to the public who seek recreation through sport fishing, hunting, or other enjoyment of our natural resources.

PUBLIC LAW 86-686, 74 STAT. 733

AN ACT

To facilitate cooperation between the Federal Government, colleges and universities, the States, and private organizations for cooperative unit programs of research and education relating to fish and wildlife, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources, the Secretary of the Interior is authorized to continue to enter into cooperative agreements with colleges and universities, with game and fish departments of the several States, and with nonprofit organizations relating to cooperative research units: Provided, That Federal participation in the conduct of such cooperative unit programs shall be limited to the assignment of Department of the Interior technical personnel by the Secretary to serve at the respective units, to supply for the use of the particular units' operations such equipment as may be available to the Secretary for such purposes, and the payment of incidental expenses of Federal personnel and employees of cooperating agencies assigned to the units.

Sec. 2. There is authorized to be appropriated such sums as may be necessary to carry out the purposes of this Act.

Approved September 2, 1960.

SELF CONTAINED UNDERWATER BREATHING APPARATUS (SCUBA) AS AN AID IN FISHERIES WORK

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ABSTRACT

The development of self-contained underwater breathing apparatus (SCUBA) in recent years has opened an entirely new world to those who are physically able to enjoy it.

SCUBA is now used extensively in marine biology and is beginning to find its place in fresh water fisheries research and management. More aquatic biologists would probably utilize SCUBA if they were more familiar with its possibilities and its limitations. It is the purpose of this paper to present information which will assist fisheries administrators and biologists in determining whether or not diving techniques could be used in their programs.

USE OF SCUBA IN FLORIDA'S FRESH WATER FISHERIES

In Florida's fresh waters many areas are suitable for underwater work. As a result, skin and SCUBA diving has been used by the Florida Game and Fresh Water Fish Commission personnel in both research and management for the past few years.

At first, diving equipment was used to recover fish from the bottom after rotenone samples. This began on a very small scale, but it soon proved so effective that it is now used state-wide when conditions are suitable and divers available.

Other sample techniques such as various types of nets and electrical gear have been used while divers observed and noted the fishes' reaction.

The evaluation of sample methods in Florida has essentially just begun, but when completed could lead to a more effective fishery program.

In waters under management, along with the routine population samples, sight population checks and observations are made when conditions permit. Fish activities are noted underwater and transferred to a diving report form after surfacing. Water temperature, visibility, depth, and other physical information is collected on dives and recorded along with the observations. When possible photographic equipment is used and the observations recorded on film. This is of considerable importance when estimating numbers of species and individuals.

TRAINING AND EXPERIENCE

Most skin and SCUBA diving schools offer basic diving courses of 15 to 30 hours duration (usually not longer than one week). There are no nation-wide minimum standards at this time for such training. Probably the best approach for fishery personnel wishing to acquire this training would be to attend a course directed by a nationally certified instructor who follows an approved course outline.

Good diving schools will usually require students to have medical clearance, and pass swimming and physical fitness tests before final qualification.

No civilian diving schools produce expert divers. The novice diver must use and develop the knowledge and skills he gains at the school, or he will have wasted his time. He should plan regular dives under varied conditions to obtain the necessary experience to become a "working diver".

PHYSICAL CONDITION

Diving is a strenuous activity and the divers' environment a potentially hazardous one. The diver should be physically able to cope with any difficulty he might encounter. The SCUBA trainee should have a preliminary physical examination for medical clearance, especially in regard to his heart, lungs, ears, and sinuses. One who suffers from claustrophobia would probably not make a good diver.

EQUIPMENT AND SUPPLIES

Most major brands of diving equipment are good if they meet current U. S. Navy standards and can be repaired easily. These diving equipment companies usually produce two or three grades of each item. The cheaper grades are safe for shallow, non-working dives; however, the best equipment available should be purchased from a reputable company for underwater work.

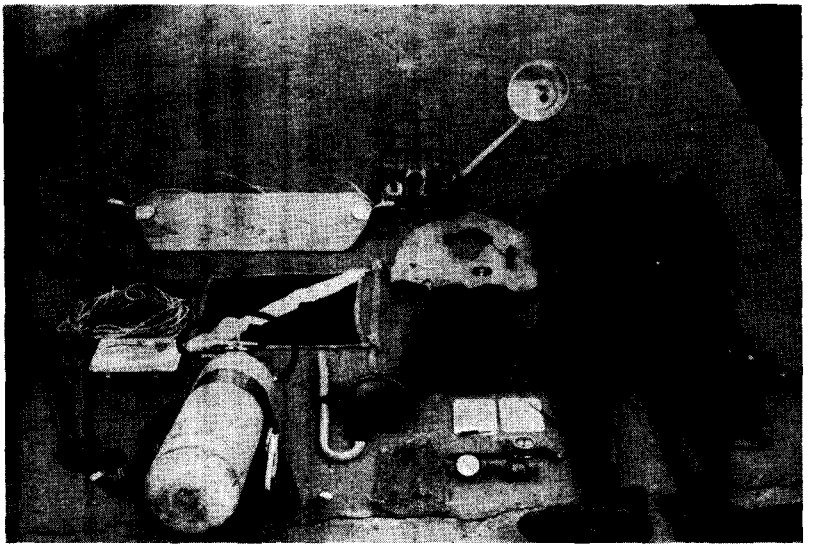
Listed below are the items of equipment and supplies needed in underwater work, according to categories shown:

Basic equipment for safe dives:

- Face mask
- Swim fins
- Snorkel
- Two-stage demand regulator
- Compressed air tank with reserve valve and harness or back-pack
- Safety float
- Knife
- Diver's flag
- Pressure gauge for air cylinder
- Depth gauge
- Exposure suit for work in cold water
- Weight belt

Accessories needed under certain circumstances:

- Portable air compressor
- Underwater light
- Compass



Diving Equipment and Accessories

Camera and underwater housing, Towboard, Underwater light, Diver's flag, Safety float, Neoprene Wet Suit, Safety line, Swim fins, First Aid Kit, Snorkel and Face mask, Underwater pencils and slates, Collecting Gun, Weight belt, Compass-Depth Gauge, Diving tank, Regulator and Back pack, Collecting bag, Cylinder pressure gauge, Neoprene Boots.

