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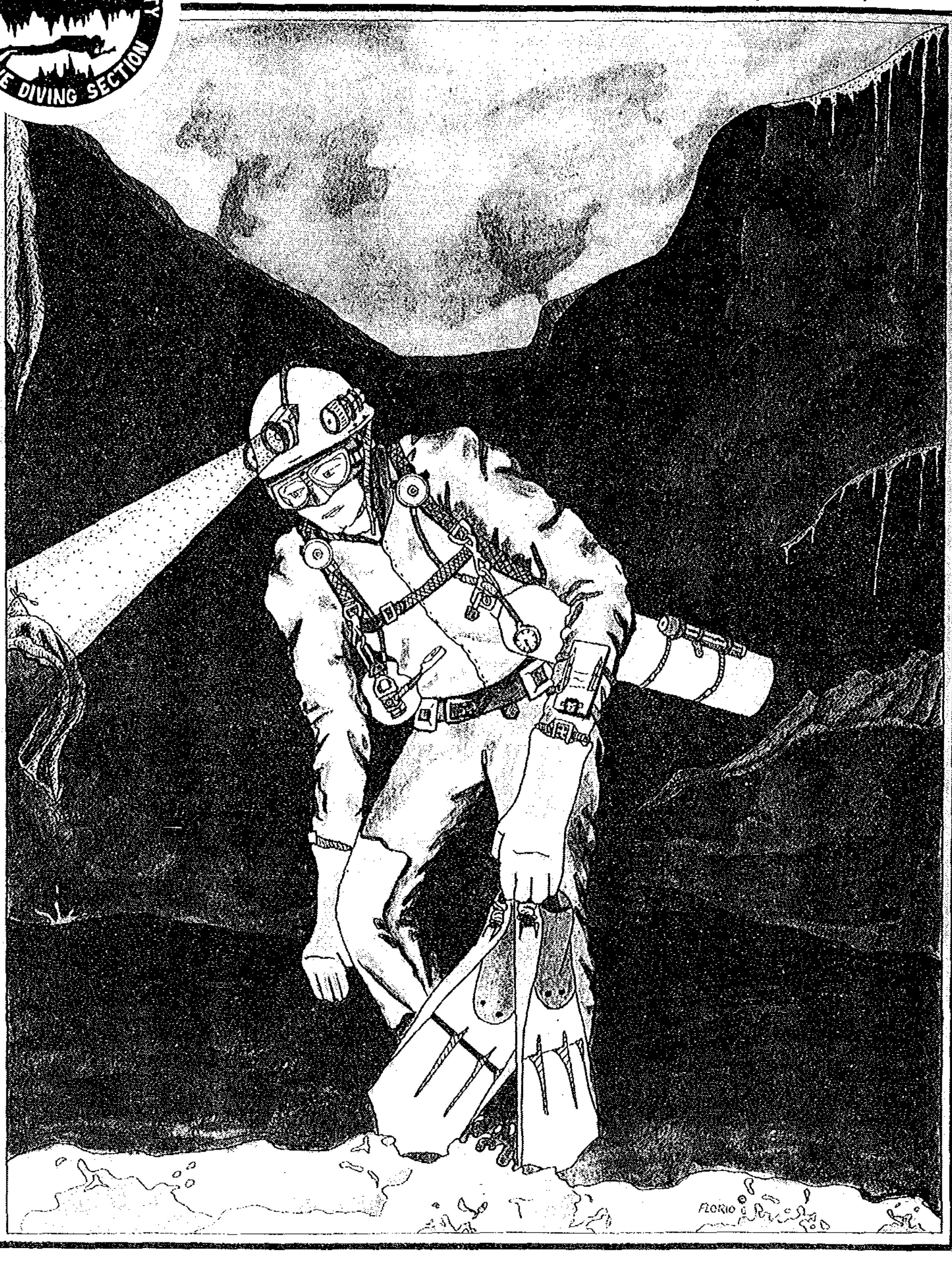

Underwater Speleology is the official newsletter of the
**CAVE DIVING SECTION OF THE
NATIONAL SPELEOLOGICAL SOCIETY, INC.**
P.O. Box 950, Branford, Florida 32008-0950

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THE NSS AND CAVE DIVING. Founded in 1941, the National Speleological Society joins together thousands of individuals dedicated to the safe study, exploration, and conservation of caves. The first cave-diving information ever published in the U.S. was in a 1947 *NSS Bulletin*. In 1948, NSS divers were responsible for the first cave dives in the U.S. using scuba. Prior to 1973, cave diving within the NSS was on a purely local level. That year saw the creation of the NSS Cave Diving Section to provide a vehicle for information exchange. Today, with over 400 members, the Cave Diving Section promotes safe cave diving through semi-annual workshops; cavern- and cave-diving training programs; warning-sign installation; search, rescue, and recovery through the National Cave Rescue Commission; cave exploration and mapping; several texts and publications on cave diving; and the bi-monthly newsletter-journal, *Underwater Speleology*, that you are presently reading.

MEMBERSHIP. The National Speleological Society welcomes the interest of anyone who has a sincere concern in the safe study, exploration, and conservation of caves, wet or dry. You may join the NSS either by writing to the NSS main office directly (National Speleological Society, Inc., Cave Avenue, Huntsville, AL 35810) or to the Cave Diving Section (NSS Cave Diving Section, P.O. Box 950, Branford, FL 32008-0950). Regular NSS Membership is now $25.00 per year, and entitles the member to monthly issues of *NSS News* and a semi-annual technical journal on speleology, voting privileges, and discounts on publications, convention fees, etc.

As a sub-organization or "section" of the NSS, the Cave Diving Section is subject to the by-laws and ethics of the NSS. Membership in the Cave Diving Section is open to anyone who is a member in good standing of the NSS. Regular membership is $5.00 per year, and we also offer a CDS Family Membership for $1.00 for family members (who are also NSS members) of regular CDS members. Membership in the Cave Diving Section includes subscription to our bi-monthly (6 issues/year) newsletter, *Underwater Speleology*, voting privileges, discounts on publications items, workshop registration fees, etc.

NEWSLETTER SUBSCRIPTION. If you do not wish to join the Cave Diving Section, but would like to keep current on cave-diving events, exploration, and technology, you are invited to subscribe to *Underwater Speleology* for $15.00 per year.

WHAT THE NSS-CDS HAS TO OFFER. The NSS Cave Diving Section sponsors two Safety and Information Exchange Workshops each year, traditionally held in Branford, Florida over the Memorial Day and New Year's Day weekends, although exact dates and formats vary. This year's SPRING WORKSHOP will be held at the Branford High School on May 27-28, 1989. The WINTER WORKSHOP will be conducted on Dec. 30-31, 1989. Information and pre-registration materials are published in the newsletter and can be obtained by writing to the NSS Cave Diving Section (P.O. Box 950, Branford, FL 32008-0950).

Information on cave-diving books, back issues of *Underwater Speleology*, T-shirts, Maps (available only to people with a cave-diving certification from an accredited agency such as NSS-CDS, NACD, YMCA, or NAUI), and free safety brochures may be obtained by writing to NSS-CDS Publications Coordinator (NSS Cave Diving Section, P.O. Box 950, Branford, FL 32008-0950).

Information on cavern- and cave-diving training can be obtained by writing to the NSS-CDS Training Director (NSS Cave Diving Section, P.O. Box 950, Branford, FL 32008-0950).

CHANGES OF ADDRESS. Members and subscribers are urged to report any change of address or address corrections in writing immediately to the Secretary-Treasurer in order to insure continuity of newsletter receipt. (The Newsletter Editor does not handle the mailing list, thank God!) Membership/subscription status, applications, and general information may be obtained by writing to the Secretary-Treasurer c/o the Section's permanent address:

Secretary/Treasurer
NSS Cave Diving Section
P.O. Box 950
Branford, FL 32008-0950

NEWSLETTER SUBMISSIONS. We welcome all current news items, reports, articles, photographs, negatives, slides, cartoons, notices for gear wanted/for sale (individuals only), letters to the Editor, or other submissions of relevance or potential interest for publication in this newsletter. We can now accept textual information on computer diskette if it is on an IBM-XT-compatible 5-1/4" 360K floppy in standard ASCII text format, WordStar version 3.0 - 5.0, Wordperfect up through 5.0, Multimate, MS-Word, and probably a bunch of other junk I haven't tried yet (no one ever reads this fine print!); however, all computer diskettes <u>must</u> be accompanied by a complete paper printout. For a small fee we can also receive FAX transmissions at the printers [FAX only (813) 484-6665 (8am-5pm M-F)]. All submissions become the property of the NSS-CDS.

All articles and letters to the Editor should include the author's name (even if he wishes to be printed as anonymous), return address, and NSS # (if any). If the subject matter refers to advanced exploration dives or techniques, or controversial topics such as deep diving, solo diving,questionable practices or safety infractions, please also include relevant biographical information such as professional qualifications (e.g., if your job is relevant or you have a doctoral degree - specify field), number of years cave diving, number of cave dives, level of certification, instructor status (if any, and number of students trained), exploration and survey projects participated in, cave-diving or NSS awards, etc. (modesty shall not be tolerated, but approximates are acceptable), so that readers may reflect upon the subject matter in the context of the author's experience or lack thereof. (Newly certified divers or non-divers are more than welcome to express their opinions; however, the advocacy of advanced techniques by unqualified divers—or manifestly unsafe practices by any diver—may be subject to review and/or censure.) All newsletter submissions should be sent in directly to the Editor:

H. V. Grey, Editor, UWS
P.O. Box 575
Venice, FL 34284-0575
813-484-7834 (evenings)

CALENDAR

<u>Dec. 30-31, 1989</u> - NSS-CDS Winter Cave Diving Workshop, "Safety and Exploration." Branford High School, Branford, Florida. See announcement on page 3.

COVER

"The Sump Jumper" - by Joanna Florio-Jefferys.

WINTER WORKSHOP

The Cave Diving Section's 1989 Winter Workshop, "Safety & Exploration," is being held December 30-31 at Branford High School in Branford, Florida. The workshop is being co-chaired by CDS Instructors Kelly Brady and Lt. Henry Nicholson.

The highlights of the workshop include a presentation by renowned cave-diving photographer Wes Skiles of his latest breathtaking films; a panel discussion of the topic, "Safety—where do we stand, where do we go from here?"; and a presentation on the conservation of underwater caves by biologist Tom Morris. There will also be a Photo Salon, with each participant able to enter up to five slides, and a Cartographic Salon, with a rare showing of new, unpublished underwater cave maps. A Recovery Workshop will be conducted Sunday.

Registration is $15 in advance and $17 at the door. The Recovery Workshop is $10 in advance and $12 at the door. CDS members and newsletter subscribers should have received a preregistration form with the last issue of UWS. For more information contact the Workshop Co-Chairmen:

Kelly Brady	Henry Nicholson
P.O. Box 2547	4517 Park St.
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PARTIAL RECLASSIFICATION OF FIRST-MAGNITUDE SPRINGS IN FLORIDA

- by William L. Wilson (NSS #12231) and Wesley C. Skiles (NSS #20850)

[Reprinted from "The Proceedings of the 3rd Multidisciplinary Conference on Sinkholes and the Environmental Impacts of Karst," sponsored by the College of Extended Studies and the Florida Sinkhole Research Institute, University of Central Florida, St. Petersburg, Florida, October 2-4, 1989, published by A.A. Balkema, Rotterdam.]

