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ALCOHOL AND PLEASURE BOAT OPERATORS

FINAL REPORT

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The work reported herein was accomplished for the U.S. Coast Guard's Office of Research and Development, Marine Safety Technolgy Division, as part of its program in Recreational Boating Safety.

The contents of this report reflect the views of Wyle Laboratories, Huntsville, Alabama, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policy of the Coast Guard. This report does not constitute a standard, specification or regulation.

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16. Abstract

This report presents an initial look at the involvement of alcohol in recreational boating. It attempts to identify a problem area. The report has three objectives: 1) to define drunkenness in small boating; 2) to describe a method of determining the degree of drunkenness of boat operators; and 3) to describe the degree of drunkenness of drowning and accident victims. In addition, there is some discussion of the effects of alcohol, especially in relation to defining levels of drunkenness. The cost and benefits tradeoffs for various methods of testing for the blood-alcohol level of a boater are discussed. Finally, available data on drowning and accident victims are analyzed and criticized, and conclusions are drawn.

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FINAL REPORT

ALCOHOL AND PLEASURE BOAT OPERATORS

By

C. Stiehl

June 1975

For

Work Performed Under Contract DOT-CG-40,672-A

Task Order 1

WYLE LABORATORIES

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ALCOHOL AND PLEASURE BOAT OPERATORS

1.0 INTRODUCTION AND SUMMARY

The subject of this report is alcohol involvement in recreational boating. Within the context of small craft, the report attempts to define drunkenness, to illustrate methods for measuring drunkenness, and to define the severity of alcohol as a contributory stressor to boating accidents. Thus, this task can be subdivided into three major areas of concern:

- Definition of drunkenness
- Method of determining degree of drunkenness
- Degree of drunkenness of drowning and accident victims.

Of these three subtasks, the first is probably the most difficult.

When is a boater drunk? This question is difficult to answer for many reasons. Besides the individual differences in reactions to alcohol, a boater may not behave as if he were drunk (no slurred speech or staggering) and yet he may suffer a significant decrement in his boating skills due to the ingestion of alcohol. Thus, the only evidence of the operator's drunkenness would be his BAC (blood alcohol concentration). At this point, a rough estimate of what levels could cause a significant decrement in boating performance can be made from the data available from automobile studies and others. However, further research is needed to better define these levels in boating, and how they influence vision, balancing, mental processing, and other aspects of boating performance.

Once the levels of alcohol that create problems are defined, then the problem becomes one of determining when an operator has attained one of these levels.

There are several devices available for measuring the degree of drunkenness of an operator.

These fall into four major categories:

- Blood-chemical (blood tests)
- Breath-chemical
- Breath-photoelectric, and
- Behavioral

The behavioral measurements (observing "drunk behaviors") are the least reliable and are not very sensitive to those levels of alcohol where the subject's ability to handle a vehicle is impaired, but he does not behave as a "drunk." The blood test has the obvious difficulty that it must be performed in a laboratory and blood must be drawn. These facts limit its usefulness. The photoelectric breath-testing device is large, heavy, and sensitive to environmental conditions such as vibration (from driving or boating) and shock. In addition, the photoelectric test requires some training, set-up, and time before making a test. The chemical breath testers are relatively inexpensive, easy to use, and require less training. However, they are not as accurate as the blood test or the photoelectric test, and their results have not been accepted in court, as the other two methods have.

Finally, finding good data on drowning and accident victims relative to alcohol is difficult. Not all victims are tested. Not all tests are done the same way by different coroners, and not all of the coroners are willing to share their data. Not all drowning victims can be tested, since ethanol is a product of decomposition and some victims are not recovered immediately.

Thus, the large number of untested victims and the inconsistency in reporting of the data make the available data of limited value. The coroners from several large cities were surveyed as to the BAC's of their drowing victims. From the data that are available, it is apparent that alcohol may be a significant problem in boating. Over 40%of the drowing victims in the cities surveyed were drunk, or, at least, had been drinking. These included women and people under 15 years old. The average BAC of boating-related drowings in Maryland was .077%which is near the "legal drunk" level.

To say the least, the data available are incomplete. To what do we compare them? How do we know the degree of drunkenness of the whole boating population? Until these questions are answered, not even complete data will allow a precise description of the alcohol problem in small craft drownings. Even then, it could be that the drunks cause the accidents without being the victims themselves.

It is recommended that some sort of survey be performed to determine what the boating population is relative to alcohol. This might be done by telephone, but it would be preferable if field measurements of BAC could be done on actual boaters, perhaps upon entering or leaving a marina. In addition, research is needed to define the type and size of decrements in boating performance due to various levels of alcohol, perhaps with an experimental apparatus such as VAST (see Appendix A for a brief explanation of the VAST apparatus).

The next section (Section 2.0) will deal with the issue of what constitutes a drunk operator in boating. Section 3.0 describes various means of measuring drunkenness, and Section 4.0 presents data concerning drowning victims and alcohol. This is followed by Section 5.0, "Conclusions and Recommendations," and the bibliography.

