stormy
Strength of Current	Strong	Strong	Strong	Strong	Strong	Strong	Strong	Strong
Wind Speed	**High (≥6 knots)**	**High (≥6 knots)**	**High (≥6 knots)**	**High (≥6 knots)**	**High (≥4 knots)**	**High (≥4 knots)**	**High (≥6 knots)**	**High (≥6 knots)**
Child Present*	Child Present	Child Present	Child Present	Child Present	Child Present	Child Present	Child Present	Child Present
Boat Size	**Small (<16 feet)**	**Small (<26 feet)**	**Small (<21 feet)**	**Small (<16 feet)**	**Small (<16 feet)**	**Large (≥16 feet)**	**Small (<16 feet)**	**Small (<26 feet)**
Activity	Fishing, racing, or white water	**Fishing or racing**	Fishing, racing, or white water	**Fishing or racing**	**Fishing or white water**	Fishing, racing, or white water	**Fishing or racing**	**Fishing or racing**
Boat movement	**Motoring**	**Motoring**	**Motoring**	**Motoring**	**Paddling or Motoring**	**Paddling or Motoring**	**Sailing or Motoring**	**Sailing or Motoring**
Number of boaters	One boater only	One boater only	One boater only	One boater only	One boater only	**More than one boater**	One boater only	One boater only
Boater position	Passenger	Passenger	Passenger	Passenger	Passenger	Passenger	Passenger	Passenger

All conditions classified into binary form; Conditions in **bold** deviate from previously categorized risk definitions
Forms distinguished on table considered to be "risky"; forms not indicated in the table considered to be "non-risky"
*Children <13 years old

Section 3.5: Using automated variable selection procedures to identify highest-associated risk factors

The analyses in this section describe the risk factors most strongly associated with higher life jacket wear rates. Using automated stepwise logistic regression model selection techniques, separate results of associations with life jacket wear rates were shown for each boat type.

The procedure: Starting with an empty model, risk factors are added one at a time and checked to see if the significance of its coefficient (an estimate of the added impact of that risk on life jacket rate) is strong enough to be placed in the model. The order in which different risk factors are added is based on the t-statistic of its estimated coefficient, whereby the risk that would contribute the strongest t-value once added to the model is selected first. Risk factors are only considered for inclusion if the significance of its coefficient estimate is less than p=0.05. Once a variable is selected for inclusion in the model, all previously added risk factors are reassessed. Risk factors whose coefficient significance drops below p=0.05 are removed from the model. Following this, t-statistics are re-calculated for all risk factors not yet included in the model, and then the next strongest risk (based on the new t-statistic) is included in the model. The process is repeated until no more risk factors can be added or dropped from the model according to the specifications outlined above.

Using this technique, the order in which risk factors are added to the model can provide some insight into the hierarchy of risk importance, whereby risks that are added first are more strongly associated with adult life jacket use, and any following risk factors added are next strongest (when controlling for all other risks already added).

Before performing this modeling selection procedure, risks were evaluated for multicollinearity (two risks that are highly correlated). If two risks are highly correlated to one another, including both risks in a model of life jacket use can lead to unstable coefficient estimates and make it difficult to determine each risk's true significance in combination with one another as well as other risks included in the model. To prevent this from happening, a correlation matrix comparing all risky conditions to one another was run for each boat type in order to determine if any of the risks were strongly associated with another risk. Risks that were consistently highly correlated with one another across several boat types were merged to create a combination variable. After assessing the correlation matrices, it was determined that cold water and cold air were highly correlated with one another, as well as choppy/rough water and high wind speed.

Thus, 2 combination variables were created as such:

- Water and/or air temperature: "risky" if cold water and/or cold air were present; "non-risky" if neither were present.
- Choppy waves and/or high wind: "risky" if choppy/rough waves and/or high wind speeds were present; "non-risky" if neither were present.

Using these two new combination variables, the modeling procedure outlined above was conducted for each boat type. See **Table 3.5** for the results of this analysis.

Table 3.5 – Risks associated with increased rates of adult life jacket use, ordered by model entry stage‡

Highest priority ‡	Boat Type							
	Powerboats				Paddlecraft		Sailboats	
	Runabout	Cabin Cruiser	Pontoon	Skiff	Canoe	Kayak	Day Sailor	Cabin Sailboat
1	Cold water and/or cold air temperature †	Cold water and/or cold air temperature †	Child on board	Cold water and/or cold air temperature †	Choppy/rough water and/or wind ≥ 4 knots	Cold water and/or cold air temperature †	Small boat (<16 feet)	Cold water and/or cold air temperature †
2	Fishing, racing, or white water activity	Small boat (<26 feet)	Small boat (<21 feet)	Single boater	Child on board	Stong current	Single boater	Small boat (<26 feet)
3	Child on board	Child on board	Cold water and/or cold air temperature †	Fishing activity	Small boat (<16 feet)	More than one boater	Racing activity	Racing activity
4	Small boat (<16 feet)	Poor visibility	Raining or stormy weather	Child on board	Fishing or white water activity	Choppy/rough water and/or wind ≥ 4 knots	Choppy/rough water and/or wind ≥ 6 knots	Sailing or motoring movement
Lower Priority (rank-ordered)	Single boater	Single boater	Choppy/rough water and/or wind ≥ 6 knots	Motoring movement	Paddling movement	Paddling movement	Cold water and/or cold air temperature †	Choppy/rough water and/or wind ≥ 6 knots
	Passenger position	Fishing activity	Passenger position	Small boat (<16 feet)	Cold water and/or cold air temperature †	Poor visibility	Poor visibility	Poor visibility
	Strong current	Passenger position	Single boater	Raining or stormy weather	Raining or stormy weather	Large boat (≥16 feet)	Raining or stormy weather	Raining or stormy weather
	Raining or stormy weather	Strong current	Poor visibility	Choppy/rough water and/or wind ≥ 6 knots	Passenger position	Raining or stormy weather	Child on board	Strong current
	Choppy/rough water and/or wind ≥ 6 knots	Choppy/rough water and/or wind ≥ 6 knots	Strong current	Poor visibility	Poor visibility	Child on board	Sailing or motoring movement	Child on board
	Poor visibility	Raining or stormy weather	Fishing activity	Strong current	Single boater	Fishing or white water activity	Strong current	Single boater
	Motoring movement	Motoring movement	Motoring movement	Passenger position	Strong current	Passenger position	Passenger position	Passenger position

†Combination variable; ‡Highest priority rank order determined by the order in which each risk was selected for entry into the model (according to automated stepwise selection procedures). Thus, the rank order represents the order of strongest association *controlling for all other risks input before.*

Section 3.6a: Priority of Risk Factors Associated with Life Jacket Wear Rates for Powerboats

Models were analyzed for each type of powerboat: Runabouts/Speedboats; Cabin Cruisers, Ponton boats, and Skiffs. The four most important risk factors for each of the boat types shared some risks in common but also had some differences. All four boat types showed the combination risk of cold water and/or cold air temperature and having a child on board were strongly associated with wear rates. Also for three of the boat types (skiffs were the exception) being on a smaller boat was important. For skiffs it was boating alone that was important. The remaining top four factors were fishing for runabouts and for skiffs, whereas for cabin cruisers it was poor visibility and pontoons raining or stormy weather. All other risk factors were less important in predicting wear rates but it should be noted that each of the seven remaining factors were all eventually entered into the model meaning that they were statistically significantly associated with wear rates but just less strongly.

We also wanted to show the cumulative impact on life jacket wear rates of the four highest priority factors for each of the types of powerboats. For each type of powerboat, observed life jacket wear rates increase as the number of "high priority 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 high priority risks present. See **Table 3.6a** and **Figure L** for life jacket wear rates, cumulative risk, and statistical test results graphically presented. These results suggest that adult boaters are situationally aware of the increased risk of drowning in boating situations in which multiple high priority risky conditions are present and are adjusting their life jacket wearing behaviors accordingly. In the tables and graphs below the count of risks groups three and four risks together since the number of observations were somewhat small for four high priority risks.

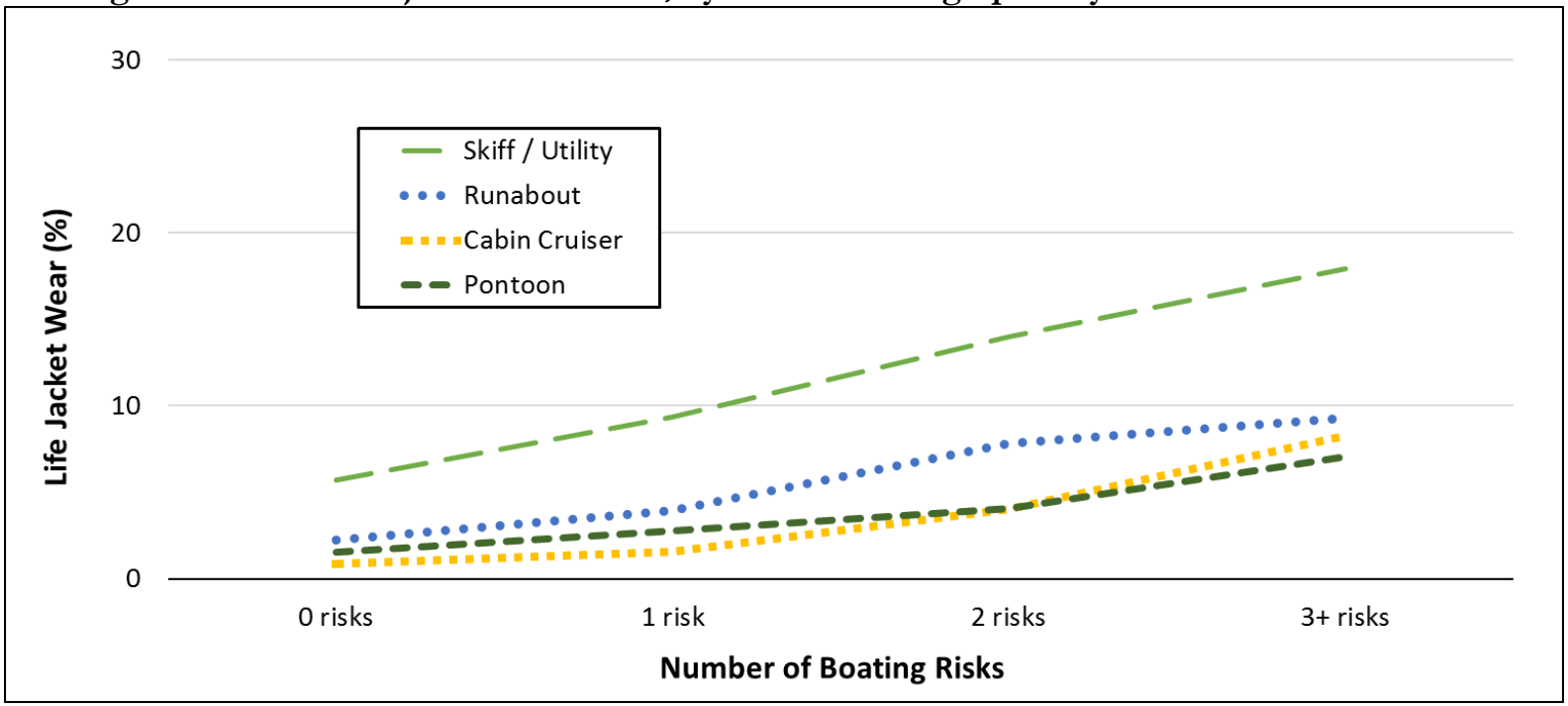
Skiff/Utility wear rates ranged from a low of 5.7% (0-1 encountered risks) to 17.9% (3-4 high priority risks).
Runabout/speedboat wear rates ranged from 2.2% (0-1 encountered risks) to a high of 9.3% (3-4 high priority risks).
Cabin Cruiser wear rates ranged from 0.9% (0-1 encountered risks) to a high of 8.2% (3-4 high priority risks).
Pontoon boat wear rates ranged from 1.5% (0-1 encountered risks) to a high of 7.1% (3-4 high priority risks).

