PROCEDURES AND POLICIES GOVERNING SAFETY IN SCUBA SPORT DIVING: AN ANALYSIS OF ALTERNATIVES

A Professional Paper
By
DENNIS CHRISTOPHER REGAN

Submitted to The Graduate Faculty of The Department of Recreation And Parks Texas A & M University in partial fulfillment of the requirement for the degree of

MASTER OF AGRICULTURE

Major Subject: Natural Resources Development

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Approved as to style and content by

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John McGraw
(Member)

(Member)
ABSTRACT

This paper analyzes various safety procedures and policies associated with the sport of scuba diving. From this analysis, a comprehensive view of the various problems, advantages, and tradeoffs involved in the implementation of diving safety standards and practices can be obtained.

There is general agreement from all interest groups associated with the sport of scuba that some forms of regulation are needed to insure the safety of the participants. However, there is currently a great deal of controversy as to who should implement these standards and practices and how they should be implemented. Six alternative mechanisms for the implementation of diving safety standards and practices are presented in this paper. They are: 1) regulatory legislation, 2) self-regulation, 3) diving gear manufactures and marketing industry safety efforts, 4) joint safety efforts of the manufacturers and diving associations, 5) advisory board efforts for establishing safety guidelines, and 6) exclusion of diving activity.

These regulatory mechanisms are evaluated using several factors central to judging the effectiveness of the alternative actions. The factors are: efforts for reducing scuba fatalities, enforceability, monetary cost, the restriction on participant to engage in the sport, and diver feedback. Each alternative action is analyzed according to each factor. Following the analysis there is an overall analysis of how each alternative mechanism affects the sport of scuba.

From the analysis presented in this report, decision-makers will be able to extract information or foresee various factors, both positive and negative,
involved in implementation of diving safety standards. Decision-makers should be better able as a result of this report, to evaluate all relevant variables concerned with safety in the sport when determining the practicality of further regulations.
ACKNOWLEDGEMENTS

Sincere and grateful thanks are due to a multitude of individuals who supplied me with the necessary ingredients for the successful completion of this professional paper. Deepest gratitude goes to Dr. Robert B. Ditton, committee chairman, who painstakingly guided me through the various phases of this paper. Additional thanks are due to Mr. John L. Seymour and Dr. B. Dan Kamp, committee members, who provided me with a thorough review and most helpful comments. I would also like to thank the various people, in and out of the world of scuba, who supplied me with ideas and appropriate data.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>iii</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>v</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>vi</td>
</tr>
<tr>
<td>List of Tables</td>
<td>vii</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Review of Literature</td>
<td>11</td>
</tr>
<tr>
<td>Methods</td>
<td>19</td>
</tr>
<tr>
<td>Alternative Mechanisms for Assuring Diving Safety</td>
<td>20</td>
</tr>
<tr>
<td>Legislation</td>
<td>20</td>
</tr>
<tr>
<td>Self-Regulation</td>
<td>27</td>
</tr>
<tr>
<td>Diving Gear Manufacturers and Marketing Industry</td>
<td>34</td>
</tr>
<tr>
<td>Safety Efforts</td>
<td></td>
</tr>
<tr>
<td>Joint Efforts of the Manufacturers and Diving</td>
<td>38</td>
</tr>
<tr>
<td>Associations</td>
<td></td>
</tr>
<tr>
<td>Advisory Board Efforts</td>
<td>40</td>
</tr>
<tr>
<td>Exclusion of Diving Activity</td>
<td>43</td>
</tr>
<tr>
<td>Analysis of Factors Central to Effectiveness of</td>
<td>45</td>
</tr>
<tr>
<td>Mechanisms</td>
<td></td>
</tr>
<tr>
<td>Efforts for Reducing Fatalities</td>
<td>45</td>
</tr>
<tr>
<td>Enforceability</td>
<td>48</td>
</tr>
<tr>
<td>Monetary Cost</td>
<td>52</td>
</tr>
<tr>
<td>Restriction on Sport Participant</td>
<td>55</td>
</tr>
<tr>
<td>Diver Evaluation and Feedback</td>
<td>58</td>
</tr>
<tr>
<td>Conclusions</td>
<td>65</td>
</tr>
<tr>
<td>Implications</td>
<td>68</td>
</tr>
<tr>
<td>References</td>
<td>70</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Recreational Economic Value of the California Coastal Waters</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Projected Growth Comparison to 1980 of Selected Outdoor Activities</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>Fatality Rate of States Having Highest Percentage of Diving Activity</td>
<td>7</td>
</tr>
<tr>
<td>4.</td>
<td>Approximate Starting Causes of Diving Fatalities</td>
<td>8</td>
</tr>
<tr>
<td>5.</td>
<td>Chronological Order of Events Concerning the Los Angeles Scuba Ordinance</td>
<td>28</td>
</tr>
<tr>
<td>6.</td>
<td>Percentage of Fatality Increase</td>
<td>33</td>
</tr>
<tr>
<td>7.</td>
<td>Efforts for Reducing Scuba Fatalities</td>
<td>50</td>
</tr>
<tr>
<td>8.</td>
<td>Enforceability</td>
<td>53</td>
</tr>
<tr>
<td>9.</td>
<td>Monetary Cost</td>
<td>56</td>
</tr>
<tr>
<td>10.</td>
<td>Restriction on Sport Participant</td>
<td>59</td>
</tr>
<tr>
<td>11.</td>
<td>Diver Evaluation and Feedback</td>
<td>62</td>
</tr>
</tbody>
</table>
INTRODUCTION

Water related activities provide a major segment of our modern society's recreational enjoyment. Studies conducted by the United States Outdoor Recreation Resources Review Commission in 1962 revealed that 44 percent of those who engaged in outdoor recreation preferred water-based activities over all others (ORRRC, 1962). Recreation, in fact, has become a major economic force in coastal zone management (Ketchum, 1972). In 1968, an estimated 12 million people spent about 14 billion dollars seeking recreation in the coastal zone (Winslow and Bigler, 1969). California, for example, attributes substantial economic value to coastal recreational activities in its coastal zone as shown in Table 1. There is a substantial number of people who are, because of their close coastal proximity, prospective participants in these activities. Recent census data indicate that 54 percent of the population in the United States live within a 50 mile coastal strip of land (Ducsik, 1974:1). This distribution of population has been shifting toward the marine perimeter as employment opportunities have expanded with the growth of economic activity in coastal regions (Ducsik, 1974:3). The sport of scuba diving, while not as popular as activities such as swimming, boating, and fishing, is growing rapidly in popularity.

The citations in this paper follow the style of the Journal of Leisure Research.

1Scuba is an acronym for self contained underwater breathing apparatus.


<table>
<thead>
<tr>
<th>Recreational Users</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourist Expenditures</td>
<td>450,000,000</td>
</tr>
<tr>
<td>Boating Expenditures</td>
<td>316,000,000</td>
</tr>
<tr>
<td>Sport Fishing</td>
<td>107,000,000</td>
</tr>
<tr>
<td>Scuba Diving</td>
<td>10,000,000</td>
</tr>
<tr>
<td>Surfing</td>
<td>3,800,000</td>
</tr>
<tr>
<td>Boat Fares for Viewing Sea Life</td>
<td>313,000</td>
</tr>
<tr>
<td></td>
<td>887,113,000</td>
</tr>
</tbody>
</table>

(887,113,000 of 1,286,413,000 total economic value)

(Clarke, 1967)
The increase in popularity of this sport began with the development of more advanced equipment such as the Cousteau-Cagnan regulator in the 1940's. From this, a wide interest in skin and scuba diving developed in the United States (Advisory Board of Underwater Parks and Reserves, 1975:3). Training for the proper use of the equipment involved was then needed. The first formal training course in the United States took place at Scripps Institute of Oceanography in southern California in 1951-1952 (Advisory Board 1975:3). This training effort grew so that by 1965, four national organizations emerged with the current training standards and requirements that are in practice today (Advisory Board, 1975:3). These organizations are: The National Association of Underwater Instructors, NAUI; The National Association of Skin Diving Schools, NASDA; The Professional Association of Diving Instructors, PADI; and the Young Men's Christian Association, YMCA.

Training certification indicates that the sport of scuba is rapidly increasing in numbers of participants. While the organizations certified 1 million divers during 1950-1970, they certified approximately 1 million more from 1970-1974 (NOAA, 1975:1). In 1975, 213,254 new divers were certified. This rapid increase is expected to continue as shown by the projected growth comparisons chart of Table 2. With this increase in participation, there has been a corresponding increase in diver expenditures. The amount of money for equipment expenditures in 1973 was 65 million dollars, while in 1974 expenditures increased to 71 million dollars (Standard and Poor's Industry Survey, 1974). In a reader survey taken in 1975 by Skin Diver magazine, 44.5 million dollars were spent on diving trips alone in a 12 month period.
TABLE 2

PROJECTED GROWTH COMPARISONS TO 1980
OF SELECTED OUTDOOR ACTIVITIES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin and Scuba Diving</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occasions (Millions)</td>
<td>6</td>
<td>7.7</td>
<td>9.8</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>5.0%</td>
<td>5.0%</td>
<td>5.0%</td>
<td></td>
</tr>
<tr>
<td>Water Skiing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occasions (Millions)</td>
<td>33</td>
<td>44.0</td>
<td>59.0</td>
<td>79.0</td>
</tr>
<tr>
<td></td>
<td>6.1%</td>
<td>6.1%</td>
<td>6.1%</td>
<td></td>
</tr>
<tr>
<td>Boating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occasions (Millions)</td>
<td>130</td>
<td>157.0</td>
<td>189.0</td>
<td>228.0</td>
</tr>
<tr>
<td></td>
<td>3.8%</td>
<td>3.8%</td>
<td>3.8%</td>
<td></td>
</tr>
<tr>
<td>Swimming</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occasions (Millions)</td>
<td>257</td>
<td>308.0</td>
<td>359.0</td>
<td>443.0</td>
</tr>
<tr>
<td></td>
<td>3.5%</td>
<td>3.7%</td>
<td>3.7%</td>
<td></td>
</tr>
<tr>
<td>Surfing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occasions (Millions)</td>
<td>14</td>
<td>16.2</td>
<td>18.5</td>
<td>21.5</td>
</tr>
<tr>
<td></td>
<td>3.0%</td>
<td>3.0%</td>
<td>3.0%</td>
<td></td>
</tr>
</tbody>
</table>

*AAGR - Average Annual Growth Rate

(Bigler and Winslow, 1969)
If one assumes the estimated active sport's participants dive at least once per month over a year or at least twelve days per year\(^2\) and that each spends 25 dollars per day on direct diving expenses, the minimum expenditure would be 142.2 million dollars. Adding the cost of travel, lodging, and meals, expenditures on diving and related activities are probably well in excess of 186.7 million dollars (NOAA, 1975:47).

The growth in scuba diving has occurred despite known dangers directly related to the sport. Scuba diving is an extremely enjoyable stress-relieving sport which does have a degree of risk involved (Hardy, 1975a:1). Two of the major dangers of diving are air embolism, and nitrogen narcosis (Council for National Co-Operation in Aquatics, 1970:15 & 62). Air embolism is a condition resulting when unvented pressure due to gas expansion forces air from sacs (alveloae) in the lungs into blood vessels surrounding these sacs. These bubbles act as dams when lodged in small vessels. The resultant lack of blood causes tissue to die (Council for National Co-Operation in Aquatics, 1970:46). Nitrogen narcosis is the result of nitrogen in the air tank breathed under pressure at depths of one hundred feet or more. It has an intoxicating effect on the body similar to that of alcohol (Council for National Co-Operation in Aquatics, 1970:61). In this irrational, intoxicated state of mind, the diver could behave dangerously (Lee, 1968:48). Lee (1968), listed a number of physical conditions that could be dangerous to a diver.

\(^2\)About 25% of all scuba divers trained and certified actually practice the sport (NOAA, 1975:46).

Skin Diver readers reported diving on an average of 24.7 days.
Among these are entanglement in weeds, insufficient air supply, currents, temperature, waves, weather and marine life.

These dangers account for lives lost each year in the United States. Table 3 shows the fatality rates for California, Florida, New York, and Washington. These are the states with the highest percentage of diving activities (Calif. State Scuba Advisory Committee, 1975).

Researchers at the University of Rhode Island conducted statistical analysis of the causes of diving-related deaths occurring in 1970 (Table 4). Waves and weather were implicated in about one fourth of the accidents. Although almost half the diver cases on which data were available had inflatible life vests, only a few divers used them. There were recorded at least five malfunctions involving life vests. Of those divers who attempted to discard their belts and/or tanks, only slightly more than half succeeded (URI, 1970:1).

Five cases of heart attacks and eight cases of lung over pressure were identified. Embolism type accidents were suspected in some twenty additional cases where in-water symptoms indicated severe central nervous system difficulties. Most victims appeared to be healthy and in good physical condition (URI, 1970:1).