2.0 DEFINITION OF DRUNKENNESS

What is a "drunk boater" or, more precisely, when has a boater had too much to drink to allow him to safely operate a boat? Alcohol is a difficult stressor to evaluate. Each individual has his own ideas and experiences relating to alcohol and its effects. Many of these are myths or prejudices. How often have you seen or heard the story about using coffee to "sober him up?" Coffee merely keeps the fellow awake; it doesn't make him sober up any faster. Even when responsible and objective research is undertaken concerning alcohol, the effects are clouded in experimental design problems, subject problems, and contaminated data problems.

The image of a drunk is an individual who staggers, talks slowly and incoherently, has slurred speech, and has difficulty maintaining his balance. However, alcohol can have significant effects long before these behavioral signs are present. This point involves one of the major misunderstandings with alcohol. One Alabama State Trooper related that the problem drunk driver is the one who doesn't think he's drunk because the behavioral symptoms have not surfaced to any noticeable degree. He is wreckless and believes he has as much (or more) driving skill as when he is sober. On the other hand, the falling-down drunk knows he is drunk and tends to drive very cautiously to avoid calling attention to himself.

These are feelings and impressions of law enforcement officers who deal with the problem every day. Researchers have also expressed the sentiment that a little alcohol can be a dangerous thing.

These are numerous studies on alcohol and its effects. A few exemplary ones and their conclusions will be outlined in what follows.

Much of the early research dealt strictly with overall driving performance. Bjerver and Goldberg (1964) found that the drinking of three to four bottles of beer (to attain a blood alcohol level of .04 to .06 percent) caused up to a 30% deterioration in driving performance. They reported that, for their subjects, the threshold of impairment was around .035%, i.e., performance decrements reached significant proportions when the concentration of alcohol in the blood was around 35 mg. of alcohol per 100 cc of blood. They also found that the same amount of alcohol consumed in different forms (beer versus distilled spirits) leads to different blood alcohol concentrations, with distilled spirits leading to higher concentrations.

Numerous studies since then have confirmed this kind of result, stating that even a couple of drinks can cause a significant change in driving abilities, and a BAC (blood aocohol level) of .10% or greater multiplies the chances of having an accident by 2-1/2 times or more.

The bulk of the studies since 1950 have had procedural or experimental design problems. As an example, Barmack and Payne (1964) reported that over 64% of a sample of 138 airmen that were involved in vehicular accidents had been drinking prior to the accident. They cited this as evidence that alcohol was a problem in driving. However, what if 75% of all airmen drink before driving, this would mean that alcohol was helping to avoid accidents since less than 75% of the accident victims had been drinking. In other words, the experimental logic was faulty.

Although much has been assumed throughout the years about alcohol and its effects, many of the supposed effects have been hard to show. Moskowitz (1972), among others, has summarized the past 20 years of research as leading to a lot of "no effect" results. Research has shown that, in many cases, motor impairment, skill impairment, visual activity, and simple reaction time are either relatively unaffected by alcohol or show no correlation with automobile accidents. Three areas where effects appear to be well-pronounced are: 1) tests involving steadiness, orientation, and balance; 2) attention, memory, and information processing (complex reaction time); and 3) peripheral vision and visual field.

Research by Mortimer and Jorgenson (1971) and others has shown that man's peripheral vision and visual field are adversely affected by alcohol. The basic effect centers upon a reduction in the number of fixations the eye can make. A BAC of .10% results in a doubling in fixation times, meaning that whereas the eye can fixate four times a second normally, it can only fixate two times a second when the subject has a BAC of .10%. Thus, he cannot see as much because he cannot move his focal point as often as before. When this fact is combined with boating speed, the effect is to reduce the operator's chances of seeing objects in he water, and to increase the amount of time it would take him to see an object.

The primary area of interest is the central processing by which the human operator selects and integrates sensory inputs. A subject's ability to process information has been shown to correlate with accident rates (Fergenson, 1971). Alcohol has been shown to affect information processing rate, the quantity of information that can be processed, and one's ability to process information from several sources. This last point is important. Boating, like driving is a skill that requires input from several sources (memory, vision, audition, etc.). It is a divided attention task. It is on this type of task that alcohol can have large effects even with relatively low levels of alcohol being present. Oddly, subjects in this type of task do not notice the impairment of performance in the secondary task and may even feel they perform better under the influence of alcohol.

Finally, there is some evidence (Cohen, 1960 and others) that alcohol may lead to more risk-taking on the part of some individuals. Similarly, the research (including Mortimer and Jorgeson, 1971) that indicates a reduction in peripheral vision due to alcohol may account for some balancing problems.