September 28, 1989

Dear Editor:

Thank you for your kind letter of September 9, 1989, in which you requested permission to reprint our Paper, "Partial Reclassification of First-Magnitude Springs in Florida." We had always intended to seek republication of the paper in *Underwater Speleology*, and were happy to learn that you liked it enough to want to publish it. It is our pleasure to give you our permission to reprint the paper and share it with the cave-diving community.

We request that you reprint the paper with the notice, "Reprinted from the Proceedings of the Third Multidisciplinary Conference on Sinkholes and the Environmental Impacts of Karst, sponsored by the College of Extended Studies and the Florida Sinkhole Research Institute, University of Central Florida, St. Petersburg, Florida, October 2-4, 1989, published by A.A. Balkema, Rotterdam." The conference proceedings are the original, professional source for the paper.

The cave springs of Florida are far from being fully documented and understood. *Springs of Florida*, by Rosenau and others (1977), was an outstanding compilation of facts, but it was never intended to be the endpoint for knowledge about the state's springs. Yet, the book was so well accepted that a 12-year hiatus has resulted in how we look at, and think about, the springs of Florida. New information, much of it acquired by cave divers, is forcing hydrologists to reevaluate our ground-water resources.

Wes and I hope that your readership will review our paper while keeping in mind that the operative word in the title is "Partial Reclassification . . . " Our paper is intended to promote and stimulate a new critical review of spring flow that will lead us to a better (more realistic) understanding of Florida's ground-water resources. Reliable data is lacking for many springs; so much field work remains to be done. We welcome any comments, questions, or new information from people who read our paper.

Science is commonly defined as a systematic body of knowledge, covering general truths or the operation of general laws, obtained and tested through study. More simply, science has been called the "art of measuring things." In this regard, any cave diver who wishes to survey caves, measure spring flow, or test water quality, is in a position to contribute to science. College degrees are helpful, but not necessary, for one to be a true scientist. We are confident that cave divers, in general, will continue to contribute significant discoveries and observations that will lead to a better understanding of ground- water resources.

Very truly,
William L. Wilson, P.G.
President, Karst Environmental Services
Wesley C. Skiles
Director of Exploration, Karst Environmental Services

PARTIAL RECLASSIFICATION 3 OF FIRST-MAGNITUDE SPRINGS IN FLORIDA

ABSTRACT

The most widely cited list of first-magnitude springs in Florida contains errors, omissions and inconsistencies that warrant extensive revision. At this time, only a partial revision is possible because of incomplete knowledge of spring discharge, especially for submarine and subriver springs that have no individual surface channel. In order to account for the complexity of springs, four separate lists are used for various types of features. The lists are for

1) single-vent springs and hydrologically related spring groups that represent the total outflow of clear water from a ground-water drainage basin,

2) river rises, which usually represent the resurgences of nearby sinking streams (the rises have brown water that is more characteristic of surface streams),

3) a combined list of first-magnitude springs regardless of the water source, and

4) karst windows, which are not springs, but constitute portals to significant underground streams. The proposed classification system eliminates double-counting of water resources, which occurred frequently on the old list, and allows a more accurate compilation of total spring flow.

Four karst windows were removed from the list of first-magnitude springs. Two river rises were transferred from the list of first-magnitude springs and placed, along with five others, on the new list of first-magnitude river rises. Four hydrologically invalid spring groups were removed from the list of first-magnitude springs, whereas two newly identified springs were added. One single-vent spring was recommended for deletion from the list of first-magnitude springs.

As a result of these changes, 19 first-magnitude, clear-water springs, or spring groups, are known in Florida; 4 other springs might have first-magnitude discharges; 7 river rises are first-magnitude; and 4 karst windows have first-magnitude flows. In order to avoid double-counting water resources, the karst windows should not be counted as ground-water resources, and the river rises can be counted as ground-water resources only if their associated sinking streams are not counted as surface-water resources.

The largest known spring, or spring group, in Florida is

Silver Springs (820 cfs) in Ocala; although the main spring at Spring Creek, south of Tallahassee, may be larger. Adjustment of the spring flow results in a net reduction of the total spring flow in Florida by approximately 1,371 cfs, or nearly 11%.

INTRODUCTION

The State of Florida is world famous for its numerous, beautiful, large karst springs. The most commonly cited list of first-magnitude springs in Florida is the one compiled by Rosenau and others (1977). They listed 27 springs, and groups of springs, each having an average discharge in excess of 100 cfs. The list needs extensive revision because it contains errors, omissions and inconsistencies. Also, the nature of cave springs and other cavernous drainage features is sufficiently complex so that one list does not adequately cover the range of geomorphic features that are present in the karst of Florida. The purpose of this article is to revise the list of first-magnitude springs in Florida, as much as existing data allow, and to point out the drainage basins where knowledge of the spring discharge is, as yet, insufficient for proper classification.

Before discussing the system of spring classification used in this paper, it is important to describe the general character of karst springs in Florida. The first-magnitude springs of Florida discharge from the cavernous Florida Aquifer (Parker, 1955), which is an Eocene to Miocene age carbonate aquifer. Lithologically, the aquifer is composed dominantly of limestone and dolomite. Much of the limestone is soft and highly porous, which makes it distinctly different from the denser, harder Paleozoic carbonates of North America. Spring vents, in Florida, may be either an open cave, or an occluded cave where the presumed conduit is blocked with boulders, gravel and/or sand. All of the large cave springs in Florida are rise pits as defined by Jennings (1971); none of them have any partially air-filled conduits at the spring.

The dominantly phreatic character of caves in the Floridan karst is a result of low relief, near-surface water tables, and the presence of clayey confining units above the cavernous aquifer in many areas. The Floridan karst is neither abnormal, nor unusual; it is an important example of karst development under a set of hydrogeologic conditions that differ greatly from the water-table drainage systems of other famous North American karst areas.

Most of the large karst springs in Florida are noted for their clear, steady flow. Visibility through the water commonly exceeds 100'. The caverns convey a steady flow of water because most, but certainly not all, are fed by diffuse recharge through a nearly ubiquitous blanket or surficial sand. Diffuse recharge and filtration of recharge contribute to the exceptional water clarity. The sandy overburden consists mostly of Pleistocene marine terraces, beach deposits, spits, and stabilized eolian dunes. Spring flow rarely varies by more than a factor or two. The most variable of the first-magnitude springs, Wakulla Spring (Rosenau and others, 1977), varies by only one order of magnitude, compared to several orders of magnitude, which is typical for karst springs in unconfined ground-water drainage basins with clay soil cover, developed in Paleozoic limestones or the Appalachian Mountains, Interior Low Plateaus and Ozark Mountains.

Clear-water cave springs usually represents discharge of ground water derived wholly, or dominantly, from diffuse recharge systems as described above. Sinking streams, although present in the Floridan karst, are not the dominant form of recharge for most cavernous drainage systems. In contrast to the clear-water springs are those which continuously discharge brown water that has a tannin content comparable to nearby surface streams. The brown-water springs are fed dominantly by nearby sinking streams. They commonly represent a component of stream flow that passes through cavernous braids, below and subparallel to the surface stream channel.

DEFINITIONS AND CONSIDERATIONS

The definition of a spring as a "natural, concentrated flow of water emerging from the ground" may seem intuitively obvious, but examination of natural springs quickly reveals a number of complicating factors. Springs must be carefully defined to suit the intended purpose of the classification system. One could, for example, consider only individual spring vents in compiling a list of major springs. Yet it has been a common practice to group hydrologically related springs because of the view that springs, ideally, represent the mouths of ground-water drainage basins. The authors prefer to adhere to this condition as much as possible, because an inventory of springs, thus defined, will serve as a measure of the total renewable ground-water resources, and this is an important datum for resource management. Consequently, in this paper we will combine both single vents and hydrologically related springs that represent, as nearly as possible, the total discharge from individual basins, but will distinguish between clear-water and brown-water systems. The clear-water systems can be counted as ground-water resources without question. The brown-water systems represent, at least in the major part, water that was counted as a surface-water resource before it passed into a swallow hole.

Hydrologically Related Springs. The concept of "hydrologically related" springs needs some amplification. In some basins, the highest-order cavern bifurcates in the downstream direction and discharges through more than one spring. In order to represent the total discharge of an individual basin, the springs must be grouped. The key criterion for spring groups is that the vents are distributary outlets for a single ground-water drainage system. Springs that are merely in proximity to one another do not necessarily qualify as a hydrologically related spring group. Differences in water quality reveal that many of the spring groups on the list prepared by Rosenau and others (1977) are hydrologically unrelated, or they are related only in the sense that they merely occur along the same surface stream channel but are not distributaries from a single drainage basin. In as much as possible, the authors have attempted to group springs in a hydrologically realistic manner, wherever sufficient data were available.

Complications. The definition of individual springs and hydrologically related spring groups as the mouth of ground-water drainage basins is complicated by the fact that 100% of the drainage may not discharge through the spring(s). Underwater cave exploration and dye tracing has repeatedly revealed that many springs are merely tap-off passages from larger conduits (Fisk and Exley, 1977; Ruppert and Wilson, 1989). At Devil's Eye Spring Group, a newly recognized first-magnitude spring group, the authors found that 27% of the water in the phreatic cave does not emerge at the known spring outlets, but passes downstream through siphon tunnels in the cavernous aquifer. Thorough study of the cavernous drainage system, including direct exploration and quantitative dye tracing, is usually necessary to fully delineate the cavernous ground-water drainage basins.

Another problem with compiling a list of single-vent springs is that discharges reported in the literature for some, supposedly individual, springs actually represent spring groups, especially where two or more vents are located in the same pool and do not have separate surface stream channels. Where one or more small spring vents are associated with a very much larger, main spring vent, then it is simpler to accept the reported discharge as the approximate value for the main spring. In many cases this assumption has no effect on the ranking of the main spring. The authors have attempted to distinguish between multiple spring vents in single pools as much as possible.

The lack of discharge measurements for large vents in the same pool or for submarine springs in the same embayment, poses a major difficulty for consistent spring-discharge ranking. Greater effort needs to be made at measuring individual spring flow by subaqueous measurement techniques, rather than relying entirely on surface-stream gauging techniques, which cannot provide individual spring discharges in many cases. Pipe-full discharge measurement techniques utilizing scuba diving need to be implemented on a routine basis in order to provide complete and reliable spring discharge data.

River Rises. In contrast to the famous clear-water karst springs of Florida, a number of springs are classified as "river rises" because they discharge brown water with a tannin content that compares closely with that of nearby surface streams. The river rises are the resurgences of sinking streams or, more commonly, major surface streams that sink partially. They are herein defined as springs which discharge water composed at least 50%, by volume, of water derived from sinking streams. In Florida, the underground course between the sinking stream and its associated rise is usually rather short—less than three miles in the cases examined to date—so the quality of the water is little affected by passage through the underground course.