Table 3.6a – Adult life jacket wear rate, by cumulative high priority risk count – Powerboats

# of high priority risks	Boat Type											
	Skiff/Utility			Runabout			Cabin Cruiser			Pontoon		
	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD	N	PFD	% PFD
Overall Avg Wear Rate	110144	9699	**8.8%**	269043	8453	**3.1%**	99460	1629	**1.6%**	49565	**1132**	**2.3%**
0 risks	44444	2538	5.7%	164511	3681	2.2%	43762	380	0.9%	24873	375	1.5%
1 risk	45605	4272	9.4%	88213	3482	3.9%	42258	667	1.6%	19765	543	2.7%
2 risks	18233	2555	14.0%	15352	1200	7.8%	12481	503	4.0%	4460	181	4.1%
3+ risks	1862	334	17.9%	967	90	9.3%	959	79	8.2%	467	33	7.1%
Linear Trend Test (Z-score)	**36.7******			**41.5******			**26.5******			**13.8******		

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

Figure L – Adult life jacket wear rates, by cumulative high priority risk count – Powerboats



Section 3.6b: Priority of Risk Factors Associated with Life Jacket Wear Rates for Paddlecraft

Models were analyzed for each type of paddle craft: canoes and then kayaks. The four most important risk factors for each of these types of paddlecraft differed based on which boat type was the focus of the analysis. For canoes the biggest determinant of wear rates was encountering choppy or rough water and/or wind greater than 4 knots. This was followed by having a child on board, being in a smaller sized canoe (less than 16 feet) and either fishing or white water activity. For kayaks the priority risk factors were a bit different. The strongest association was encountering cold air and/or cold water temperatures followed by strong current, more than one boater and then, like canoes, choppy or rough water and/or wind greater than 4 knots. Although these were the four highest priority risk factors associated with wear rates, it should be noted that the remaining seven risks also eventually entered into the model. This means that although of lower priority, these other risks still contributed significantly to increasing wear rates.

We also wanted to show the cumulative impact on life jacket wear rates of the four highest priority factors for each of the two types of paddlecraft—canoes or kayaks. For each observed life jacket wear rates increase as the number of "high priority 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 high priority risks present. See **Table 3.6b** and **Figure M** for life jacket wear rates, cumulative risk, and statistical test results graphically presented. These results suggest that adult boaters on paddlecraft are situationally aware of the increased risk of drowning in boating situations in which multiple high priority risky conditions are present and are adjusting their life jacket wearing behaviors accordingly. In the tables and graphs below for the count of high priority risks, we combined three and four risks together since the number of observations were somewhat small for four high priority risks.

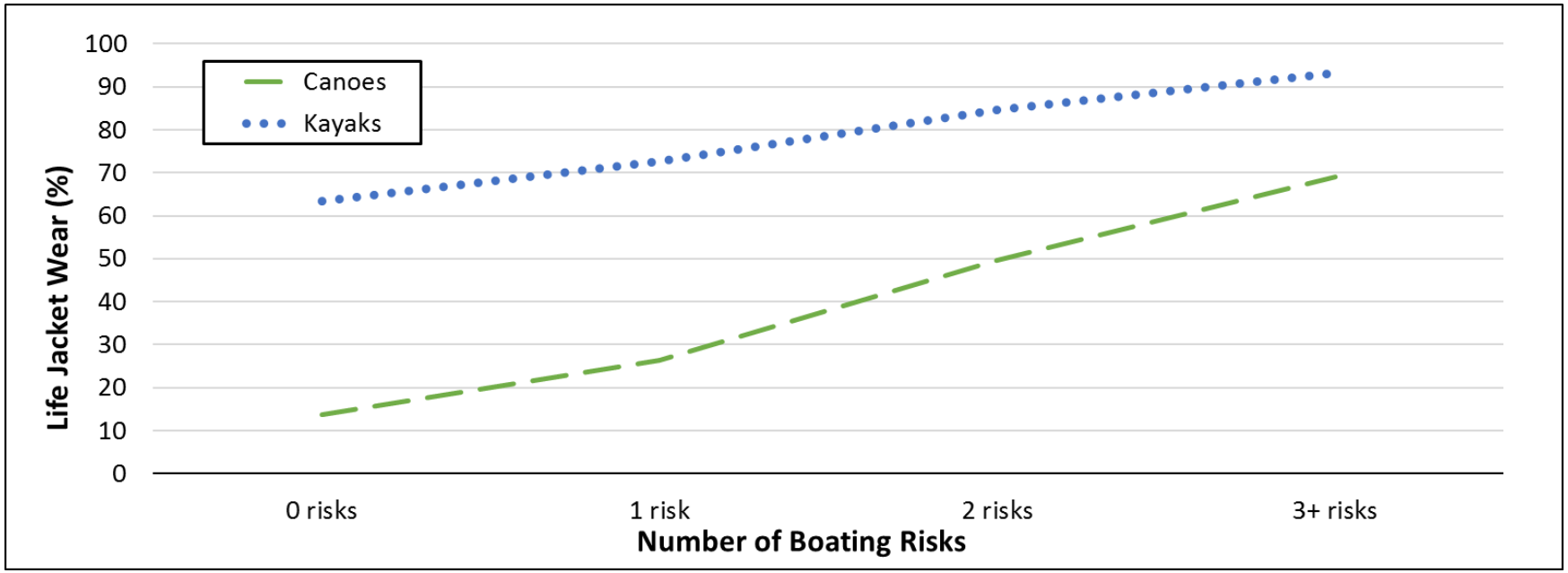
Canoe wear rates ranged from 13.7% (0-1 encountered risks) to a high of 69.0% (3-4 encountered high priority risks).
Kayak wear rates ranged from 63.3% (0-1 encountered risks) to a high of 93.2% (3-4 encountered high priority risks).

Table 3.6b – Adult life jacket wear rate, by cumulative high priority risk count – Paddlecraft

Number of Risks Present	Boat Type					
	Canoes			Kayaks		
	N	PFD	% PFD	N	PFD	% PFD
Life Jacket Wear Rate	11467	**3100**	**27.0%**	17752	**13342**	**75.2%**
0 risks	4478	613	13.7%	4534	2869	63.3%
1 risk	4630	1219	26.3%	7025	5104	72.7%
2 risks	1865	927	49.7%	4643	3925	84.5%
3 risks (*3+ for canoes*)	494	341	69.0%	1550	1444	93.2%
Linear Trend Test (Z-score)	**35.9******			**29.2******		

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 – Paddlecraft



Section 3.6c: Adult Life Jacket Wear Rates by Cumulative Risk Count on Sailboats

Models were also analyzed for each type of sailboat: day sailors and then cabin sailboats.. The four most important risk factors for each of these types of sailboats differed based on which boat type was the focus of the analysis. For day sailors the biggest determinant of wear rates was being in a smaller day sailor (less than 16 feet in length). This was followed by sailing alone and then being involved in a racing activity and finally choopy or rough water and/or wind exceeding 6 knots. For cabin sailboats the priority risk factors were a bit different. The strongest association was encountering cold air and/or cold water temperatures followed by a smaller sized boat (under 26 feet in length) then also being involved in a racing activity and finally being underway either via sail or motor. Although these were the four highest priority risk factors associated with wear rates, it should be noted that the remaining seven risks also eventually entered into the model. This means that although of lower priority, these other risks still contributed significantly to increasing wear rates on sailboats.

We also wanted to show the cumulative impact on life jacket wear rates of the four highest priority factors for each of the two types of sailboats—day sailors and cabin sailboats. For each sailboat type, observed life jacket wear rates increase as the number of "high priority 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 high priority risks present. See **Table 3.6c** and **Figure N** for life jacket wear rates, cumulative risk, and statistical test results graphically presented. These results suggest that adult boaters on sailboats are situationally aware of the increased risk of drowning in boating situations in which multiple high priority risky conditions are present and are adjusting their life jacket wearing behaviors accordingly. In the tables and graphs below for the count of high priority risks, we combined three and four risks together since the number of observations were somewhat small for four high priority risks.

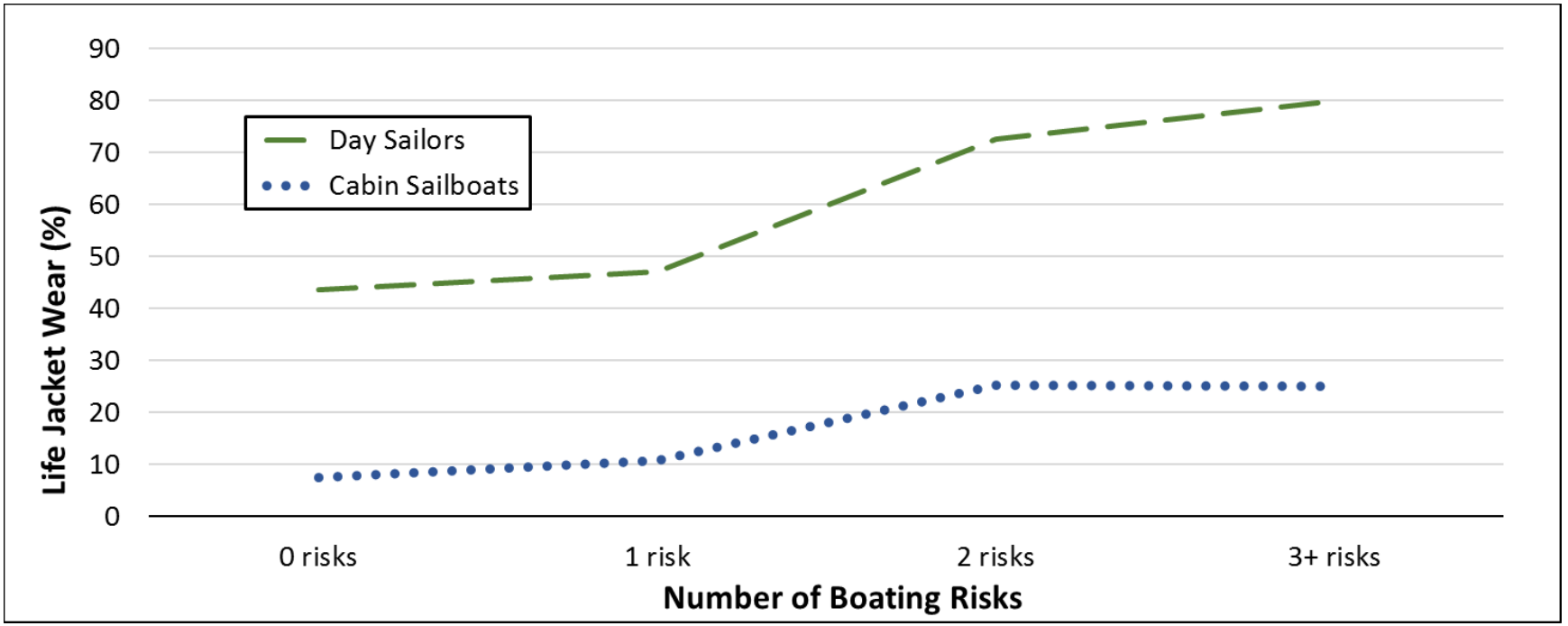
Day sailor wear rates ranged from 43.6% (0-1 encountered risks) to a high of 79.9% (3-4 encountered high priority risks).
Cabin sailboat wear rates ranged from 7.5% (0-1 encountered risks) to a high of 25.1% (3-4 encountered high priority risks).

Table 3.6c – Adult life jacket wear rate, by cumulative risk count – Sailboats

Number of Risks Present	Boat Type					
	Day Sailors			Cabin Sailboats		
	N	PFD	% PFD	N	PFD	% PFD
Overall Life Jacket Wear Rate	13358	**6994**	**52.4%**	50666	**7252**	**14.3%**
0 risks	4048	1764	43.6%	520	39	7.5%
1 risk	6136	2888	47.1%	37472	4006	10.7%
2 risks	2632	1909	72.5%	12196	3087	25.3%
3+ risks	542	433	79.9%	478	120	25.1%
Linear Trend Test (Z-score)	**25.2******			**39.4******		

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

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



Section 3.7: Conclusions about Situational Awareness of Risky Conditions and Influence on Wear Rates

The results of this analysis suggest that patterns of life jacket use among adult boaters are associated with specific boat type as well as situational and environmental characteristics. These findings support our model of situational awareness being a key component of whether boaters wear life jackets. The key take-aways from our analyses in this chapter are listed below.

1. The 4 risky conditions most strongly associated with adult life jacket use differed somewhat for each boat type. This supported the element in our model that says the first step in evaluating risks for a boating activity is to take into consideration what type of boat you are on. Then both static risk factors (e.g. size of boat, training, swimming ability etc) and dynamic risk factors (e.g wind speed, weather conditions, activity engagement, impaired status, etc) can be assessed in relation to the type of boat being used. In particular, assessing the extent to which the current situation runs the risk of falling into the water and the risks of drowning if a boater did fall in the water.

2. Across all eight types of boats that we determined the priority of risk factors, it turns out that the most common strongest risk factor was presence of cold water and/or cold air temperature. It was the number one predictor for five of the eight boats and in the top four for a sixth boat. Only for canoes and day sailors was this condition not in the top four risk factors.