This literature review is by no means all-inclusive, but it attempts to summarize the significant results from the mass of data accumulated about alcohol in the past two decades. The primary results with respect to boating appear to be: 1) reduction in visual field (peripheral vision); 2) possibly some increase in risk-taking; 3) reduction in balancing capabilities, and, finally, 4) decrements in information processing capabilities and performance on divided attention tasks. These effects, especially (4), can begin at BAC levels as low as .035 percent. So, in the sense of boating safety, there are grounds for taking the position that a "drunk" boater is one with a BAC as low as .035 percent.

What are the legal standards? In most states, the legal drunk is one with a BAC of .10 percent or higher. In many areas one can be charged with "driving while intoxicated" with a BAC of .05 percent to .10 percent <u>and</u> testimony from the arresting officer and/or witnesses as to the drunken state of the offender. Great Britain and Denmark have reduced their legal drunk levels to .08 percent due to arguments such as those above. Norway has long enforced a .05 percent limit. Some countries and states are considering going lower than this. Experts from across the country have expressed opinions that even very small amounts can cause problems. Dr. Hulbert of UCLA writes:

> "My experience indicates that even relatively small amounts of blood aocohol, such as .02, can markedly affect the ability of an operator who is essentially a non-drinker or a beginning drinker. These effects can be even more serious if the operator is also a novice operator and/or is operating in a territory to which he is a stranger, or operating under the effects of some other stress such as fatigue or a stressful situation."
>
> (Personal Communication)

Dr. Hulbert has described a situation that is not uncommon in boating, a couple of beers and a novel or stressful environment.

At this point, one might naturally ask how long it takes the body to reduce the BAC. Medical research indicates that alcohol is removed by the body at a relatively constant rate of .015 percent per hour. So, a drinker who was operating a boat at, say, .05 percent (about 3 beers in 3 hours for a 160 lb man) would need over 3 hours to get back down to 0 percent BAC again. One who was "legally drunk" (.10 percent BAC) would need seven hours without drinking to get back down to 0 percent BAC. The legal drunk limit of 10 percent BAC represents over two ounces of alcohol in the bloodstream of a 160 lb man.

The question of, "When is he <u>drunk</u>?", has now been discussed. It does seem that the .10 percent BAC criterion used in automobiles is very lenient to the operator. In boating, you have the additional problems of a hostile environment (water), balancing, exposure, inexperience (relative to the number of hours one typically spends in a car), and the lack of human factors concern in boating design. All of these things argue for the tolerable BAC in boating to be even lower than in cars. How low? Is the .02 percent level too strict? What about .035 percent where so many central processing effects become readily apparent? What about the few individuals where a BAC of .13 percent causes little apparent impairment? It appears that drunkenness depends upon several factors, some of which may be factors other than alcohol (age, etc.), but it does not take much alcohol to create a potentially dangerous situation.

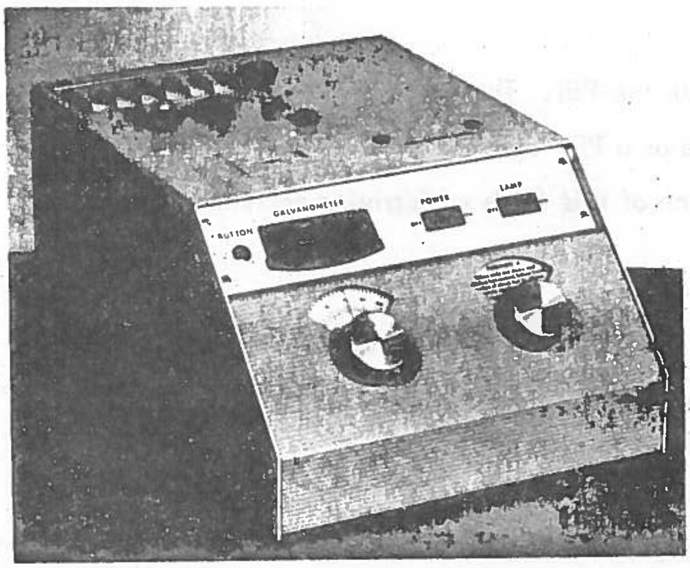
3.0 METHODS FOR DETERMINING DEGREE OF DRUNKENNESS

Basically, there are four means of determining an operator's blood alcohol concentration (BAC). These are: 1) blood-chemical tests; 2) breath-chemical tests; 3) breath-photoelectric tests, and 4) behavioral measures.

The blood-chemcial tests are performed on blood samples in a laboratory. The tests simply measure the volume of alcohol in the blood. These tests are very reliable and accurate, but they require a blood sample to be drawn from the operator and transported to the laboratory for test. Then, of course, the test requires the lab, test equipment, and technicians. All of this makes this kind of testing impractical for the purposes of measuring a boating operator's BAC. The chances of having a person available to draw the blood are remote to say the least.

The breath-chemical testers are typically very mobile and easy to use. However, they are not as accurate as blood tests or breath-photoelectric tests. There are several types of these devices, but most of them can be set up on a bench, or seat, or any small flat area. The apparatus is typically housed in a small case, smaller than a briefcase with extendable sampler which the subject blows into. The reading can be made within 30 seconds of taking the breath sample and accuracy is ±.01% BAC. The alcohol in the breath is chemically treated (oxidized), producing an electrical signal which is translated into BAC on a meter display on the device. Calibration is relatively easy. The device should be kept at a constant temperature while performing tests.