River rises are identified separately in order to avoid double-counting surface-stream flow as a ground-water resource. Inclusion of some river rises on the list of first-magnitude springs by Rosenau and others (1977), has led to compilation of a total spring discharge for Florida that overstates the size of the ground-water resource. However, the discharge of the river rises is augmented, to some extent, by ground water. Yet very little data is available on the imput and output of the sinking stream/river rise systems, so the amount of ground water discharged through these springs is virtually unknown and cannot be included in ground-water resource estimates. It is imperative that input/output studies be conducted at river rises in order to fully assess Florida's ground-water resource.

Karst Windows. Karst windows are a type of sinkhole in which an underground stream is temporarily exposed to the surface because of cave-roof collapse (von Osinski, 1935). Although the cave stream is at the surface for a short distance, the fact that it sinks within the same topographic depression in which it resurges, indicates that the stream has not returned to flow in surface channels in a meaningful way. An underground stream should not be called a spring just because it can be seen through a hole in the cave roof. To do so leads to the illogical situation of counting the same stream of water more than once when compiling a list of springs.

Inclusion of karst windows on the list of first-magnitude springs by Rosenau and others (1977) has resulted in overstatement of the total spring flow in Florida. However, some karst windows are significant features, in that they expose cave streams of first-magnitude ranks, so they will be entered on a separate list of first-magnitude karst windows rather than combining them with springs.

CHANGES IN THE LIST OF FIRST-MAGNITUDE SPRINGS

Deletion of Karst Windows. Four of the "springs" presented on the list of first-magnitude springs by Rosenau and others (1977) are karst windows, rather than true springs. Kini "Spring," River Sink, Natural Bridge "Spring" and Falmouth "Spring" are transferred from the list of first-magnitude springs to the list of first-magnitude karst windows. The discharges are deleted from the ground-water resources of Florida because the flow is counted at true springs.

Kini "Spring" (176 cfs) and River Sink (164 cfs) are almost certainly upstream segments of flow that resurges at Wakulla Spring, although no dye trace has yet been performed to confirm this hypothesis. Natural Bridge "Spring" (106 cfs) is a brown-water flow system that very probably contributes flow to St. Mark's River Rise.

Falmouth "Spring" (158 cfs) is an entrance to the Falmouth-Cathedral Cave System, which extends northwest-southeast as a single major trunk passage for over 10,000' (Exley, 1989). Water in the cave system flows northwest toward the Suwannee River located approximately 4 miles from Falmouth "Spring." The water probably resurges through a previously unreported spring known as Line-Eater Spring, which occurs inconspicuously along the south bank of the Suwannee River. Line-Eater Spring may have a first-magnitude discharge, but no measurements are available. The spring is the entrance to an underwater cave containing 1.5 miles of surveyed passage extending southeast toward the Falmouth-Cathedral Cave System. The unusual name of the cave comes from the fact that the water velocity in the cave is so high that guidelines placed by cave divers flap in the current, abrade against the rock walls, and break in a matter of hours, rather than lasting for years, as at most other underwater caves.

Deletion of Invalid Spring Groups. Four of the spring groups on the list of first-magnitude springs prepared by Rosenau and others (1977) discharge water of various sources and quality. The lack of valid hydrological relations is reason to remove Ichetucknee Springs, Crystal River Springs, Spring Creek Springs and Wacissa Springs from the list of first-magnitude springs. The discharge from these spring groups remains as part of the ground-water resources of Florida, but the ranking of the springs by discharge is changed.

Ichetucknee Spring Group (361 cfs) consists of at least nine individual springs that occur along a 2.3-mile-long segment of the Ichetucknee River, on the border between Suwannee and Columbia Counties. None of the springs are known to be connected by caves and they probably convey flow from different sides of the river. Jug Hole (also known as Blue Hole) may be a marginal first-magnitude spring by itself, but individual discharge measurements are not available.

Crystal River Spring Group (916 cfs) consists of at least 23 individual springs located in a two-mile-square area of Crystal Bay along the central-west coast of Florida, in Citrus County. All of the springs are submarine and no direct measurements of individual springs discharges have been made. Discharge for the springs comes from a wide area north, east and south of the bay, indicating that many of the springs are hydrologically unrelated. Tarpon Spring, in the central-east part of the bay, is the largest individual spring in the group, but it probably is not a first-magnitude spring.

Spring Creek Spring Group (2,003 cfs) consists of at least 14 submarine springs in two separate branches of a tidal creek at Oyster Bay, along the coast south of Tallahassee. The springs are discharging water with chloride contents ranging from less than 250 mg/L to 1,200 mg/L (Rosenau and others, 1977). Because of the chemical differences and the lack of known cave connections, these springs cannot, at this time, be considered as a valid, hydrologically related spring group. The main spring in Spring Creek (also known as Spring No. 1, or Spring Creek Rise) is definitely a first-magnitude spring. The vent at Spring Creek Spring is approximately 30' in diameter and discharges water with such a high velocity that it is difficult for divers to hold onto the walls. Divers have descended through the vent to a depth of 180', with no decrease in flow (Exley, 1989). Measurements performed by the USGS on May 30, 1974 indicate that the discharge of the main spring is less than 764 cfs, but direct observations by divers indicate that the average discharge may exceed 1,000 cfs, which would make it the largest spring in the United States. Additional study of this large spring group is greatly needed in order to understand the karst ground-water resources of the Woodville Karst Plain.

Wacissa Spring Groups (3389 cfs) in Jefferson County, northern Florida, consists of 12 springs, but the discharge reported by Rosenau and others (1977) is for a total of at least 18 springs. Many of the spring vents in the group have different quality water, indicating that they represent different ground-water drainage basins. Big Spring commonly discharges green water; Cassidy, Little Blue and Minnow Springs usually discharge blue water; whereas Log, Thomas and Spring No.1 commonly discharge brown water. Big Spring may be a first-magnitude spring by itself, but no individual discharge measurements are available.

Newly Identified First-Magnitude Springs and a Questionable Ranking. Devil's Eye Spring Group is a newly identified first-magnitude spring group (Wilson and Skiles, 1988) located along the Santa Fe River in Section 34, T. 7 N., R. 16 E. Three springs, Devil's Eye, Devil's Ear, and July Spring, are connected by cave passages and serve as distributary outlets for a single ground-water drainage basin that extends north and northeast from the springs. More than 6.8 miles of underwater cave passages have been surveyed. July Spring occurs on the north bank of the Santa Fe River, in Columbia County. Devil's Ear Spring occurs in the floor of the Santa Fe River on the south side of the river, and Devil's Eye Spring occurs in a spring run on the south side of the river, in Gilchrist County. All of the springs discharge clear water into the river, which is dark brown because of tannin. The combined discharge of the spring group averages 284 cfs. Devil's Ear, the largest single vent in the group, discharges an average of 124 cfs and is a first-magnitude spring by itself. Rosenau and others (1977) reported these springs, estimated that they had second-magnitude discharges, and knew that they were connected by caves, but did not recognize them as a first-magnitude spring group.

Croaker Hole is a spring in the floor of the St. Johns River, near the southwest corner of Little Lake George, approximately 0.2 mile north of Norwalk Point, in Putnam County. At a depth of 40' is a horizontal cave entrance, 12' high and 25' wide. A strong current of clear water issues from the cave. The authors estimate the discharge is approximately 360 cfs. The passage inside the entrance is approximately 12' high and 15' wide. It extends approximately 100' to a collapse where boulders prevent further penetration.

Rosenau and others (1977) reported Hornsby Spring (163 cfs), along the Santa Fe River, in Alachua County, as a first-magnitude spring based on the average of two discharge measurements. The discharges were 76 and 250 cfs. The authors have no additional measurements to present, but based on years of observation, are of the opinion that Hornsby Spring has an average discharge closer to 76 cfs, and that the 250 cfs discharge represents an unusually high flood flow. Hornsby Spring should be studied further to determine if it is a first-magnitude spring. The authors recommend deleting it from the list until additional supporting data become available.

River Rises. Springs that discharge brown water are the resurgences of sinking streams that usually have passed short distances underground, as described above. In order to avoid double-counting surface water as ground water, it seems advisable to place first-magnitude river rises on a separate list. Rosenau and others (1977) reported two first-magnitude springs, Alapaha Rise (608 cfs) and St. Mark's Spring (519 cfs), that are, in fact, river rises. These two springs are transferred to the list of first-magnitude river rises. The discharge of these two rises is deleted from the ground-water resources of Florida. The proportion of ground water that augments the flow of the rises is completely unknown except at Santa Fe Rise where ground-water contributes 25 to 43% of the discharge based on two measurements (Skirvin, 1962).

Five known river rises of first magnitude were not included on the list of first-magnitude springs by Rosenau and others (1977). Santa Fe River Rise, Suck Hole Rise, Siphon Creek Rise, Steinhatchee River Rise, and Chipola River Rise are added to the list of first-magnitude river rises. The first three rises occur along the Santa Fe River, in north-central Florida. The Santa Fe River repeatedly sinks, or sinks partially, along its course and has significant surface and subsurface components of flow.

Santa Fe River Rise is located in Alachua County, north-central Florida. The average discharge of the rise is at least 586 cfs (Hunn and Slack, 1983). The Santa Fe River sinks completely in O'Leno State Park, at a point 3 miles northeast of the rise. Based on average flow, the Santa Fe River is probably the largest sinking stream in the United States. According to Skirvin (1962), when the volume of water entering the sink is between 200 and 570 cfs, then the amount of ground-water augmentation at the rise is fairly constant: 150 to 190 cfs, respectively. This implies that as the stage of the river rises, the potentiometric surface of the ground water rises in nearly direct proportion.

Suck Hole rise is located several hundred yards upstream from the US Highway 27 Bridge across the Santa Fe River, northwest of the town of High Springs, in Alachua County. Approximately 160 cfs discharge from an underwater cave opening 4' high and 20' wide. Even during low water, the current is so strong that it is difficult to enter the cave. The water discharging from Suck Hole Rise probably sinks at Suck Hole, located on the north side of the river approximately 3,400' northeast from the rise.

Siphon Creek Rise is located along the south side of the Santa Fe River in north-central Gilchrist County. Approximately one-third of the flow in the Santa Fe River sinks at a group of three swallow holes called Big Awesome Suck, Little Awesome Suck and Track 1 Swallow Hole. The sinks are located on the north side of the river approximately 1 mile upstream from Siphon Creek rise. The swallow holes and rise are connected by a humanly traversable connection that is 7,800' long. The cave system contains a total of 21,000' of surveyed passage. Most of the cave system is 90' to 120' underwater. Several side passages contribute clear streams of ground water to the brown, sinking-stream water, but the proportion of flow is not known. Siphon Creek Rise is an underwater cave entrance 10' high and 30' wide discharging approximately 600 cfs.

The Steinhatchee River sinks completely along the border between Dixie and Taylor Counties, northeast of the small town of Tenille, approximately 10 miles inland from the northwest coast of peninsular Florida. A USGS gauging station 1/2 mile upstream from the sink, has recorded an average flow of 328 cfs. The discharge of the rise, located 3/4 mile southwest of the sink, may be slightly higher, but no gauging records are available.

The Chipola River sinks in Florida Caverns State Park, approximately 2 miles north of Marianna in Jackson County, in the central part of the Florida Panhandle. The underground course of the stream is only about 1/4 mile long, and the stream flows from north to south. The average discharge of the Chipola River Rise is not known, but very likely exceeds 100 cfs, based on the authors' observations.