From analysis of the apparent causes of scuba fatalities, the URI study offered a number of suggestions: A) Scuba certification should not be given to persons who have not had ocean or open water training. B) Present transition from pool to open water appears to be too abrupt in most training situations. C) The buddy-system which is in wide
TABLE 3

FATALITY RATE OF STATES HAVING HIGHEST PERCENTAGE OF DIVING ACTIVITY

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>26</td>
<td>31</td>
<td>25</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Florida</td>
<td>22</td>
<td>13</td>
<td>26</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>New York</td>
<td>2</td>
<td>11</td>
<td>2</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Washington</td>
<td>10</td>
<td>3</td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

(California State Scuba Advisory Committee, 1975)
### TABLE 4

PROXIMATE STARTING CAUSES OF DIVING FATALITIES, 1970

<table>
<thead>
<tr>
<th>Apparent or Estimated Cause</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosed embolism:</td>
<td>8</td>
</tr>
<tr>
<td>Possible embolism, panic, or exhaustion:</td>
<td>20</td>
</tr>
<tr>
<td>Cramp and possible panic:</td>
<td>2</td>
</tr>
<tr>
<td>Nausea, vomiting:</td>
<td>3</td>
</tr>
<tr>
<td>Possible heart attack:</td>
<td>5</td>
</tr>
<tr>
<td>Possible pollution-related fever:</td>
<td>1</td>
</tr>
<tr>
<td>Head injury in rough water:</td>
<td>3</td>
</tr>
<tr>
<td>Tangled in external line:</td>
<td>4</td>
</tr>
<tr>
<td>No safety line, air gone in cave:</td>
<td>6</td>
</tr>
<tr>
<td>Out of air in cave:</td>
<td>2</td>
</tr>
<tr>
<td>Tangled or lost in kelp or weeds:</td>
<td>6</td>
</tr>
<tr>
<td>Diving in rough or dangerous water:</td>
<td>13</td>
</tr>
<tr>
<td>Sucked into drain or pump:</td>
<td>3</td>
</tr>
<tr>
<td>Lost in turbid water:</td>
<td>1</td>
</tr>
<tr>
<td>Caught in rocks:</td>
<td>1</td>
</tr>
<tr>
<td>Failed to pull reserve:</td>
<td>3</td>
</tr>
<tr>
<td>Possible bad air:</td>
<td>5</td>
</tr>
<tr>
<td>Overweighted:</td>
<td>1</td>
</tr>
<tr>
<td>Drunk and Overweighted:</td>
<td>1</td>
</tr>
<tr>
<td>Deep dive, apparent narcosis or confusion:</td>
<td>4</td>
</tr>
<tr>
<td>Run over by boat, no diver's flag:</td>
<td>1</td>
</tr>
<tr>
<td>Mask broken, face injured:</td>
<td>1</td>
</tr>
<tr>
<td>Possible deep dive equipment failure:</td>
<td>1</td>
</tr>
<tr>
<td>Neck strap jammed while trying to leave water</td>
<td>1</td>
</tr>
</tbody>
</table>

**TOTAL** 96

(URI, 1970)
use by divers may often not work effectively. Training in preventive accident management should be part of all scuba courses. D) Straps and attachments should be redesigned so that removal of equipment is made easier both for the person in trouble and for his buddy. E) Inflatable life vests are poorly designed and produced. Generally they are unsatisfactory and need improvement.

The analysis and suggestions offered by the University of Rhode Island study suggest that certain aspects of the sport could be adjusted. If this is so, the sport seems to be lacking specific safety standards and requirements that would protect the scuba diver. The purpose of such requirements would be to insure the safety of the diving participants. Perhaps, the number of scuba fatalities could be reduced.

Questions arise, however, as to what mechanism or mechanisms should be utilized for safety controls. There are a wide range of possibilities. Six alternative mechanisms are currently receiving attention. In this report, each of these alternatives will be analyzed as to its effects upon the sport. Where possible, examples of existing or proposed procedures or policies will be evaluated for their effectiveness at reducing scuba fatalities. The degree to which these safety procedures and policies are regulatory in nature varies. Some procedures exercise more actual control over the sport and its participants than do others. Yet all six possibilities offer restrictions or requirements for meeting certain safety standards. These procedures are, however, interrelated.

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3 A cardinal rule in the sport of scuba is never to dive alone. In the advent of an accident, the drivers 'buddy' is therefore available for assistance.
in their restrictions on the sport. The six mechanisms to be studied are: 1) regulation by legislation, 2) self-regulation by a diving association, 3) diving gear manufacturers and marketing industry safety efforts, 4) joint safety efforts of the manufacturers and diving association, 5) advisory board efforts for establishing safety guidelines, and 6) exclusion of diving activity.

These mechanisms were chosen to provide the reader with a perspective on the varied approaches to possible regulation. To help demonstrate this variance, certain factors will be analyzed for each mechanism. These factors are: efforts for reducing fatalities, enforceability, monetary cost, restriction on participant to engage in the sport, and diver feedback. This will help demonstrate the variance between the mechanisms. The specific factors were chosen to allow for analysis of important variables concerned with the reductions of scuba fatalities.
REVIEW OF LITERATURE

While there have been previous studies done in scuba safety, albeit limited, a literature search revealed no previous research that compared safety procedures and policies. The literature on the evolution of the sport of scuba is fairly extensive. There is general agreement concerning the sport's history and development.

The major controversy regarding the alternative mechanisms centers around the question of regulatory legislation resulting from the implementation of the Los Angeles County scuba ordinance (1974). As a result there is a wide variety of material available on the factors involved in safety regulations for the sport of scuba. However, it seems that much of the information varies by source and therefore appears to be biased. Consequently, this paper includes information taken from several perspectives. These perspectives are from the diving industry (diving associations, manufacturers, and retailers) who generally favor self-regulation, and from various concerned interest groups that desire more stringent regulatory procedures.

To plan properly for, and administer this developing sport of scuba, decision-makers should know more about the people who participate in the sport. Therefore, to help describe the typical characteristics of scuba participants, two sources will be used. One source is from a major scuba magazine (Skin Diver, 1975a) which conducted a nationwide survey of their readers in 1972. The other source is an unpublished survey report done on scuba
diving in Texas by Graham and Ditton (1974). Two populations were surveyed in the Graham and Ditton study. One population consisted of registrants at the Seaspace Conference in Houston, Texas held in October, 1974. The other study group was a random sample of certified Texas divers. The findings from these studies serve to develop a profile of the average diver.

The median years of age for a diver is 26.1 for the Skin Diver sample, 30 for the statewide (Texas) sample, and 28.5 for the Seaspace Conference sample. Males seem to be the dominant sex in the sport with 76% for the conference survey, and 84% for the statewide and 93.3% for the Skin Diver survey. Marital status was similar between the two studies. In the Skin Diver survey, 50.8% of the respondents were single, and in the Graham and Ditton survey, slightly less than one-half the selected divers from both samples were single. Level of educational attainment was similar also with 67.8% of the Skin Diver sample having attended college or better, while the figure was approximately 80% of the respondents in both samples of the Texas study. The median income of the household in which the diver lives was $19,455.00 for the Skin Diver sur-

---

4 Texas has one of the largest scuba sport diver populations in the country. California has the largest, Florida is a relatively distant second, and Texas is grouped third along with Hawaii, Massachusetts, New York, and Washington (NOAA, 1975).

5 The sample size of the Skin Diver survey was 2008 people, the Texas conference was 300, and the Texas statewide study was 212.

6 While the 'average' diver may in actuality not exist (Shafer, 1969) these baseline data are useful where no previous knowledge of divers exist.
vey. More than one-third of both Texas groups reported income levels of more than $15,000.

Statistics reflecting the degree of participation show that in the Skin Diver survey, 96.4% of the respondents had done either scuba diving or snorkeling during the past 12 months, that 88.9% had taken basic scuba diving and that 22.6% had taken advanced scuba diving courses. Both the Texas samples had an average of five years experience with the sport. The average total investment in skin diving equipment in the Skin Diver survey was $703.00. While in the Texas statewide sample, divers spent approximately $236 on acquisitions and $20 on repairs during the previous year, and the conference sample diver spent an average of $398 on acquisitions and $30 on repairs during the previous year.

Pertaining to where the Skin Diver survey participants dive, 81.3% took diving trips during the past year, 18.4% took out-of-state trips, and 39.3% took out-of-continental United States trips. The length of these trips averaged 7.3 days. The divers spent an average of $515.40 and traveled an average total of 2,155 miles for all dive trips during the past year.

Though these surveys are limited, one to the readers of a particular magazine, and the other to Texas residents, the information is generalizable to a degree for determining the amount of money spent, the general characteristics of a typical diver and their participation in the sport.

Another source of information on scuba diver characteristics is provided by a report from the National Oceanic and Atmosphere Administration (NOAA), March 1975. In this report, the rapid increase in recreational diving is demonstrated. This study also provides charts which estimate the United States
civil diving population in four diver categories: commercial, scientific/educational/institutional, nonmilitary governmental, and recreational. The geographical distribution of the civil diving population, the estimated annual expenditures for civil diving purpose, the training, and the estimated population and location of recreational divers by geographic area are also included.

Recreational participants should be aware of the degree of danger associated with the sport of scuba.

"Although divers are living and functioning in the aquasphere, they are still dependent on the atmosphere. Accordingly, they must make a number of psychological and physiological compromises in order to cope with it. For this reason, it is absolutely essential for a diver to understand the limits and demands that are imposed." (Lee, 1968).

There are a myriad of dangers that a diver could encounter. These range from disregarding a basic law of physics, to a physical danger relating to the marine environment. These dangers to the diver are explained in Owen Lee's book, (1968) and also by a book written by the Council for National Co-Operation in Aquatics, The New Science of Skin and Scuba Diving.

"At least 122 Americans died in diving accidents during 1970, 21 while skin diving and 101 while using compressed air in recirculated scuba" (URI, 1970). Researchers at the University of Rhode Island conducted a statistical analysis of scuba related fatalities in 1970. The resulting report describes a research project to determine the frequency and cause of scuba

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7To be included in this survey, an accidental death had to be proven to be related to diving activity, either of a sport or commercial nature. This accounts for the discrepancy between the total figures on Table 4 and the total number of fatalities.
fatalities. The University of Rhode Island study, pinpointed the major causes of death. This type of information would seem to be extremely important when deciding whether or not a safety regulation can be of preventative value (refer to Table 4). To implement an effective safety regulation, decision-makers involved with the sport of scuba should know the exact cause or causes of fatalities. Once the causes are known, it appears the various methods of prevention which have been established would have greater effectiveness. For example, it appears most fatalities occur from causes that could have been prevented with proper scuba education. The two most common categories of causes are 'embolism, panic, exhaustion', and 'diving in dangerous water'. Proper scuba education should give ample warning against these dangers to prevent fatalities. With knowledge of accident causes, decision-makers should then concentrate on the educational interface between student and instructor for possible improvements in scuba safety.

The six regulatory mechanisms analyzed in this report effect some degree of control over the sport. Since these mechanisms overlap in their regulatory control, much of the available data concerning these controls are interrelated.

A Los Angeles Times article (August 25, 1974) (Appendix C) was instrumental in causing the County of Los Angeles, California to implement a safety ordinance in their county. This article criticized the diving instructional organizations for their lack of standards. Examples of faulty instruction were cited, such as student overloading of classrooms. This article, was considered by the diving associations to be biased: "The Los Angeles Times article, on which this legislation was based was sensational,
one-sided, inaccurate, and a misleading irresponsible piece of journalism" (Hardy, 1975a).

For assistance in formulating the ordinance, the County government asked for statistical assistance from the Los Angeles County Underwater Safety Committee. This committee studied diving fatalities in the Los Angeles area. The study involved a number of agencies in the area for assistance in data collection, such as the Los Angeles County Department of Parks and Recreation, the Los Angeles County Sheriff, the United States Coast Guard, and a conglomerate of diverse diving interests. However, the involved diving community did not agree with the ordinance. Some of the recommendations made by divers were changed by the departments' administrators who overruled their recommendations on several points (Hardy 1975a: 3).

One area of contention was the legality of the ordinance. There was a question as to whether or not the government can interfere with an individual's right to act as he desires as long as the action does not injure or interfere with the rights of others. The diving industry contended that a scuba diver is not in a position to harm anyone else. Therefore an ordinance that restricts a diver's privileges, rights, and liberties was felt to be unconstitutional by some in the diving industry. This constitutionality issue of individual rights was examined with the aid of law reviews.

The diving associations responded to the ordinance by devoting their combined efforts, to public awareness of the facts, and advocating a repeal. They did this through communications with County agencies such as the Department of Parks and Recreation, the Board of Supervisors, and numerous newsletters and articles to
the diving community and the public. While these communications and publications contained many statements of advocacy, several presented facts; for instance, the actual percentage of fatalities in relation to the number of divers was decreasing even before the implementation of the ordinance. These articles also described the effects of the ordinance on the diving community, both positive and negative. These publications attempted to present the facts concerning the procedures and policies related to the safeness of the sport of diving. These facts ranged from the purity of the compressed air in the tanks to the ineffective instruction of classes. Most of these articles were written by Jon Hardy, the General Manager for NAUI. While most of these reports pertain to the sport of scuba in Los Angeles County, they can be viewed from a broader national perspective as well. The topics covered in the reports pertain mostly to considerations of self regulation, manufacturers safety controls and governmental interjection in the sport.

The California State Scuba Advisory Committee study on the safety aspects of the sport brought agreement with the same facts and figures that the diving industry disclosed in their fight at the local level.\(^8\) It also provided insights into the organizational structure, purposes, and objectives of an Advisory Committee. The committees' basic purpose was to serve the informational needs of a community regarding scuba activity.

The Los Angeles County Department of Parks and Recreation provided another alternative that

\(^8\) The resultant conclusion being that the ordinance was not necessary.
was a compromise between the diving industries desire for self regulation and the County-enacted ordinance. It proposed partial repeal of the ordinance. The Parks and Recreation Department recommended self-regulation with monitoring done by the local government. However they did favor retention of the standards for instructors as embodied in the ordinance.

An example of exclusion of scuba diving is derived from material from San Diego. This city has banned scuba diving activity from two areas of its harbor. These areas are off-limits for reasons of safety or national security. The safety aspect of excluding scuba use is due to a strong current combined with heavy vessel usage. The national security reason pertains to the presence of a United States Navy base.

Another source of information concerning safety standards is from the American National Standards Institute (ANSI). This organization identifies industrial and public needs for national consensus standards and coordinates their development, resolves national standards problems, and insures effective United States participation in international standardization (American National Standard Institute, 1976: 4). The ANSI has established existing standards for the manufacture of certain scuba equipment, and are proposing new standardizations on other equipment.
METHODS

This paper will examine various safety mechanisms. The objectives of this study are, 1) to provide a comprehensive view of the problems, advantages and trade-offs involved in regulating scuba, and 2) from this analysis, to assess possible effects of future regulatory procedures and policies. These objectives will be accomplished by use of content analysis of various secondary materials. The objective of content analysis is to reduce the flow of available material to produce classifications on quantities that are required (Babbie, 1975). By the use of this process, interrelationships between various forms of regulatory mechanisms can be compared.

The six regulatory mechanisms will be evaluated through the use of specific factors. These factors have been selected to allow for the truest possible measurement of the total effects of each safety mechanism. The factors are: efforts for reducing scuba fatalities, enforceability, monetary cost, restriction on participant to engage in the sport, and diver evaluation and feedback. The degree to which the factors apply to each mechanism will be analyzed. Following this description, a diagram will visually demonstrate the relationship between the mechanism and each factor studied.