3. The other most common high priority risk factor was being in a smaller boat; this factor was in the top four risks for six out of the eight boats (only skiffs and kayaks did not show this factor in the top four). Also with strong associations with adult wear rates was whether there was a child on board. This held true for five of the eight boats (only for kayaks, day sailors and cabin sailboats did this factor not rise to the top four). Finally, type of activity engaging in was important for five of the boats; either racing or fishing or white water boating.

4. While the purpose of these analyses was to identify the conditions that most strongly correlate with adult life jacket use, many risky conditions outside of the top 4 priority conditions identified for each boat type were still significantly related to adult life jacket wearing behaviors. The fact that they were of lower priority may indicate that these risks are "unrecognized", or are not as strongly related to perceived risks of water entry or drowning. Thus, the lower priority conditions should not be ignored.

5. Highly statistically significant linear trend tests for all boats indicated that adult life jacket wear rates increase with the cumulative number of "risky" conditions present, suggesting that for adult boaters the more risks that are present, the more likely there will be influence on wearing behavior.

6. While it is encouraging that adult boaters in every boat type category seem to be considering situational risk factors and that this consideration influences the decisions to wear life jackets, there are two important caveats. One, a lack of perception of a risk factor does not mean the risk is not present. Two, even in conditions that are in fact more benign, falls overboard or capsizing can still happen and therefore potential drownings can occur. Thus, life jackets should be worn at all times.

7. The challenge of these results for the boating safety community is how to do two things at once—(1) teach boaters how to become more situationally aware and to respond by wearing a life jacket; and (2) no matter what the perceived risks are to ALWAYS wear a life jacket while boating.

IV. CONCLUSIONS FOR LIFE JACKET WEAR RATES - NATIONAL TREND DATA 1999 TO 2018

1. For many different age groups of boaters on all types of craft, wear rates in 2018 mark substantial improving trends since the 1999 baseline year. Here we list the types of boaters and cumulative increases using as baseline the years 1999-2001.
    a. All boaters on all types of boats excluding PWCs: 29% increase (15.4% to 19.9%)
    b. All adults (18+) on all types of boats excluding PWCs: 32% increase (9.2% to 11.9%)
    c. All youth (0-17) on all types of boats excluding PWCs: 21% increase (56% to 67.8%)
    d. Children (0-5) on all types of boats excluding PWCs: 3% increase (87.8% to 90.4%)
    e. Children (6-12) on all types of boats excluding PWCs: 18% increase (73.1% to 86.2%)
    f. Teenagers (13-17) on all types of boats excluding PWCs: 33% increase (28.9% to 38.3%)

2. For adults there have been notable increases in wear rates by type of boat comparing 2018 levels to the 1999-2001 average.

    a. Day sailors: 203% increase (34.6% to 70.4%) (2018 are the highest levels observed in our study for this type of boat)
    b. Cabin sailboats: 266% increase (10.2% to 27.1%) (2018 are the highest levels observed in our study for this type of boat)
    c. Open motorboats: 42% increase since 2006 (4.5% to 6.4%)

3. The number of adult standup paddleboarders has increased each year since 2010 and wear rates have been in excess of 50% since 2012. In 2018 the wear rate was 55.3%.

4. Wear rates on PWCs for both adults and children are almost universal with the 2018 adult wear rate 97.4%.

5. Cold water and/or cold air temperature was the highest priority predictor for adult life jacket use for six of eight boats included in our analyses (Runabouts/speedboats, skiffs, cabin cruisers, pontoon boats, kayaks, and cabin sailboats).

6. Having a child on board was a top four priority predictor for adult wear rates for all boat types included in our analyses except kayaks, day sailors, and cabin sailboats, boat types which are less likely to have children on board in the first place.

7. Life jacket wear rates increase with the cumulative number of risky conditions encountered for adult boaters in all boat types. This suggests that adult boaters are modifying their life jacket wearing behaviors dependent on how risky they perceive their boating situation to be.

8. While it is encouraging that adult boaters in every boat type category seem to be situationally aware when deciding to wear life jackets, it should be a goal of educators to teach that a perceived absence of risky conditions does not mean that there is no risk for drowning. It is possible that risks exist that boaters do not understand or notice. It is also true that, capsizing or falling overboard occurs in less-risky conditions as well. Thus, the number one message for promotion is that life jackets should be worn at all times.

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: 2018 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

13685

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 2018

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

JSI Data Collection Form: 2018 Site Form

PFD Study 2018

# 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

★★ **Loaner Board**: ○ **Yes (COMPLETE 'Loaner Board' section on back of page.)** ○ **No**

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

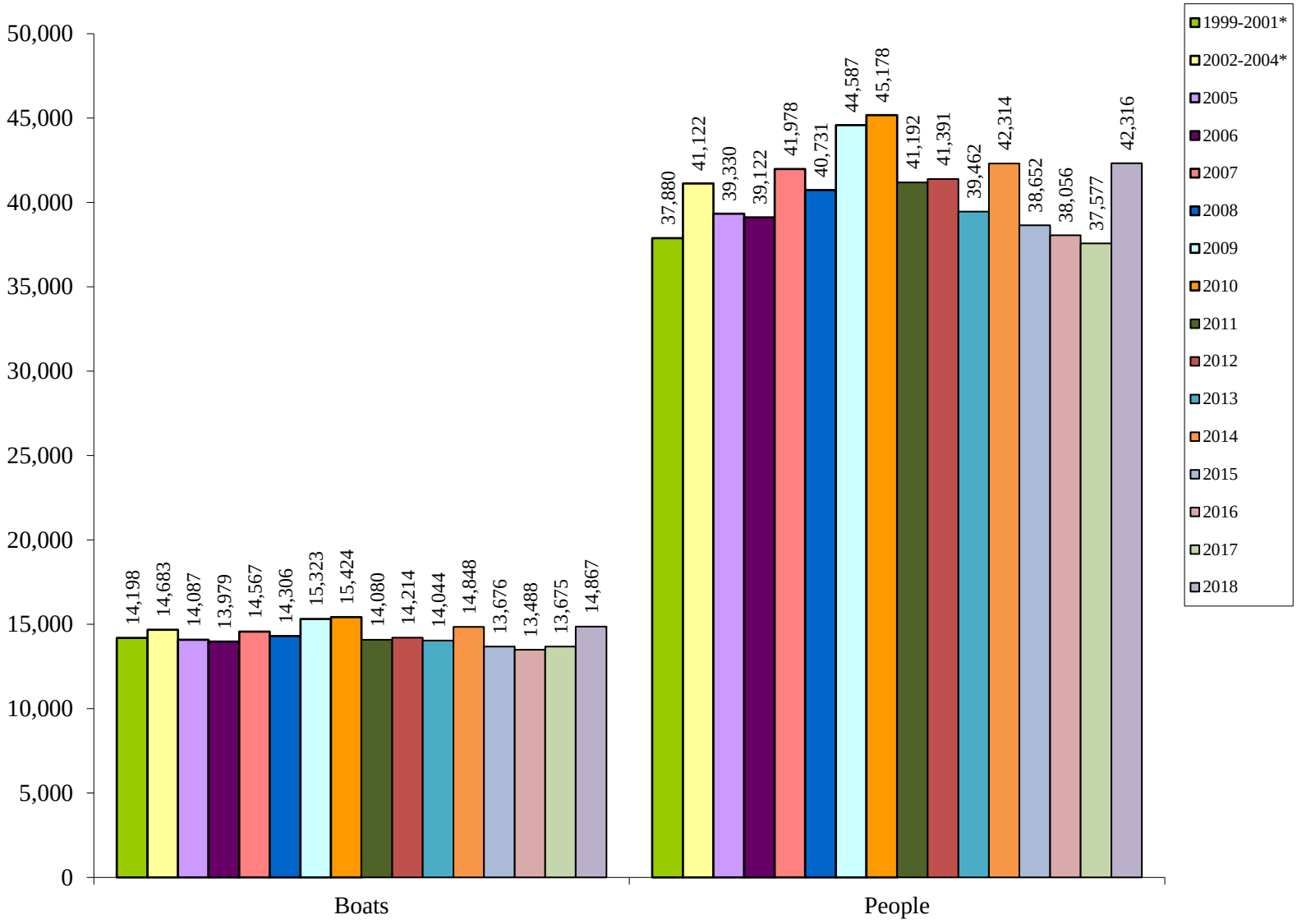
VI. INFORMATION ON BOATS & PEOPLE OBSERVED

From 1999 to 2018, JSI has observed a total of 287,221 boats and 808,892 boaters (Figure N). This year, 2018, 14,867 boats carrying 42,316 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.

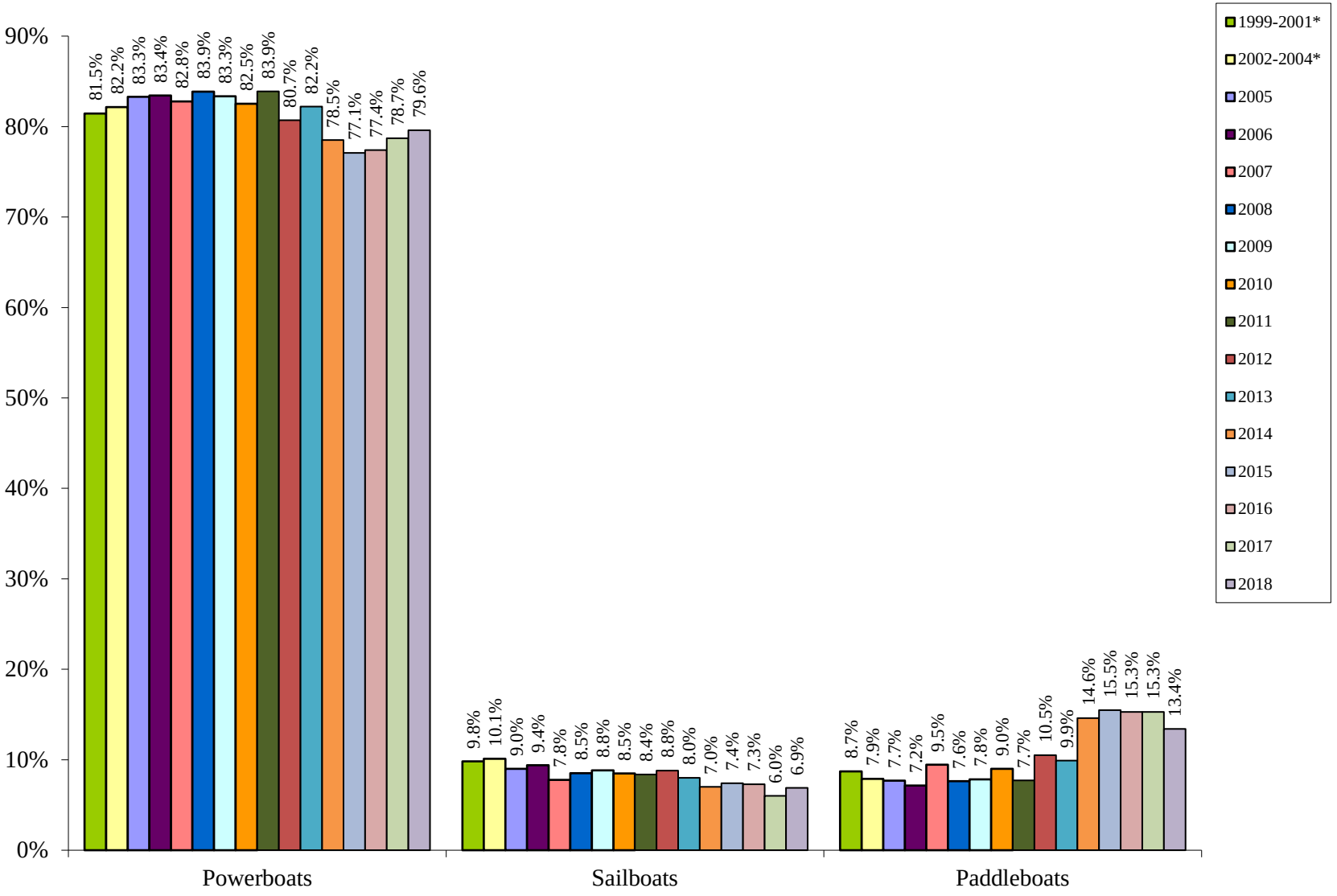
All figures in this section have been modified slightly from reports prior to 2011. The percentages now exclude (like the 2011 report) any missing observations on a particular characteristic. Since missing observations are relatively rare, this switch in presentation does not result in any major shifts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