SUMMARY AND CONCLUSIONS

Based on the changes described above, the clear-water, first-magnitude springs of Florida are ranked by discharge in Table 1. River rises are defined and treated separately in order to avoid double-counting water resources. The first-

TABLE 1

First-Magnitude, Clear-Water, Single-Vent and Hydrologically Related Spring Groups in Florida

Spring Rank and Name		County	Average Discharge (cfs)
1	Silver Springs	Marion	820
2	Rainbow Springs	Marion	763
3	Spring Creek Main Spring	Wakulla	<764?
4	Wakulla Spring	Wakulla	390
5	Croaker Hole	Putnam	360
6	Holton Spring	Hamilton	288
7	Devil's Eye Spring Group	Gilchrist & Columbia	284
8	Blue Springs	Jackson	190
9	Manatee Spring	Levy	181
10	Weeki Wachee Springs	Hernando	176
11	Homosassa Springs	Hernando	175
12	Troy Spring	Lafayette	166
13	Blue Springs	Volusia	162
14	Gainer Springs	Bay	159
15	Chassahowitzka Springs	Citrus	139
16	Alexander Springs	Lake	120
17	Blue Spring	Madison	115
18	Silver Glen Springs	Marion	112
19	Fannin Springs	Levy	103
	Other clear-water springs that might be first-magnitude:		
20	Jug Hole Spring	Columbia	
21	Big Spring	Jefferson	
22	Tarpon Spring	Citrus	
23	Line-Eater Spring	Suwannee	

Note: The list above specifically excludes river rises, which discharge brown water derived mostly from nearby sinking streams.

TABLE 2

First-Magnitude River Rises in Florida

Spring Rank and Name		County	Average Discharge (cfs)
1	Alapaha Rise	Hamilton	608
2	Siphon Creek Rise	Gilchrist	≈600
3	Santa Fe Rise	Alachua	>584
4	St. Marks Spring	Leon	519
5	Steinhatchee Rise	Dixie	>328
6	Suck Hole Rise	Alachua	≈160
7	Chipola	Jackson	>100

Note: River rises are cave springs that discharge brown water having a tannin content comparable to nearby surface streams. The discharge is composed dominantly of water from nearby sinking streams, and should not be counted as a ground-water resource unless the flow in the sinking stream in not counted. Ground water augments the discharge at the rises, but the proportion of ground water in the flow is unknown except at Santa Fe Rise, where it ranges from 25 to 43%, based on two measurements (Skirvin, 1962).

TABLE 3

First-Magnitude Springs in Florida, Regardless of Water Source

Spring Rank and Name		County	Average Discharge (cfs)
1	Silver Springs	Marion	820
2	Rainbow Springs	Marion	763
3	Spring Creek Main Spring	Wakulla	<764?
4	Alapaha Rise	Hamilton	608
5	Siphon Creek Rise	Gilchrist	≈600
6	Santa Fe Rise	Alachua	>584
7	St. Mark's Spring	Leon	519
8	Wakulla Spring	Wakulla	390
9	Croaker Hole	Putnam	360
10	Steinhatchee Rise	Dixie	>328
11	Holton Spring	Hamilton	288
12	Devil's Eye Spring Group	Gilchrist & Columbia	284
13	Blue Springs	Jackson	190
14	Manatee Spring	Levy	181
15	Weeki Wachee Springs	Hernando	176
16	Homosassa Springs	Hernando	175
17	Troy Spring	Lafayette	166
18	Blue Springs	Volusia	162
19	Suck Hole Rise	Alachua	≈160
20	Gainer Springs	Bay	159
21	Chassahowitzka Springs	Citrus	139
22	Alexander Springs	Lake	120
23	Blue Spring	Madison	115
24	Silver Glen Springs	Marion	112
25	Fannin Springs	Levy	103
26	Chipola	Jackson	>100
	Other clear-water springs that might be first-magnitude:		
27	Jug Hole Spring	Columbia	
28	Big Spring	Jefferson	
29	Tarpon Spring	Citrus	
30	Line-Eater Spring	Suwannee	

Note: The springs and spring groups listed above include both clear-water cave springs, the discharge from which can be counted as a ground-water resource, and brown-water springs, herein termed "river rises," that represent the resurgence of sinking streams. In order to avoid double-counting surface water as ground water, the river rises should not be counted as ground-water resources.

TABLE 4

First-Magnitude Karst Windows in Florida

Spring Rank and Name		County	Average Discharge (cfs)
1	Kini "Spring"	Wakulla	176
2	River Sink	Wakulla	164
3	Falmouth "Spring"	Suwannee	158
4	Natural Bridge "Spring"	Leon	106

Note: Karst windows are collapse sinkholes which expose a segment of cave stream. Karst windows are not springs. Their discharge should not be counted as a ground-water resource, because doing so will result in double-counting the water if it is also counted at the true spring. A good example of this is Kini "Spring" and River Sink. Water flows from Kini "Spring" to River Sink and probably resurges at Wakulla Spring.

magnitude river rises are shown in Table 2. The clear-water springs and the brown-water river rises are, in fact, all true springs, so a combined list is shown in Table 3 to illustrate the ranking of Florida's largest springs, regardless of the water source. Karst windows were formerly, erroneously, counted as springs, but this resulted in double-counting of water resources. First-magnitude karst windows are ranked by the discharge of the exposed cave stream in Table 4.

The most frequently quoted list of first-magnitude springs in Florida was prepared by Rosenau and others (1977). Six of the features on the list to be deleted in order to avoid double-counting water resources. Four of the features are karst windows and the other two are river rises. Deletion of these features from the list of springs reduces the total discharge of springs in Florida by 1,731 cfs or 13.7% less than the total amount estimated by Rosenau and others (1977).

Addition of Croaker Hole, a previously unreported first-magnitude spring, increases the total spring flow by approximately 360 cfs, so the net change in the total spring glow is 1,371 cfs (10.9%) less than that estimated by Rosenau and others (1977). The Devil's Eye Spring Group was known to Rosenau and others (1977), but was not recognized as a first-magnitude spring by them, so its discharge is not considered to be a net change in the total spring flow.

Individual spring discharge measurements are not available for many major springs in Florida, especially submarine springs such as those at Spring Creek and Crystal River. An expanded program of periodic spring measurement is needed to accurately and completely characterize the renewable ground-water resources in Florida. Underwater gauging techniques need to be developed and standardized for use at springs that discharge into bodies of water and have no individual surface stream channel.

The inflow at major swallow holes and sinking streams needs to be measured and compared to the discharge at river rises in order to determine the amount of ground-water augmentation. Significant amounts of ground water join the pirated stream water, but the proportions are almost completely unknown. The river rises are an important type of first-magnitude spring in Florida.

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THE NOHOCH PUSH EXPEDITIONS - by Steve Gerrard (NSS #26640)

[ABOUT THE AUTHOR: Steve Gerrard is one of our most active cave-diving instructors, certifying through the NSS-CDS, NACD, and NAUI, and teaching full time. He has been cave diving since 1975 and has trained over 600 divers in cavern and cave diving. He is currently President of the National Association for Cave Diving (NACD) and Editor of its newsletter, The NACD Journal. *He was involved with finding the first Remipede in Mexico, along with the first "live" species of two troglobitic snails in northern Mexico, and has done extensive exploration of underwater caves in Belize, the Bahamas, Mexico, Missouri and Florida.]*

During November of 1987, Felipe, who is the son of Don Pedro and employed by Mike Madden of Cedam Dive Centers, reported to Mike about a huge cenote located on their family ranch, which they use for their water supply. The description of a huge pit with crystal clear water intrigued Mike enough to investigate. Hiking on a dense jungle trail to the property, Mike was shown the cenote, which had at least a 20' drop and was covered thickly with vegetation. On the far side was a slope that enabled one to walk down into the hole.

Sure enough, crystal clear, blue, fresh water existed. Mike jumped in and snorkeled around, and was able to go back at least 500' in distance and still find surface air. Incredible! Also amazing were pure white cave decorations galore underwater going in every direction imaginable. This was too good to be true and Mike got excited with many ideas. On Thanksgiving Day, using the horse belonging to Don Pedro to haul the diving equipment in, Mike, Denny Atkinson, Juan José Tucat, and Ron Winiker made the first cave dive into the system. The trip to Disney World had begun.

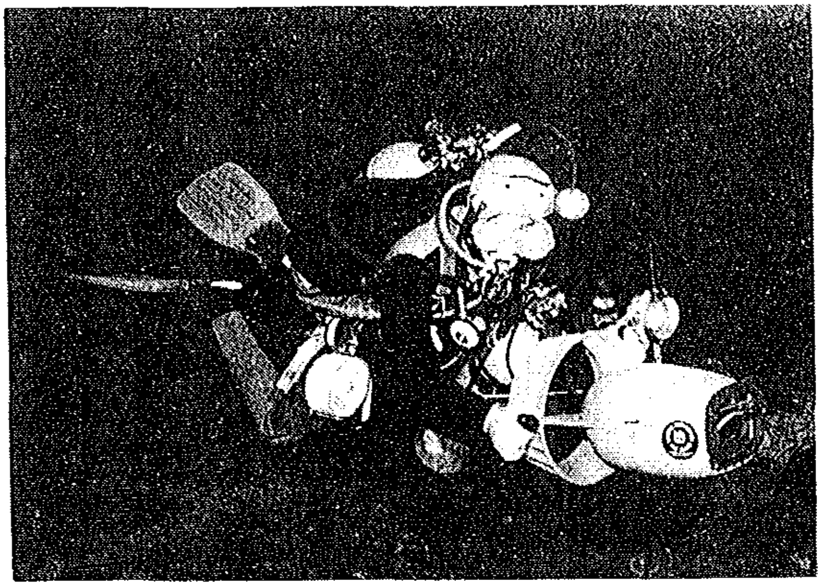
Obviously, the biggest problem was the logistics involving the cave-diving equipment. Explaining this unique system to Don Pedro, an agreement was reached where Mike would obtain two horses and pay for their feed and care if they could stay on the ranch and be used to transport equipment in and out from Highway 307. With this done, the first cave dives took place and the magic adventure started.

The cave system is enormous and, better yet—shallow. Like kids with candy, each dive was spent laying line and exploring as far as possible until they ran out of guideline on the reel. During the next 12 months, with the help of many individuals, such as Denny, Juan José, Parker Turner, Dr. Alberto Rodriguez, Randy Lathrop, Ed Fiorell and Charlie Hancock, the cave system developed on the map with all survey data collected. *Nohoch* means *big, huge,* or *giant* in Mayan, and this name suited the cave system perfectly.

The first 1000' or more is almost too difficult to describe as the cave appeared to be all one room—or was it a variety of different passageways? (This aspect is still being hotly debated.) Judging from the survey, it can be said that the width was just as big as the length and, if so, is this the biggest subterranean room in the world? Some people think so! With subsequent dives, about 1500' back, finally a defined underwater river passageway evolved, which had flow, never went over 30' in depth, and had no vents to the surface.

On one dive, Mike made a significant discovery 5400' back: a tremendous air pocket which had a round shaft 15' in circumference going 30' up to the surface of the jungle. With double 80's and stage bottle, the guideline was pushed to a maximum distance of 5400' and still going. Mike vowed he would return with bigger and more toys to push it further.