Following these descriptions, the total rating of each of the mechanisms is analyzed to understand how the regulatory control method affects the sport of scuba.

Conclusions and possible implications of the data presented concerning mechanisms implemented upon the sport of scuba are also presented.
ALTERNATIVE MECHANISMS FOR ASSURING DIVING SAFETY

Regulation by Legislation

To illustrate regulatory procedures by legislation, the Los Angeles County Scuba Diving Ordinance (11,037) will be examined. This ordinance was the first comprehensive legislative regulatory procedure imposed on the sport of scuba (Rozenberg, 1975). Therefore, review of the history and subsequent development of this ordinance will provide the reader with a perspective on the effectiveness of this type of regulatory procedure.

At the time of this writing, there is a newly proposed Commercial Diving Standards regulation (Federal Register, 1976:48950). These standards were developed by the Occupational Safety and Health Administration (OSHA) of the Department of Labor, and the U. S. Coast Guard. These standards are in Part V of the Federal Register of November 5, 1976. These standards apply to all commercial diving and related operations conducted in connection with all types of work and employments (Federal Register, 1976). The standards only relate to scuba diving when the employed divers descend below decompression depths. Since safe sport scuba diving does not include decompression diving, these standards should not include or directly effect the sport of scuba. However, the exact implications on sport diving are not yet known.

There are other legislative regulatory procedures governing the sport of scuba. One example is Florida's law requiring scuba divers to display a red flag with a white diagonal stripe when diving (F.C.S.S. 861:065). Another example is the Department of Transportations requirements to have scuba tanks hydrostatically tested every five years. However these types of regulations only pertain to one section of the sport. They are also not as controversial since divers generally feel that these regulations are reasonable safety precautions.
The Los Angeles County Scuba Diving Ordinance was passed in 1974. A stimulus for this ordinance was the article that appeared in the Los Angeles Times (August 25, 1974). This article, discussed earlier, criticized the diving industry, particularly the diving instructional organizations, for their lack of standards on diving certifications. Statistics of diving accidents were presented. One such statistic was that more than forty Los Angeles county divers, most of them certified locally, had died in diving accidents in the previous two years (Los Angeles Times, 1974).

The article emphasized that the diving associations were fiercely competitive. Also that they were supposedly seeking quantity instead of quality in membership. An example of the lack of quality in membership was that a national diving association certified a dog and a seal through mail-order programs with a $50.00 application fee (Los Angeles Times, 1974).

A high school diving class also was exposed. In one particular school district, composed of eighty high schools, scuba class enrollment was as high as sixty students. Some people were not even receiving in-water training. Ten thousand people were certified in these classes. In response to these kinds of practices, five hundred warning letters from the Los Angeles community were written to the school district. As a result of this public pressure, nine instructors were suspended by their association (Los Angeles Times, 1974).

The article and related news stories and editorials were cause for a number of letters and other communication to be directed to the Governor and to members of
the Legislature (Advisory Board on Underwater Parks and Reserves, 1975:2).

In response to this action, the Los Angeles County Board of Supervisors, in 1974, held discussions on the subject and ultimately approved an extensive ordinance regulating the sport within the county (Advisory Board on Underwater Parks and Reserves, 1975). This ordinance established requirements for certification of scuba divers, recertification of scuba divers, certification of scuba diving instructors, and vessels operated for hire as a base of operations for scuba diving. It also included performance standards for scuba diving equipment (Appendix A).

The County Board of Supervisors asked the Los Angeles County Department of Parks and Recreation to draft the ordinance they eventually approved. There was no previous legislation on scuba safety regulation to review for format or from which to extract information. For assistance, the department solicited and received recommendations from the Los Angeles County Underwater Safety Committee: a group of diverse diving interests, law enforcement people, lifeguards, and other county agency officials (Tzimoulis, 1975:4). Thus the diving industry (composed of teaching organizations, manufacturers, dive shops, and charter boats) was involved in drafting provisions of the ordinance. However, this was done under protest, as the industry did not at the time agree that an ordinance was necessary. In fact, only a few individual diving instructors ever supported the move for county diving regulations (Tzimoulis, 1975). Regardless of diver disapproval, the ordinance was passed in thirty-seven days. Although the diving
community agreed with most of the elements of the ordinance because it conveyed safe diving practices, the diving community did not agree that an ordinance was appropriate. Some of the recommendations made by divers were changed by certain departmental administrators who overruled the Advisory group's recommendations on several points (Hardy 1975a:3).

The final version of the ordinance's goal was to promote safe diving practices, thus reducing the number of diving fatalities (Hardy, 1975a). However this goal would be enacted under the police powers of the county. While all interest groups involved were in agreement with the objective of this goal, there was strong disagreement as to the means. The diving industry felt that it could effectively regulate its own affairs, and that an ordinance was unnecessary (Hardy, 1975a:1) (see section on self-regulation). The question of whether or not the government can legally enforce such an ordinance also was questioned by the diving industry.

In order for the exercise of the police power to be valid, due process requires that there be a just, fair, and reasonable connection between it and the promotion of safety, public health, public morals, and the welfare of society (Murcko, 1968:422). The sections of the ordinance relating to the methods of operation for instruction and equipment standards are directly related to the safety and welfare of the sports' participants. Thus it would seem that these sections are constitutional.

However, the section of the ordinance restricting diver participation may be argued as being unconstitutional. The point in question being that a person is entitled a certain 'zone of privacy' in which that
individual has a right to act as he desires so long as the action does not injure or interfere with the rights of others. This 'zone of privacy' is derived from the third, fifth, ninth and fourteenth amendments to the constitution\(^{10}\) (Jacobs, 1971).

However, an argument against this view is that diving is an activity that should be participated in by more than just one person. For safety precautions, divers are taught never to dive alone. They should always dive with a buddy, thus other divers are in the vicinity in the event of an accident. However, one diver may become injured by the mistake of another diver. It would then seem that a safety ordinance restricting a divers' action would also be for protection to other divers as well. Thus this law could be constitutional.

Another argument for the constitutionality of a safety ordinance is that the government has the power to protect members of the public from becoming injured and possibly becoming public charges. Thus, the burden on the taxing public and society as a whole is reduced (Jacobs, 1971:534). However, since the question of constitutionality of a scuba safety ordinance has not been brought to court, a

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\(^{10}\)These amendments are: conditions for quarters for soldiers; provisions concerning prosecution. Trial and punishment—private property not to be taken for public use without compensation; rule of construction of constitution. The enumeration in the Constitution, of certain rights, shall not be construed to deny or disparage others retained by the people; and citizenship rights not to be abridged, respectively.
definitive determination is not known.\(^{11}\) As it stands now, the ordinance is constitutional since court procedure is that a law is constitutional unless it is proven otherwise.

The actual effectiveness of enforcing the ordinance is also open to question. Enforcement of the ordinance was to be the responsibility of the Los Angeles County lifeguards and Sheriff's Department, and was to be monitored by the County Department of Parks and Recreation. However, Seymour Greben, Director of the Los Angeles County Department of Parks and Recreation stated in a letter to the Board of Supervisors (August 14, 1975), that the Sheriff's Depart-

\(^{11}\) Court rulings of a similar nature to the scuba safety ordinance are concerned with the mandatory wearing of a helmet for riding a motorcycle. In the case of the motorcycle law, court rulings have gone both ways. As described in Jacob's law review article (1971), some courts rule that it is constitutional, while others say that it is not.

An Illinois court held the helmet requirements unconstitutional because the legislature, in attempting to protect the motorcyclist, went beyond the scope of the police power (People v Fries 42, Ill. 1965). The court said in effect, that legislation to protect the individual from himself was an invalid exercise of the police power (Jacobs, 1971:534).

Those favoring motorcycle helmet requirements argue that such regulation helps to protect members of the public by keeping individuals from being injured and possibly becoming public charges. Thus, the burden on the taxpayer public and society as a whole is reduced (Jacobs, 1971:534).

A New York City court held that the prevention of injuries and the avoidance of making one so injured a burden on society was reason enough to uphold the statue (People v Newhouse 55 misc. N.Y.L. mun., 1968).
ment did not have the available manpower or boats to properly enforce the ordinance. Thus the ordinance's enforcement and hence effectiveness would be severely limited.

Because of public pressure from the diving industry concerning repeal of the ordinance, the County Board of Supervisors requested the Department of Parks and Recreation to study the feasibility of repealing the safety law (Tzimoulis, 1975:4). This study was strongly influenced by a subsequent statewide study conducted by the State Advisory Board on Underwater Parks and Reserves (Advisory Board, 1975).

Following the implementation of the Los Angeles Ordinance, the State of California prepared a regulatory bill for the sport. However, its authors and other legislators who expressed interest in sponsoring a scuba bill suspended their efforts pending evaluation of a report written by the State Advisory Board on Underwater Parks and Reserves of California (Advisory Board, 1975:1). This advisory board was under the direction of the State Park and Recreation Department. The director of the California Department of Consumer Affairs requested the Advisory Board to undertake an investigation of the need for statewide legislation governing the sport of scuba diving (Advisory Board, 1975:1).

The Advisory Board felt that the present concern at the state level for regulating scuba originated with the Los Angeles Ordinance (Advisory Board, 1975:1). For information to their study, they reviewed the events that occurred in Los Angeles County, and conducted three public hearings. These meetings were held in San Diego, San Francisco, and Los Angeles. The hearings were designed to bring the diving community, members of the legislature, city and county officials, and all interested parties together to express their views (Advisory Board, 1975:7). After
compiling and analyzing the data received from these meetings, the Board recommended that safety in diving remain primarily a matter of self-policing by divers and the diving industry (Advisory Board, 1975:16). From this report, the State of California decided against implementation of a safety ordinance (Hardy, c:4). Further, Los Angeles County repealed its ordinance in its entirety. (Refer to table 5 for chronological order of events concerning this ordinance)

Self-Regulation

The advent of a government regulatory ordinance alarmed many scuba diving participants because they felt they could safely regulate their own sport without government interference. Therefore, the four diving associations pooled their resources and became a cohesive advocacy group for self-regulation.

Thus the ordinance was the impetus for the diving industry to re-evaluate their safety standards. However, while seeking to improve these standards, the diving industry also fought to remove the government legislation. They did this through the compilation of pertinent data relative to the ensuant effects of the Los Angeles Ordinance.

The diving industry opposed the Los Angeles ordinance from its emergence as a bill. When it became law, they banded together and fought for its repeal (Hardy, b:1). Both the procedure for preparing the ordinance (lack of consultation of experts and public hearings) and its provisions were severely criticized, with litigation over constitutionality, economic hardship, and loss of insurance coverage cited as direct results (Advisory Board, 1975:2). Thus, the ordinance negatively affected the operation of the diving industry. The diving industry had a
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 9, 1974</td>
<td>Los Angeles Times newspaper article criticizing the scuba industries safety requirements.</td>
</tr>
<tr>
<td>November 21, 1974</td>
<td>Los Angeles Scuba Ordinance passed by the Board of Supervisors.</td>
</tr>
<tr>
<td>November 26, 1974</td>
<td>The Director of the California Department of Consumer Affairs requested the State Advisory Board on Underwater Parks and Reserves to undertake an investigation of the need for statewide legislation governing the sport.</td>
</tr>
<tr>
<td>January 16, 1975</td>
<td>Assembly Bill 515 introduced in California Legislature</td>
</tr>
<tr>
<td>February 10, 21, March 4, 1975</td>
<td>Public hearings in San Diego, San Francisco and in Los Angeles respectively, to determine public reaction to statewide scuba regulations.</td>
</tr>
<tr>
<td>April 10, 1975</td>
<td>California State Scuba Advisory Board recommends that safety in diving remain primarily a matter of self-policing by divers and diving industry.</td>
</tr>
<tr>
<td>August 14, 1975</td>
<td>Letter by Seymour Greben, director of Department of Parks and Recreation in Los Angeles County requesting partial repeal of Ordinance.</td>
</tr>
<tr>
<td>August 20, 1975</td>
<td>Letter by Jon Hardy to Board of Supervisors of Los Angeles County requesting repeal of Ordinance.</td>
</tr>
<tr>
<td>October 1975</td>
<td>Ordinance repealed.</td>
</tr>
</tbody>
</table>
difficult time following the passage of the regulation (Hardy, b:3). There was a financial decline throughout the Los Angeles County diving industry, less students were being trained, less overall participation of scuba activity in Los Angeles County, and associated insurance and legal actions (Hardy, b:2). Several different variables, however could have accounted for this decline: negative newspaper publicity, the Los Angeles Ordinance, the general economic recession, and non-cooperation within the industry (Hardy, b:3). However, with the advent of the ordinance, the amount of scuba activity was reduced from the amount of activity occurring before the law was put into effect (Hardy, b).

In Los Angeles County diving was down 35% compared with a 20% decline nationally (Bernier, 1975:1).\textsuperscript{12} While a cause-effect relationship is not certain it is possible.

Jon Hardy, general manager of NAUI, compiled a report in which he listed the negative effects of the ordinance. The following is a brief summary of those effects:

1) A financial decline throughout the industry including manufacturing, retailing, dive boats, instructors and instructors associations (Industry spokesmen estimated that more than $1,000,000.00 was lost in the Los Angeles area) \textit{(Skin Diver, 1975)}.

2) Less students were trained, a 20 percent decline from the previous year. Less new instructors were trained.

3) With less participation in the sport, diving

\textsuperscript{12}The national decline was believed to have been associated with the current recession.
services and equipment increased in cost. This has led to bankruptcy for a number of diving retailers and dive boats in the Los Angeles area.

4) Many people stopped diving in the county of Los Angeles due to ordinance and ensuing administrative confusion.

5) There was a great loss of public confidence in the sport of scuba.

6) The Los Angeles County Parks and Recreation Department was hurt by the lack of attendance at its underwater unit.

7) There were damaging insurance and legal actions. Every aspect of the diving community either had their insurance company refuse to renew their policies, or had significant increases in premiums. There were also more claims outstanding, involving legal action against the sport.