Figure O – Number of Boats and People



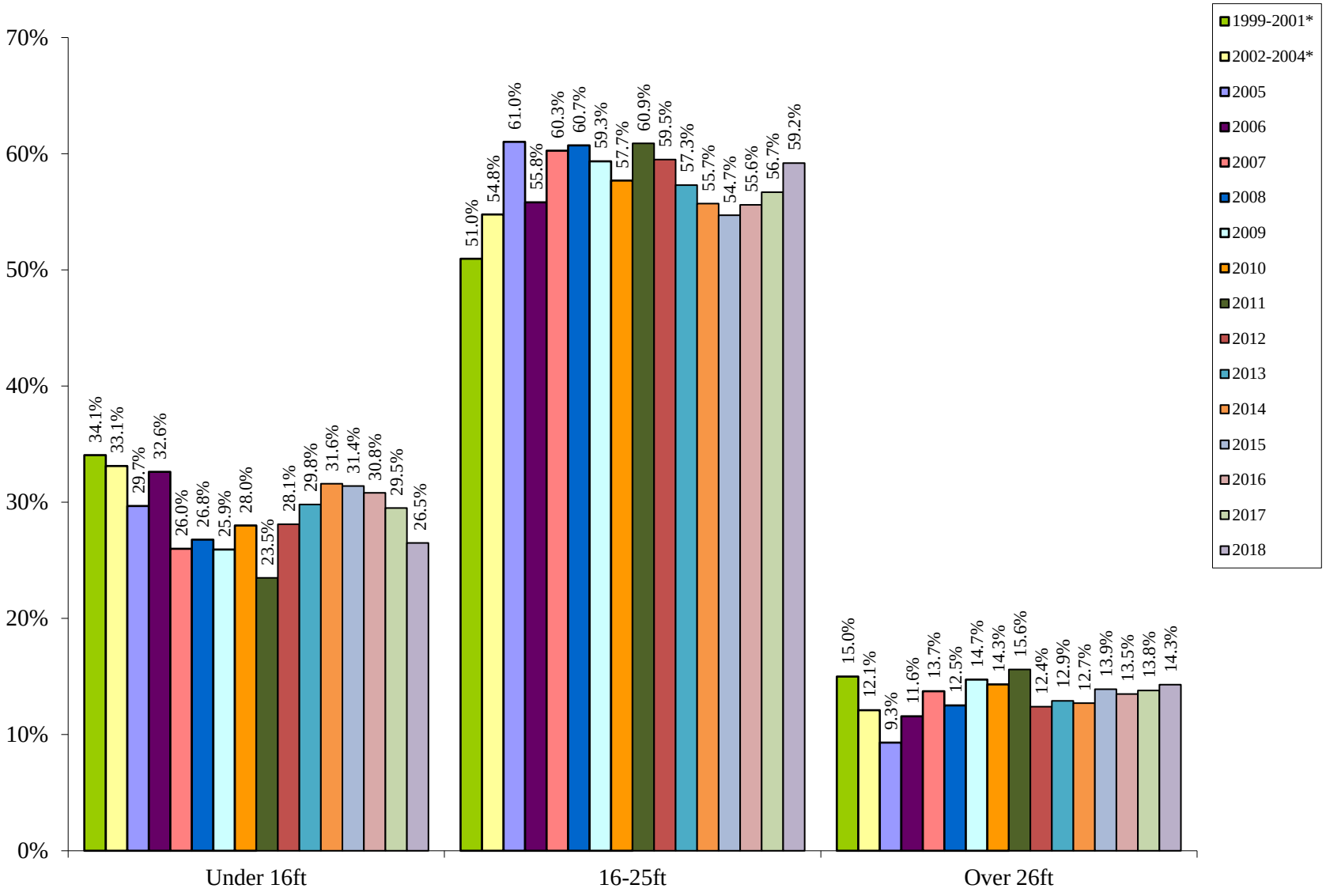
*Three-year average

Figure P – Types of Boats



*Three-year average

Figure Q – Length of Boats



*Three-year average

Figure R – Length of Boats 2004-2018 Data Only

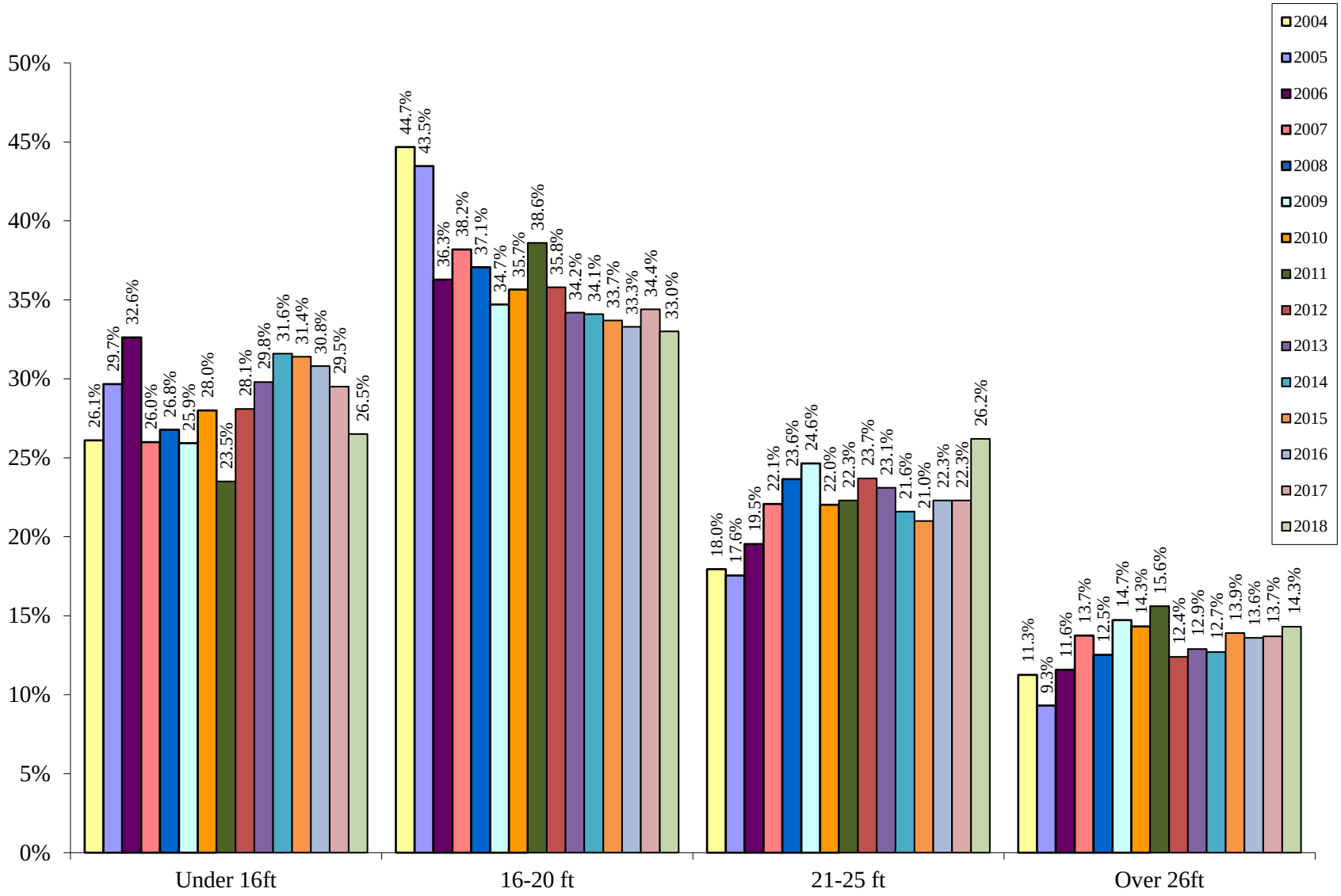
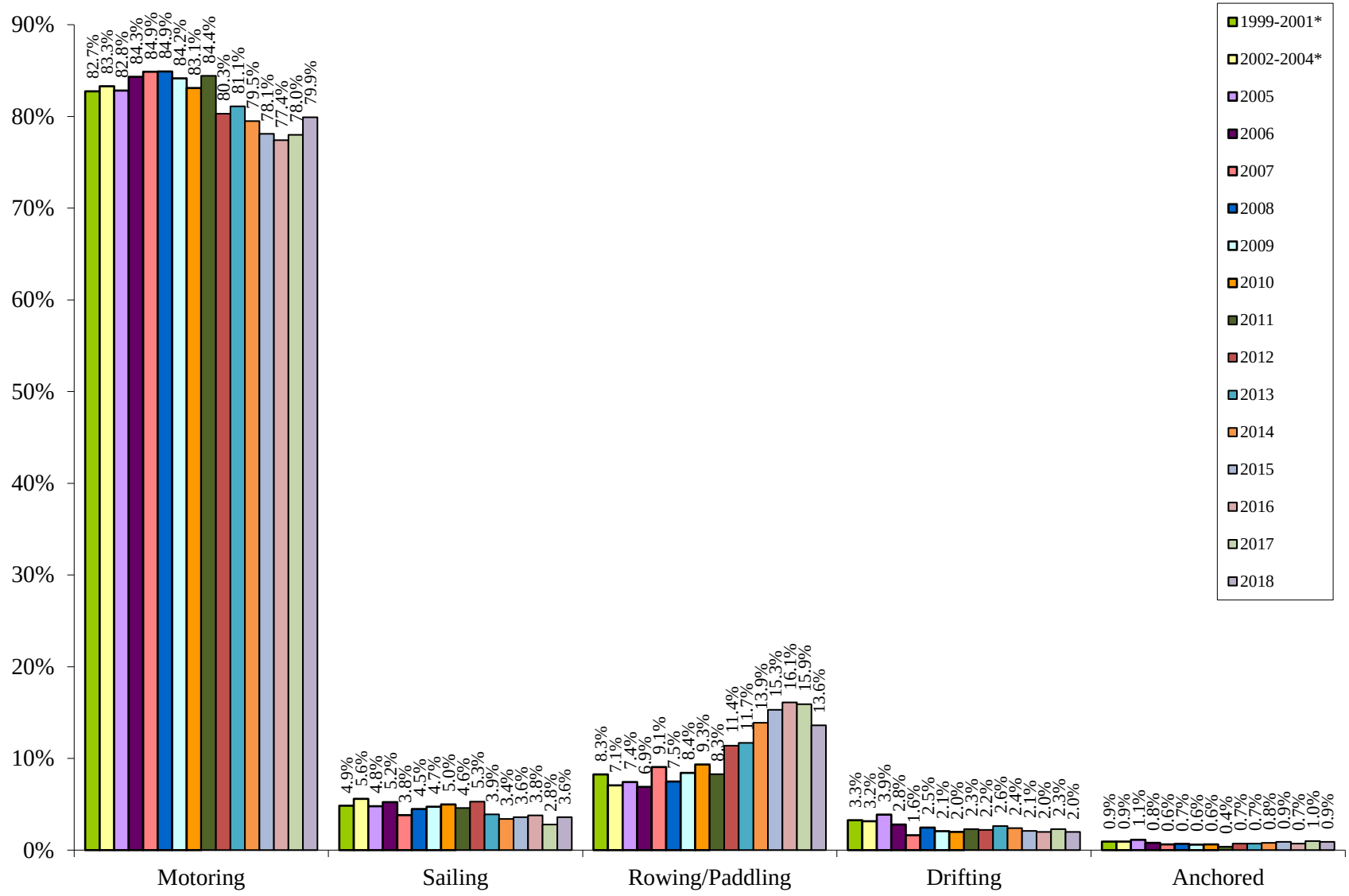
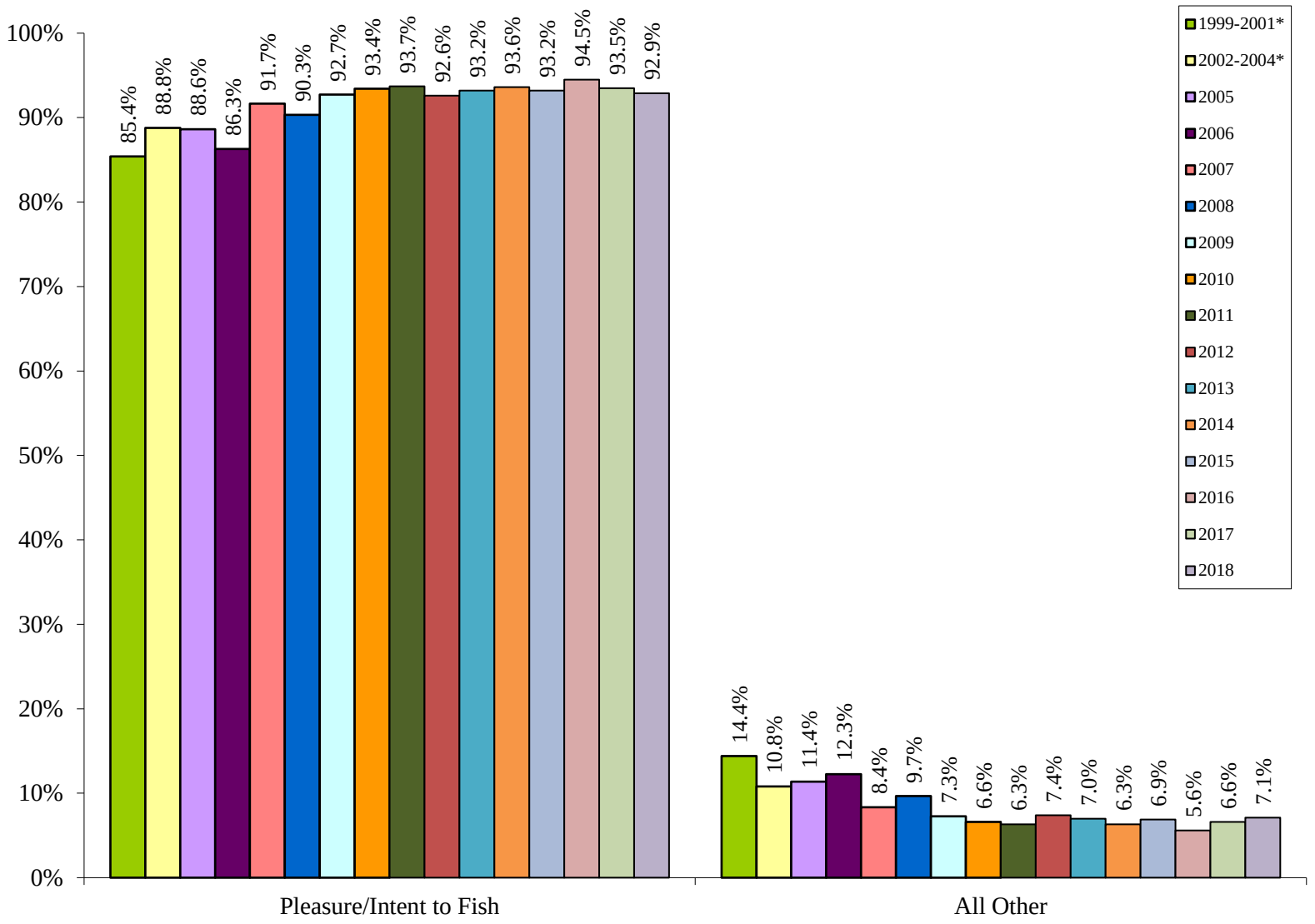


