

BREAKING DOWN THE NUMBERS

A CLOSER LOOK AT EXPOSURE HOURS FROM THE 2012 NATIONAL RECREATIONAL BOATING SURVEY

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If you love statistics, then you'll find plenty to ogle in the U.S. Coast Guard's recently released summary report of results from the 2012 National Recreational Boating Survey (NRBS). If you loathe them, then you'll probably be inclined to shield your eyes from the collection generated by the NRBS trio of survey components.

The 2012 NRBS numbers come from three survey components:

A **Boat Survey** gathered detail on owned (registered and unregistered) boats in the U.S.; provided the basis for estimating the number of boats in a given state; and served as the recruiting tool for Trip Survey panel members.

A **Trip Survey** gathered monthly detail on boat usage from boat-owning panel members identified through the Boat Survey, and provided the data used to calculate exposure hours nationally, regionally, and at the state level. The trip detail was based on respondents' recall, not trip diaries.

A separate **Participant Survey** gathered information on household and individual adult and child participation in recreational boating and activities, and awareness of safe boating practices. No exposure hours were generated from this survey.

Whatever your predisposition for numbers, it's worth taking a closer look at the 2012 figures. Like mosaic tiles, they've been, and will continue to be, pieced together in different ways to create pictures of recreational boating that inevitably will invite varying inferences about boating participation, boater behaviors, and boat usage.

In the run-up to the release of the data and Coast Guard report for this round of the NRBS, a charge team of NASBLA's Engineering, Reporting & Analysis Committee (ERAC) spent time becoming familiar with many of the 2012 *mosaic tiles*, learning how they were produced and connected, whether their representations would be true-to-life, and what they're likely to be used for over time. In this article and "Tell me more about the 2012 NRBS" (pp. 20-21), as well as future products and forums, we'll lean heavily toward using "layperson speak" in sharing what we've learned.

So, while the information we pass along shouldn't require you to be a *mosaic artist*, we hope it will help you become a more *discerning observer* of the pictures of recreational boating that are being created—starting with the 2012 portrayal of *exposure hours* and *risk* on the water.

The expectations surrounding exposure

Of all the numbers to come from the 2012 NRBS, recreational boating exposure hours were among the most anticipated. That was, in part, because the 2012 set of figures would go beyond the national and regional estimates produced by the 2011 NRBS to include exposure hour estimates all the way down to the state level. But it was the possibility of using those exposure hours to more accurately quantify and compare recreational boating "risk" that fueled interest in them before the first survey had even been conducted.

For years, recreational boating casualty and fatality rates have been one set of markers used to evaluate boating safety. The rates have been figured by taking the numbers of boating injuries or fatalities (numerator) and dividing them by the reported number of state-registered boats (denominator). To allow comparisons of the rates across time and jurisdictions, the results typically have been multiplied by a factor of 100,000 to standardize them.

But over time, and the span of two national recreational boating safety strategic plans, the call went out to "fix" the fractions used to calculate the rates, and especially to "fix the denominator problem" in them. While efforts were already under way to improve the collection of the accident report data



used in the top half of the fraction, the Coast Guard's continued use of the number of state-registered boats in the bottom half was targeted as a "problem" for various reasons, not the least of which are the states' different registration requirements. One promising fix was the collection and use of exposure hours as a new denominator. The presumption was that exposure hours would represent a more meaningful relationship to actual risk on the water than boat registration totals. As a bonus, they would make the casualty and fatality rate calculations more comparable to those used in other transportation and recreation modes.

So, although the Coast Guard had set several goals for the NRBS on inception, generating valid and reliable recreational boating exposure hours from the survey was at or near the top of every list describing its purpose.

NRBS measurement goals identified by the Coast Guard

- Exposure hours
- Boating participation and boat ownership
- Boating safety awareness and behaviors
- Economic impact of recreational boating
- Other boat statistics

But beyond the anticipation of being able to use exposure hour estimates—and other NRBS data—to create more solid measures for objectives in the national strategic plan, was the prospect of being able to make broader and deeper improvements to other recreational boating safety performance measures.

