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**SCUBA Diving in the Galápagos Islands:
A Study of Diving Safety with Recommendations**

by

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PREFACE

The terrestrial flora and fauna of the Galápagos Islands are world renowned as examples of evolutionary divergence. Scientists and, over the last few decades, tourists have arrived in increasing numbers to study, observe and enjoy this unique archipelago. Evidence indicates that the islands' marine environment is equally as distinctive and merits protection. In 1986, the Government of Ecuador, in accordance with its ongoing efforts to preserve areas of outstanding natural interest, established a marine reserve in the islands.

During the planning stage, in 1983, the Government of Ecuador extended an invitation to the Marine Policy Center (MPC) of the Woods Hole Oceanographic Institution (WHOI) to conduct studies on coastal and marine issues to assist Ecuadorian authorities in making informed decisions concerning the creation of an effective management strategy for the archipelago's marine area.

The MPC comprises social and natural scientists who collaborate in interdisciplinary studies that address issues arising from increased use of the world's marine and coastal resources. Research is both national and international in scope with an emphasis on providing technical information required by decision makers in identifying and evaluating management and policy options.

Previous MPC reports involving the Galápagos Islands include: Coastal and Marine Resources Management for the Galapagos Islands by J. Broadus, I. Pires, A. Gaines, C. Bailey, R. Knecht and B. Cicin-Sain (WHOI Technical Report No. WHOI-84-43) and The Recruitment and Application of Scientific Information in Coastal and Marine Resources Management: Analogs to the Galápagos Islands by S. McCreary (WHOI Technical Report No. WHOI-85-14). In addition to this report, an economic analysis of tourist demand for the Galápagos Islands is forthcoming.

MPC work in the Galápagos Islands is conducted in cooperation with the Government of Ecuador and supported in part by the Tinker Foundation. This report is based upon on-site research in December, 1985. Traveling aboard the Beagle III, a MPC team which included MPC Director and Principal Investigator, James Broadus, visited several of the more popular diving sites accompanied by a diving guide. A survey was also conducted with knowledgeable divers and diving naturalist guides and persons possessing knowledge of the islands and facilities available for treating diving related injuries. Additional information was collected from international diver training organizations, equipment suppliers and touring companies. The authors, Margaret A. Rioux and Terrence Rioux, were Guest Investigators at the MPC to conduct this study. Both are SCUBA diving instructors in the United States, members of the National Association of Underwater Instructors and have broad backgrounds in recreational and scientific diving. Terrence is Diving Safety Officer at WHOI.

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EXECUTIVE SUMMARY

This report briefly describes the development and current status of diving activities in the Galápagos Islands. The objective is to evaluate diving practices and regulations and to present suggestions to improve diver safety and protection of the marine environment.

Setting

The Galápagos Islands are situated on the equator 600 miles off the Pacific coast of Ecuador. The archipelago comprises 15 major islands and dozens of smaller islets and rocks, each of which is volcanic in origin. The islands rise from a relatively shallow submarine platform. Water depths above the southern portion of the platform (San Cristobal to Fernandina and southward) seldom exceed 500 meters compared with 900 meters in the northern portion. Shallow areas, created by uplifting or lava flows are common in many coastal locations, but most land masses plunge steeply into the ocean. Depths of 2,000 to 3,000 meters are common in waters surrounding the platform.

The dominant currents are the warm periodic El Niño, the Humboldt, which transports cool water and the Cromwell, a countervailing subsurface current that originates in the Pacific. The interaction of these currents produces a wide variety of habitats which are occupied by an assemblage of marine flora and fauna that are as distinctive as their more publicized terrestrial counterparts.

Creation of a marine reserve to protect this unique environment has been envisioned since the early 1970s and materialized with the 1986 Executive Decree No. 1810-A which established a marine resources reserve that includes all the interior waters of the Archipelago plus a surrounding 15 miles buffer zone. The intent of the decree is to protect and sustain the ecological, scientific, educational, economic and political benefits that can be derived from this resource. Meanwhile, increased research and publicity coupled with growth in diving worldwide and the Galápagos tourist industry will increase the demand for diving access to this special marine area.

Diving

Diving, other than free diving, in the Galápagos appears to have originated with commercial divers that came from the continent to harvest lobsters. In this instance, the traditional practice is to breathe air supplied through a tube connected to a compressor on the surface. SCUBA gear was introduced by persons associated with the tourist industry and visiting scientists conducting marine research.