Meanwhile, during these same months of exploration, Mike and Ron Winiker of Santa Cruz, CA, along with the help of Ed Fiorell of Soquel, CA, began to seriously take photos of the numerous and beautiful cave decorations which were beyond



Mike Madden, owner of Cedam Dive Centers, piloting his way through the Nohoch Expeditions of July 1, 1989. Photo by Bill Carlson.

the comprehension of reality. Using a Nikonos V stationed on a parked tripod, Mike and Ron tirelessly began using a slave strobe, with Mike positioning himself to "paint" the planned scene, sometimes firing the strobe up to sixteen times to create the beauty of the cave feature. With audacious imagination to title each scene and Ron's expert work in the darkroom, no doubt the BEST underwater photos taken so far in the history of the cave-diving community emerged.

The cave tunnel was still going and Mike became impatient knowing there was a huge trail still waiting to be blazed. There is an old Mayan legend where the Mayans traveled underground by canoe when the water levels were much lower, between the cities of Chichen-itza, located over 100 miles into the Yucatan interior, to the coastal city of Tulum. Could this be that hidden underground roadway? Only one way to find out: if you don't go you will never know.

During February, 1988 that day arrived as Mike, Juan José and I had the opportunity and brought in our bigger toys of 104's, two stage bottles apiece, and seven packed reels of #18 nylon guideline. We were LOADED for bear. We began the dive expecting a six-hour bottom time. At 2500' we dumped our first stage bottles, and at the air pocket with the shaft to the surface, we dropped our second stage bottles. Mike named this location the "Dinnerhole," as we had packed our sandwiches and Mike's cigarettes in an empty light canister, plus soft drinks in our pouches. From this point we reached the end of the line 5500' back and began to lay new line with the first reel.

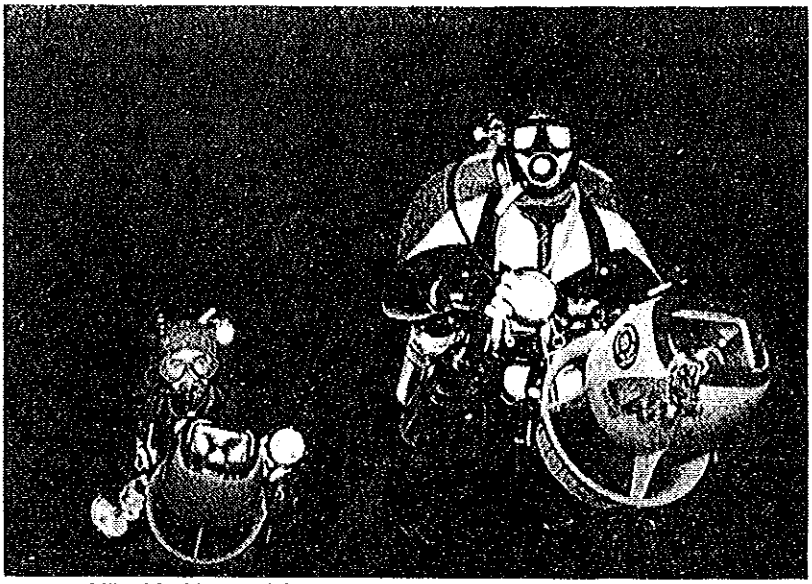
There is ONLY one reason why I cave dive and that's because it is FUN. When I hear other people say they cave dive for reasons beyond enjoyment, I certainly feel sorry for them. There is almost NO better feeling to experience than seeing "virgin" passageway and going where no person has ever been before. Incredible! As we deployed knotted guideline and emptied each reel, we found that the scope of this cave system was beyond our wildest dreams. Halfway through the sixth reel, we hit our thirds and called the dive. Carefully surveying out, we found we had laid the unbelievable amount of 4100' of new line, a feat that will probably never have the opportunity of being matched again as far as the distance of laying/surveying new line on one dive goes. Reaching the "Dinnerhole" and taking a short break, we finally exited the cave system after 5 hours and 40 minutes. We were tired puppies and realized we had swum 19,400', or almost 4 miles. A few other cave divers have done more challenging or difficult dives, but it was a satisfying feeling to know that we had given it our best shot 3km back in the jungle.

A year went by and lots of discussion of when would be our next move to push Nohoch. Finally, during early May of 1989, we decided that we would try again to push this incredible cave system for one week in July. But this time we would need our mules (Tekna DPV's). Our first thought was to get four scooters and stage them. We realized the range of the Tekna DPV was about 10,000' total distance on good batteries. Mike made the decision to abandon that idea and have Felipe, Del and Sabino (Don Pedro's sons) hack out a trail to the "Dinnerhole." We would have to pack in ALL our gear to that point. Question was, where was the "Dinnerhole" out in that dense jungle?

Using the underwater data kind of helped but Mike decided the only way was to scooter back solo to the "Dinnerhole," climb out like a "monkey," and yell for the guys to find him. For this goal, Don Pedro produced a bull horn's trumpet and this tool was used very effectively for Mike to signal where he was and be found. After an hour of blowing and almost giving up, they found Mike in the dense brush at the top of the shaft. Immediately, the four weeks' work began to cut out a trail for the pack horses, build a ladder to climb down the hole, and rig a pulley hoist to lower all the equipment. What fun! Guess what? Our new entrance into the cave system was now 8km back into the jungle from the highway. What a nightmare. The second week of July was targeted for the "Nohoch Push" and we realized we needed much more help. Mike invited Tony DeRosa, Joanie Patrick, and Jim Coke of Akumal; Tom Young of Houston, TX; Bruce Schadow and Bill Carlson of Minneapolis, MN; and myself.

The goal was for Mike and myself to use the motors and

Members of the 1989 Nohoch Expedition: Mike Madden, Sergio, Felipe, Del, Steve Gerrard, Joanie Patrick, Bruce Schadow, (kneeling) Tony De Rosa, Bill Carlson



Mike Madden and Steve Gerrard scootering through the incredible Nohoch Cave/Cenote System during July, 1989. Photo by Mike Madden.

concentrate upstream beyond the 9600' end point, while Tony and Bill worked on any leads within a reasonable distance of the "Dinnerhole" using stage bottles, and Bruce and Joanie concentrated on trying to find a lead to another cenote discovered earlier in the year by Mike, Bill and Bruce, which is called "Lunas y Sombranos," or "Moons and Shadows," about 1000' east of Nohoch. Organizing and directing all the necessary gear and divers is NO picnic, and I was very impressed with how Mike managed to do so and still not turn into a jello brain nerd.

Amazingly, for six hard working days we made many new discoveries and were able to lay an additional 15,000' of new guideline to push the total cave system from an existing 21,000' up to 36,000' total. This would make the underwater cave system definitely the biggest in Mexico by far and perhaps the 2nd or 3rd largest in the world, depending on whom you talk to or whom you believe knows what is what. (Sadly, the cave-diving community is very disorganized regarding FACTUAL information on the sizes and distances of cave systems through the world.)

For Mike and myself, our four scooter dives were memorable and very productive. Using double 104's, one stage bottle apiece, and the Tekna motors, we would motor back from the "Dinnerhole" 4800' back to the end of the line from February, 1988 dive, and begin laying new line. We were able to get to this point on one stage bottle, so we parked the mules and bottles and began our quest with "fresh" 104's. What excitement as we carried our huge mambo reels packed to the gills with clean white #118 knotted nylon guideline.

On our first dive, we swam only 100' beyond our scooter station and hit a beautiful, huge dome room. Sticking our noses in the flow of water, we guessed our way along. But, what happened with all four dives was awesome and frustrating within itself. What we had found was a tremendous swiss-cheese area of cave that made it impossible (so far) to find a defined passageway beyond. Everywhere we went we ended up at dead ends. We were able to lay approximately 9000' of line, but could not find the source of the main flow.

We found 17 dome rooms and the sheer beauty and decorations comatosed our precious but few brain cells into a "high" I have never experienced before. So stunning was the cave that the phrase, "The Best of the BEST," will probably never be reached. The impact of the features and decorations was like slapping my face to the point of numbness! Though we did not find a continuous passageway, we both knew we would be back to push more and have fun because we will find the way.

Tony and Bill were very successful, too! They found two distinct passageways that eventually petered out, but which were very significant discoveries. During the middle of the week Mike was feeling poorly and decided not to dive, so Bill and I did a stage dive swimming and were able to find a beautiful 1000' of tunnel that emerged into the original swiss-cheese room from another direction. It was fascinating how each evening we would gather at Mike's house and "plot" our survey data and witness the map grow in size and actually see a picture of the cave form into an image of beauty and understanding.

On the syphon side of the Nohoch Cenote, 3000' of explored cave was already established. On the last day of our expedition, Tony and Bill were able to push the cave system another 2000' downstream and discovered a pristine room that had surface air and an exit to the surface. A major find and still going!

Everyone was very happy and satisfied with the effort and results that occurred with our week of diving. We saw a lot and established many new facts and data about this cave system. It was a total team effort, with our companionship and capability working to the extreme side of pure pleasure and enjoyment. The bond of friendship grew stronger and the respect of each person's ability and contributions were reinforced into a more positive force. We all agreed we would be back to blaze more line, find more discoveries, and who knows . . . maybe we will establish the biggest cave in the world down the road because . . . if you don't go, you'll never know!

MODIFICATIONS TO NAVY TABLES FOR SAFER DECOMPRESSION DIVING - by Randy Bohrer (NSS #24169)

[ABOUT THE AUTHOR: Randy Bohrer is an NSS instructor and has been a frequent contributor in past years to UWS. His profession has required him to travel to many exotic parts of the world, and he has favored us with interesting accounts of some of foreign cave-diving explorations.]

With all of the recent discussions and controversy regarding various decompression tables and computers, I thought that it would be appropriate to pass along some information that I have run across during my research into decompression theory.

From June 1975 to June 1977, Nippon Salvage Company (NSC) conducted a salvage operation on the *Caribia*, a 25,794-ton passenger ship that had run aground at the entrance of Apra Harbor, Guam. 14,358 dives were conducted, most between 90 and 150 feet. Bottom times were as long as 90 minutes. An extensive amount of data was collected, and since these dives are similar to decompression dives in caves with respect to depth, duration, and physical exertion, the findings may be applied to cave diving.

The US Navy Standard Air Decompression Tables were used as the fundamental schedules for the operation. Due to the fact that Navy tables dived to their limits will produce decompression sickness in more than 2% of the dives, NSC modified the tables to (1) decrease the incidence of Decompression Sickness (DCS), (2) prevent the occurrence of DCS during decompression, and (3) increase the efficiency and comfort of the divers.

Four modifications, designated as MKI, MKII, MKIII, and MKIV were made and used during the project. For the MKI modification, half of the divers used a schedule 10 feet deeper than the actual dive depth, and the other half used a schedule 10 minutes longer than the actual dive time. There was no significant difference in DCS incidence between the two groups. 4,726 dives were made, with 22 cases of DCS, or 0.47%. This rate would be acceptable except that during one month 7 out of 621 dives (1.13%) resulted in DCS and 9 of the 22 cases overall occurred during decompression.