Figure S – Operation of Boats



*Three-year average

Figure T1 – Activity of Boaters—ALL YEARS*



*Three-year average

Figure T2 – Activity of Boaters 2007-2018 Data

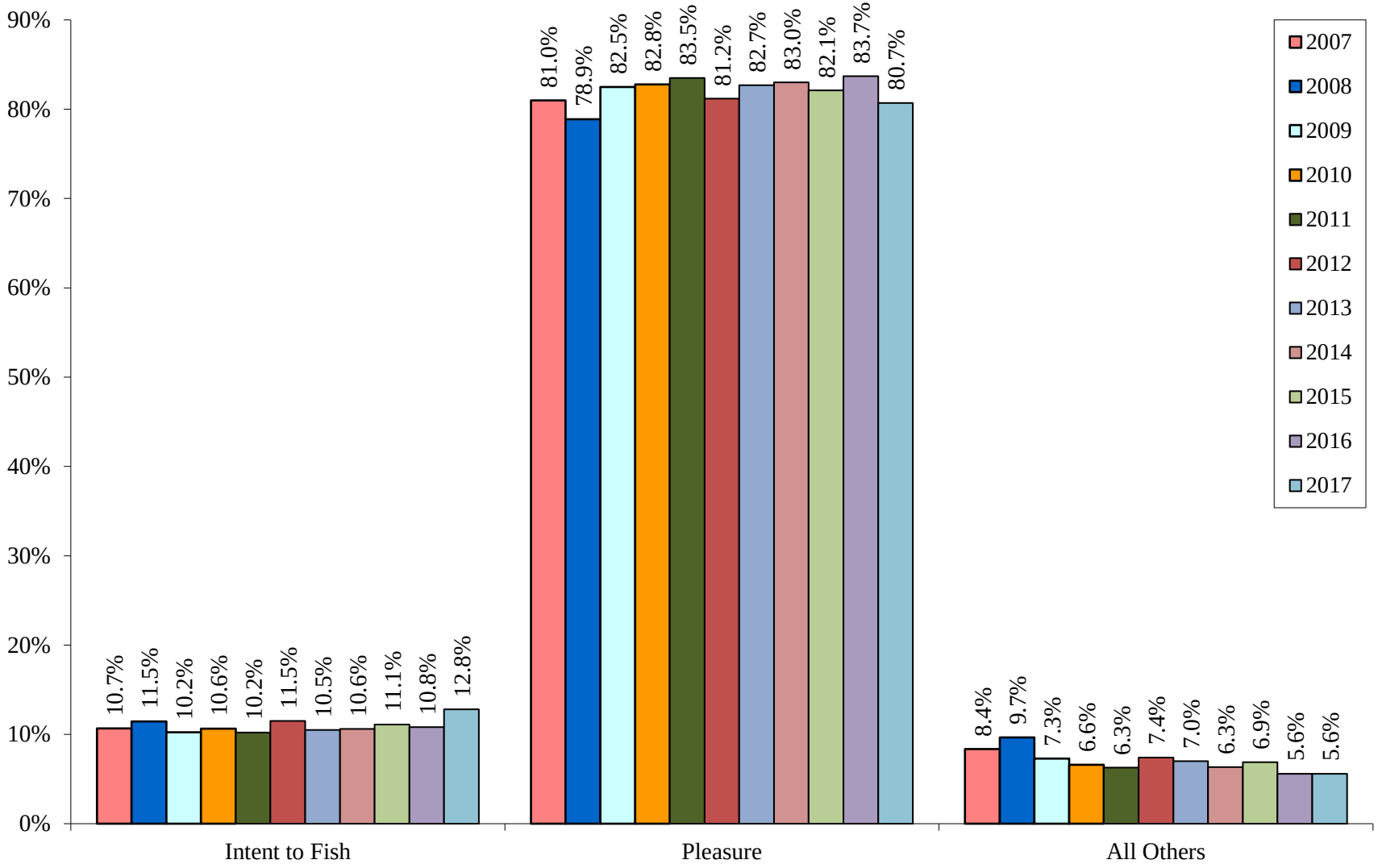
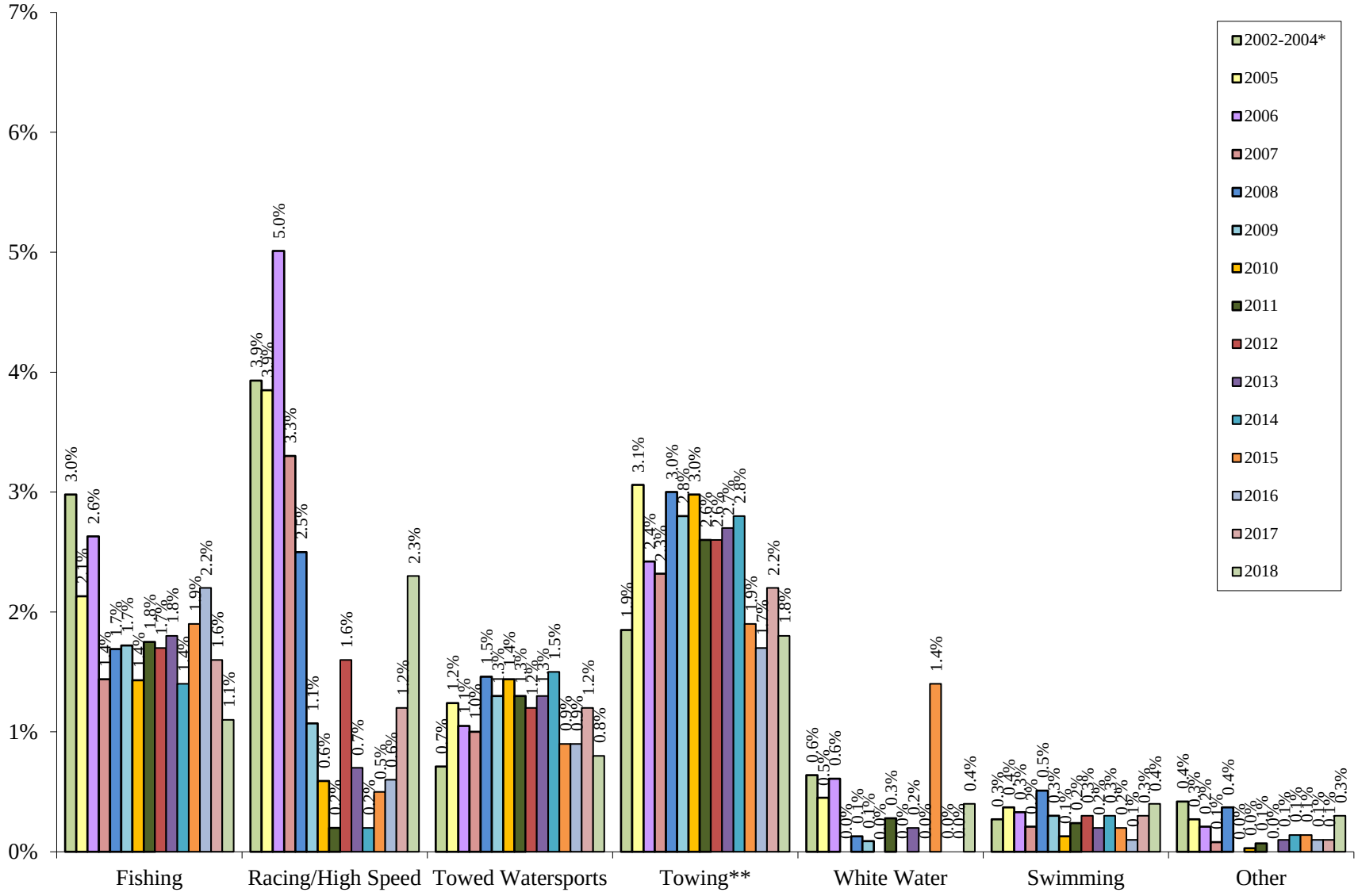