Most diving is associated with the tourist industry. Estimates vary, but during 1986 between 80 and 200 divers visited the islands and the number appears to be growing. The majority of diving tourists come from North America with tours booked through two U.S. companies that specialize in diving trips. Metropolitan Tours conducts most of these trips through two of its vessels, but five independent vessels are also available.

Due to the great depths, ocean swells and surges, strong currents, cold water and upwellings, conditions are considered too arduous for novice divers. In addition, entry and exit from skiffs is challenging. While these facts are mentioned in brochures, it is difficult to predetermine whether tourists have the level of expertise required to dive comfortably and safely in Galápagos waters before they arrive in the islands.

All diving tourists are accompanied by a diving guide who is responsible for ensuring that tourists are sufficiently skilled in diving, properly equipped and instructed and that the marine environment is protected. Most, if not all, of these guides are licensed by the Galápagos National Park Service (SPNG) as naturalist guides and have received training and certification by international diving organizations. There appear, however, to be no additional formal requirements to qualify as a diving guide.

The lack of uniform equipment, spare parts and competent repair and maintenance are deterrents to the development of diving within the islands. These problems accrue from the international nature of Galápagos tourism, remoteness from main trade channels, limited demand and the various complications which arise in the course of conducting international commerce.

The absence of specially equipped and available transport for emergency evacuation, medical facilities and personnel to treat diving-related injuries is a major concern. A small hospital on Santa Cruz and a clinic on San Cristobal are capable of treating minor mishaps, but no facility for hyperbaric treatment is located in the islands. The closest chambers are in Guayaquil, 600 miles away or Panama, 1,000 miles away. Commercial airlines servicing the islands are not equipped to handle such an emergency. In addition, lines of communication between dive boats, which may be in remote areas of the archipelago, either directly or indirectly with authorities on the mainland are often problematic. Even with rapid communication, coordinating an evacuation effort could require a considerable amount of effort and precious time. Also, emergency oxygen supplies and the medical competency of those on dive boats are minimal.

In summary, while access to and use of the land areas of the national park are closely studied, monitored and controlled, diving within the island has evolved in an unorganized manner with little or no regulation. The fact that, to date, there have been no serious accidents involving diving tourists is a positive reflection on the efforts and precautions taken by those directing diver activities. Nonetheless, the chances of a serious accident and environmental degradation increase as more and more divers frequent the islands.

OBSERVATIONS AND DISCUSSIONS

Pre-screening of qualifications to ensure that tourists possess the capabilities required to enjoy the Galápagos marine environment safely is an area of concern. While booking companies endeavor to make prospective divers aware of existing conditions, problems could arise if a person deemed not to possess adequate skills arrived in the islands. At this point in time, it is difficult to discourage such a person from diving. While it is admittedly difficult to evaluate divers before their arrival, a standard pamphlet with

explicit descriptions of conditions, diving procedures, regulations, skill and experience requirements and recommended equipment should be published and distributed to all who are contemplating diving in the islands. This action will not resolve the problem (diver evaluation will continue to be a necessary ongoing process) but it may discourage inexperienced divers.

A licensing scheme mandating that diving guides demonstrate a predetermined level of competence in diving leadership, providing basic medical treatment (including CPR), rescue techniques, the handling of diving emergencies and knowledge of dive sites as well as marine flora and fauna existing at each site should be implemented. This effort should be supported by formal training, educational material and practical exercises.

Efforts should be made to facilitate the acquisition of spare parts, standardized equipment, and equipment maintenance and inspection. The best manner to achieve these goals is beyond the scope of this report. One alternative, however, might be the creation of an association of all those active in Galápagos diving.

A comprehensive protocol describing procedures for medical treatment, communication, transportation coordination and evacuation should be formalized and presented to all participating in diving. In addition, each vessel should be required to carry a minimum supply of oxygen with a suitable delivery system and at least one person per vessel should possess knowledge of treating diving related injuries and the proper use of oxygen.

Creation of the marine reserve and management authority will lead to regulation and preservation of the marine environment. A foundation for achieving these objectives already exists, as some of the expertise and experience developed by the Galápagos National Park Service and the Charles Darwin Station in managing the Galápagos National Park can be modified and applied to activities within the marine reserve. Implicit within this effort are the identification and classification of dive sites including the frequency and magnitude of diving permitted at each site, creation of regulations governing the removal of organisms and delegation of authority to enforce these regulations.