However, the Los Angeles ordinance did produce significant beneficial effects for the diving associations, not only in Los Angeles County, but throughout the country. One of the most important was the new cooperation developed within the diving community (Hardy, b:5). The four national certification agencies (NAUI, NASDS, PADI, and YMCA) took positive steps toward formulating a more unified system of quality control in training. A product of this cooperation was the origination of the National Scuba Training Council (NSTC) (Skin Diver, 1975:6). The objectives of this council are: to share information about the quality of disciplined instructors, to re-
vise existing diver training standards, to formulate a common set of instructor standards and instructor ethics, to strengthen instructor renewal requirements, and to increase emphasis on open water training (Hardy, b:5).

The ordinance also helped to accelerate funding and expanded efforts in the area of diving accident investigation (Tzimoulis, 1975b). Accident reports were reviewed to find causes or contributing factors to the accidents (Hardy b:5). With these reports, data on fatalities can be better analyzed as to the cause (see Appendix B). The effectiveness of a safety procedure or policy could be greatly enhanced if the actual causes of death are known.

Following the implementation of the ordinance, there was an increase in the number of articles on safe diving published in the various diving periodicals (Hardy, b:5). Six new textbooks on safe diving also were written (Hardy, b:5). In addition, new teaching systems were incorporated, complete with audio-visual materials and workbooks for programmed instruction. These systems help standardize the theory of diving, and help assure that the instructor does not leave out vital information (Hardy, b:5).

With this unification of effort, the diving associations were able to compile pertinent data with which to rebut the ordinance. It was felt that if the ordinance was not repealed, the negative effects would continue and be mutually reinforcing (Hardy, b:6). Therefore with the aid of research studies such as that of the University of Rhode Island, the industry compiled statistics which demonstrated the actual number of scuba-related fatalities. In a four year period from 1970 through 1973, the number of divers trained per year doubled. At the same time, there was an increase of only 5 percent in the number
of diving fatalities. From 1970 through 1974 approximately 1 million divers were trained by the national certifying agencies. These, in addition to an approximately equal number of persons trained between 1950 and 1970 make up the total diver population exposed to possible diving accidents (Hardy, a:1). The statistics in Table 6 were developed using the records of the four national certifying agencies (NASDS, NAUI, PADI, YMCA), and the University of Rhode Island reports (Hardy, d:1). These statistics demonstrate the actual degree of safeness, or danger, of the sport.

Several specific areas of concern regarding the safety of the sport, challenged by pro-ordinance groups, were defended by the diving industry. One concern was that divers may have accidents due to unsafe operation of a dive boat or lack of rescue equipment and personnel (Ordinance, 1974). The industry found that for the 15 charter dive boats operating from ports in Los Angeles County from 1970 through 1974, there were 20 scuba deaths. In this same period there were approximately 450,000 scuba dives from these 15 dive boats. This is a fatality rate of 0.00005 per exposure (Hardy, d:2). This figure demonstrates the relatively low rate of fatalities associated with dive boats. Dive boats already are controlled by several different government agencies from the United States Coast Guard to the Federal Communications Commission (Hardy, b:10). The boat operators already have an incentive to maintain safe diving practices. With the threat of legal action and the need for insurance, boat operators will strive for safety in their operations (Hardy, b:10).

There was also a major concern that underwater instructors do not adequately prepare students to be
<table>
<thead>
<tr>
<th>Year</th>
<th>Total Divers Certified by National Agencies</th>
<th>Total Scuba Divers</th>
<th>Possible Divers</th>
<th>Fatality Rate/Diver</th>
<th>Percentage Increase</th>
<th>Nationally</th>
<th>Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>115,125</td>
<td>1,116,125</td>
<td></td>
<td></td>
<td>0.000010</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>152,639</td>
<td>1,268,764</td>
<td></td>
<td></td>
<td>0.000009</td>
<td>114</td>
<td>2%</td>
</tr>
<tr>
<td>1972</td>
<td>186,313</td>
<td>1,455,077</td>
<td></td>
<td></td>
<td>0.000008</td>
<td>118</td>
<td>5%</td>
</tr>
<tr>
<td>1973</td>
<td>230,851</td>
<td>1,685,928</td>
<td></td>
<td></td>
<td>0.000007</td>
<td>118</td>
<td>5%</td>
</tr>
<tr>
<td>1974</td>
<td>235,600</td>
<td>1,921,528</td>
<td></td>
<td></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>921,528</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

1. This figure is the amount of divers certified that year plus the total amount of existing divers.
safe and effective divers. This was a result of many instruction-related variables: not being adequately trained, being unethical in their conduct, not meeting standards, not staying current in the field, and using unsafe practices during training (Hardy, b:16). These problems have become the concern and focus of the newly formed coordination groups such as the NSTC which deals specifically with such matters (Hardy, b:16).

The pro-ordinance interest group also believed that accidents occurred because divers do not follow safe diving practices and that they do not use good judgement, particularly in emergencies (Hardy, b:11). The University of Rhode Island study (1970) (Table 4) shows that a large percentage of the deaths started with one of the following: "diving in rough or dangerous water," "deep dive, apparent narcosis or confusion," or "out of air." Each of these categories represents hazards that every certification organization educates their students to avoid (Shamlian, 1975:3). The students are informed of such hazards. In the water it is up to the individual student to apply what was taught in class. This application of knowledge or lack thereof, is a determining factor for the possibility of accidents occurring. This is demonstrated by the fact that most diving accidents are caused by diver error, not by training, equipment, air or dive boats (Hardy, a:1) (refer to Table 4).

Diving Gear Manufacturers and Marketing Industry Safety Efforts

The Los Angeles ordinance also placed restrictions on diving gear manufacturers and the marketing
industry when doing business in Los Angeles County. The people involved in this aspect of scuba diving, to the contrary felt that they could regulate their own business. Therefore, they refuted the necessity of the law's restrictions. One such restriction was on the quality of compressed air. Their position in this regard seems to be sound since the URI scuba fatality reports show that no one died as a result of bad air in the last five years (the last reported case was in 1954 from a private compressor) (Shamlian, 1975:3). Further, there are already a number of safe standards concerning breathing air promulgated by organizations like the American National Standards Institutes (ANSI), Compressed Gas Institute, and the U. S. Navy (Hardy, b:9).

The ordinance also placed restrictions on scuba diving equipment (Ordinance, 1974), even though the 1972 University of Rhode Island report stated that there was no verification of a fatality caused by regulator failure due to manufacturing (Shamlian, 1975:2).

14A person shall not sell, rent, or furnish for use scuba diving equipment unless it complies with the performance standards of Article X of the Ordinance (sec. 108).

Compressed Air Furnished for Scuba Diving. (a) A person shall not furnish compressed air for use in scuba diving that does not comply with the air purity standards set forth in Article VIII of the Ordinance, (b) A person shall not furnish compressed air to the public for use in scuba diving to any individual nor possessing current certification as a scuba diver and/or instructor, or to any individual not a student in a recognized scuba certification and/or recertification program (sec. 106). (For complete ordinance, refer to Appendix A).
1975). The equipment presently being manufactured does not appear to be a cause for fatalities. Further, the need for insurance and the threat of legal action causes manufacturers and retailers to insure that the equipment is as safe as possible. Thus it would seem that the implementation of an ordinance that restricts equipment manufacturing is not necessary.

The compressed air capacity in scuba tanks is standardized for the manufacturers under Department of Transportation regulations (Hardy, b:9). Also, under these regulations, scuba tanks are to be hydrostatically tested\textsuperscript{15} every five years. The tanks are stamped with the year of the test. Dive shops are required by law to refuse to refill any tank with air that does not have the proper updated stamp on the tank (Coast Guard Auxiliary Pamphlet, C-5).

Further protection is offered by the use of stickers that are placed on tanks. This visual safety inspection is done by the dive shops yearly to help insure that the tank is in good condition. Dive shops could refuse to refill tanks without this sticker. However, this inspection is only voluntary for the dive shops.

The individual diving gear manufacturers also have their own company standards for the manufacture of equipment. However, due to inter-company competition, these specific requirements are unable to be included in this report (Cerniway, 1976).

\textsuperscript{15}The strength of the steel cylinder weakens with time and use because of corrosion and oxidation. This oxidation process is difficult to see since it is concealed inside the tank (Lee, 1968:20).
The manufacturers have formed an association referred to as the Diving Equipment Manufacturers Association (DEMA). This association which is composed of some 23 manufacturers has been in existence for years. However, it recently has restructured itself into a full-time agency (Hall, 1975). DEMA is a nonprofit corporation to which member manufacturers belong for the purpose of promoting the sport of diving, participating in census reports, and to battle restrictive legislation (Hall, 1976:88). The restructuring of the organization as a dealer/manufacturer interface was in response to the economic slowdown caused by the recent recession and the needs of the modern dive retailer (Hall, 1976).

DEMA works closely with the American National Standards Institute's committee Z86 in setting standards for scuba equipment (Hall, 1977). After DEMA proposes a standard design, it sends this standard to the manufacturers for feedback. When a workable safety standard is reached, DEMA forwards this standard to ANSI for possible acceptance as a national standard. ANSI so respects the judgement of DEMA that these standards usually are incorporated into ANSI regulations (Hall, 1977). Jim Hall, the General Manager for DEMA, feels that this technique of improving scuba safety standards will help improve the quality of foreign equipment, since insurance companies are refusing to cover scuba companies that do not follow the recommended ANSI safety standards.

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16 ANSI and committee Z86 are discussed further in the section of this paper referred to as 'Joint Efforts of the Manufacturers and Diving Associations.'
Joint Efforts of the Manufacturers and Diving Associations

In addition to organizing the diving industry, the Los Angeles ordinance also helped to bring together all of the interest groups concerned with the sport of scuba. This resulted in the formation of the National Scuba Advisory Committee (NSAC) (Icorn, 1975). The NSAC is composed of the Underwater Society of America (USA), the Diving Equipment Manufacturers Association (DEMA), and the National Scuba Training Council (NSTC). This committee is considered to be representative of the entire diving industry.

Another important organization in the scuba community is the Council for National Cooperation in Aquatics (CNCA). In 1968, the CNCA which represents the major non-profit aquatic organizations in the United States,\(^{17}\) was designated as the secretariat of the American National Standards Institute's Committee Z86. The Institute (ANSI) is a private organization that identifies industrial and public needs for national consensus standards and coordinates their development, resolves national standards problems, and ensues effective United States participation in international standardization (DiGiovani, 1976). The purpose of Committee Z86 is to develop national scuba safety standards (Icorn, 1975:37). It is composed of the four national training organizations, the United

\(^{17}\) These organizations are the American National Red Cross, Amateur Athletic Union (AAU), American Assn. for Health, Physical Education, and Recreation (AAHPER), National Safety Council, National Surf Lifesaving Assn., National YMCA, Boy Scouts of America, and the four national scuba training organizations.
States Coast Guard, and various experts in underwater safety in the United States. Under their direction, several national standards were developed for diving instruction in 1972 (Icorn, 1975:37). These standards have since been reviewed and revised by the National Scuba Training Council (NSTC) and the CNCA (Hardy, a:1). To date the Z86 committee has three scuba standards in operation: Z86.1-1972, Commodity Specification for Air; Z86.1-1973, Underwater Accident Report Form (appendix B); and Z86.3-1973, Minimum Course Content for Safe Scuba Diving Instructions. A standard on skin and scuba diving hand signals has been submitted to ANSI for approval; as of yet it has not been finalized. Z86 also has two standards projects underway, but with no draft available to date. These projects are concerned with certification of scuba sport diver instructors, and safe equipment standards for scuba sport divers. Two more standards are presently in the process of being drafted or revised, but have not yet been submitted to ANSI. These regulations deal with scuba sport dive boat carrier standards, and the scuba sport divers flag (DiGiovanni, 1976).

ANSI has a Committee for Safety in Professional and Commercial Diving Operations, the Z135 committee. Their scope is to establish standards for safety in professional and commercial diving operations and equipment including but not limited to personal medical requirements, qualifications and training, techniques, procedures, practices, performance requirements, inspection, testing, and maintenance of equipment. These standards are presently in the process of being drafted or revised, and have not yet been submitted to ANSI (DiGiovanni, 1976). Even
though committee 2135 deals specifically with commercial diving, the standards and requirements set for equipment and operation could impact on sport diving. Anyone operating outside of the recommended American National Standard assumes the legal liability for not following recognized safe practices (Icorn, 1975:37). In addition, all training requirements, instruction control, and organization responsibility is subject to direct supervision of the NSTA and the CMCA. These organizations, along with the influencing factors of business competition, and increasing insurance cost, will help insure enforcement of safety standards through self-regulation.

The diving industry has been strengthened with the formation of state Scuba Advisory Committees nationwide (California State Scuba Advisory Committee (CSSAC), 1975:1). California has formed such a committee. These committees serve the informational needs of any scuba-related agency or organization (CSSAC, 1975). The growth of these committees will help serve as useful tools for the diving industry to receive information as to their effectiveness at scuba safety. The scuba community realizes fatal accidents will occur, but that there is no way to eliminate human error (Hardy, b:19).

Advisory Board Efforts

Another approach was suggested by the Los Angeles Department of Recreation and Parks. They recommended self-regulation with monitoring done by the government (in this case, the Los Angeles County Board of Supervisors). Their report, in effect, was a suggested partial repeal of the Los
Angeles ordinance. They did retain the standards for instructors (Greben, 1975:16). Los Angeles County already has an underwater safety committee operating to aid in the implementation of this procedure.

In July 1961, the Los Angeles County Board of Supervisors specifically instructed the Director of the Department of Parks and Recreation to establish a committee composed of invited representatives of specialized groups, agencies and commercial businesses involved in skin and scuba diving to meet at his call for the following purposes:

a. To develop public information programs emphasizing the necessity for training and certification.

b. To review skin and scuba diving deaths and accidents and to make remedial recommendations with respect thereto to the Director of Parks and Recreation and through him, when appropriate, to the Board of Supervisors.

The committee was officially designated as the Los Angeles County Underwater Safety Committee and its first members were selected by the Recreation Department's Underwater Unit.