The breath-photoelectric devices are the most widely used by law enforcement agencies, because of their accuracy and the fact that they have been accepted in the courts. These devices are relatively large, heavy, and non-portable. They are sensitive to environmental conditions such as vibration, which may cause the machine to need calibration frequently.



THE PHOTO-ELECTRIC INTOXIMETER

Before leaving the discussion of testing devices, it might be useful to discuss the principles behind the tests. The photoelectric intoximeter (PEI) will be used as an example, but many of these principles apply to the breath-chemical testers as well.

The subject must be kept from smoking or drinking for at least twenty minutes before testing with the PEI. This is to allow the alcohol to clear from the mouth and throat before the test. The breath sample for the test should be deep breath air, or air from where the alcohol is exchanged through the lungs' membranes and the concentration is equalized across those membranes. Thus, the subject blows through the sampling apparatus until deep breath air is coming through (the unsampled breath fills a waste bag). About 2100 cc of deep breath air holds the equivalent alcohol concentration as 100 cc of blood. For all of these tests, .10 grams per 100 cc blood, or 100 mg% , is what is measured to get a BAC of .10%.

The breath sample is blown into a small ampul containing sulfuric acid and hydrochloride. The ampul changes color depending upon the concentration of alcohol in the breath; the lighter the color, the more alcohol is present. A photocell is placed behind the treated sample and the light transmittance characteristics of the ampul are measured to determine the alcohol concentration.

Some training is required to run and calibrate the PEI. The state of Alabama, for example, requires a 105 IQ to be trained and licensed as a PEI operator. Operators go through a refresher course every three months, but much of this deals with giving testimony about the alcohol tests.

The fourth and least reliable way of testing for BAC is to use behavioral measures. Law enforcement officers look for behavior patterns in the following areas:

- General muscular coordination,
- Skill (walking a straight line),
- Slurring of speech
- Blurry eyes, and
- Vehicle operating behaviors.

From the previous discussion of BAC levels and effects, this list of behaviors does not apply to many people whose bAC's may be high enough to affect their driving abilities; i.e., by the time these behaviors show up, the subject may have been "drunk" in an operating sense for a long time.

Some officers have become very proficient at spotting subtle behavioral changes that occur in the .07 percent to .10 percent BAC range. These officers have had extensive training and specialize in this sort of work. They must practice (in the sense of observing drunks) to maintain their high level of skill.

For research and investigative purposes, the portable chemical testers seem to be best suited for the Coast Guard's uses. They are portable, easy to use, and relatively insensitive to environmental factors. If the Coast Guard were ever to come to the point of enforcing a law concerning alcohol and boating, the use of a PEI may be warranted since its results are acceptable as evidence. An officer's testimony is acceptable also, but even with his testimony, it is best to have a reading from a PEI of at least .05% to back him up.

There are a few companies who make the testing equipment. These are listed below. The cost ranges from around $600 to $1500 depending upon the calibration equipment used and the particular device chosen.

ALCOHOL TESTING EQUIPMENT MANUFACTURERS

Alcohol Level Evaluation Road Tester (ALERT)
Alcohol Countermeasure Systems, Borg Warner
Borg Warner, Wolfe and Algonquin Roads
Des Plaines, Illionis 60018

Breath Alcohol Tester
Century Systems Corporation
Arkansas City, Kansas

Intoximeter, Incorporated
1901 Locust Street
St. Louis, Missouri 63103

Smith and Wesson Electronics Company
Eatontown, New Jersey 07724

4.0 ALCOHOL AND DROWNINGS DATA

A survey was made of several big city coroners and medical examiners to determine how many drowning victims are drunk and how drunk they are.

TABLE I. DROWNING VICTIMS AND BAC
DATA FROM CORONERS AND MEDICAL EXAMINERS

City	Year	No. of Drownings	No. Tested	Not Tested	BAC> 0.10%	BAC> 0.0%	BAC =0%
San Diego	1974	42	21	21	6	8	13
Boston	1974	15	15	0	2	5	10
Houston	1974	79	52	27	14	23	29 *
Baltimore	1973	19	13	6	2	5	8
Maryland(incl. Balt.)	1974	141	83	58	29	52	31
	1959	117	25	92	13Δ	?	?
	1958	130	30	100	16Δ	?	?
	1957	154	29	125	18Δ	?	6
	1956	140	26	114	9Δ	?	?
	1955	145	25	120	13Δ	?	?
San Francisco	1974	6	6	0	?	3	3
Miami	1974	98	64	34	29	?	?
Chicago	1974	154	154	0	?	61	93
Minneapolis	1964-74	185	?	?	47+	?	?

Δ means that these victims were above 0.15%, even more were probably above 0.10%

+ means that these victims were measured to be above 0.05%, it is not known how many were above 0.10%.