In the 2012 NRBS report, the Coast Guard readily acknowledges that over the years different performance audits of the national RBS program have found weaknesses in several areas, among them the lack of solid criteria for monitoring the states' RBS program efforts and reliable, consistent data to conduct those evaluations. The report describes several actions the Coast Guard has taken or plans to take to meet the audits' recommendations, including the following:

"...Over the next several years, the RBS Program plans to utilize exposure-based risk ratios as a primary performance criterion that will be employed to evaluate the effectiveness of efforts to reduce accidents and fatalities..." (National Recreational Boating Survey 2012 Report, p. 9)

And *that* creates one more expectation about exposure hours.

If the intent is that the effectiveness of recreational boating programs, campaigns, and services designed to reduce accidents and deaths will one day be measured by a "risk ratio" based on an exposure-hour standard, then it's probably a good idea for anyone involved in developing, implementing, or researching these programs, campaigns, and services to understand what that's about. Let's break it down.

First, what is an "exposure hour"?

By definition, *an exposure hour is one hour of one day of one person's time spent on the water participating in a recreational boating activity.*

But for purposes of the 2012 NRBS and understanding the data collected from its trip survey respondents, what did "time spent on the water" really mean?

Exposure hours' estimates produced from the 2012 NRBS trip survey interviews were based on people's reported time on *owned* boats—both registered and unregistered—and time spent on the boats *while they were being operated*. But what about the use of rental boats and the time boaters spent at the dock?

The collection of rental boat data was part of the original NRBS plan. But, after determining rental boats would have a marginal impact on the total number of exposure hours, the Coast Guard ultimately couldn't justify the extra effort needed to collect reliable information on their use. And while "docked day" information was collected from the 2012 NRBS trip survey respondents, it was left out of the exposure hour calculations because it wouldn't match the conditions for recreational boating accidents reported by the states to the Coast Guard. That's relevant in light of the Coast Guard's use of exposure hours as the basis for calculating and presenting what it has labeled in the 2012 NRBS summary report as "risk ratios" for deaths and casualties at the national, regional, and individual state levels. Those ratios are reported out in Table 54 of the 2012 report (pp. 82-83).

(Continued on page 16)

What is a “risk ratio” as used in the 2012 NRBS summary report?

It's intended as a measurement of potential “risk”—potential exposure to accident, injury or death—for a given group, and it's expressed as a fraction. The group could be the nation, a region, a state, a boat type or some other unit.

To allow like-for-like comparisons between groups, the risk ratios presented in the 2012 NRBS summary report are standardized to 100 million exposure hours.

The result of the:

**Actual number of events for the group
(accidents, injuries, deaths)**

-----divided by the-----

Estimate of exposure hours for the group

multiplied by a factor of 100 million exposure hours.

For example, in 2012, Ohio had 11 events (boating deaths). The 2012 NRBS estimated 83 million total exposure hours for Ohio boaters in 2012.

Ohio's 2012 fatality “risk ratio” was calculated by dividing the number of deaths (11) by the state's exposure hours' estimate (83 million), and then multiplying by the factor of 100 million to equal ...

13 boating fatalities for every 100 million exposure hours.

And how were the exposure hours estimated?

Calculating the exposure hours eventually used in those ratios was a complicated matter. But the core elements boil down to a formula that accounted for the number of days that boaters reported



they had spent on the water in a given time period, the number of hours that the boaters reported they had spent on the water on the days they boated, and the number of persons reported to have been on board the boat on the days they boated.

Core of the Exposure Hour Calculation

The number of Boater Days times

The number of Boater Hours per Day times

The number of People on Board the Boat per Day

Before information could even be collected to plug into that three-part formula, though, an intricate process was used to figure out *which* boats and boat owners would even be selected to participate in the survey.

When the Coast Guard set out to collect and calculate national estimates of exposure hours, it wanted the estimates to reflect the use of **all** boats owned in the U.S. But the cost of surveying all boats would have been prohibitive. Instead, the Coast Guard achieved its

goal through statistical sampling—that is, a sample of boats and their owners would be surveyed in each state. Through a series of phases, the target universe of “all owned boats” was whittled down—first to the subset that would be selected for the NRBS boat survey and then to the even narrower subset that would be used to capture exposure data from the NRBS trip survey respondents.