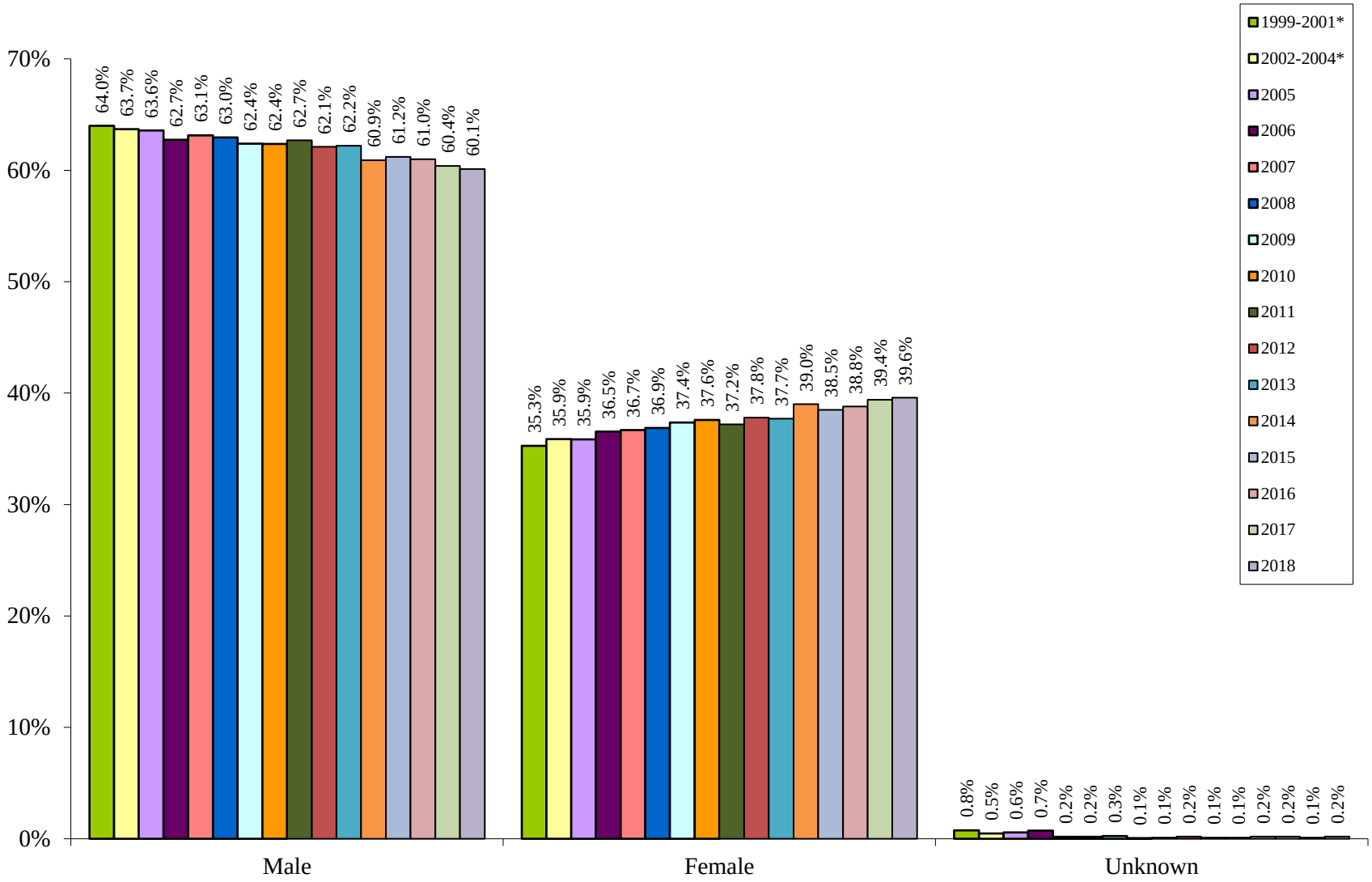
Figure T3 – Activity of Boaters 2002-2018
Detailed Breakdown of ALL OTHER Category from Figure P1



*Three-year average

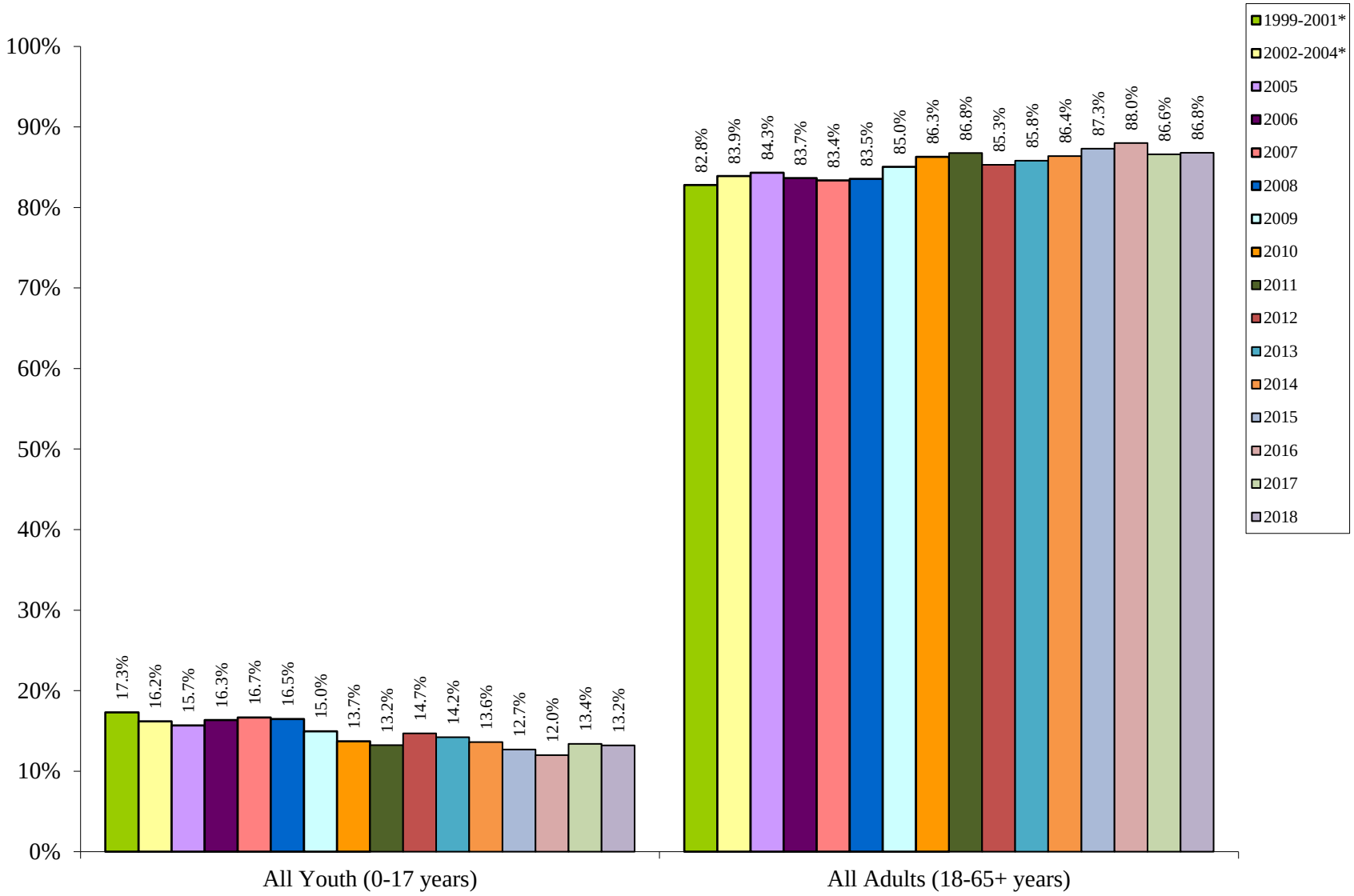
**The activity "Towing" indicates that these boaters were passengers in a boat towing water-skiers or other towing activities. Likewise, "Towed Watersports" includes all towing sports and is reserved for the boaters in the water being towed. The label was changed in April 2010.