Safety line
Underwater watch or timer
Float

Equipment available for fisheries work:
Underwater photography and television equipment
Spear and slurp guns
Towboards and sleds
Underwater pencil and slate
Underwater communications system
Wrist thermometer

Needs for underwater fisheries work:
Underwater dart gun (for capture of live specimens)
Other devices and containers for underwater specimen collections, bottom sampling, and water sampling
Luminescent fish tags

WATER CONDITIONS

The greatest limitations for underwater work are water conditions such as visibility, current, obstructions, temperature, etc. The most important of these is visibility. If visibility is good, most other limitations lose their importance.

Visibility in water is not always what it seems to be from the surface. Turbidity, stain, type and color of bottom material, and light penetration are but a few of the factors that influence underwater vision. The water might look murky from the surface but if there is a light sand bottom below, the visibility near the bottom could be good, due to light reflection on the sand.

In lakes containing thermoclines, visibility can vary considerably according to depth. Clear lakes are usually more turbid below the thermocline, while muddy lakes are sometimes clearer below the thermocline. Naturally,

diving conditions can change drastically in such lakes during the fall "turnover".

Extreme temperatures, both hot and cold, can limit diving activities. Since the human body's cooling system depends upon perspiration, and a man cannot perspire underwater, diving is practically limited to water temperatures below 90°F. Exposure suits are used when water temperatures are in the lower 70°'s and below.

UNDERWATER NAVIGATION AND COMMUNICATION

Surface navigation on fresh water lakes and streams is seldom a problem, but due to the lack of recognizable landmarks, this is not true underwater. Guide lines from the surface and underwater compasses are frequently used for sub-surface navigation. Even compasses are limited when working near large metal objects and in water of little or no visibility.

Electronic communcations systems for underwater use are now on the market but are still quite expensive.

Hand signals and/or grease pencil and slate are the most popular methods of underwater communication used.

SAFETY PRECAUTIONS

Below are some often neglected safety precautions in diving that would mean extra expense to a diving project. These precautions are sound and should be mandatory procedures on work dives.

1. Never dive alone—This would require the purchase of at least two complete diving outfits.

The others necessitate the purchase of minor equipment.

2. Wear an inflatable float.
3. Always carry a snorkel, even when diving with SCUBA.
4. Use a diver's flag in boating areas.

In most cases, a working diver should not spend over four hours per day in the water. For strenuous work or for work in deep water, the time limit would be much less.

For purposes of safety as well as organization, one experienced diver should be designated as the diving supervisor for each operation. He should

Photo by Florida Game and Fresh Water Fish Commission

Striped Bass *Roccuss saxatilis* Walbaum at Silver Springs, Fla.

make the decision as to whether or not conditions are satisfactory for a safe dive. A non-diver should never make this decision.

DANGERS AND DIVING DISEASES

Contrary to popular belief, poor swimming ability and exhaustion are the principal causes of death while diving.

Air embolism is probably the most serious diving disease because it can occur in shallow water and is often fatal. This disease is a result of a person breathing compressed air underwater and ascending without properly exhaling.

Decompression sickness (Bends) is also a serious disease but does not affect divers working less than 40 feet deep. Deeper dives can be made with little danger of decompression sickness if U. S. Navy decompression tables are followed.

DISCUSSION

The usefulness of SCUBA as a fisheries tool in freshwater is yet to be fully realized. Biologists are beginning to see the advantages of being able to observe and study fish without permanently disturbing the aquatic environment. New underwater techniques are now needed. As developments occur in SCUBA methods, they should be reported as soon as possible to reduce duplication of effort and therefore improve fishery research and management methods, which is the ultimate goal.

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A STUDY ON STRIPED BASS EGG PRODUCTION IN THE CONGAREE AND WATEREE RIVERS

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INTRODUCTION

For several years the Santee-Cooper Reservoir has enjoyed a fabulous reputation due to the presence of a freshwater population of striped bass. Current studies, during the 1961 and 1962 spawning seasons, indicate that approximately 95 percent of the total annual production of striped bass eggs occurs in the Congaree River and five percent in the Wateree River. Recruitment of the striped bass fishery in the reservoir is entirely dependent on the number of eggs spawned in these two rivers; therefore, it is apparent that any changes in the physical characteristics of the rivers, especially the Congaree River, will directly influence the fishery. The striped bass of the Santee-Cooper Reservoir is a warm water fishery; however, it represents the only, the term only is used advisedly, established, self-sustaining, totally freshwater population of this species in the world.

The major problem in sustaining a successful spawn from year to year is directly related to the spawning habits of the striped bass, the physiology of the egg and the physical characteristics of the spawning habitat. Striped bass, like most anadromus fish, are free spawners. The eggs, which have a specific gravity slightly greater than fresh water and a comparatively high metabolic rate, must remain suspended in water until they hatch. Being slightly heavier than fresh water, it is necessary that a certain amount of current be present to keep the egg suspended. In the absence of current, the eggs would slowly settle to the lower layers of water where there might exist a deficiency of dissolved oxygen and thus die or settle to the bottom when they would silt-over