But in order to get back to the original target and create those national estimates of exposure hours from the much smaller set of boat trip respondents' data, there had to be some statistical compensation for not having all boats and boat owners in the sample—whether that was due to the survey's sampling structure, invitees declining to participate, or participants dropping off along the way for other reasons. A complex data weighting scheme with adjustments was used in the reconstruction process.

The use of a weighting system and series of adjustments isn't unusual for surveys like this. But their use does rely heavily on the assumption that the boaters who end up responding to the survey have characteristics and behaviors *similar* to boaters who weren't selected for the survey or who were selected but didn't respond to the survey requests. That assumption about

non-respondents and the impact on the collection of exposure hours is worth another look, both for purposes of evaluating the quality and validity of the estimates from the 2012 NRBS, and for refining how exposure hours might be collected in the future.

But other factors that may vary widely from year-to-year or place-to-place could also have an impact on the total number of exposure hours, their use in the Coast Guard's ratio calculations, and in figuring out what the results of those calculations of *risk* really mean. Climate swings, environmental changes, culture, and the economy, among many other variables, could affect exposure hour computations and ratio interpretations.



Do exposure hours have a more accurate connection with risk?

In theory, gathering up the total number of hours that boaters in a certain group are actively on the water in a given time period should offer a more accurate estimate of their exposure to *actual risk* on the water than just knowing the total number of registered boats for that group. After all, not all boats are registered—there *are* state-to-state differences in registration requirements—and not all boats are used to the same extent, for seasonal and other reasons. But whether exposure hours or registered boats are used as the basis for estimating risk and making comparisons, there are caveats associated with each. Some are described in “Things to keep in mind when you’re interpreting rates”.

Things to keep in mind when you’re interpreting casualty or fatality rates that use the ...

Number of state-registered boats as the denominator in the fraction

- If two states have an equal number of injuries or fatalities, the state that registers *all boats* will show a *lower* casualty or fatality rate than the state that registers only a portion of its boats--not necessarily because the former's “risk” for injury or death is really lower, but because the denominator used in its rate calculation will be larger.
- It could be misleading to compare casualty or fatality rates between states that have longer boating seasons and states that have much shorter seasons--even if the number of registered boats in each is similar, their average number of boat use hours will be different.

Number of exposure hours as the denominator in the fraction

- Boating injuries and deaths are assigned to the states where they actually occurred. Exposure hours from the NRBS are assigned to the states on the basis of where the boats were registered or the owners resided at the time of the survey, not on the basis of where the boats were operated. For some states, that might not make much difference in the calculation of their casualty or fatality rates. But for states where a large proportion of boats used on their waterways—and becoming involved in accidents—are from out-of-state, the impact on their rates could be significant.
- As averages based on the entire population of boaters associated with some group (e.g., nation, state or boat type), rates that use exposure hours aren't necessarily stating the “risks” that would be experienced by an individual boater. The average rate might *overstate* risk for an operator who uses a well-equipped boat at slow speeds in daylight and *understate* risk for an operator who uses a less well-equipped boat at high speeds at night

So, what *do* the 2012 exposure hour estimates and risk ratios tell us?

Apart from the table of casualty-related figures, the 2012 NRBS report offers a summary of the “average risk ratios” for the U.S., comparisons of the regional figures, and identification of states with the “highest risk” and “lowest risk” of casualties and deaths based on those for which 2012 ratio calculations were made and presented. But it doesn't spend a lot of time in that discussion and probably for good reason. While the exposure hour estimates and ratios calculated for the nation, four regions, and individual states are interesting, there are limits to the conclusions that can be drawn from them right now, for a number of reasons.

For example, the national and regional exposure hour estimates and ratios generated by the 2011 NRBS and 2012 NRBS can't legitimately be compared because of methodology differences between the two surveys as described in the 2012 report and by Dr. Philippe Gwet of the U.S. Coast Guard in his article “Highlights of Findings from the Coast Guard 2012 National Recreational Boating Survey” (pp. 10-13). But, even if there'd been *no* differences in the methods used for the 2011 and 2012 versions of the NRBS, there'd *still* be reason for caution in suggesting year-to-year changes because those changes might not be statistically significant.