The Committee's volunteer membership represents all segments of the diving and diving-related community . . . a multidisciplinary group reflecting varied viewpoints and reactions during statistical presentations and case studies. Membership includes potential representation of such fields as:
- Medical science and diving research
- Coroner pathology and medico-legal investigation
- Manufacturers of diving equipment
- Dive shops retailing equipment and selling air
- Diving charter boats
- Diving instructional programs
- Legal aspects and liability
- Law enforcement and investigation
- Safety engineering and regulation
- Lifeguard and emergency services
- Diving publications and public media
- Diving clubs and organizations
- Offshore rescue coordination centers
- Safety committee administrative management

(Los Angeles County Underwater Safety Committee)

With the close cooperation of the Office of the Chief Medical Examiner-Coroner and the several emergency service agencies involved, a standard procedure was adopted for diving accident follow-up investigations (Los Angeles County Underwater Safety Committee).

The Los Angeles County Department of Parks and Recreation Underwater Unit was designated as the central office for reporting all skin and scuba diving deaths and accidents. This office was to maintain complete files of all such cases and make them available for analysis at periodic Underwater Safety Committee meetings (Los Angeles County Underwater Safety Committee).

The State of California also has an established State Advisory Board on Underwater Parks and Reserves. The Board was established in July, 1968 under the aegis of the Department of Parks and Recreation and has been a functioning body ever since (Sirskind, 1975:12). Its membership covers a broad spectrum of interest, use and expertise in the field of under-
water parks. Members are appointed by the Director of the Department of Parks and Recreation (Sirskind, 1975:12).

Exclusion of Diving Activity

The exclusion of scuba activity also is a means for reducing scuba related fatalities. However, this method, due to its severity, probably will have limited use. San Diego, California with two harbors that exclude diving, provides an example of this technique. San Diego Bay excludes diving activity for reasons of safety and national security. Roger Chung, superintendent of the aquatic division of the city’s Park and Recreation Department, feels that scuba safety efforts must recognize tidal ebbs and floods. The body of water is relatively narrow and deep, thus a great flow exists. This along with heavy vessel usage creates a dangerous situation for the prospective diver (Chung, 1976).

Security is founded upon the fact that the United States Navy has a major naval base and air facility in the harbor. Its nuclear fleet, anti-submarine school, undersea laboratories, and warfare schools are based in the harbor. Security dictates that unauthorized activities be kept clear of these facilities.

While diving is permitted only in certain areas of Mission Bay by permit, diving is strictly forbidden in other areas under the jurisdiction of Mission Bay Park for safety reasons. While the park is designed as an aquatic recreational area, it has very high vessel usage. Such activity, along with strong currents under its three bridges, creates a very dangerous situation for the diver (Chung, 1976).
Now that the six mechanisms have been reviewed, they will be analyzed in the following section.
ANALYSIS OF FACTORS CENTRAL TO EFFECTIVENESS OF MECHANISMS

Tables 7 through 11 will assist in the analysis of the tradeoffs involved with the various regulatory mechanisms. Each table will address a specific factor relative to scuba safety regulation. These factors will be: efforts at reducing scuba fatalities, enforceability, monetary cost, restriction on participant to engage in the sport, and diver evaluation and feedback. Specific data of a mechanism in relation to the factor in question will be listed. An explanation and discussion of the variables listed will precede each table. In this manner, we will be able to compare regulatory mechanisms on their relative merits for reducing scuba fatalities. This analysis technique will help develop a perspective concerning the various tradeoffs involved with each scuba safety regulations.

Efforts for Reducing Fatalities

From the examples cited earlier, it appears that there is a great deal of diversity among the various mechanisms. Some procedures are revealed to be more effective as a means of control over the sport than others.

Legislation. It appears that regulation by legislative action is limiting to personal freedom, and it may be damaging to the sports' popularity and to the industry's economy. As Hardy (1974) and the University of Rhode Island study (1970) demonstrated, the majority of diving fatalities seem to be caused by diver error, not by equipment failure. Therefore the actual effectiveness of the "legislative solution" seems to be negligible. Diving error,
however, could be directly related to inadequate diver preparation for the dangers involved in the sport. Divers may not have been trained properly. However, this problem may be remedied by upgraded instructional procedures and the standardization of teaching methods. The Los Angeles ordinance was effective though in that it caused the diving associations to re-evaluate their instructional procedures, which resulted in the improvement of their safety precautions.

Self-Regulation. From the previous discussion, it would seem that the improvement of the instructional procedures would increase the effectiveness of the diving organizations for preventing fatalities. These organizations are supervised by the National Scuba Training Council (NSTC). The NSTC governs the minimum instructional requirements. Thus, the degree of education and training of new divers is the responsibility of NSTC. This knowledge and familiarity of the sport will be directly related to the effectiveness of the instructional organizations at reducing scuba fatalities. Since the major cause of diver fatality is related to diver error, these educational practices would seem to be an effective means of minimizing fatalities.

Diving Gear Manufacturers and Marketing Industry Safety Efforts. Manufacturers and scuba equipment marketing firms employ several means relative to the reduction of fatalities. The federal policy concerning the five-year stamped inspection of the tank is a direct factor in the guaranteed safe maintenance of equipment. This policy helps decrease the possibility of death due to faulty equipment. The yearly visual inspection, while not mandatory,
is an added precaution to insure equipment safety. Deliberate efforts to avoid compliance may succeed, however, the American National Standards Institute aids in promoting equipment safety by setting specific manufacturing standards. These standards are recognized as the recommended standards to follow. Any corporation operating outside these standards assumes the legal liability of not following recognizes safe practices.

The individual manufacturing firms also establish specific standards for their own equipment produced. Due to insurance liability, all equipment manufactured has certain minimum safety standards of performance that must be met (Hardy, b). These safety standards help to insure that the equipment used by divers will guarantee a certain degree of performance. This performance level is set to assure safe usage.

Joint Efforts of the Manufacturers and Diving Associations. Joint representation of the diving organization and the manufacturer and marketing industry combine their positive attributes regarding safe diving. This combination of instructional procedures, ANSI standards, manufacturers requirements, and requirement of tank inspection, aid in increasing the positive safety factors related to safe diving practices.18

18 U.S. Divers, which is a major scuba equipment manufacturing firm, guarantees product reliability for the lifetime of the original owner against defects in material and workmanship under normal use, proper care and reasonable and necessary maintenance. U.S. Divers dealers are required to replace or repair damaged equipment.
Advisory Board Efforts. An advisory board comprised of government officials and scuba enthusiasts utilizes all the variables of joint representation in addition to the possible expertise of the committee members in specialized fields. By bringing a multi-disciplined group of people together, increased informational exchange concerning scuba-related fatalities will help to be maximized. This exchange could help in creating more realistic solutions to specific problems concerning scuba activities. This, in turn, could aid in reducing fatalities. However, this process could create a bureaucracy which may be detrimental to the sport of scuba in that decisions could be made based on political motivations.

Exclusion of Diving Activity. Exclusion of scuba activity, if enforced, would eliminate any possibilities of a fatality in a particular restricted area. Fatality reduction, however, is not always the primary rational as demonstrated for excluding activity from specific areas.

Enforceability

Enforceability varies with the type and degree of control that is implemented. Enforcement can come either from within the diving industry or from government intervention. Government legislation could impose regulations on various segments of the sport. These could include mandatory flags for divers in the water, to complete coverage such as the Los Angeles County ordinance. However, for legislation to be effective, there needs to be an appropriate means of enforcement. If there is none,
<table>
<thead>
<tr>
<th><strong>TABLE 7</strong></th>
</tr>
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</table>

**EFFORTS FOR REDUCING SCUBA FATALITIES**

| Legislation | Standardized Requirements for Certification as a Scuba Diver  
Standardized Requirements for Recertification as a Scuba Diver  
Standardized Requirements for Certification as Instructor of Scuba Diving  
Standardized Periodic Recertification Requirements as Instructor of Scuba Diving  
Standardized Air specifications |
| --- |
| Self | Upgraded instructional procedures, standardization  
Supervision of NSTC |
| Manufacturers and Marketing Industry | Five year stamped inspection -- hydrostatic test  
Visual inspection  
ANSI guidelines  
Manufacturers requirement -- business competition and insurance cost, liability  
DEMA |
| Joint Representation | Five-year stamped inspection  
Visual inspection  
ANSI guidelines  
Manufacturers requirements -- business competition and insurance cost  
DEMA  
Standardization of teaching  
Supervision of NSTC |
| Advisory | All variables of Joint regulation  
Possible expertise in specialized fields of members in committee  
Possible increased information system |
| Exclusion | Absence of diving activity will eliminate fatality possibilities |
the legislation could be meaningless.

The diving industry has an interrelated range of enforcement procedures. With this range they are able to maintain relatively close control over enforcement on the sport. This is due largely on their relationship to the sport both in their desire to create a safe diving atmosphere for the sport and in their position to dictate diving actions and equipment standards. These actions and standards are imposed by the diving associations, and by the manufacturers and marketing industry.

**Legislation.** Legislation, to be enforced properly, needs the use of manpower and equipment to insure its effectiveness. If sufficient manpower and equipment are not available, this regulatory procedure would be extremely difficult to enforce. However, even if they were available, the law might still be difficult to enforce. As an example, the seatbelt legislation has shown that it is difficult, if not impossible, to legislate personal safety.

**Self-Regulation.** Self-regulation of scuba will be enforced by the National Scuba Training Council, which has the responsibility of constantly evaluating scuba instruction practices to insure optimum quality. This organization, which is comprised of the instructional organizations, has direct control on the degree of instruction that each diver receives. Thus the NSTC has a direct effect upon enforceability of scuba instruction. From review of diver fatalities, a majority of deaths are related to diver error. Improved diver education can provide the diver with the necessary familiarity of the sport so as to decrease the chance of fatality.
Diving Gear Manufacturers and Marketing Industry Safety Efforts. The manufacturers and marketing industry, has enforcement over the sport in terms of the five year tank test, the direction of the dive shops for visual tank inspection, the safety standards established by the ANSI, and the manufacturers production quality standards.

The enforceability of the five year tank test depends upon the cooperation of the dive shops. The shops are required by law to refuse to refill a tank if the proper stamp is not imprinted on that tank. However, due to the large number of dive shops, this procedure is difficult for officials to enforce. Therefore, enforcement is left largely up to the dive shop owners as to whether or not they grant a refill of air. Visual inspection also is left up to the discretion of the shop owner.

Due to insurance liability and business competition, the safety standards set by the ANSI and the individual manufacturing firms, are likely to be enforced by the manufacturers. This would help insure the safety of the equipment. Although there are regulations governing the use of equipment, the enforceability ultimately is left up to personal discretion.

Joint Efforts of the Manufacturers and Diving Associations. Joint representation has the same degree of enforceability as the manufacturers and marketing industry does, plus the enforcement of the NSTC on scuba instruction.

This effort deals with more aspects of diving, not just production, marketing, and services. This helps to create a more thorough system of safety control through an alternative of methods with a single focus; that being scuba safety.
Advisory Board Efforts. The advisory board efforts has the same degree of enforceability over the sport of scuba as does the joint effort. This method of safety implementation utilizes production, marketing services, and instruction as the forms of enforceability. No new forms of enforcement are associated with this method.

Exclusion of Diving Activity. The exclusion procedure makes enforceability relatively simple because there are no degrees of compliance involved. Personnel and boating equipment are needed to properly enforce this law.

Monetary Cost

There is a significant difference between the monetary cost involved in each regulatory procedure. The major difference is in who pays for the procedure. The cost associated with the diving industry procedures and policies are internalized. That is, the only people who pay for the sport's regulatory controls are the people actively involved with the sport. The cost associated with government control is paid by general taxes. With this method, people who are not associated with the sport provide revenue for regulatory procedures.

Legislative. The cost involved in implementing the legislative procedure would be for the financing of manpower and boating equipment. This money could come from public tax revenues. The degree of cost for the personnel and equipment will be directly related to the degree of effectiveness that is desired to be obtained. The more effectiveness desired, the greater the amount of personnel and equipment needed.
### Table 8

**Enforceability**

<table>
<thead>
<tr>
<th>Legislation</th>
<th>Use of police power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self</strong></td>
<td>National Scuba Training Council</td>
</tr>
</tbody>
</table>
| Manufacturers and Marketing Industry | Federal law of tank inspection  
Discretion of dive shop on visual inspection  
ANSI  
Manufacturers production |
| Joint Representation  | Federal law of tank inspection  
Discretion of dive shop on visual inspection  
ANSI  
Manufacturers production  
Coordination of all agencies governing scuba |
| Advisory               | All variables of Joint Representation |
| Exclusion             | No degrees of compliance  
Use of Police Power |
Self-Regulation. Self regulation entails the cost of the course for students and any educational equipment needed, such as informational publications. This cost is placed directly on the scuba diver. Thus, the allocation of funds for maintenance of safety through better training would come from diving participants. This cost is internalized into the sport. People not involved with scuba would therefore not have to pay as they would if the funds were allocated from the general taxes.

Diving Gear Manufacturers and Marketing Industry Safety Efforts. These efforts transfer the increased costs that are tied to improvement of safety and quality to the consumers of the equipment. Thus, the degree of additional safety promoted would be directly related to the price of diving equipment. Therefore, there is a trade-off between safety restrictions and cost of equipment. This cost of safety regulations is passed on only to scuba participants and not to the general public.

However, there is also a trade-off involved with the cost of safety and business competition. This trade-off is between the expense of insuring safe equipment and the less expensive equipment associated with a lesser degree of safeness. Therefore, the degree of monetary cost can vary.

Joint Efforts of the Manufacturers and Diving Associations. Joint representation includes the cost of the course and educational equipment, plus the cost to the consumers of the scuba equipment. With both techniques, safety is further enhanced and the cost is imposed only on diving participants.

Advisory Board Efforts. The advisory board procedure discussed earlier is a non-profit organization
composed of volunteers who expend their own time to help make scuba diving a safer sport. Therefore, there is no extra cost to divers or the public.

Exclusion of Diving Activity. The cost of enforcement could be minimized through multiple-use harbor management. This could be accomplished through the use of the harbor police to help enforce scuba regulations. This procedure would make best use of the existing harbor conditions.

Restriction on Sport Participant

The degree of restriction on the sport's participants also shows a diversity among the various procedures and policies under study. For example, action such as the Los Angeles Country Ordinance could be very restrictive to the diving community since every major phase of the sport was affected by this law. The highest degree of restriction, however, would be from the exclusion of the activity altogether.