Figure U – Gender of Boaters



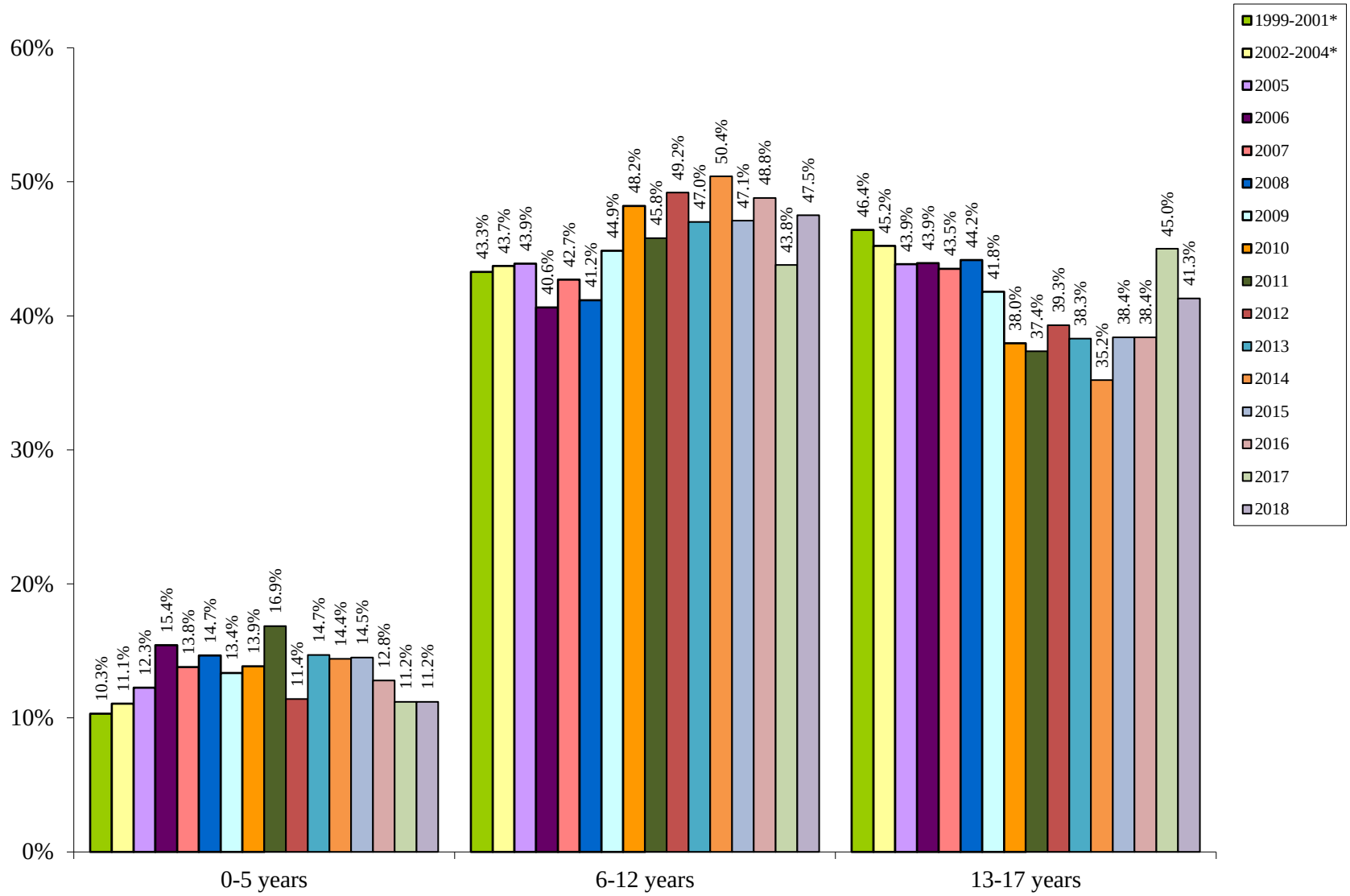
*Three-year average

Figure V1 – Age of Boaters



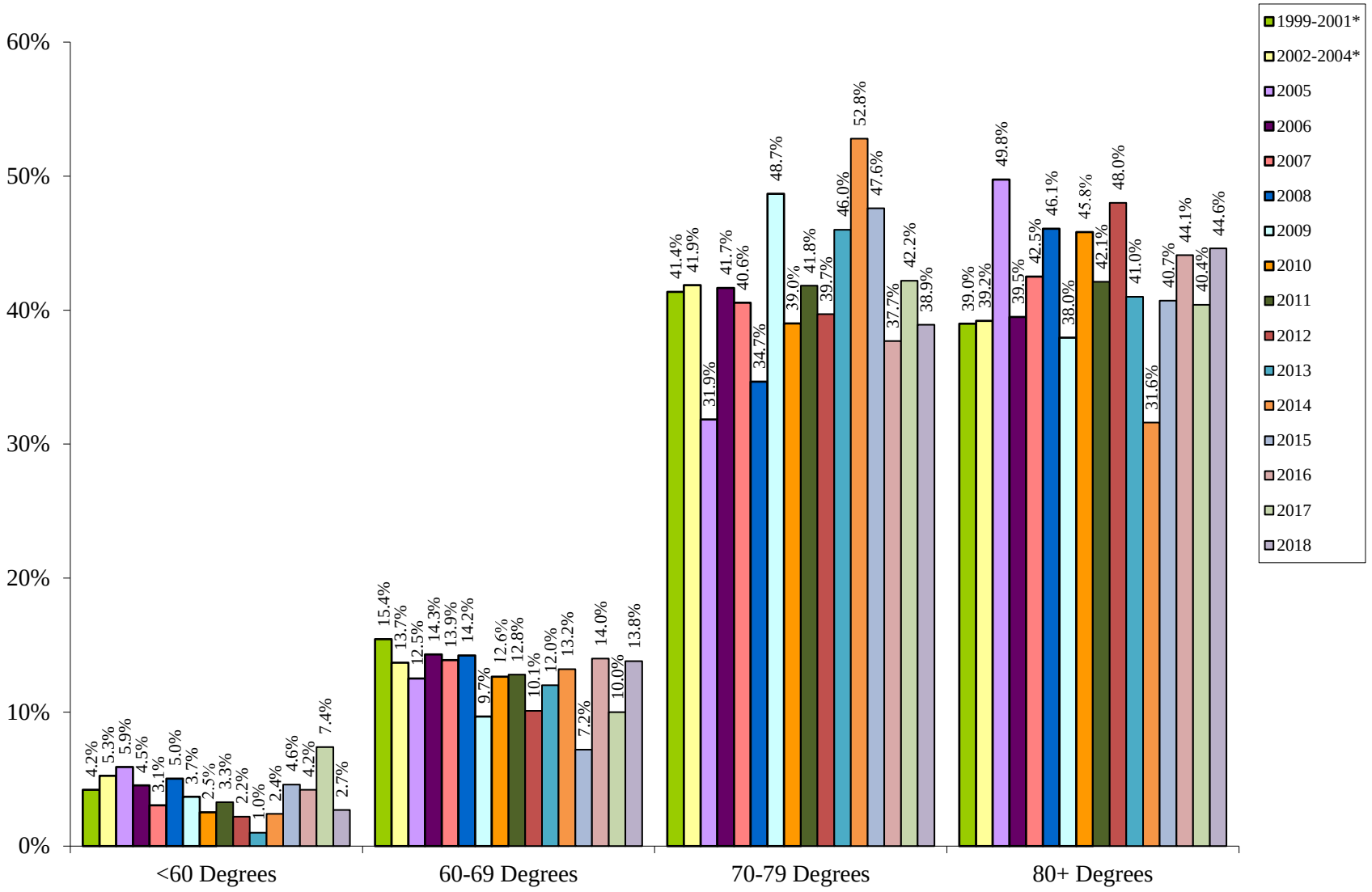
*Three-year average

Figure V2 – Age of Youth Boaters



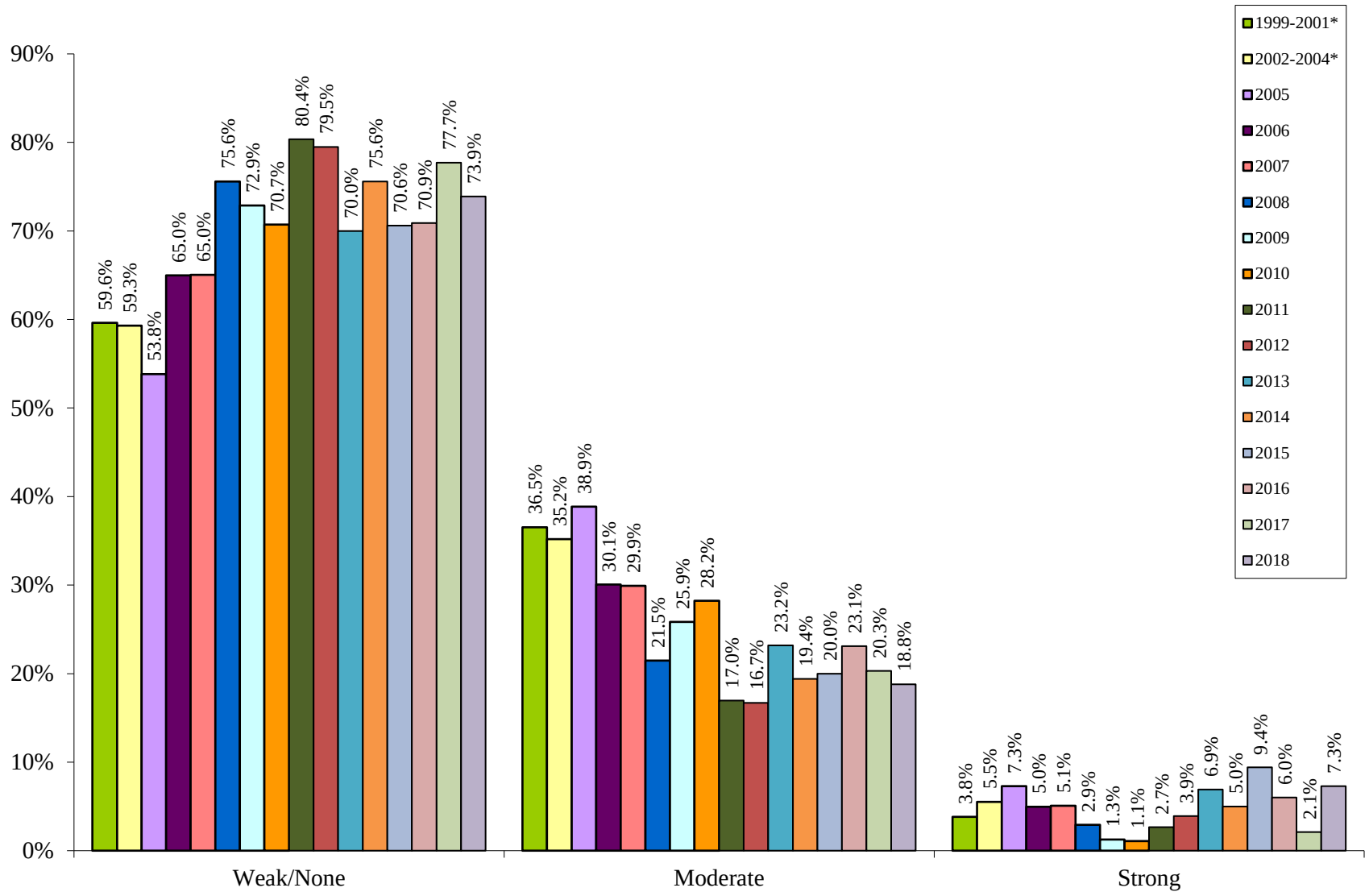
*Three-year average

Figure W – Water Temperature in which ALL Boaters were Observed



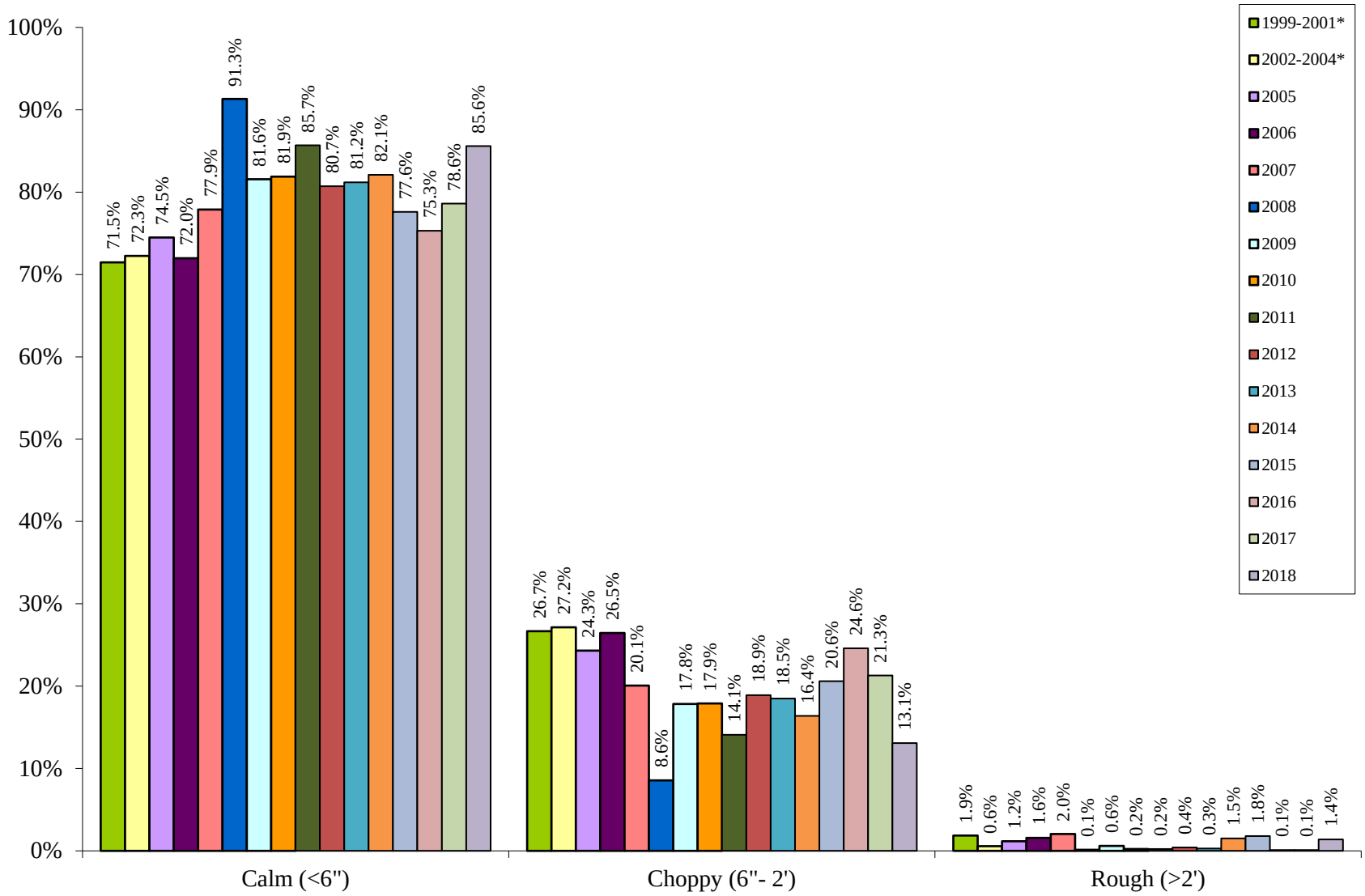
*Three-year average

Figure X – Water Current in which ALL Boaters were Observed



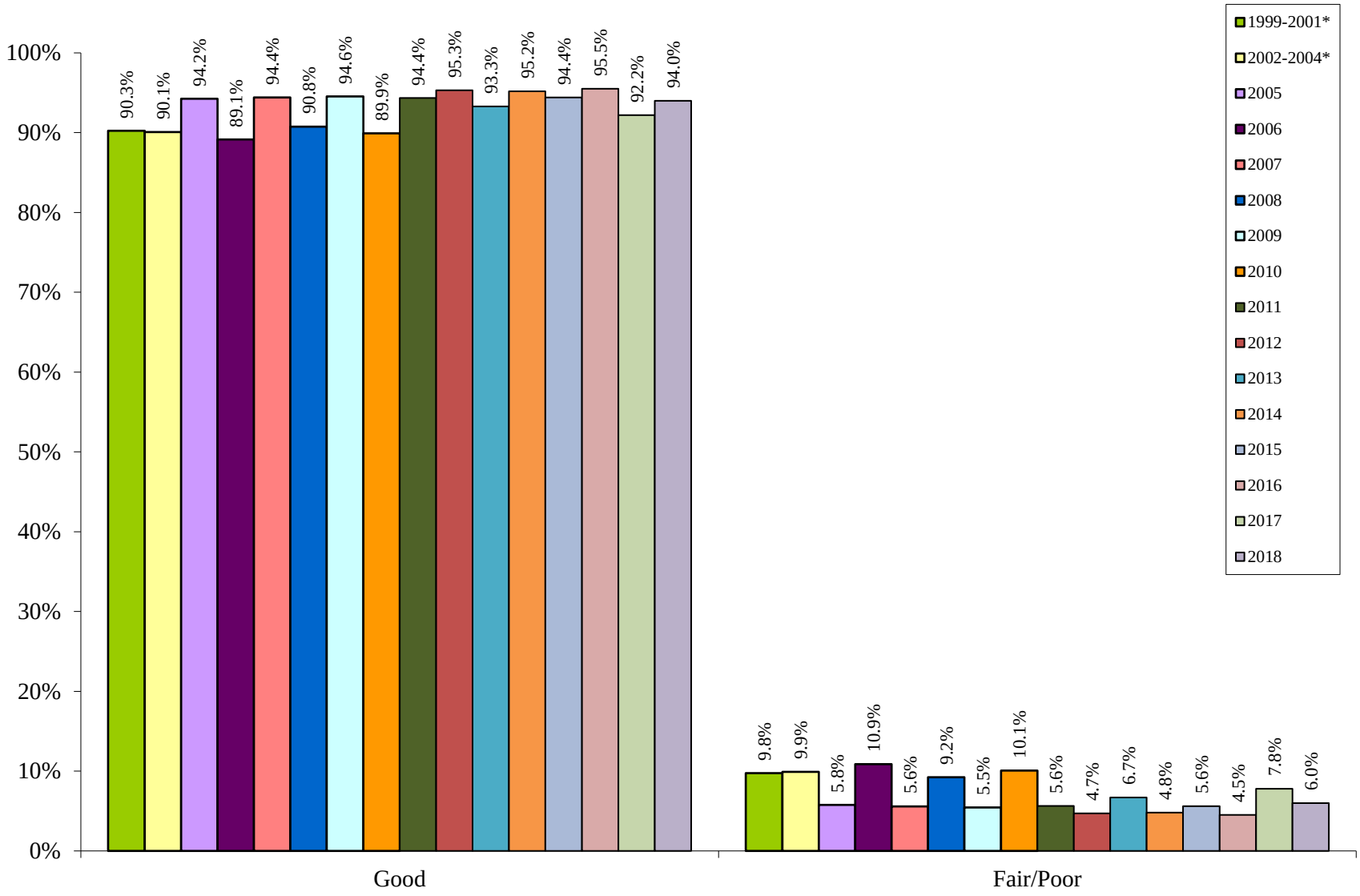
*Three-year average