And for the states, the one year's worth of exposure hour estimates and ratios resulting from the 2012 NRBS does not make for a trend analysis. On the other hand, *why* three of the jurisdictions *don't have* the year's worth of casualty and death ratios to consider because of a “large statistical error” in their 2012 calculations, does make for an important future analysis of the measures themselves—that is, how do you resolve ratio calculations when either the exposure hours estimates or the numbers of accidents themselves are *too low* to result in valid statistics for a state?

All that said, a first glimpse into the state-level ratios lends a few clues that

(Continued on page 18)

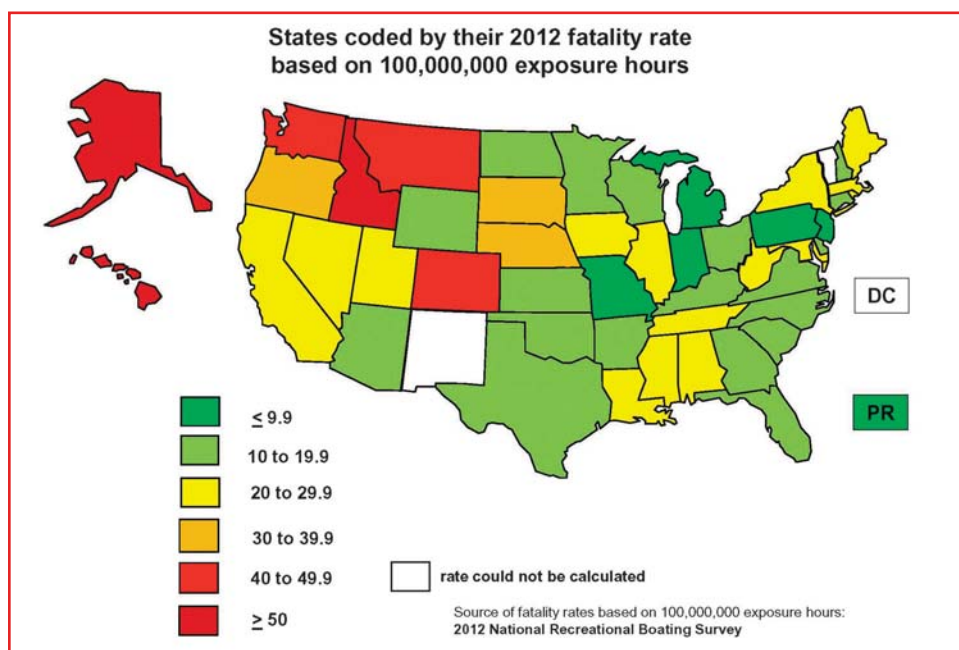
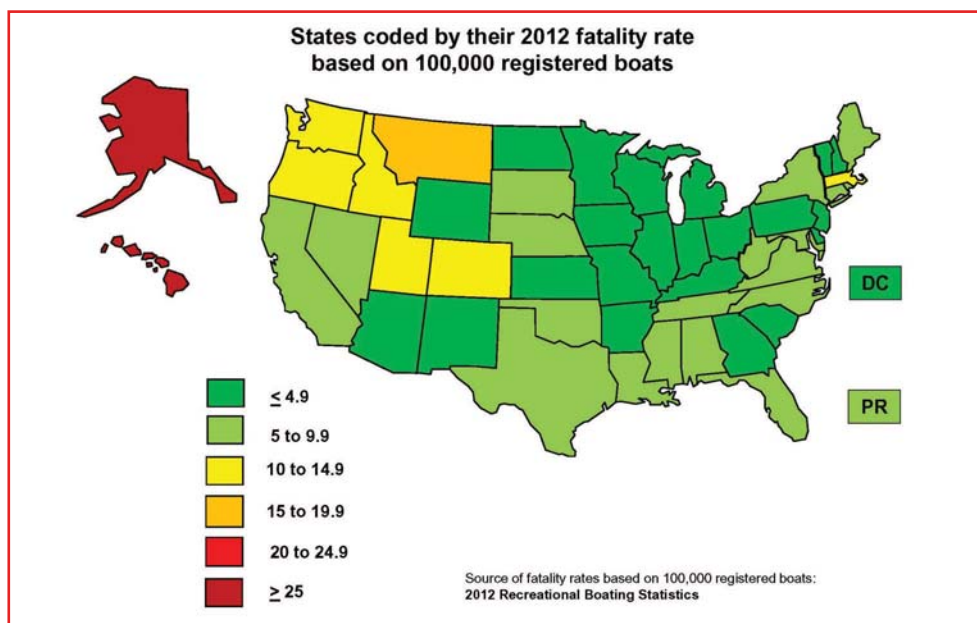