The methods of regulation implemented by the diving community do not appear to be severly restrictive. Once a diver completes the course and buys the equipment, there are few instances where they are further restricted.

Legislation. The legislative procedure could place restrictions on any and every phase of the sport. The degree of restriction on the sport would be determined by the type of legislation desired (refer to Appendix A, Article 11).

Self-Regulation. Self-regulation imposes restrictions on course and instruction requirements. Since the certification agencies have formed the
TABLE 9

MONETARY COST

<table>
<thead>
<tr>
<th>Legislation</th>
<th>Payment for manpower and boats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost of course and educational equipment</td>
</tr>
<tr>
<td>Self</td>
<td>Cost of course and educational equipment</td>
</tr>
<tr>
<td>Manufacturers and Marketing Industry</td>
<td>Cost passed to consumer by manufacturer</td>
</tr>
<tr>
<td>Joint Representation</td>
<td>Cost of course and educational equipment</td>
</tr>
<tr>
<td></td>
<td>Cost to consumer</td>
</tr>
<tr>
<td>Advisory</td>
<td>All variables of Joint Representation</td>
</tr>
<tr>
<td>Exclusion</td>
<td>Multiple use enforcement</td>
</tr>
</tbody>
</table>
NSTC, the course requirements are the same for all the certification agencies. To become certified, students must follow specified instructional guidelines. These course guidelines pose the only restriction on divers. Self-regulation also includes the restriction that the individual diver imposes upon their own activities. Thus it appears that there is not a great deal of restriction, as we commonly think of restriction, imposed by self-regulation.

Diving Gear Manufacturers and Marketing Industry Safety Efforts. This form of regulation restricts divers both directly and indirectly. Indirect restriction results from the regulatory standards set by ANSI, Compressed Gas Institute, and the United States Navy. This restriction is imposed on the composition of compressed air. Another form of indirect restriction is the safety standards set on scuba equipment. These requirements are placed on the equipment from standards set by ANSI and the individual manufacturing firms. Direct restriction is placed on the divers equipment and supplies, which in turn places indirect restrictions on the diver in that the diver must pay for and use the equipment which was manufactured according to specific safety standards.

Direct restriction on the diver occurs from the federal law pertaining to the five year hydrostatic testing of tanks. The dive shop owner could refuse to refill an out-of-date scuba tank. Thus, this procedure could place total restriction on the diver in his participation in the sport. The yearly sticker tank inspection also is a method of direct restriction on the sport of scuba. However, overall there does not appear to be a noticeable restriction to the
diver of the sport from manufacturing and marketing efforts.

**Joint Efforts of the Manufacturers and Diving Associations.** Joint representation of the diving associations and the manufacturers combine the restrictions involved with both these interest groups. These restrictions include the instructional restrictions of the NSTC, self-imposed diver restrictions, the indirect restrictions of the composition of compressed air and the safety standards set on scuba equipment, and the direct restrictions of the five year and yearly tank inspections. Thus, it appears that this procedure does not noticeably restrict diver participation.

**Advisory Board Efforts.** Since the purpose of the advisory board is simply to monitor scuba activities, there would be no new restrictions involved. The restrictions on the scuba diver would be those that were imposed from other sources. Thus advisory board efforts appear not to be very restrictive to scuba divers.

**Exclusion of Diving Activity.** Exclusion of scuba participation places complete restriction on the sport's participants.

**Diver Evaluation and Feedback**

Divers' opinions on the various regulatory procedures differ. The feedback listed in Table 11 is derived from publications of various scuba organizations and agencies. There is some agreement concerning the opinions of divers about these procedures and policies. Most divers tend to favor self-regulation of their sport and generally oppose government intervention.
<table>
<thead>
<tr>
<th>Legislation</th>
<th>On any phases and of any degree of diving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self</td>
<td>Course requirement</td>
</tr>
<tr>
<td></td>
<td>Self imposed</td>
</tr>
<tr>
<td>Manufacturers and Marketing Industry</td>
<td>On five year inspection of tank ANSI regulations Manufacturers production standards</td>
</tr>
<tr>
<td>Joint Representation</td>
<td>On five year inspection of tank ANSI regulations Manufacturers production standards Diver self restriction Course requirement</td>
</tr>
<tr>
<td>Advisory</td>
<td>All variables of Joint Representation</td>
</tr>
<tr>
<td>Exclusion</td>
<td>Complete restriction</td>
</tr>
</tbody>
</table>
Legislation. Generally, the majority of scuba divers do not believe that a legislative procedure is necessary (Greben, 1975:1). They feel that most diving accidents occur from diver error, legislative action will not necessarily improve the safety of the sport.

There is also question concerning the constitutionality of any restricting law. The spokesmen for the diving community feel that the sport of diving could also be afflicted with economic hardship and loss of insurance coverage due to any implementation of a regulatory legislation. Therefore, the majority of divers oppose any form of government implementation of scuba safety regulation (Advisory Board on Underwater Parks and Reserves, 1975:9).

Self-Regulation. Most divers feel that they understand the problems associated with their sport. They are also very much concerned with making their sport as safe as possible. The diving community feels that they understand the various factors involved with their sport more thoroughly than people who are not connected with scuba. Likewise, the diving community also strongly desires their sport to be as safe as possible. Therefore, they feel that they are in a better position than government to implement any safety regulations. They do not want to lose control of their sport. They want to keep all factors of the sport, including regulation, within their sphere of concern and action.

Diving Gear Manufacturers and Marketing Industry Safety Efforts. The divers feedback on industry efforts are much the same as for the self-regulation approach in that restriction be imposed from within the diving community and not from outside sources.

Joint Efforts of the Manufacturers and Diving Associations. Joint representation also is favored
by the majority of divers because that regulation
comes from within the diving industry and not from
outside sources.

Advisory Board Efforts. Divers feel they know
more about what is needed for scuba than do non-
divers.

Exclusion of Diving Activity. It would appear
that if there is a justifiable reason for an area
being excluded from diving participation, it would
be understandable for the majority of divers.
Divers understand the dangers that could be involved
in specific water localities.

For an overall perspective, a legislative
regulatory procedure is questionable as to whether
it actually provides an effective means for reducing
scuba fatalities. The regulations imposed by this
approach may not be placed where they would be
effective because the restrictions are not directly
regulating the actual causes of death. Therefore
the legislative approach may not serve any beneficial
purpose, and in fact may be a hinderance to the sport
of scuba. It also could be expensive to enforce.
The degree of restriction imposed could vary sub-
stantially, depending upon the desires of the
decision-makers. It is also extremely unfavorably
regarded by the majority of the sport's participants.

Self-regulation seems to have improved the
deficiencies in instructional procedures to help
reduce scuba fatalities. The enforcement of these
procedures over the sport is now coordinated to pro-
vide efficient supervision of scuba instruction.
The cost of these procedures are absorbed by divers
in their course and equipment. Self-regulation has
direct restrictions of course requirements and self-
restrictions imposed by the individual diver. Divers
seem to desire this form of regulation since they
| Legislation                          | Divers do not think it is necessary  
|                                    | Constitutionality  
|                                    | Economic hardship  
|                                    | Loss of insurance coverage  
| Self                                | Regulation from within diving community -- agreeable  
| Manufacturers and Marketing Industry | Regulation from within diving community -- agreeable  
| Joint Representation                | Regulation from within diving community -- agreeable  
| Advisory                            | Divers do not think it is necessary  
| Exclusion                           | Positive if used for a just reason  |
feel they can regulate their own sport without outside intervention.

The manufacturers and marketing industry maintain and enforce regulations to help reduce fatalities. Added cost is placed on the consumer of the equipment and supplies. The degree of restriction on the sport is minimal. Most diving participants are favorable to manufacturer's safety efforts.

Safety regulation by the manufacturers and diving organizations seems to be effective at reducing fatalities. This is largely due to the direct supervision and enforcement of diving activity with a relatively minimal degree of diver restriction. The majority of scuba divers are agreeable to regulation from this sphere of the sport of scuba because it is regulation from within the diving community.

Regulation by an advisory board would have approximately the same effectiveness at reducing fatalities as the joint efforts of manufacturers and diving organization. However, it has the possible expertise in specialized fields of its members. This may increase the safety information available to the diving community. It also would serve as a liaison between the diving community and non-divers who are concerned about the safety of the sport. The enforceability of this approach is the same as that of the joint procedure. There would be no extra cost for this procedure since the members volunteer their time and efforts. The degree of restriction on the sport would be from those imposed through other sources. However, the majority of diving participants do not favor any government legislative control over the sport of scuba. They would rather keep all diving regulations under the jurisdiction of the diving community.
Regulation by exclusion of the activity is severe yet totally effective, if enforced properly. Enforceability could come from existing law enforcement agencies in the vicinity such as the harbor patrol. This multiple use would save additional manpower and revenue. Exclusion provides complete restriction over the sport, yet the divers do understand the reason, if the cause is justifiable.
CONCLUSIONS

The purpose of each of the regulatory mechanisms reviewed here is to insure the safety of scuba diving participants. The various procedures presented provide varying degrees of regulatory control over the sport. However, from the analysis of these procedures, it appears that there are specific trade-offs and externalities associated with each alternative procedure and policy.

The variables considered in the analysis demonstrate that each procedure differs to some degree in its impact on the sport of diving. There are administrative trade-offs as well to be considered with each procedure and policy.

The various procedures seem to be divided into two major groupings: regulation by the diving community, and regulation by the government. For governmental regulation, it appears that the effectiveness of reducing scuba fatalities is questionable unless scuba activity is entirely excluded. However, given the economic importance and impact of diving in a state like California, for example, the possibility of total exclusion is extremely limited. It also appears that the ordinance approach is not likely to succeed for two other major reasons. One is that diver error, which is believed to be the major cause of scuba deaths, is extremely difficult to govern by law. The other reason is that the diving community will not support any such ordinance. As seen from the reaction and ultimate repeal of the Los Angeles Diving Ordinance, the diving community is now a strong interest group that intends to have a definite voice in its future.

Legislation could place any degree of restric-
tion on diving. This could range from assigning an advisory committee to a supervisory capacity, to complete sport restriction through exclusion.

The diving organizations feel that any government intervention on the sport of scuba is unnecessary. Legislated procedures could even be detrimental. Legislators who may not completely understand the sport of scuba could impose a law that would only pose negative externalities for the sport and its participants.

Regulatory procedures as implemented by the diving industry would come from either the diving instructional organizations, the diving equipment manufacturers and marketing industry, or a combination of the two. This unification would include an advisory board comprised of diver interest groups. The various checks and balances implemented by the instructional organizations and by the manufacturers and marketing industry combined together, cover a wide spectrum of safety standards. These standards range from instructional procedures, to manufacturing safety standards, to inspection of equipment once in use. These safety standards help to ensure the safety of scuba participants.

The cost of the non-governmental approach is internalized into the sport. This occurs in both the cost of the coursework and the equipment. In this manner, only diving participants pay for the safety requirements implemented. The major policy issue involved in paying for outdoor recreation activities such as scuba diving, is the degree to which users of the activity shall pay for it individually and directly as they use it, as compared with raising the necessary revenues by general or special taxes (Clawson and Knetsch, 1974:315). Payment of cost by means of taxes is not related to individual
participation in the recreation opportunities provided, and probably is not proportionate to general social values arising out of the availability of recreation to others (Clawson and Knetsch, 1974:264). If there are broad social benefits, then it is appropriate that much of the costs of outdoor recreation be met by taxes imposed upon the entire public. However to the extent that most or all of the benefits of an outdoor recreation activity accrue to those directly consuming recreation services, it is appropriate that more of the cost be met by charges imposed upon the users (Clawson and Knetsch, 1974). Thus, since non-scuba divers do not benefit from scuba activities, they should not have to provide funding for the implementation of regulatory procedures. For these reasons, Clawson and Knetsch (1974) predict that the trend in the future will almost surely be toward greater use of internalized charges, as the demand for outdoor activities grows and as the need for funds becomes more acute.

The degree of restriction on sport participants is minimal with either of the techniques involved with self-regulation. The restriction would come from the diver, coursework, the hydrostatic test requirement, or standards imposed on the equipment manufacturing process.

Due to the externalities involved, scuba divers appear favorable to regulation by the industry rather than from the government. Therefore, even though every procedure and policy analyzed has similar objectives, they vary in effectiveness, enforceability, cost, restrictions on sport participation, and in diver reaction.
IMPLICATIONS

Use of the specific categories relating to the regulatory procedures, helps to reveal a systematic approach with which to analyze each specific procedure. From this analysis, a wider perspective of the externalities involved with each procedure can be developed.

Due to these externalities involved, decision-makers, whether public or private, must consider which type or types of regulatory procedures are best suited to the sport of scuba. A review of various mechanisms used and their effects on the sport can aid in the implementation of any future regulatory safety procedures.

The mechanisms reviewed are forms of safety regulation that provide insight to the various approaches involved in attempting to make scuba diving a safer sport. Decision-makers can analyze how each procedure affects the sport of diving as to effectiveness, enforceability, cost, sport restriction, and diver feedback. From this analysis, decision-makers will be able to extract information or foresee various factors, both positive and negative, involved in implementation of scuba safety standards. Decision-makers must weigh all these variables carefully when deciding upon the practicability of further regulations.

Whatever decision is reached, it will undoubtedly affect scuba divers to a lesser or greater degree. Divers will have to abide by whatever decisions are implemented. Therefore, it would seem that any decision made concerning scuba safety should carefully consider the opinions of the diving community. Diving is a unique activity in that it is solely a participant sport. As discussed in the legislation
section of this paper, a diver's action affects only other divers. This raises the question of implementing a regulatory procedure or policy on scuba diving that is against the desires of the diving community. Would it be of value? Can it be enforced? Another important question to ask is who should pay for such a safety procedure or policy. Should non-divers, or should the scuba divers pay for it? Another major consideration is that the legislation of the Los Angeles Scuba Ordinance caused the diving community to strengthen their procedures for implementing safety in their sport. Thus the need for government legislation may have been alleviated by the implementation of the Los Angeles Ordinance. These are the major factors that decision-makers should examine when considering mechanisms that govern safety in scuba sport diving.
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Advisory Board on Underwater Parks and Reserves. 1975. Summary of Hearings on the Subject of Scuba Regulations in California.