* means that these victims were below 0.02 percent.

PROBLEM: Not everyone is tested, due to age, decomposition, length of time in the water. For those tested, nearly 40% were legally drunk.

The data were obtained by mail, by phone, and in person from the coroners and medical examiners. Several of the cities gave complete and useful records of the drownings in their area, including the precise BAC record for each victim. Other cities did not give enough data to allow each category of the chart to be pulled out, but they did give some useful statistics. Still others were not willing or able to forward any numbers relative to the problem (these are not listed). On the whole, the coroners and medical examiners were responsive and helpful.

There are problems with these data, however. Not everyone was tested. In many cases this was due to decomposition or the fact that the body had been in the water too long to allow an accurate BAC measurement.

In other cases, because of age or another factor, the test simply wasn't run. Some coroners do not test drowning victims under age 15 for BAC, preferring to assume they could not have been drunk. In areas where tests were run on victims under 15, some of them were found to have alcohol in their system, so that the exclusion of these victims from testing by some examiners does not seem justified. In any case, basing conclusions on the percent of those tested who are drunk is risky since the true percentage of drunks may be different if everyone were, or could be, tested.

Not all areas look for the same levels of BAC. Some merely report the presence of alcohol; some report any BAC above .10 percent; some look for .15 percent. This makes comparisons of data difficult.

Thus, the available data are incomplete and often not comparable to each other. Aside from these factors, how do we know how many of these drowning victims were involved in boating incidents? What percentage of the boating population in general is drunk? It could be that the drunks merely cause the accidents, instead of being directly involved and winding up as drowning victims.

Table II depicts the data, as they stand now, concerning drunks and drownings from the cities where these categorizations could be done. Not all of the cities reported data that would allow this breakdown. There were 344 data points relative to the question of the presence of alcohol, and 383 data points where information was given as to whether the victim was legally drunk or not. Those cities which only reported "legal drunks" were not included in the BAC > .00% sample. The important point is that 40-50 percent of the drowning victims are either drunk, or, at least, have been drinking. It should be noted that in Houston, "negative" results include victims with BAC's of up to 0.02%.

TABLE II. ALCOHOL AND DROWNINGS

No. Tested for BAC >.00%	Percent With Some Alcohol
344	44.2+%
No. Tested for Alcohol Concentration > .10%	Percent With Alcohol > .10% (Legally Drunk)
383	39.4+%

Data were gathered from Maryland that allow further breakdowns for the 1974 drownings. In Maryland 75 of the 141 drownings of 1974 were definitely or possibly boating related. These 75 are broken down as shown in Table III.

TABLE III. 1974 MARYLAND BOATING DROWNINGS

# of Drownings	# Tested	# BAC> 0.10	#BAC >0.0	#BAC=0	# Not Tested
75	44	14	28	16	31

Average BAC of those tested = 0.077%.

These data can be broken down even further into age and sex differences, and precise BAC's as shown in Table IV.

TABLE IV. SEX AND ALCOHOL

Sex	# Drownings	# Tested	#BAC>0.10	#BAC>0.00	#BAC=0	Avg. BAC
Female	8	4	2	2	2	.085%
Male	67	40	12	26	14	.075%

The sex breakdown is not terribly significant because of the small sample of women. The two women who had measurable BAC's were both well above the 0.10% level for drunkenness.