For the MKII modification, a 10-minute stop at a depth 10 feet deeper than the first stop on the Navy tables was included. There were 13 DCS cases out of 1,627 dives or 0.8%. The proportion of cases that occurred during decompression remained essentially unchanged.

The third modification involved a decrease in the ascent rate and oxygen breathing at the 10-foot stop. The divers ascended at 60 feet per minutes (fpm) for the first 30 feet, then at 6 fpm to 40 feet. The divers remained at 40 feet until a total of 15 minutes had elapsed since leaving the bottom. The Navy schedule was then carried out, and the divers breathed 100% oxygen for the first 15 minutes of the 10-foot stop. There were 31 DCS cases out of 2,394 dives, or 1.29%. The increase in DCS incidence does not indicate that the new procedure was faulty, because most of these dives were at depths from 120-150 feet, whereas the previous dives were at around 100 feet.

The final modification, MKIV, was similar to MKIII except that the ascent rate was further decreased and the extra stop omitted. The divers ascended at 60 fpm for the first 30 feet, then at 3 fpm to the 30-foot stop. The Navy schedule was then followed, and the divers breathed 100% oxygen for the first 15 minutes of the 10-foot stop. For the second dive of the day, the RNT from the Navy tables was increased by 10 minutes (only two dives per day were conducted throughout the project). There was 20 cases of DCS out of 5,611 dives, of 0.36%, which was apparently acceptable to NSC.

Another finding of the project was that although the divers ranged in age from 20 to 52 years, there was no correlation between age and susceptibility to DCS. Also noted was that one diver was afflicted 6 times, 9 divers were afflicted 4-5 times each, and 15 divers were never afflicted. There were 46 divers on the project and all used the same decompression procedures.

A summary of the table modifications versus DCS incidence as well as a chart illustrating the comparative schedules for the US Navy and NSC modifications follow this article.

Apparently, since many of the cases of DCS during the project occurred during decompression, the use of the Navy tables as is, with oxygen breathing through the 10-foot stop, as is common practice among cave divers, will do little to decrease DCS incidence during decompression. Part of the problem is the 60-fpm ascent rate. Arbitrarily changing the ascent rate, however, can cause excess gas loading to occur during the deep part of the ascent, which the tables do not account for. Obviously, the NSC MKIV method works very well for dives in the 90-to-150-foot range for bottom times of 60 to 90 minutes. Its use by cave divers would provide the following advantages.

1. DCS incidence would be about 1/3 of a percent for two dives per day.
2. For single 100-foot dives, total ascent time would be increased by only 15 or 16 minutes.
3. Less oxygen (only 15 minutes at 10 feet) is required, reducing logistical complexities and diving cost. (Of course, for greater safety and peace of mind, oxygen can be used for the entire 10-foot stop.)
4. Two dives per day can be conducted with greater safety.
5. Although the discussions herein are relatively complete, divers intending to adopt these procedures should read the article from which this information was taken. It is called "Safer Air Decompression Procedures Developed During a Two Year Salvage Diving Operation" and is by Hisashi Yano and E. L. Beckman. It appeared in the report from the 17th Undersea Medical Society Workshop (September 6-7, 1978) entitled *Decompression Theory.* This report is available from:

Undersea and Hyperbaric Medical Society
9650 Rockville Pike
Bethesda, MD 20014
(301) 571-1818

NSC NAVY TABLE MODIFICATIONS & DCS INCIDENCE

Modification and description		# of dives	#DCS cases	# of cases occurring during decom.
I.	Use 10-ft deeper schedule or 10-min longer schedule.	4,726	22 (0.47%)	9
II.	Include stop for 10 min 10 ft deeper than first stop required by Navy tables.	1,627	18 (0.80%)	6
III.	Ascend at 60 fpm first 30 ft, ascend at 6 fpm to 40 ft. Remain at 40 ft until 15 min have elapsed since leaving bottom. Breathe O_2 during first 15 min of 10-ft stop.	2,394	31 (1.29%)	11
IV.	Ascend at 60 fpm first 30 ft, ascend at 3 fpm to first Navy tables stop. Breathe O_2 during first 15 min of 10-ft stop.	5,611	20 (0.36%)	6

Comparative Air Decompression Schedules for USN and Those Used by NSC for 120 fsw Dive for 90 Minutes

Table Source	Rate of Ascent	Time to First Stop	40 fsw	30 fsw	20 fsw	10 fsw	Total Decom Time, min
USN	60'/min	1.5		19	37	74	132(Z)
NSC MKI	60'/min	1.3	8	19	45	80	154
NSC MKII	60'/min	1.3	10	19	37	74	142
NSC MKIII	60'/min (From 120 to 90 fsw) 0.5 6'/min (From 90 to to 30 fsw) 100	10.5	4.5	19	37	74 (Including 15' 100% O_2 breathing)	146 (161 air equiv.)*
NSC MKIV	60'/min (From 120 to 90 fsw) 0.5 3'/min (From 90 to 30 fsw) 20.0	20.5		19	37	74 (Including 15' 100% O_2)	151 (166 air) equiv.)*

*Air equivalent time is based upon the theory that air decompression time is one-half as effective as an equal period of breathing 100% oxygen during decompression, i.e., 15 minutes of breathing 100% oxygent is as effective in ridding the body of nitrogen as 30 minutes of air breathing at the same depth.

including articles by Dr. Bill Hamilton, the Wakulla Springs Project consultant, and David Yount, whom Hal Watts references in his deep-diving manual.

Any other questions should be directed to:

C. Randy Bohrer
HUD2-B Box 2004
Nashua, NH 03031

RECENT DATA ON SHALLOW-WATER SATURATION DIVING: AN INTRODUCTION - by Milledge Murphey, Ph.D. (NSS #24433)

[ABOUT THE AUTHOR: Milledge Murphey, Ph.D. (Psychology) is Director of the University of Florida Academic Diving Program, Training Chairman of the NACD (National Association for Cave Diving), and a recipient of the International Safe Cave Diving Award (which recognizes the completion of 1000 cave dives). He has written extensively on cave diving for numerous diving and caving publications.]

William Shane, M.D. has, perhaps more than any other individual, made significant contributions to the current body of knowledge regarding diving medicine. Among the many scholarly papers which Dr. Shane has produced are several which define what is known about shallow-water saturation diving. I have recently meta-analyzed his publications in this area and offer the following information in the interest of diving safety, assuming that it will be of interest to all cave divers currently engaged in exploration or touring in the recently discovered stellar sties in Mexico and other countries.

These large, long and shallow systems offer an unparalleled opportunity for extended penetrations and long bottom times which have, under less hazardous conditions, been experienced by Dr. Shane and his scientific diving colleagues in the past. The information included here is from an Undersea and Hyperbaric Medical Society paper presented by Dr. Shane.

Background: *The NOAA Office of Undersea Research has operated Hydrolab continuously in Salt River submarine canyon, just off the north shore of St. Croix, U.S. Virgin Islands, since 1978. Scientists from 89 major American universities and from 9 foreign countries have come to Hydrolab to live and work there of their own choosing. The facility is staffed on NOAA's behalf by Fairleigh Dickenson University, which has a satellite campus, West Indies Laboratory, on St. Croix.*

The operational staff consists of four marine engineers, a services coordinator, and a staff physician. There are two staff scientists. The habitat is situated on a 52' bottom, with a hatch depth of 245.7 kPA (47 fsw). Air is the breathing medium for storage, excursions, and decompression. Upward excursions are limited to 224.2 kPA (40 fsw), and downward excursions to 562.0 kPA (150 fsw). Since 1978, 97 saturation missions have been conducted, most of them 6-1/4 days (150 hours) in duration. These missions have involved 366 aquanauts and 57,872 manhours. About 25% of the available time is spent in the water column, with 10.6% of the time spent in decompression.

Observations: *I [Dr. Shane] will briefly describe several of the practical clinical observations during the past 7-1/2 years of operation with the habitat. None are very profound and none are substantiated by data; however, each may help operators of future habitats [Author Murphey's note: cave divers who participate in long shallow penetration dives] to deal with scientist aquanauts.*

1. During the first two years of our operation, our aquanauts ate freeze-dried foods as their major source of calories. Nearly all aquanauts lost weight during saturation, with weight losses of 2-3kg being common. Since then we have been providing a normal diet for the aquanauts each day in sealed plastic bags which are then reheated in the habitat prior to consumption. A study is currently underway to estimate the total daily caloric intake by saturated scientists. Preliminary data suggest that intake is high, but is sufficient to meet metabolic requirements.

2. We have been able to nearly eliminate skin and external auditory-canal problems by meticulous attention to skin and ears. We ask our scientists to bathe with soap and freshwater after each excursion, and then to dry with a clean dry towel. In addition, to avoid urine and urine by-product retention in wetsuit bottoms, we ask our scientists to carefully wash the crotch of their wetsuit bottoms at least every other day with a washing detergent which we provide. Similar care is lavished on the external auditory canal.

Prior to saturation all excess cerumen is removed from the external auditory canal. At the end of every excursion, we ask our scientists to gently lavage the external auditory canal with freshwater, to allow the water to drain out, and then to dry the pinna with a towel, and then to blow dry the external auditory canal with a conventional hair drier. Finally, at the end of each excursion day, they are asked to flush each external auditory canal with a special solution of ethanol and acetic acid, which we provide. We have yet to be required to abort a single excursion due to otitis externa. Rarely, when otitis externa does develop, it has always been managed successfully with antibiotic ear drops, and, if there is an accompanying lymphangitis, with orally administered tetracycline.

3. Reflux esophagitis is seen frequently among our aquanauts. Immediately upon report of heartburn, we recommend the prophylactic use of oral antacid, either tablet or liquid, taken prior to each excursion. This treatment regimen has prevented recurrence of the symptoms.

4. A substantial burning and difficulty in getting a deep breath is a common complaint of many but not all aquanauts early in the saturation. This usually develops during the second day and is gone by the fourth day of saturation. It has never been severe enough to compromise the research and the syndrome has been reported in other saturation situations by the name "work lung."

5. Winter water temperature in St. Croix may get as low as 25.5° C (48° F). In spite of this relatively warm water and the protection offered by full 1/4" wetsuits with hoods, when scientists work in the water for 6-8 hours per day, they become uncomfortably cold, shivering becomes distracting and complicates manipulations, and, late in the mission, the enthusiasm for entering the water diminishes significantly. We believe that the divers are becoming "cold soaked."

The habitat itself is uninsulated, and we feel that even while in the habitat, with an air temperature equal to the water temperature, they are losing heat to the cooler walls through radiation. They are asked to wear sweat suits while in the habitat, and slippers to keep their feet off the moist carpet; a knit cap is recommended; and the ingestion of a warm beverage at regular intervals is encouraged.

"Warm water" can make one very cold. We have found that wearing a leotard under the wetsuit helps greatly in the conservation of body heat as well as making the donning and doffing of the suit much easier. Further, such leotard lessens skin chafing due to wetsuit abrasion. There has been some initial reluctance to wear the garment; however, after trying it almost all scientists become converts to its use.