Figure Y – Wave Height in which ALL Boaters were Observed



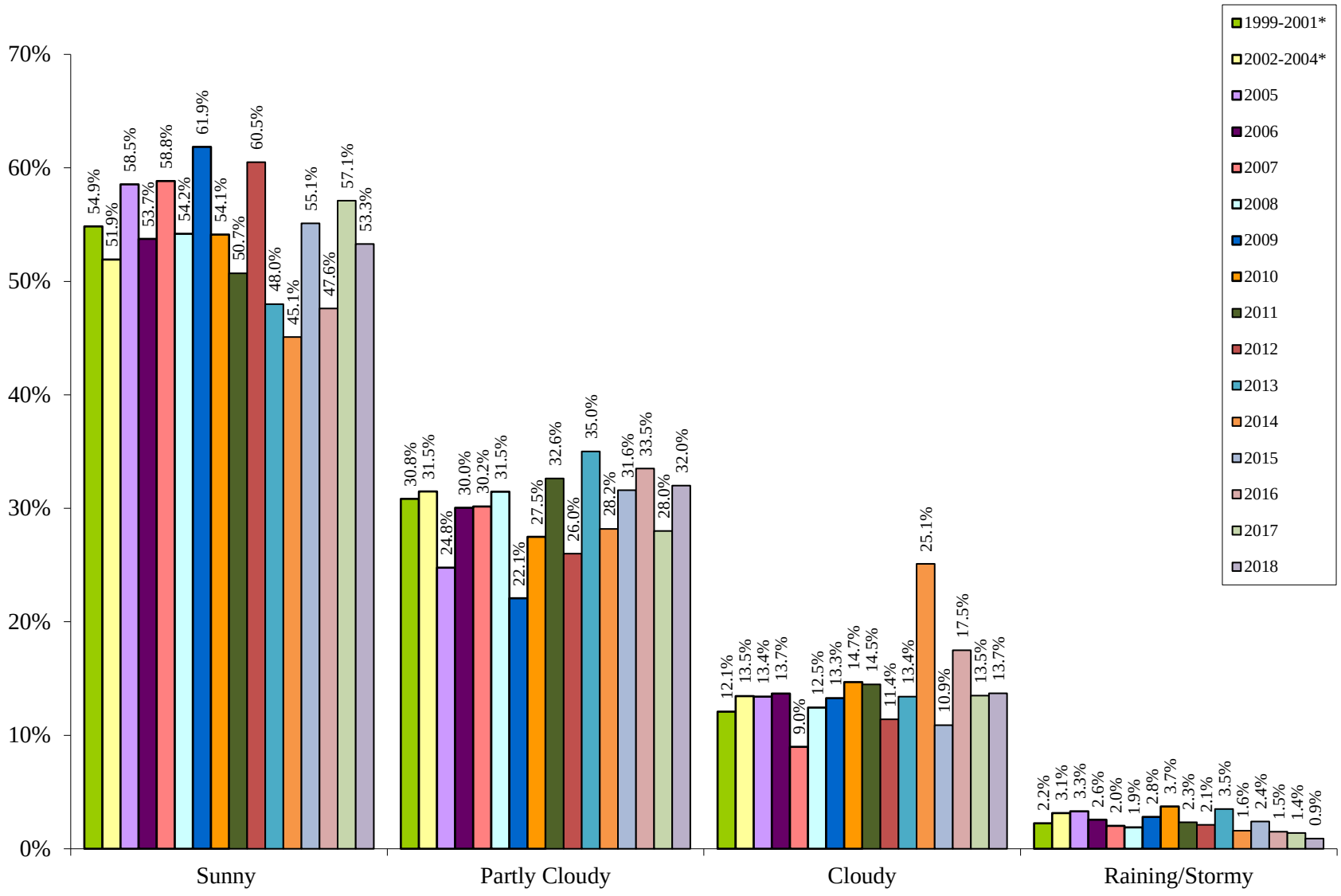
*Three-year average

Figure Z – Visibility in which ALL Boaters were Observed



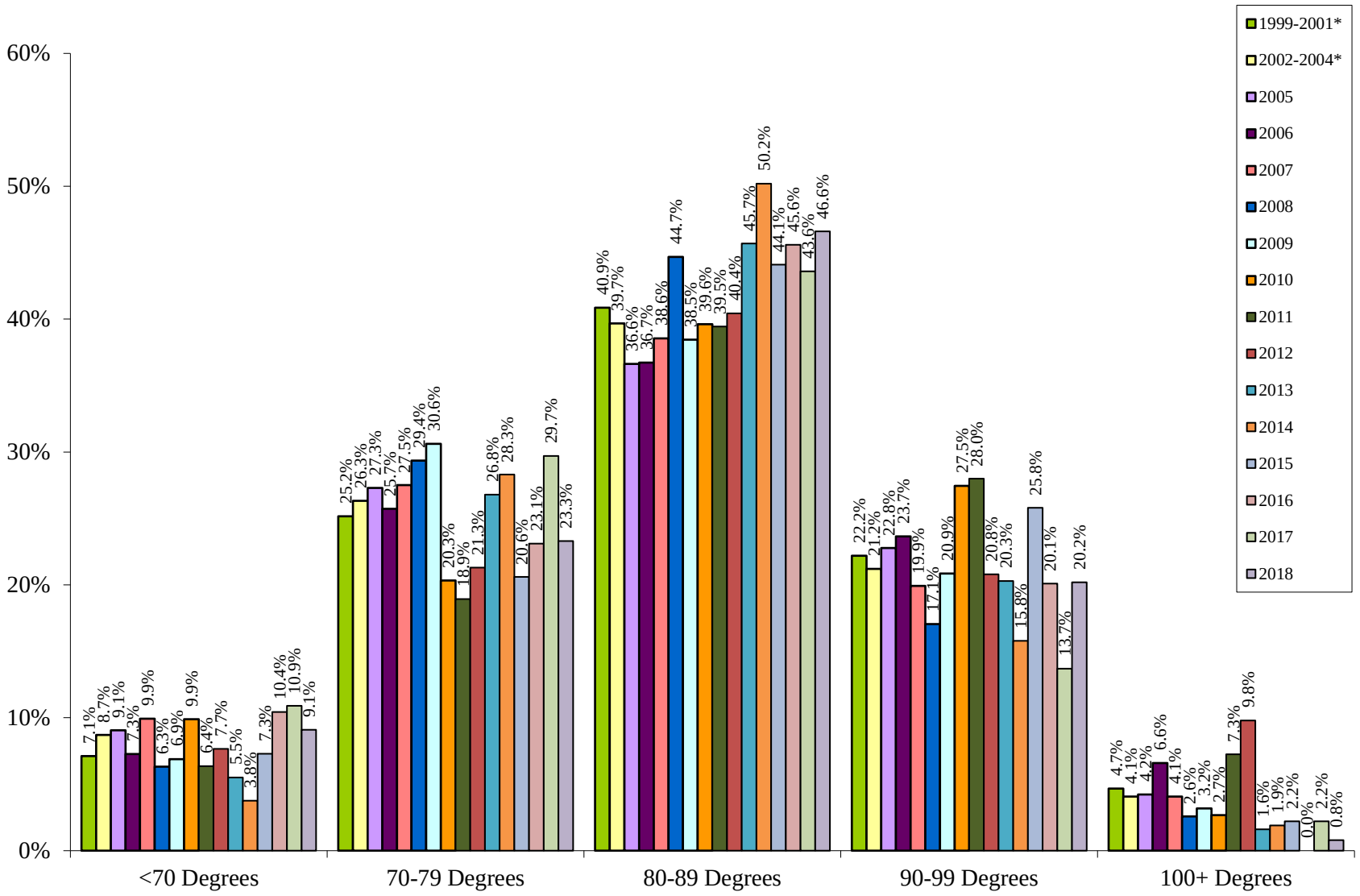
*Three-year average

Figure AA – Weather in which ALL Boaters were Observed



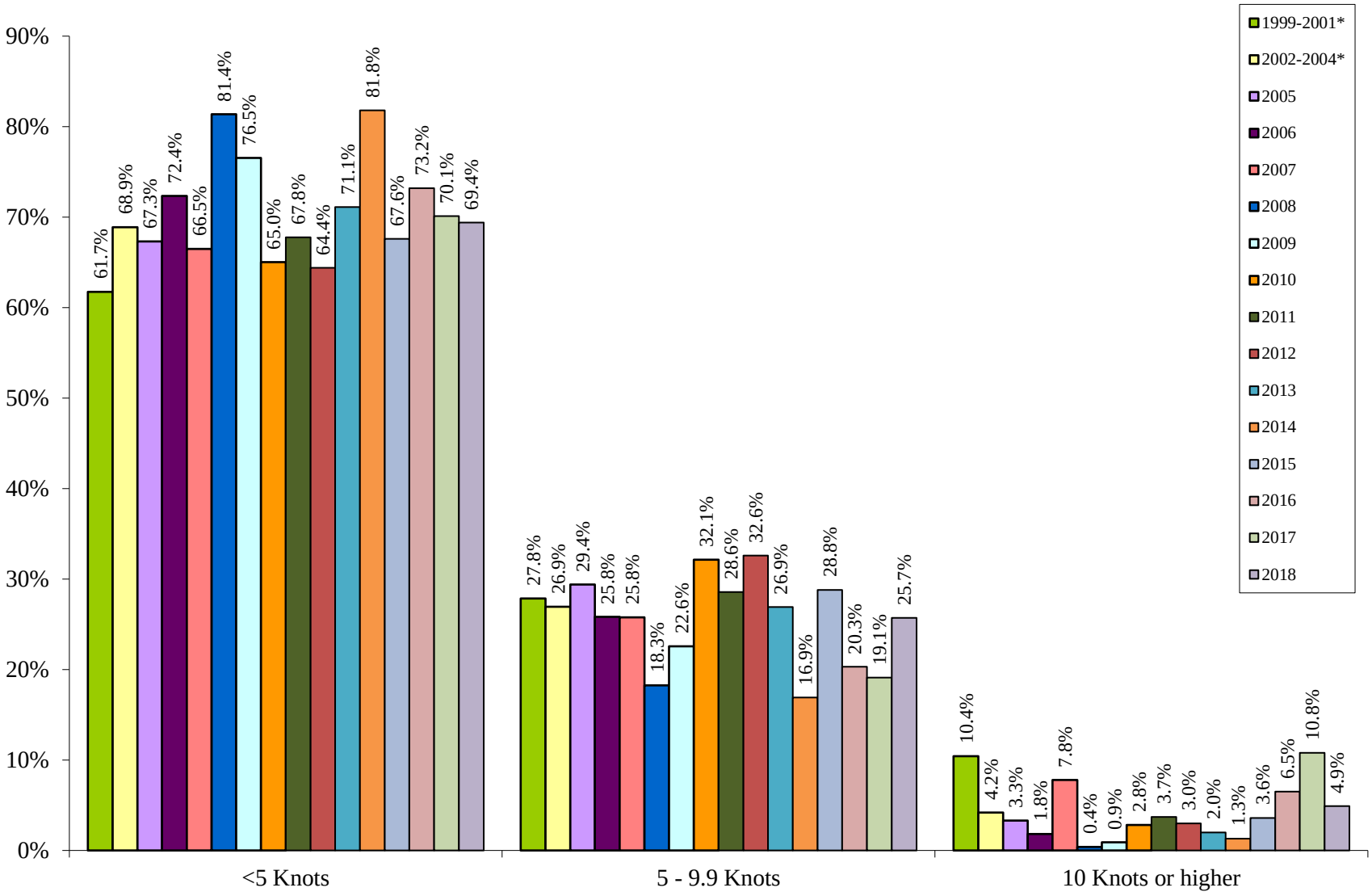
*Three-year average

Figure AB – Air Temperature in which ALL Boaters were Observed



*Three-year average

Figure AC – Wind Speed in which ALL Boaters were Observed



*Three-year average

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