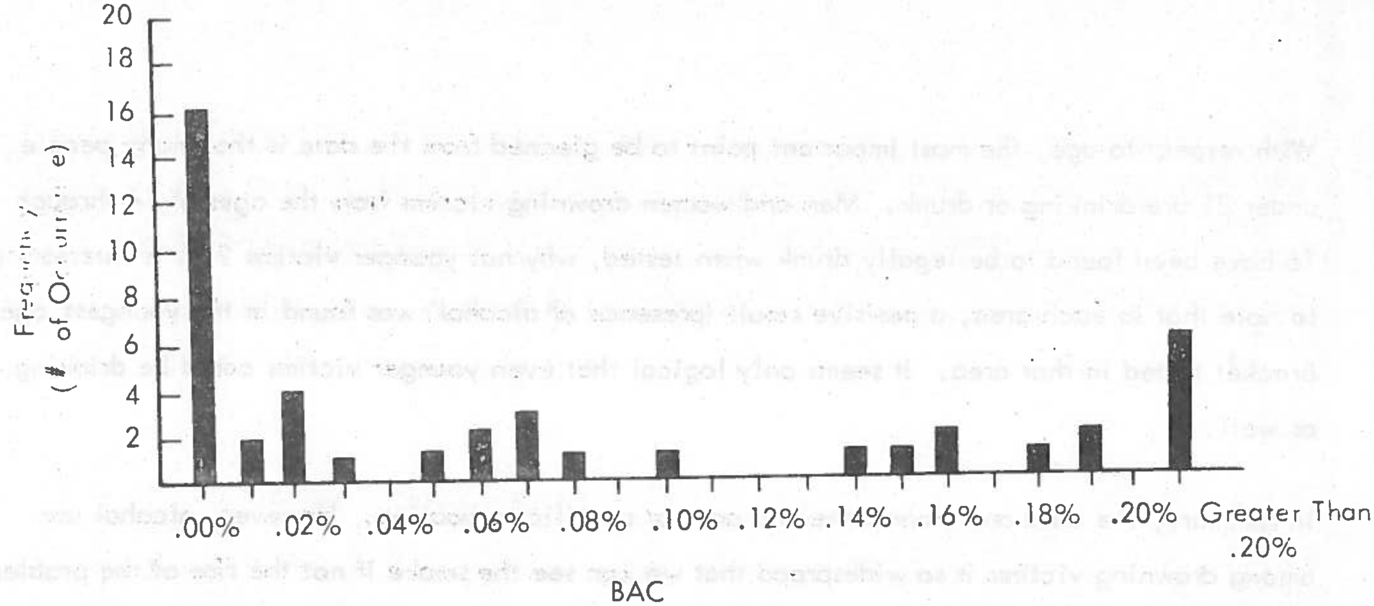


Figure 1. BAC Frequencies: Maryland Boating Related

Figure 1 above indicates the frequencies of various BAC's for boating related drownings in Maryland in 1974. One curious point is the lack of occurrences of BAC's in the .09% to .13% range. Figure 2 also illustrates this phenomenon. It is a similar frequency plot for all individual BAC's from drownings from the survey. It is not known how many of these are actually boating related. There are 121 sample points for this graph. It is interesting to note that the average BAC for data in Figure 1 (boating related) is very close to the average BAC in Figure 2 (all drowning victims): .077% versus .079%.

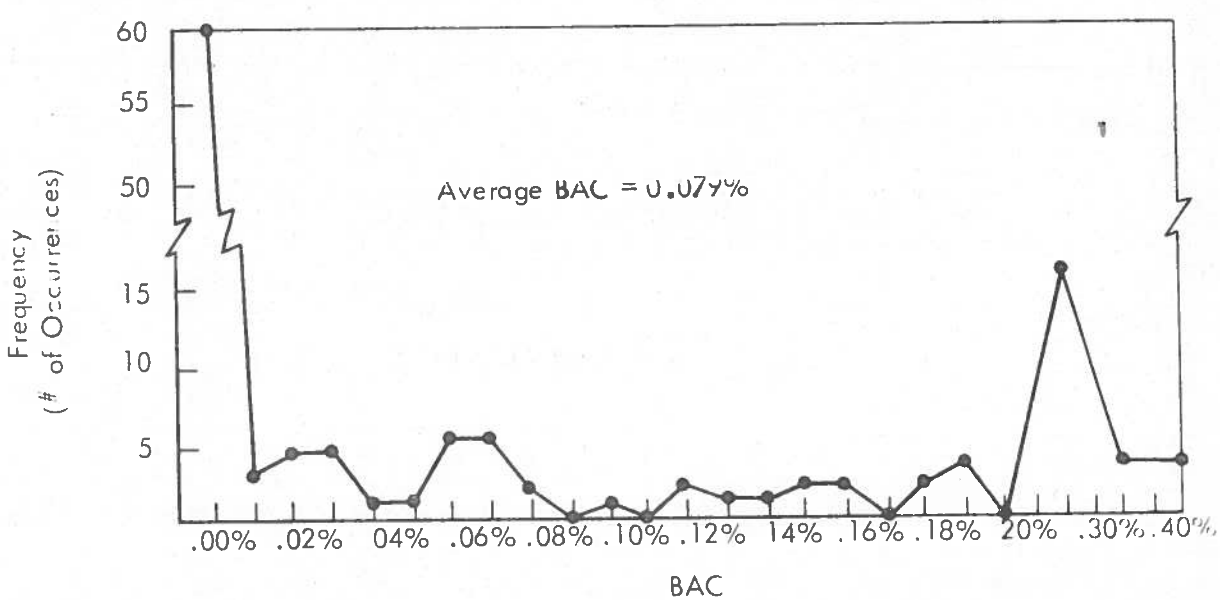


Figure 2. BAC Frequencies: All 1974 Drownings Surveyed

NOTE: These data include San Diego, Houston, St. Louis, Maryland.

With respect to age, the most important point to be gleaned from the data is that many people under 21 are drinking or drunk. Men and women drowning victims from the ages of 14 through 16 have been found to be legally drunk when tested, why not younger victims ? It is interesting to note that in each area, a positive result (presence of alcohol) was found in the youngest age bracket tested in that area. It seems only logical that even younger victims could be drinking as well.

In summary, the data are incomplete and are not specific to boating. However, alcohol use among drowning victims is so widespread that we can see the smoke if not the fire of the problem in boating.