6. Over the years, I have sutured many skin lacerations in the habitat. I have found that the eventual result can be a quite good approximation of the stratum germinativum. Then, even if the epidermis imbibes water during excursions, and the wound edges become soft and macerated, the eventual scar *will be thin, and have satisfactory cosmetic appearance. To attempt to reduce imbibition, prior to excursions, we ask the scientist to cover the wound with a petroleum-base ointment, and then occlude with an adhesive bandage.*

7. For the first 6-1/2 years of our operation, our decompressions were conducted solely on air, using NOAA Table 12-10: 16 hours and 19 minutes from 239.5 kPa (45 fsw) to the surface. During that period, the scientists generally slept for most of the day of recovery. We attributed this to accumulated fatigue, cold, and the long decompression.

In mid-1984 we introduced two 20-minute oxygen-breathing cycles—20 minutes on oxygen, 20 minutes on air—early in the decompression. Calculations indicate that this regimen will reduce the 480-minute halftime-compartment inert gas load by about 6 kPa (24 fsw). Since instituting this procedure, the scientists have noticed increased alertness and improved ability to work on the day of recovery. We now believe that the lethargy the earlier groups experienced was very likely due to mild decompression sickness, which these two short oxygen exposures are sufficient to prevent.

8. Although we have no data substantiation, there is no question in the minds of the staff who interact daily with the aquanauts, that these persons exhibit nitrogen narcosis, even at our storage depth of 235.7 kPa (47 fsw). Many of the scientists themselves report unusual jocularity and slowness with mathematical computations while saturated, and most report clearing of these manifestations through the course of decompression.

The foregoing points made by Dr. Shane are food for thought for the cave diver contemplating saturation diving. As research finds are reported, all cave divers should take note and modify personal procedures accordingly. Attendance at one or more of the several national and international diving-medicine meetings held each year will insure that all available knowledge is used to insure safety and minimize decrements which are ever present when man is exposed to long-term breathing of gases at pressures greater than atmospheric.

RECOMMENDATIONS FOR INTERNATIONAL CAVE DIVER TRAINING STANDARDS - by Rob Palmer

[ABOUT THE AUTHOR: Rob Palmer is considered one of Britain's foremost underwater explorers. His new book, Deep into Blue Holes *(available through NSS-CDS Publications), details the Andros Project, which he directed. As a freelance writer, diver and photographer, he has also helped produce three films on blue holes for the BBC and National Geographic television. He is a Fellow of the Royal Geographical Society and Explorers' Club, and was recently awarded the first Colin McLeod Prize for outstanding contributions to international diving activities by the British Sub Aqua Club.]*

The following text outlines the proposals made at the 1989 meeting of the Cave Diving Commission of the Union Internationale de Speleologie (U.I.S.) for a joint UIS/CMAS International qualification standard for cross-certification of cave divers. One- or Two-Star qualifications could be awarded by regional cave-diving organizations within a national cave-diving training organization affiliated with UIS or CMAS, but Three-Star qualification can only be awarded centrally by the national training organization, or by the UIS Cave Diving Commission where no such national organization is recognized or in existence.

UIS/CMAS cards can be issued only by national cave-diving organizations affiliated with the UIS/CMAS cave-diving commissions, or, where no national organization exists, by application to the UIS Cave Diving Commission for consideration.

Comments on the material outlined below are should be sent to the author, Rob Palmer, at 17 Cradoc Road, Brecon, Powys, LD3 9LH, United Kingdom by December 31, 1989.

UIS/CMAS One-Star Cave Diver:

i. Must have at least one year's dry-caving experience with a minimum of 20 dry-caving trips.

ii. Must have diver training qualifications or experience and knowledge to at least CMAS Two Star Open Water Standard.

iii. Must be capable of passing a straightforward 200m sump.

iv. Must be at least 16 years of age.

v. Must have training and experience in line laying and following, in buoyancy control, and in the correct techniques of underwater movement.

vi. Must be able to use, and be aware of the need for, a dual-tank system suitable for cave diving.

vii. Must be trained in, and familiar with the reasons for, UIS/CMAS-recommended safety rules and techniques for safe cave diving.

viii. Must have completed a minimum of 8 cave dives at at least 3 separate sites.

ix. Must have a working knowledge of cave-diving equipment, and of its basic maintenance.

x. Must be capable of solo diving in underwater caves in safety.

xi. Must have the recommendation of a national or international cave-diving organization whose training schedules meet UIS/CMAS standards.

UIS/CMAS Two-Star Cave Diver:

i. Must have a minimum of one year's cave-diving experience, and 30 cave dives at at least 10 separate sites, three of which must be to a depth of 30m.

ii. Must be at least 18 years of age.

iii. Must be capable of passing constricted or complex sumps in poor visibility, up to 400m long.

iv. Must be aware of, and practiced in, silt-control techniques.

v. Must have vertical-caving experience.

vi. Must have a working knowledge of decompression procedures relevant to cave diving.

vii. Must be familiar with the practice of stage diving.

viii. Must be capable of surveying underwater caves to an acceptable standard.

ix. Must be able to operate and maintain a compressor.

x. Must have a basic knowledge of sump-rescue techniques.

xi. Must have the recommendation of a national or international cave-diving organization whose training schedules meet UIS/CMAS standards.

UIS/CMAS Three-Star Cave Diver:

i. Must have a minimum of 150 cave dives, and three years of cave-diving experience

ii. Must be familiar with both back- and side-mounted open-circuit breathing systems as used in cave diving.

iii. Must be familiar with the safe procedures necessary for oxygen decompression in underwater caves.

iv. Must be familiar with the problems associated with mixed-gas diving in caves, though not necessarily experienced in its use.

v. Must have a knowledge of diving theory, and practical diving skills, equivalent to CMAS Three-Star Open-Water Standard.

vi. Certification must be awarded at national or international level.

Instructor

Cave-diving instructors should be trained to at least Two-Star Cave Diving Standard, and should be appointed by a national organization recognized by UIS/CMAS for cave-diving training.

Note that these recommendations have yet to be approved by both CMAS and the constituent national organizations of the UIS Cave Diving Commission. They represent the recommendations of the UIS Cave Diving Commission to those bodies. Final ratification of these proposals will probably be made in early 1990, and the sooner that comments are received, the sooner they can be actioned.

These are not designed as a training course, but to give an indication to other national and regional cave-diving organizations and relevant authorities (e.g., show-cave owners) of the comparable degree of cave-diving skills held by individual cave divers. The UIS/CMAS qualifications are not in any way regarded as compulsory, but are available for divers who feel they may require an international accreditation. They will not replace national cave-diving qualifications.

Cave Diving Commission, Union International de Speleologie, 1989.

UIS SAFETY RECOMMENDATIONS FOR CAVE DIVING

1. No people outside cave diving should make safety rules, regulations or recommendations regarding cave diving.
2. Every cave diver should be able to exhibit the necessary degree of common sense and judgment, and should be in good physical and mental health, to meet the hazards involved in cave diving.
3. Each cave diver should commence his or her training in the company of experienced cave divers. Cave-diving certification courses or controlled training programs should be preferred for this purpose.
4. Temporary or permanent guideline, or a combination of both, must be used when diving in a cave or in any similar closed environment, irrespective of visibility, cave environment, or other factors. Non-rotting, adequately strong line must be used.
5. Guidelines permanently installed in a sump must be provided with direction markers, showing direction out at least every 10m.
6. Direction out should be marked at any crossing where two or more lines join.
7. Permanent lines should be properly placed and tensioned to minimize friction and the possibility of entanglement, while enabling easy following.
8. There must be a continuous line from any point of the dive to the surface.
9. Minimum equipment recommendations are that ALL vital parts of the life-support system must be at least doubled, especially regulators, lights and decompression meters. Each cave diver should use at least the following equipment on any cave dive:
   - Two regulators with independently controlled tank valves
   - Submersible pressure gauge on each independent regulator
   - 3 or more independent lights, each of them having a burn duration exceeding that of the planned dive
   - Isothermic suit with thermal insulation properties appropriate to the water temperature and dive duration
   - Mask or diving helmet and a spare mask
   - Depth gauge
   - Watch; if there is no stay planned beyond a sump, a dive computer or bottom timer can be used
   - Protective helmet
   - Protective cover or cage on tank valves
   - Safety (backup) reel
   - Fins where applicable
   - Buoyancy compensator or a drysuit suitable for buoyancy compensation, where applicable
   - If a dive computer is used, it must be doubled on complex dives, or backed up by the appropriate decompression tables, watch and depth gauge on more simple dives
10. All the equipment must be arranged so that free-hanging pieces and sharp edges on equipment are avoided, and everything is streamlined to prevent entanglements or guideline damage.
11. Cave-diving training should be organized in cave-diving courses or controlled training programs, complying to the UIS training standards.
12. Proper diving planning is an important part of any cave dive. It should involve information gathering, group planning, and individual planning. Specific features of particular caves must be considered, as well as equipment requirements, training an experience levels of the cave divers involved.
13. Solo cave diving is considered a commonly acceptable practice, and should be preferred in caves where proper cooperation and mutual help of cave divers in a team is not possible.
14. Cave divers should give due consideration to the cave environment, for safety and conservation reasons. Air in closed air spaces should be treated with caution.
15. A maximum of one-third (1/3) of initial air supply should be used for penetration, two-thirds (2/3) must be reserved for the return journey, to allow for a reserve supply to meet any emergency that might arise en route. More conservative rules are recommended on difficult cave dives.
16. Any cave dive on which it is planned to exceed 40m in depth should be approached with due care, considering the increased risk, and the deep-diving experience of the divers involved.
17. When cave diving, proper care must be given to guideline techniques (laying, following, etc.), taking into consideration that in more than 50% of cave-diving accidents guidelines were involved.
18. Proper techniques of buoyancy control and propulsion should be followed to minimize silting of the cave and maximize diving efficiency.

LETTERS TO THE EDITOR

November 11, 1989

Dear Editor,

I am writing to set the record straight regarding an incident which took place during the recent tests of the Cis-Lunar MK-2 rebreather at Merritt's Mill Pond, Jackson County, Florida. The tests were proprietary in nature, which is why there has been no public discussion of what was done there. However, it seems now that at least one aspect of the program must be aired before the scuttlebutt gets out of hand.

As you know, for some five years now we have been working on the development of a redundant, computer-controlled rebreather for cave diving. The first version was used at Wakulla Spring in the fall of 1987. The successor to this design, the MK-2, has been under development since then and is a true exploration rig. Pool tests were successfully carried out in August, and open-water and cave-diving tests were scheduled to be carried out at the end of October at Merritt's Mill Pond. The intent of the latter was to put the system through a series of extensive experiments designed to determine its operating limits and performance under realistic working conditions.

I stress the experimental nature of these dives. There really is very little practical knowledge concerning the performance of mixed gas rebreathers in the cave-diving environment. What is known was gained using non-redundant Rexnord Mark

15/16's on Andros Island in 1987 and on Grand Bahama this past summer, and with the Cis-Lunar MK-1 at Wakulla Spring in 1987. Most of the individuals involved with the above projects were present for the MK-2 tests, and we were keenly aware of the array of things that could go wrong when diving experimental Scuba in which the partial pressure of oxygen is under human or computer control. At least one, and generally two, support divers were in the water at all times during the conduct of a test, and a surface team, which included a medical doctor, was on standby to assist.