Graham, Robert D. and Ditton, Robert B. 1974. Scuba Diving Behavior Patterns on the Texas Gulf Coast, unpublished paper. Texas Agricultural Experiment Station (Recreation and Parks) Texas
A&M University, College Station, Texas.


b. Report Justifying Repeal of the Los Angeles County Scuba Diving Ordinance. For presentation to Director of L. A. County Department of Parks and Recreation. NAUI, Grand Terrace, Ca.

c. Some True Facts on Scuba Diving. NAUI, Grand Terrace, Ca.


Los Angeles County Underwater Safety Committee. Committee History and Development.


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State v Lombardi. 1968. RI-,241A 2d, 625.


United States Department of Commerce, National Oceanic and Atmospheric Administration.

Appendix
Appendix A

ORDINANCE NO. 11-037
An Ordinance amending Ordinance No. 11-037, entitled “The County Scuba Diving Ordinance,” adopted October 22, 1974, and Ordinance No. 8833, entitled the “License Ordinance,” adopted November 27, 1951, and declaring the urgency thereof and that this Ordinance shall take immediate effect.
The Board of Supervisors of the County of Los Angeles do ordain as follows:

Section 1. Ordinance No. 11-037, entitled the “County Scuba Diving Ordinance,” adopted October 22, 1974, is amended in its entirety so as to read as follows:

ARTICLE I
General Provisions
Sec. 1. Short Title. This Ordinance shall be known and may be cited as the “County Scuba Diving Ordinance.”

Sec. 2. Applicability. The provisions of this Ordinance and any rules and regulations adopted pursuant thereto shall be applicable to and within the unincorporated territory of the County of Los Angeles.

Sec. 3. Aircraft Operations Meeting Certification Requirements. The Director of Parks and Recreation of the County of Los Angeles shall maintain a current roster of all organizations certifying scuba divers and instructors of scuba diving whose programs for certification and re-certification for scuba divers and instructors of scuba diving comply with the requirements set forth in Articles IV through VII, inclusive, of this Ordinance.

Sec. 4. Severability. If any provision of this Ordinance or the application thereof to any person or circumstances is held invalid, the remainder of this Ordinance and the application of such provisions to other persons or circumstances shall not be affected thereby.

Sec. 5. Violations. Violation of this Ordinance is deemed a misdemeanor punishable by a fine of not more than one thousand dollars ($1,000.00) or by imprisonment in the County Jail for not more than six (6) months or by both such fine and imprisonment. A repetition or continuation of any violation of any provision of this Ordinance on successive days constitutes a separate offense for each day during any portion of which such violation is committed, continued, or permitted.

Sec. 6. Construction of Sections. The masculine gender includes the feminine.

ARTICLE II
Prohibitions
Sec. 101. Scuba Diving. A person shall not scuba dive unless:
(a) He is currently certified or recognized as a scuba diver or instructor of scuba diving by a recognized certifying organization, or
(b) He is diving in compliance with the requirements of Article IV for certification as a scuba diver, or
(c) He is diving in compliance with the requirements of Article VI of this Ordinance for re-certification as a scuba diver, or
(d) He is diving in compliance with the requirements of Article VII of this Ordinance for emergency re-certification as an instructor of scuba diving,

Sec. 102. Possession and Display of Credentials by Scuba Divers. A scuba diver shall be in possession of and display at all times a recognized scuba diver certification issued by a recognized certifying organization attesting to his certification as a scuba diver and a recognized form of official identification at the immediate vicinity of his diving location at all times while diving and shall display both credentials and identification upon demand by a peace officer enforcing the provisions of this Ordinance.

Sec. 103. Scuba Diving Equipment. An instructor of scuba diving shall have the most recent credential issued to him by a recognized certifying organization attesting to his certification or re-certification as an instructor of scuba diving as an instructor of scuba diving by a recognized certifying organization.

Sec. 104. Possession and Display of Credentials by Instructors of Scuba Diving. An instructor of scuba diving shall have the most recent credential issued to him by a recognized certifying organization attesting to his certification or re-certification as an instructor of scuba diving and the recognized form of official identification in the immediate vicinity of his location at all times when teaching the use of scuba diving equipment and shall display both credentials and identification upon demand by a peace officer enforcing the provisions of this Ordinance.

Sec. 105. Compressors Used to Furnish Compressed Air for Diving. A person shall not furnish compressed air for use in scuba diving from a compressor without maintaining, at the compressor or storage, a record of hours of operation, repairs, overhauls, and maintenance, temperature adjustment, and results of all analyses and tests for air sampled.

Sec. 106. Compressed Air Furnished for Scuba Diving. A person shall not furnish compressed air for use in scuba diving that does not comply with the purity standards set forth in Article VIII of this Ordinance.

Sec. 107. Prohibited Activities. A person shall not engage in any of the following activities:
(a) Furnishing compressed air for use in scuba diving where the vessel is operated at speeds exceeding fifteen (15) miles per hour,
(b) Furnishing compressed air for use in scuba diving over any lands or waters where there is a hazardous waste material present,
(c) Furnishing compressed air for use in scuba diving where the compressor is not equipped with a pressure gauge.

ARTICLE III
Definitions
Sec. 201. Certified Instructor of Scuba Diving. Shall mean a person who has completed the requirements for certification and/or re-certification of this Ordinance.
Sec. 202. Cylinder: Shall mean a container with a circular transverse cross-section with the capability of containing high pressure gases.

Sec. 203. Director: Shall mean Director of Parks and Recreation of the County of Los Angeles.

Sec. 204. Exhalation Resistance: Shall mean the effort measured in inches of water at the mouthpiece necessary to keep the exhaust valve in a regulated position.

Sec. 205. Flotation Equipment: Shall mean any inflatable device used to support a diver's body in water.

Sec. 206. Gauge Lens: Shall mean the transparent portion of the pressure gauge's outer case that allows viewing of the guilloché markings inside.

Sec. 207. Horse Reinforcing Bands: Shall mean the broad fabric layer of lining in a rubber pressure hose that contributes the tensile strength necessary to contain the pressurized gas.

Sec. 208. Hydrostatic Test Interval: Shall mean the maximum allowable period of time between successive water pressure tests.

Sec. 209. Inhalation Resistance: Shall mean the effort measured in inches of water at the mouthpiece necessary to keep the demand regulator open.

Sec. 210. Internal Case Pressure: Shall mean the pressure inside the case of a breathing apparatus.

Sec. 211. Inhalation Inlet: Shall mean of those substances defined in Sections 2304, 2305, 2306, or 2307 of the Business and Professions Code of the State of California.

Sec. 212. Inert Gas: Shall mean any of those substances defined in Sections 1161, 1162, 1163, 1164, or 1165 of the Health and Safety Code of the State of California.

Sec. 213. Open Water: Shall mean any body of water other than a swimming pool.

Sec. 214. Pressure Hose: Shall mean a flexible hose device usually made of fabric, reinforced rubber used for conveying and controlling the flow of a pressurized gas from one location to another.

Sec. 215. Recognized Certification Organization: Shall mean an organization whose requirements for certification and recertification of scuba divers and instructors of scuba diving have been recognized by the Director as meeting the requirements set forth in Articles IV through VIII, inclusive, of this Ordinance.

Sec. 216. Regulator: Shall mean a device for controlling the delivery of a gas to the diver's mouth or respiratory apparatus.

Sec. 217. Scuba Diving: Shall mean diving with a self-contained underwater breathing apparatus.

Sec. 218. Valve: Shall mean a device for controlling the flow of gas by opening or closing a valve.

Sec. 219. Weight Belt: Shall mean a long flexible strap with appropriate means of fastening around the waist to which ballast is attached.

ARTICLE IV
Requirements for Certification as a Scuba Diver

Sec. 221. Qualifications: The diver shall participate in a scuba diving course by having satisfied the following requirements:

(a) (1) Have completed a medical history form approved by the Director.

(b) (2) If the diver is 45 years of age or older, or if the diver's completed medical history form reveals a condition which might be hazardous to the health and safety of the diver when scuba diving, then the diver must be examined physically by a scuba diving physician whose examination included the diver's ears and sinuses, respiratory system, and cardiovascular system.

(c) The requirements of subsection (a) shall be completed prior to the use of scuba diving equipment.

(d) Demonstrate the ability to swim continuously for 200 yards or more without swimming aids; swim 50 feet underwater without swimming aids; swim 50 yards towing another person without swimming aids; float and/or tread water with minimal movement for 10 minutes, and breast ride with legs only for 20 seconds.

(e) Fulfillment of swimming requirements in accordance with Sec. 301 (a), (b), and (c) of this Ordinance.

Sec. 222. Open Water Diving: The diver shall have received and successfully completed eighteen (18) hours of combined classroom and water training. This water training may be conducted in a pool or other water which is confined or protected. The case of students to instructor ratio during this water training shall not exceed 12 to 1. The training shall have consisted of the following:

(a) Instruction from a certified instructor of scuba diving on the use, preventive maintenance, and care of scuba diving equipment, laws of physics relating to scuba diving; physiology with emphasis on the large circulatory system, ears, and sinuses, medical-psycho-physiological problems related to scuba diving resulting from effects of pressure breathing compressed air, carbon dioxide build-up, hyperventilation, physical maladies, exposure, temperature, and cardiac blood volume; marine hazards; orientation to head last, mount, surface, and controlled descent; undersea exploration and scientific diving; recommended defensive practices including the buddy system, communications, diver's logbook, emergency procedures, accident reporting, dive plan, procedures for surf and tide, and theoretical knowledge, oceanography, laws and ordinances associated with the sport, and information sources for continuing education in scuba diving.

(b) Practice in water with a certified instructor of scuba diving in the use of mask, fins, and snorkel, use of personal flotation devices; surface dives; water entry techniques, use of weight belt, use of personal flotation device under normal and emergency breathing conditions and buddy breathing.

Sec. 223. Final Open Water Training: The diver shall have received and satisfactorily completed nine (9) hours of open water training with a certified instructor of scuba diving. No more than six (6) hours of open water training shall have been received during any one day. This training shall have been received where the ratio of students to instructor did not exceed 12 to 1 when using scuba diving equipment nor 1 to 1 when using, i.e., surf, swimming and diving equipment. The training shall have consisted of practice entries and exits from a live-lifted boat, and in and without scuba diving equipment, use of mask, fins, and snorkel, descent and ascent with and without scuba diving equipment, buoyancy control, and control of the breathing equipment, breathing control at the surface and with and without scuba equipment, and in and around Boyle's Law. The mask, the use of a characteristic breathing control, and control of the breathing equipment, breathing control at the surface and with and without scuba equipment, and in and around Boyle's Law. The mask, the use of a characteristic breathing control, and control of the breathing equipment, breathing control at the surface and with and without scuba equipment, and in and around Boyle's Law. The mask, the use of a characteristic breathing control, and control of the breathing equipment, breathing control at the surface and with and without scuba equipment, and in and around Boyle's Law.
Sec. 501. Qualifications. The instructor shall have complete control of the ability to scuba dive. The instructor shall have demonstrated in water and in a controlled environment the ability to perform the tasks necessary for certification. The instructor shall have completed the following requirements:

(a) Possess current certification in first aid, life saving, cardiopulmonary resuscitation, and current scuba certification.

(b) Pass a physical fitness test to scuba dive by a physician whose opinion is based upon a physical examination of the diver that includes an examination of the diver’s ears, nose, and throat, respiratory system, cardiovascular system, and medical history.

(c) Demonstrate the ability to swim at least three hundred (300) yards, demonstrating a skill level of at least one hour, at least ten minutes surface survival techniques, back floating, swimming, and dropping, and maintaining an average speed of twenty-five (25) feet per minute, and be able to execute five (5) scuba diving skills in a controlled environment.

(d) Underwater environment: scuba diving equipment, use and perform preventive maintenance on scuba diving equipment, and use and recognize safety procedures associated with scuba diving.

Sec. 502. Training. The instructor shall have received and satisfactorily completed a course of training in the operation of a recognized certifying organization during which the following instruction shall be included: first aid, knowledge and skill in conducting presentations, practical teaching presentations, teaching theory, methods, techniques, evaluation, and use of diving environment, medical aspects of scuba diving, decompression and emergency procedures, emergency procedures and open water diving, diving physiology, diving physical fitness, diving medical care, diving fitness, emergency rescue, legal aspects of diving instruction, advanced and specialty diving certification, and subjects related thereto.

Sec. 503. Certification. The instructor shall be subject to the following examinations covering the instruction received. The content of the written examination shall be prepared by the instructor in such a manner as to ensure a thorough understanding of the material covered. The examination shall be administered by a recognized certifying organization in accordance with the requirements of the training received.

ARTICLE VII Emergency Recertification. All persons certified as instructors of scuba diving who have not been recertified in accordance with Section 501 shall be required to obtain certification by March 1, 1975. An instructor who fails to obtain the certification required under this section shall not be a certified instructor of scuba diving.

ARTICLE VIII Compressed Air. All compressed air shall be in accordance with the Compressed Air Association CCR-1973 and shall meet the following specifications:

(a) Oxygen content shall not be less than 9.5% nor more than 23.5%.
(b) Carbon dioxide content shall not exceed 20 parts per million.
(c) Condensed water shall not exceed 5 milligrams per cubic meter.
ARTICLE IX
Requirements for Vessels Operated for Hire As a Base of Operations for Scuba Diving.

Sec. 301. Certification Check. Every scuba diver shall be required to display before boarding the vessel, a credential issued by a recognized certifying organization attesting to the diver's current certification or certification as a scuba diver or instructor of scuba diving. This section shall not preclude an individual who is a student of a scuba diving course of a recognized certifying organization from being and using the vessel as a base of operations for scuba diving when accompanied by a certified instructor of scuba diving.

Sec. 302. Required Emergency Equipment. Within thirty (30) days from the effective date of this Ordinance the vessel shall be equipped with emergency equipment including an oxygen respiratory unit, head and neck flotation device for quickly reaching and aiding a distressed diver, a recall system capable of being heard or seen by scuba divers under and on the surface of the water, and a marker buoy.