5.0 CONCLUSIONS AND RECOMMENDATIONS

At present, we have no data to allow us to assess the magnitude of the alcohol problem in boating. The fact that the boating related drownings in Maryland in 1974 showed an average BAC of .077% and all drownings together showed an average BAC of .079% lends some credence to the argument that there is an alcohol problem. However, we do not know how many boaters drink, or how many are drunk. Thus, we can't even be sure that the drunk is the one who winds up on the coroner's report. It could be that there is a higher percentage of drunks among those who do not drown than those who do drown. There is no way to know at present.

In this regard, it would be useful to somehow survey "typical" boaters and determine their BAC's while operating a small craft. This could be done with a portable breath tester at marinas or on the water. Such a sampling would yield data about the boating population which could be compared to the drowning victim data.

It is natural to want to compare drowning or boating BAC data to automobile data. How many boaters are drunk as compared with drivers? This comparison is not easily made. While there is a wealth of data concerning automobile drivers and alcohol, most of its is suspect, misquoted, or misrepresented. Zylman (1974) in a recent article has outlined the numerous problems with automobile data. The biggest problem, as he sees it, is the widespread misquoting of the figures. In truth, the estimates on the number of fatal crashes in which one or more of the drivers had had some alcohol (not necessarily the driver at fault, and not necessarily drunk) range from 25% to 34%. Since there are often two or more drivers per crash, the number of drivers with BAC's over .00% who are involved in fatal crashes is probably in the neighborhood of 20%. In drownings we just saw that the number of victims who have had something to drink (or have had some barbiturates) is nearly 50%. Thus, using these figures, our problem may be more than twice as great as the problem in automobiles.

When is the operator drunk? The studies have shown that peripheral vision, balance, and information processing can be affected almost as soon as one starts drinking. By the time an operator's BAC reaches .035 percent, the impairments in relatively normal operations are significant. A BAC of .02 percent can be enough to cause significant effects in combination with novel or stressful situations. These levels are well below the "legal drunk" levels of 0.10% (or .05% plus an officer's testimony).

How can drunkenness be measured? Several devices are available. The chemical breath testers are the best suited for operation in the boating environment because they are portable, easy to use and maintain, fairly accurate, and give quick readings with minimal training required.

At this point, we need to know:

1) What does the boating population look like with respect to alcohol consumption? Or, is it possible that the drinkers cause accidents rather than being victims? This would be evidenced by more drinkers in the population than in the victims.

2) What BAC's might we find in collision victims and capsizing/swamping victims?

3) What levels of alcohol are enough to influence boating performance? This can be determined through programs such as the VAST test program (see Appendix A).

4) How does alcohol interact with other stressors in boating? Again, VAST will be useful here.

5) What countermeasures are available and feasible for the Coast Guard to use in combating the alcohol problem?

Important Facts to Remember About Alcohol

— A "legal" drunk in most areas is 0.10% BAC.

— Psychologists and others have found performance effects in the 0.02%-0.04% range.

— For an "average" 160 lb man, 6, 12 oz beers in three hours will get him up to 0.10% BAC

— The body gets rid of alcohol at a relatively constant rate of 0.015% per hour, so it would require about seven hours to go from 0.10% to 0% BAC.

5.0 CONCLUSIONS AND RECOMMENDATIONS

At present, we have no data to allow us to assess the magnitude of the alcohol problem in boating. The fact that the boating related drownings in Maryland in 1974 showed an average BAC of .077% and all drownings together showed an average BAC of .079% lends some credence to the argument that there is an alcohol problem. However, we do not know how many boaters drink, or how many are drunk. Thus, we can't even be sure that the drunk is the one who winds up on the coroner's report. It could be that there is a higher percentage of drunks among those who do not drown than those who do drown. There is no way to know at present.

In this regard, it would be useful to somehow survey "typical" boaters and determine their BAC's while operating a small craft. This could be done with a portable breath tester at marinas or on the water. Such a sampling would yield data about the boating population which could be compared to the drowning victim data.

It is natural to want to compare drowning or boating BAC data to automobile data. How many boaters are drunk as compared with drivers? This comparison is not easily made. While there is a wealth of data concerning automobile drivers and alcohol, most of its is suspect, misquoted, or misrepresented. Zylman (1974) in a recent article has outlined the numerous problems with automobile data. The biggest problem, as he sees it, is the widespread misquoting of the figures. In truth, the estimates on the number of fatal crashes in which one or more of the drivers had had some alcohol (not necessarily the driver at fault, and not necessarily drunk) range from 25% to 34%. Since there are often two or more drivers per crash, the number of drivers with BAC's over .00% who are involved in fatal crashes is probably in the neighborhood of 20%. In drownings we just saw that the number of victims who have had something to drink (or have had some barbiturates) is nearly 50%. Thus, using these figures, our problem may be more than twice as great as the problem in automobiles.

When is the operator drunk? The studies have shown that peripheral vision, balance, and information processing can be affected almost as soon as one starts drinking. By the time an operator's BAC reaches .035 percent, the impairments in relatively normal operations are significant. A BAC of .02 percent can be enough to cause significant effects in combination with novel or stressful situations. These levels are well below the "legal drunk" levels of 0.10% (or .05% plus an officer's testimony).