what would have been “concluded” about fatalities based on their registered boats-based rate alone. In a broad-brush comparison, states that presented what might be termed *low* rates using the registered boats measure generally also had *low* rates using the exposure hours’ calculation; the same generally can be said for states on the other end of the rate spectrum. But what if the rates were used to “rank order” the states? Turns out that for some states, a more marked difference would appear if comparisons were made between how they rank on their fatality rates based on registered boats and on their rates based on exposure hours. At least eight states

eventually could help answer questions at the core of expectations about using exposure hours to calculate casualty and

fatality rates: *Do they really provide a more accurate and meaningful measure of “risk” in recreational boating?; and Are the “results” of exposure-based rates distinctly different from those based on the total number of registered boats?*

State-level fatality rates based on 100 million exposure hours and on 100,000 registered boats are both available for 2012—the former from the 2012 NRBS and the latter from the Coast Guard’s 2012 Recreational Boating Statistics. Based on a preliminary examination of the figures, for many of the states for which 2012 exposure hour calculations could be made, there’s little apparent difference between those results and



would shift in their “rank order” by 10 or more places. Half of them would fare *better* using the exposure hours-based measure; half of them would fare *better* with the registered boats-based measure. What isn’t immediately clear is *why*?

It’s another question that deserves more attention in the continuing evaluation of the exposure findings from the 2012 NRBS—not just for getting a better handle on the meaning behind the current numbers and their relationships to the current registered boats-based measure, but also for figuring out what fine-tuning might need to be made to the next round of collections and calculations.



Continuing the exploration...

At the 91st meeting of the National Boating Safety Advisory Council in May 2014, Capt. Jonathan Burton, Director of Inspections and Compliance for the Coast Guard, announced a postponement in the administration of the next NRBS, which had been scheduled to get under way this year. The delay, due largely to funding uncertainties associated with the reauthorization of the Sport Fish

Restoration & Boating Trust Fund, does have some positive aspects, however. It should afford additional time for more of the interested parties to carefully examine the 2012 data, and ultimately, it should help chart the course of the next round of surveying.

ERAC will continue exploring the exposure hour estimates, including breakdowns of the state-level estimates

by main boat types, and evaluating other data, especially at the state-level, that didn't receive as much or any attention in the 2012 summary report. The committee welcomes additional input and insight from interested parties throughout this process, and readers can join in that discussion by e-mailing info@nasbla.org (subject line: ERAC) with your thoughts, comments, and suggestions for analysis. *

Deborah Gona serves as committee staff to ERAC. Committee Chair Tamara Terry is Recreational Boating Accident Program Manager, Ohio Department of Natural Resources' Division of Watercraft. Both wish to acknowledge the significant time, effort, and valued expertise that all of ERAC's team members have brought—and continue to bring—to the committee's charge to evaluate the NRBS methodology and findings. Special thanks is extended to Dr. Philippe Gwet, U.S. Coast Guard, for his invaluable assistance and responsiveness to the team's work, providing key data and resources for its use, as well as patient answers to the team's many questions; and to Dr. L. Daniel Maxim, U.S. Coast Guard Auxiliary, for his contributions to the team's discussions on statistical and measurement issues and preliminary evaluations of exposure hours data, and for his ongoing efforts toward improvements in recreational boating data quality.