RESUMEN

El ambiente marino en las Islas Galápagos del Ecuador consiste de ecosistemas con ricas y variadas comunidades de organismos. El creciente reconocimiento de atributos únicos y la importancia científica de este recurso marino ha impulsado la investigación científica, el establecimiento de una reserva marina dentro de las islas por el Gobierno de Ecuador y el aumento de visitas de buzos deportivos organizadas por compañías de turismo. La primera sección de este informe resume el desarrollo y el estado actual del buceo en las islas. Se enfoca en la industria turística que es responsable por la publicidad y la organización de las actividades de buceo en la islas. La segunda sección sugiere formas para mejorar la protección de los buzos y del medio ambiente. El trabajo considera los siguientes temas: una breve descripción de las condiciones de buceo y los niveles recomendados de habilidad para el buzo, la aptitud y la capacitación de guías-buzos en el conocimiento de la flora y fauna submarinas, una discusión sobre el tratamiento médico disponible en las islas y una descripción de las facilidades para el tratamiento hiperbárico en caso de accidentes, junto con sus localidades y los procedimientos de evacuación.

PALABRAS CLAVES: Galápagos, buceo, seguridad del buzo, protección del medio ambiente marino

RESUMEN EJECUTIVO

Este breve informe describe el desarrollo y el estado actual de las actividades de buceo en las Islas Galápagos. El propósito es evaluar las prácticas y regulaciones del buceo y sugerir nuevas direcciones para mejorar la seguridad de los buzos y la protección del medio ambiente.

Descripción Geográfica y Antecedentes

La Islas Galápagos se encuentran a 960 kilómetros al oeste de la costa pacífica de la República del Ecuador. El archipiélago está compuesto de quince islas principales, docenas de islas pequeñas y rocas, todas de origen volcánico. Las islas se emergen de una plataforma submarina relativamente somera. La profundidad del agua en la región sur de la plataforma (desde San Cristóbal a Fernandina y también más al sur) pocas veces excede los 500 metros, habiendo una profundidad promedio de 900 metros en la sección norte. En muchas zonas costeras son comunes áreas submarinas poco profundas, originadas durante elevaciones geológicas o flujos de lava. Sin embargo, en la mayoría de los lugares, la costa se precipita abruptamente al mar. Es común encontrar profundidades de 2,000 o 3,000 metros en las aguas que rodean la plataforma.

Las corrientes marinas dominantes son El Niño (cálida y periódica), la Corriente de Humboldt que transporta agua fresca y la Corriente de Cromwell que es una corriente compensatoria y submarina originada en el Océano Pacífico. La interacción de estas corrientes produce una gran variedad de habitats ocupados por comunidades de flora y fauna marinas que son tan llamativas como sus equivalentes terrestres, las que a menudo reciben más publicidad.

Desde los principios de la década de los 70 se concibió la creación de una reserva marina para proteger este medio ambiente único. El área protegida se materializó en 1986 con el Decreto Ejecutivo No. 1810-A que estableció una reserva de recursos marinos que incluye todas las aguas interiores del archipiélago y, además, una zona de protección de 24 kilómetros alrededor del archipiélago. La intención del decreto es proteger y mantener los beneficios ecológicos, científicos, educativos, económicos y políticos derivados de este recurso. Al mismo tiempo, el aumento de la investigación y la publicidad junto con el crecimiento global del buceo deportivo y el desarrollo de la industria turística en las Galápagos aumentarán la demanda de buzos para conseguir acceso a esta especial área marina.

El Buceo

El buceo - además del buceo libre - probablemente se originó con los buzos que viajaban del continente para pescar langosta. En esta práctica tradicional, el buzo utiliza aire proporcionado por un tubo conectado a un compresor en la superficie. El equipo SCUBA fue introducido por personas asociadas al turismo y científicos que realizaban investigaciones marinas.

En la actualidad, gran parte del buceo está relacionada con el turismo. Se estima que durante 1986 entre 80 y 200 buzos visitaron las islas. Esta cifra continúa en aumento. La mayoría de los turistas-buzos vienen de Norte América y viajan con excursiones organizadas por dos compañías norteamericanas especializadas en viajes de buceo. Metropolitan Tours utiliza dos de sus propios barcos, pero también hay a disposición cinco barcos independientes.

Debido a las grandes profundidades, el oleaje, las corrientes y las surgencias, las condiciones no son propicias para el buzo principiante. Los deportistas tienen que usar barcos para ir a los sitios donde van a bucear, lo que crea desafíos adicionales. Aunque estas condiciones son mencionadas en la literatura, es difícil determinar con anticipación si los turistas poseen el nivel de competencia requerido para bucear con comodidad y seguridad en las Galápagos.