How can drunkenness be measured? Several devices are available. The chemical breath testers are the best suited for operation in the boating environment because they are portable, easy to use and maintain, fairly accurate, and give quick readings with minimal training required.

At this point, we need to know:

1) What does the boating population look like with respect to alcohol consumption? Or, is it possible that the drinkers cause accidents rather than being victims? This would be evidenced by more drinkers in the population than in the victims.

2) What BAC's might we find in collision victims and capsizing/swamping victims?

3) What levels of alcohol are enough to influence boating performance? This can be determined through programs such as the VAST test program (see Appendix A).

4) How does alcohol interact with other stressors in boating? Again, VAST will be useful here.

5) What countermeasures are available and feasible for the Coast Guard to use in combating the alcohol problem?

Important Facts to Remember About Alcohol

— A "legal" drunk in most areas is 0.10% BAC.

— Psychologists and others have found performance effects in the 0.02%-0.04% range.

— For an "average" 160 lb man, 6, 12 oz beers in three hours will get him up to 0.10% BAC

— The body gets rid of alcohol at a relatively constant rate of 0.015% per hour, so it would require about seven hours to go from 0.10% to 0% BAC.

6.0 BIBLIOGRAPHY

The bibliography that follows is a listing of those articles and monographs which made a significant contribution to this report. The literature on alcohol and its effects is extensive. More detailed bibliographies and reference lists can be found in the following sources:

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Dr. Jack K. Weaver, Director
Safety Education Program
Texas A&M University
College Station, Texas

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APPENDIX A
THE VAST PROGRAM

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The purpose of this appendix is to familiarize some of the readers with the VAST program. The Visual Alertness Stressor Test (VAST) is designed to enable the investigation of stressors in the boating environment and their effects on boating safety. The apparatus is a seventeen foot runabout with a light display, controls, minicomputer, and other devices mounted in the vicinity of the cockpit. Figure A-1 is a drawing of the VAST apparatus showing the semi-circular light display, subject, and experimenter.

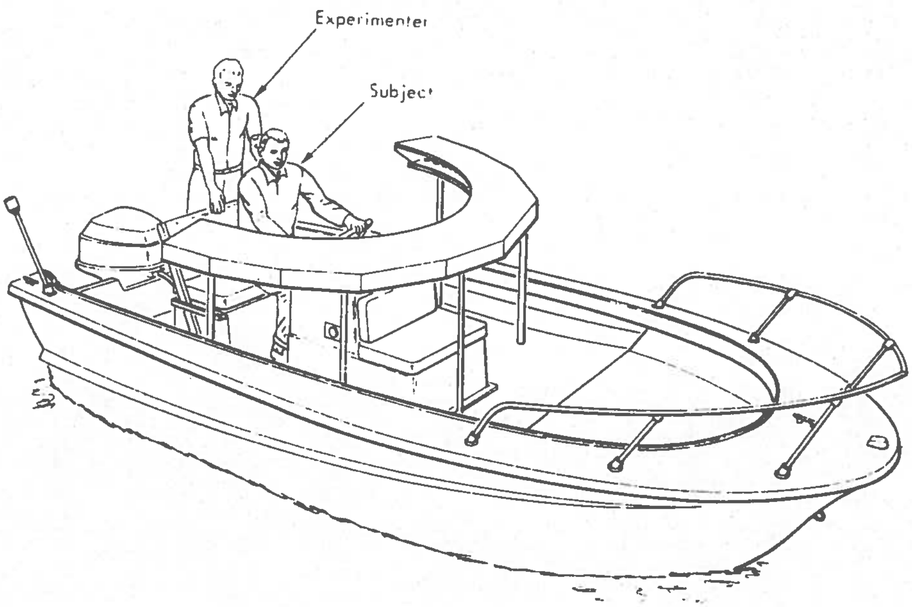

Figure A-1. Experimental Apparatus - Visual Alertness Stressor Test (VAST)

The subject's task is to respond to particular patterns of lights on the display by depressing a button on the throttle. At the same time, he must maintain a course dictated by the experimenter. The minicomputer is programmed to control the light displays and record responses. Devices are included which alert the subject to the fact that he is off course, signal the beginning and end of the experimental session, and indicate the appropriateness or inappropriateness of the subject's responses. Performance measures include reaction times and error rates on the light task, and error rates on the task of staying on course. Additional measures can be taken, such as g-loading on the operator, and correlated with the other indices.

The VAST apparatus is at the heart of a program to investigate stressor effects. It has been baptized in an experiment to determine the total effect of a combination of typical daytime stressors and will be used in further research into other areas, such as alcohol involvement in boating. The device is sensitive to performance degradations and can be adapted to many applications. It is the type of apparatus that can be very useful in the evaluation of the effects of alcohol, and other stressors.