The incident in question occurred on the 6th day of our research program. Brad Pecel was the test diver; I was the safety. The mission was a routine follow on to one conducted by John Schweyen and Jim Brown to the 28m depth level of a nearby spring, during which the rig was to be operated under manual control to simulate a computer-system malfunction. Shortly after the dive began, at a distance of approximately 60m inside the cave and at a depth of 14m, Pecel suffered an oxygen convulsion and had to be transported to the entrance. On the surface he was revived after several minutes of artificial respiration and was taken to the Jackson County hospital for observation. He was discharged five hours later and has fully recovered.

The rig was subsequently inspected and the status of all subsystems noted. The problem during Pecel's dive, stated simply, arose from plugging a quick-disconnect electrical cable into the wrong output port. This fed erroneous information on oxygen partial pressure to the display being used for control of the unit. Pecel interpreted the spurious data to indicate low partial pressure and added oxygen, inadvertently pushing the PO_2 into the toxic region and inducing the convulsion. The ports have since been reconfigured to prevent a field connection error in the future. I feel it is important to indicate that extensive hyperbaric calibrations and environmental tests have shown the sensing and display system that is used in the rig to be very reliable, and that it was a field connection error, not the system itself, that led to the incident.

The MK-2 was successfully used for three additional days of tests, which included a 5-kilometer fins-only dive (measured) and a two-hour dive at 16m depth to reaffirm the reliability of the manual oxygen control and advisory system. We will provide further information on the MK-2 once the qualification program has been completed.

Sincerely,
Bill Stone, Ph.D.
President, Cis-Lunar Development Laboratories, Inc.

October 30, 1989

Dear Editor:

I just returned from a cave-diving trip to the Akumal, Mexico, area. I felt fortunate to have shared this experience with Todd Rowe and Mike Abbott, also from MN.

We stayed in a primo condo near Aventuras Akumal rented out by Tony & Nancy de Rosa. Tony and Nancy did everything possible to make our stay in Mexico comfortable and convenient. We were made to feel like family.

Tanks, air, and guidance were professionally and personably provided by Mike Madden, Joan Patrick, and the staff of the CEDAM Dive Center at Aventuras Akumal. Even though we are just one- week-a-year tourist cave divers, we were treated like visiting royalty.

Special highlights of the trip were an all-day excursion to the mind-boggling Na Hoch cave system, guided by Joan Patrick, and a not-to-be-missed seafood banquet catered by the Casa de Rosa.

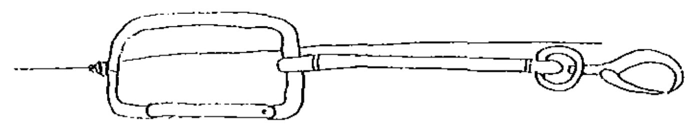
Access to several of the cenotes had been improved. A permanent wooden ladder into the Temple of Doom made this beautiful dive much easier.

Wow. Akumal just keeps getting better. My thanks to all involved.

David Lund, Minneapolis, MN

CLARIFYING SUMP ILLUSTRATION

In response to a reader's question, author John Schweyen has submitted a revised illustration for Figure 4C of his article, "Cave Diving in the Northeast, Part 3: Unusual Guideline Techniques," featured in the last issue of UWS (16:5, Sept./Oct., 1989). "After twisting the carabiner as described in the text, you should have something that looks like this. Note that the line passes through the gate of the carabiner only once, i.e., when you clip the 'biner to the line." [The Editor apologizes for any confusion resulting from the original illustration.]



CAVE DEATH IN THE YUCATAN

Jim Coke of Akumal, Mexico, wrote in a quick, preliminary report on the deaths of two open-water divers on Sunday, September 10, 1989, at Cenote Bolom Chojol (near Merida, Yucatan). According to Jim, two novice divers were taken to the cave by two friends who were instructing them in diving. One of the students had less than two years' diving experience and had been in cenotes only two or three times; the other had had three months of pool work and was making his first "open-water" dive. The four divers went to a depth of 90'+, with a penetration of 210', including the depth of the 90' pit located 120' from the entrance of the cave.

The dive proceeded as planned until the ascent from the pit, when one of the trailing students had a light problem. One of the experienced divers corrected the problem and then the two experienced divers exited the cave, expecting the novice divers to follow. When neither of them did, a search for them was begun. Jim was contacted after several days of unsuccessful search efforts.

From the evidence gleaned from the recovery, the two novice divers appeared to have left the line in confusion after the light problem, and penetrated a deeper and unexplored section of the cave, to 120' (freshwater). The divers were not equipped with wetsuits, weight belts, BCD's, octopuses, or depth gauges; only one of them had an SPG, and they each had only one light.

ANNOUNCEMENT FROM THE EDITOR

This announcement may seem superfluous—unless you are one of the frustrated people who has tried to contact me by phone over the past couple of years. I now have a new, genuine, bona-fide, certified home telephone number, complete with obnoxious answering machine. (Its only redeeming feature is that you may leave a message of up to three minutes in length. When you call, chances are I won't be home, so be prepared with your message. [Joe Prosser says I deliberately call his machine when I know he won't be home, and blather into it for "therapy."])

My telephone number is **813-484-7834**. If you feel you must talk with me, rather than my machine, your best bet is to call sometime after 9:30 pm (EST) Monday - Friday. (Weekends I am going to try to be underwater!)

If you need me to talk to you, please leave information as to the best times in the evening to try to call you. (I **cannot** call you back during business hours weekdays.)

If I am going to get your machine, go ahead and ask your questions (you've got three minutes, and if you need longer, call a second time) so that I can tell your machine the answers. If you just say, "Call me," I'll call, say to your machine that I've called, figure I've done my duty, and the call (ball) will be back in your court. (Ultimately, you will probably figure out what I figured out long ago: that letters are cheaper, quicker, and ultimately more reliable.)

Also, I am not very good at guessing voices on the telephone. Please give your first and last name (and if it's an unusual last name that I wouldn't have heard before, speak distinctly and/or spell it.) If you just say this is John, or Joe, or Bill, or Bob, or Llellewyn (I can't tell you how many Llellewyns I know!—And their voices all sound alike), I'm probably not going to know who you are. And when you also don't leave a phone number, and get pissed off because I don't call you back—because "you" could be any one of 15 people I know with that same first name—it'll be your own fault!

But!—let me save you the price of a phone call by answering some of the most commonly asked questions:

1. **Would I be interested in publishing your article on cave diving?** "Would I be interested...?" No, we don't publish articles on cave diving in this magazine. *(Yes, yes, of course, I would be interested!! By all means—SEND IT!! SEND IT!! Nothing is too short/long/boring/unimportant/ungrammatical/controversial, etc. for UWS consumption. Although, please read the two paragraphs under "Newsletter Submissions" on the inside cover page for some other important guidelines.)*

2. **When am I going to press?** (Hahah! That's a good one!) "Soon." It's always "soon." Because it seems like I just barely get finished with one issue when it's time to begin work on the next one. No rest for the wicked. In any event, I will endeavor to put your article in the very next issue after receipt.

3. **Will I be able to print your article in its entirety?** Probably. Because, as you have probably noticed, the newsletter length changes from issue to issue, depending upon how much I have to put in. In the five or so years that I have been Editor, we have had issues as long as 28 pages and as short as 8 pages. I do try to keep the number of pages divisible by 4 (e.g., 8, 12, 16, 20, 24, 28) to keep the collating as cost-effective as possible. As a consequence, occasionally a non-time-critical item may get bumped at the very last moment because it won't fit (and I don't have enough material to stretch to the next 4-page length), but this is fairly rare.

4. **Would I be interested in photos, drawings, or other illustrations?** Good heavens, no, we *never* print any photographs or illustrations. For example, I wouldn't *dream* of putting a photo or drawing on the front cover. And I certainly would never put in any cartoons or jokes or humorous cave-diving articles. That would be against my religion. *(Yes! Yes! Send your photo, drawing, cartoon, etc. If I'm really desperate, you might even make the front cover! You might make the front cover even if I'm not desperate. Would you like to take a wild guess how many times, in desperation, I have put myself on the front cover?)*

5. **Do we print little personal ads for Gear for Sale or Gear Wanted?** Yes, for individuals (as opposed to dive shops). And there's no charge. Other personal ads are also accepted, for example, people who need dive buddies, who want to share babysitting arrangements while they cave dive, who need information they think other cave divers might be able to provide, etc. (Please read the two paragraphs under "Newsletter Submissions" on the inside cover page for some other important guidelines.)

6. **Can I read your material from a computer diskette?** Aha! Glad you asked that! Because I have just started a new job where I have a brand new IBM-compatible 80386 with lots of capabilities our Section computer does not have. While I prefer 5¼" floppy diskettes formatted to 360K, so that I can plug them right into the Section computer, I can now handle some other formats. I can read high-density diskettes of both the 5¼" and 3½" variety. *Supposedly* (and I say, "supposedly," because I haven't had much success with it so far) I can read Macintosh text files on my little Macintosh converter drive. (I would really like to experiment with this some more, so it's worth trying to send your material on disk.) And it's worth your while to send a diskette, even for short stuff: if I don't have to retype your article, letter, etc., there's less likelihood of additional typos and errors being introduced into your text (and, more importantly, I will be eternally grateful to you for being spared the extra work!).

7. **What computer text format would I like?** IBM compatible, plain old ASCII; WordStar (for WordStar 2000 use the conversion utility to translate it to ASCII); Word Perfect 4.1, 4.2, and 5.0; Multimate, MS Word, etc. Most good wordprocessing programs have a feature that translates their format into ASCII or "generic" wordprocesser, or something like that. That is a safe bet if you don't have one of the standards listed above. (I can even read Lotus files [although *why* anyone would want to do a cave-diving article in Lotus I can't imagine] if they are "printed to a file.") If you use Macintosh, try doing anything that your wordprocessor allows to "simplify" your text format, and I'll try to read it.

8. **Is there anything you can do as you type your article to save me extra work preparing it for UWS?** Oh, how thoughtful! Yes, as a matter of fact, there is. 1) Put two spaces after periods (question marks, exclamation points, etc.) that end sentences. 2) If you are using WordStar (or any wordprocessing program that puts in spaces when you tab), try to use a real Tab character. (For older versions of WordStar, ^O^V turns the "Vari-Tabs" off and inserts a tab character instead of spaces. For others, check you manual. If you can't figure it out, don't worry about it.) 3) Proofread carefully. Verify your numbers, proper nouns—the names of people and caves and special equipment, cities, etc. Those I am not always able to look up.

9. **Can I correct your address on the mailing list?** No. (And this time it's a serious "No.") I do not handle the mailing list. I don't even *see* the mailing list, and quite frankly, don't have the slightest idea who's even on it! Contact the Secretary/Treasurer, Lee Ann Hires, for any problems relating to incorrect address, no address, expired membership/subscription, etc. If you call me, I will pass the request on to her, but for much faster service, contact her directly.

10. **Can I send you back issues?** Maybe, if I happen to have what you need. But by edict of the High Command, I have been instructed to send the bulk of all remaining back issues to the new Publications vict . . . I *mean*, Publications Chairman, Lamar Hires. Lamar is now the unfortunate person who gets to handle all the odious requests for back issues, books, T-shirts, maps, doo-dads, etc. If you call me, I will pass your request to him, but for much faster service, contact him directly.

11. **Do I want to go cave diving?** Yes. (Talk about dumb questions!)

Cave Diving Section of the
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