Sec. 303. Trained Operator For Emergency Equipment. Within thirty (30) days from the effective date of this Ordinance the vessel shall carry personnel trained in the use of the emergency equipment described in Section 302.

Sec. 304. Roster of Scuba Divers. A roster of all scuba divers and passengers using the vessel as a base of operations for scuba diving shall be kept aboard the vessel during the voyage. The roster shall be displayed upon command by a peace officer. In the event of a fatality or injury requiring evacuation of a scuba diver while diving, a manifest of all passenger’s names, addresses, and air pressure hose with cuts or abrasions sustained shall be obtained prior to disembarkation of passengers.

Sec. 305. Insure Diving Equipment. In the event of a fatality or injury requiring evacuation of a scuba diver while using the vessel as a base of operations for scuba diving, the operator of the vessel shall attempt to secure possession of all scuba equipment separated from the diver and the separated equipment from access persons other than a peace officer investigating the fatality or injury. Possession of the separated equipment shall be delivered only to a peace officer.

ARTICLE X
Performance Standards For Scuba Diving Equipment

Sec. 301. Regulators. Shall comply with the following standards:
(a) Have a satisfactory performance at altitude not to exceed three (3) inches of water pressure at normal elevation rates at 1 atmosphere absolute pressure or air.
(b) Not leak water upon initiation or exhaustion.
(c) Do not have an excessive gas volume with cuts or abrasions sustained through the hose or connections.
(d) Do not sustain cuts or abrasions with cuts or abrasions sustained through the hose or connections.
(e) If equipped with a integral reserve mechanism, shall warn the diver that the air supply is low at a cylinder pressure of 250 psi or more.

Sec. 302. Valves. Shall comply with the following standards:
(a) Is not to have the regulator that will allow the regulator to be properly attached to the valve and maximum pressure prescribed to be applied to the connection.
(b) If equipped with a reserve mechanism (U-valve), shall have a noticeable restriction to breathing or other suitable means to warn the diver that he has reached his reserve level. Pressure at which this function becomes noticeable shall be a minimum of 250 psi. Units which use flow restriction as the warning mechanism shall have reduced expansion upon release of the reserve by the diver.

Sec. 303. Cylinders. Shall comply with the following standards:
(a) Be within its hydrostatic test schedule as specified by the United States Department of Transportation.
(b) Within six (6) months from the effective date of this Ordinance be visually inspected annually by a certified inspector of scuba diving equipment.
(c) Cylinders shall be free of any condition which would prevent proper use of the equipment including hoses, regulators, and hoses not properly attached to the equipment.

Sec. 304. Satisfactory Pressure Gauges. Shall comply with the following standards:
(a) Be within 5% accuracy of full scale over the entire gauge range.
(b) Be equipped with a means of removing internal gas pressure without exposing the gauge, the hose, or the tank cutter.
(c) Be equipped with a means of removing internal gas pressure without exposing the gauge or the hose to the air or the environment.

Sec. 305. Weight Bell. Shall comply with the following standards:
(a) Have a weight bell that will remain in place under a minimum weight of two hundred pounds.
(b) Be replaceable by the diver upon selection of the release mechanism by the diver.

Sec. 306. Flotation Equipment. Shall comply with the following standards:
(a) Be designed and capable of holding a pressure of two psi minimum with weight values checked.
(b) Possess a minimum buoyancy of 15 pounds when fully inflated at the surface.
(c) Have a means by which it shall be attached to the diver and be capable of being inflated and deflated by the diver.
(d) Be equipped with an over-pressure valve capable of releasing a fully inflated and deflated inflatable by a device from 33 feet without sustaining damage to the unit. This device shall be a unit that can be released by means other than a compressed gas cartridge.
(e) Not be used with compressed gas cartridges with capacities greater than those recommended by the manufacturer unless equipped with an over-pressure mechanism.
(f) Be maintained in a clean, serviceable condition, whether or not compressed gas cartridge, high pressure, or both the scuba cylinder is filled, or not.
(g) Not contain components with cuts, abrasions, or cuts, or holes that affect the structural integrity of the cylinder.

Section 2. Chapter XXII of Ordinance No. 5866, entitled the "License Ordinance," adopted November 27, 1951, is repealed.

Section 3. Declaration of Emergency. Safe scuba diving requires that users of self-contained underwater breathing apparatus be physically capable of diving, receive instruction in the use of the equipment from a qualified instructor, and maintain proficiency through scuba diving. That air furnished for use in scuba diving must meet specific standards for air purity that equipment has been tested for use at scuba diving must meet specific performance standards, and that vessels being used as bases of operations for scuba diving receive specific operating procedures and to comply with the inspection procedures for the protection of the scuba diver at the present time. Compliance with all aforesaid requirements is voluntary, increases in prices of personal and marine diving equipment that scuba diving requires that safe scuba diving may be achieved through programs of voluntary compliance. Due to an increasing participation in scuba diving in the State of California for Los Angeles and the increasing use of the territorial waters of the County of Los Angeles for scuba diving, it is imperative that the public health and safety be maintained immediately by the establishment of mandatory standards designed to make scuba diving safe. This Ordinance establishes such standards. By reason of the foregoing fact, this Ordinance is hereby enacted for the immediate preservation of the public peace, health, and safety, and the same shall take effect at once upon the passage thereof.

Section 4. This ordinance shall be published in the Metropolitan News, a newspaper printed and published in the County of Los Angeles.

KENNETH PAINT
Chairman

(SEAL)

ATTTEST

JAMES S. MEZE
Executive Officer-Clerk of the Board of Supervisors of the County of Los Angeles

Heres: None.

JAMES S. MEZE
Executive Office-Clerk of the Board of Supervisors of the County of Los Angeles

Effective date November 21, 1974

Reprinted from Metropolitan News 285 Broadway, 822-4384
# Appendix B

## UNDERWATER ACCIDENT REPORT

**Forward report to:**

NATIONAL UNDERWATER ACCIDENT DATA CENTER
P.O. Box 68 — Kingston, R. I. 02881

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<th>DESCRIPTION OF DIVES AND ACTIVITIES</th>
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## Equipment Data

**NOTE:** Equipment Brand, Type and Serial Number data need be included only if malfunction or failure were contributory to the incident.

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**Flotation Device:** Used: (Yes or No)  Tank: Air Lift: (Ton or Mt)  MFG. Date: (Year)

**Used after event?** (Yes or No)  Last Hydro-Test Date: (Year)

**Regulator Tested?** (Yes or No)  Last Visual Inspection Date: (Year)

**Results:**  Internal Condition: Clean  Slight Corrosion  Extensive Corrosion

**By:**  NAME  ADDRESS  PHONE

**Special Comments on Equipment:**

**Equipment Inspected by:**  NAME  ADDRESS  PHONE

**Equipment Replaced by:**  NAME  ADDRESS  PHONE
DETAILED DESCRIPTION OF ACCIDENT

Describe in detail how the accident happened, including what the person was doing, any specific marine life or objects and the action or movement which led to the event. Include details of first aid or resuscitation efforts. Describe any "Decompression" and/or "Decompression-Treatment" in description of accident.
Appendix C

Many Called Inadequate

Scuba Diver Classes: License for Disaster?

BY MIKE GOODMAN

Each of the 12 Beverly Hills High School youngsters poised for the underwater dive off Santa Catalina Island proudly carried the shiny plastic card proclaiming them accredited scuba divers.

But the skipper of the diving boat they had chartered watched in horror as the teenagers fumbled with their gear and stumbled--arms and legs flailing about--into the water from the deck.

A veteran of more than 1,000 diving charters, the skipper said he suddenly realized that several youngsters could barely swim and would surely drown.

One girl immediately became tangled in her gear and clung desperately to the anchor line, gagging and choking on the ocean water as the boat bobbed in the swells. Others thrashed about nearby.

"For God's sake get those kids aboard."
Skipper Jim Milner recalled yelling to his crew, though he said later his only responsibility is transporting charter groups to diving areas.

"It would have been legalized murder to let them continue diving." added Milner, who operates two diving charter boats out of San Pedro. He wrote a scathing letter to public school and diving association authorities.

The shiny piece of plastic the youngsters carried was a certification card issued locally through a national diving association upon completion of an accredited diving course.

The card certifies the diver as thoroughly trained in the use of scuba (Self Contained Under-
water Breathing Apparatus) gear and qualified to dive unsupervised into deep ocean waters.

But Milner, like a growing number of skippers, lifeguards, diving experts and officials, said many of the certification cards issued to hundreds of Southern California divers monthly are no more an indication of diver ability than a piece of wallpaper.

"Many of these divers are so poorly trained, I thank God each time we bring them all back alive or uninjured," Milner said.

He said his crews have pulled four divers aboard dead this year and rescued more than 100 exhausted divers who probably would have drowned.

More than 40 divers, most of them certified locally through national diving association, have died in Southland area waters the last two years and scores more have been rescued said Tom Ebro, aquatics chief for Los Angeles County.

The death toll this year--now a record 21--could top 30 because 75% of the deaths and injuries historically occur from September to April, said Ebro, who is also a deputy coroner and has investigated all but a handful of the recent deaths.

"Being undertrained and unable to cope in minor emergencies has become the leading cause of diving fatalities," Ebro said. "Reform is desperately needed."

Many tragedies are blamed by aquatic experts on "assembly-line" training of diving instructors and students through fiercely competitive diving associations accused of stressing quantity over quality.

One national diving association unwittingly certified a dog and a seal as bonafide diving instructors through a mail-order program with a $50 application fee, reported Leonard Greenstone, an executive member of the county Underwater Safety Committee.
A duck also was certified through the mail as an accredited scuba diver to demonstrate shoddy practices within the industry, diving association sources said.

County investigative reports and diving association complaint files obtained by The Times also disclosed.

--Some instructors have certified divers without ever attending or holding classes.

--Other instructors have skipped town with application fees, equipment and deposits.

--Students have complained that instructors have been drunk, abusive, and sometimes have ignored basic safety precautions.

When asked about the complaint cases, Greenstone said they represented extreme examples, but added that the industry has become infested with shoddy certification practices.

Milner, a scuba charter boat skipper for 14 years, said his crews this year have rescued at least six so-called "instructors" from drowning themselves because of inexperience.

Lifeguard death and accident reports at Catalina, which has the heaviest concentration of divers (about 85,000 yearly), disclosed that three recent deaths occurred with certified "instructors" present.

One national association was forced to suspend nine instructors this summer after an investigation into "assembly-line" commercial scuba programs taught at 80 Southland high schools, according to association documents.

The investigation by officials of Los Angeles County and a diving association discovered that instead of the 12 hours required for in-pool training, many students were receiving only a few hours in-pool training and some none at all.

Many classes, usually held during a 45-minute
gym period, had 40 to 80 students for each instructor when the proper ratio was 10 students per instructor, the investigation showed.

The students were billed $35 to $50 each for the semester course, but the instructor was not paid until the student was certified, reports revealed.

Five hundred warning letters were sent to school principals, but thousands of teen-agers already had been certified to think they were adequately trained in the use of scuba gear, Ebro said.

An estimated 10,000 youngsters were certified under the programs in the last two years, according to association memos.

"The public has a right to be protected," Ebro said.

Ebro said the industry has been slow in policing its own and virtually no basic standards or controls exist for air purity in the tanks instructor competence, equipment performance, diver certification or screening of students.

"Scuba diving grew too fast and currently is under almost total control of private industry," Ebro said. Annual estimated of gross instructional and equipment sales in Southern California range from $5 million to $15 million.

Many diving instructors admittedly sell equipment on a commission basis and sometimes are ordered by employers to push certain brands, even during class periods.

Instructors often are affiliated with commercial dive shops and sporting goods stores sometimes hired more on sales ability than instructional technique, according to interviews with dive shop operators and instructors.

But most merchants and instructors were fearful about speaking openly about internal problems.

"If you quote me in the newspaper, they'll turn on me like a pack of wolves," said a Long Beach dive shop operator. "I won't get equipment, my instructors will quit. I'll be cut off."
Ebro said he was personally threatened when he tried to introduce standardized and supervised diving instruction at county pools.

A charter boat skipper who asked to remain anonymous said his boat was sabotaged--dock lines cut, gear ruined--when he supported reforms.

Other diving industry spokesmen also point out that more and more groups are pushing for internal reform to head off possible legislation.

"These people had better get their act cleaned up," said John Gaffney, executive director of the National Assn. of Skin Diving Schools.

He termed the various diving programs a "Tower of Babel--everybody has a different technique of program."

But he said the diving industry has made serious attempts to upgrade instruction, "though we've got one hell of a long way to go."

Scuba diving is one-tenth as dangerous as riding a bike--improperly trained," Caffney said.

Some dive shop operators say that rising death figures are misleading because with the large increase in scuba divers, deaths and injuries are bound to increase.

But at Santa Catalina, where the largest concentration of deaths and injuries occur, the Los Angeles County lifeguards specializing in scuba rescues have a different view.

Lt. Roger Smith, commander of the isthmus lifeguard station, said he has personally investigated the most recent 50 diving incidents, including 15 deaths.

He said many of the incidents seem to be linked to lack of training drills or ineffective instruction.

He said that in most of the 15 deaths, one or more of the three basic safety measures appears to have been violated.
--Proper breathing during pressure changes.
--Dropping the weight belt in emergencies.
--Diving with a buddy.

Smith said that nine of the 15 deaths indicated improper breathing, all 15 failed to drop their weight belts, and 5 of the 15 were buddy-team related.
Vita

Dennis Christopher Regan was born in Waterbury Connecticut, on December 3, 1951, the third son of John and Martha Regan.

His education to date has been successful completion of Watertown High School in Watertown Connecticut in 1970, and Springfield College in Springfield Massachusetts in 1974 where he obtained a Bachelor of Science degree in Community and Outdoor Recreation. In the fall of 1975, Mr. Regan enrolled in the Masters program at Texas A&M University, pursuing a degree in Natural Resource Development with a specialization in Marine Recreation Resource Development/Management.

During his graduate work, Mr. Regan served as an assistant to Dr. Robert B. Ditton. In the summer of 1976, he completed a three month internship program with the University of Rhode Island Marine Advisory Service, under the direction of Mr. Neil W. Ross, Marine Recreation Specialist.

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