Cada turista es acompañado por un guía-buzo que asegura que los turistas son buzos competentes y poseen el equipo adecuado. El guía también procura que se proteja el medio ambiente. La mayoría, y quizá todos estos guías han adquirido la certificación como guías naturalistas otorgada por el Servicio del Parque Nacional de las Galápagos (SNPG) y, además, han recibido certificación de las organizaciones internacionales de buceo. Sin embargo, no existen otros requisitos formales para calificar como guía-buzo.

Algunos de los obstáculos para el desarrollo del buceo en las islas incluyen la falta de equipo estandar, repuestos, reparación y mantenimiento competentes. Estos problemas provienen de la naturaleza internacional del turismo a las Galápagos; su posición alejada de las rutas de comercio importantes, la demanda limitada y las complicaciones que surgen cuando se lleva a cabo comercio internacional.

Una preocupación importante es la ausencia del transporte disponible y equipado para evacuaciones de urgencia y la falta de personal y facilidades médicas que podrían atender accidentes relacionados al buceo. Un hospital pequeño en Santa Cruz y una clínica en San Cristóbal tienen solamente capacidad para tratar accidentes menores. En las islas no existe ninguna facilidad donde realizar tratamiento hiperbárico. Las cámaras de descompresión más cercanas están en Guayaquil a 960 kilómetros de distancia, o en Panamá a 1,600 kilómetros. Las aerolíneas comerciales que sirven a las islas no están preparadas para tales urgencias. Además, la comunicación directa o indirecta entre los barcos de buceo, que podrían estar en áreas remotas del archipiélago, y las autoridades en tierra firme podría ser bastante problemática. Aún habiendo una comunicación rápida, la coordinación de una evacuación requeriría esfuerzo considerable y tiempo precioso. Los barcos de buceo cuentan con mínimas reservas de oxígeno para urgencias y poca competencia médica.

El buceo en el archipiélago ha evolucionado de un manera desorganizada y con poca regulación. Esto contrasta con el acceso y el uso del área terrestre del parque nacional que son rigurosamente estudiados, regulados y controlados.. El hecho de que hasta la fecha, los turistas-buzos no han sufrido accidentes serios refleja de un modo positivo los esfuerzos y el

cuidado tomados por los que dirigen las actividades de buceo. Sin embargo, las probabilidades de un accidente serio y la degradación del medio ambiente crecen con el aumento del número de buzos que visitan las islas.

OBSERVACIONES Y DISCUSIONES

Una área de interés es la evaluación previa de las aptitudes de los turistas para asegurar que poseen las competencias requeridas para gozar con seguridad del ambiente marino de las Galápagos. Aunque las compañías que organizan las excursiones intentan advertir a los futuros buzos de las condiciones existentes, un problema se manifestaría con la llegada de un turista-buzo carente de los conocimientos necesarios. Hoy día, sería difícil disuadir de bucear a tal persona. Debido a que es tan difícil evaluar a los buzos antes de que lleguen, se debe publicar y distribuir un folleto patrón a todos los que contemplan la posibilidad de bucear. Dicho folleto contendría descripciones explícitas de las condiciones y procedimientos de buceo, regulaciones, competencia y experiencia requeridas y equipo recomendado. Esta acción no eliminaría el problema (la evaluación de los buzos continuará siendo una actividad necesaria) pero podría desalentar a buzos inexpertos.

Se debe implementar un plan de certificaciones para los guías-buzos exigiendo la demostración de un nivel predeterminado de competencia en dirección de buceo, tratamiento médico básico (incluyendo la resucitación cardíaco-pulmonar), preparación para enfrentar casos de urgencia y conocimiento de los sitios de buceo, así como la flora y fauna existentes en ellos. Este plan debe ser llevado a cabo por medio de capacitación formal, material educativo y ejercicios prácticos.

Se debe hacer todo lo posible para facilitar la adquisición de repuestos y equipo estandar, su mantenimiento y su inspección. Aunque la manera más eficaz para realizar estas metas no está dentro del alcance de este informe, una alternativa podría ser la creación de una asociación de todas las personas activas en el buceo en las Galápagos.

Un protocolo completo que delinee los procedimientos para tratamiento médico, comunicación, coordinación del transporte y evacuación debe ser formalizado y distribuido a todas las personas relacionadas con el buceo. Además, debe ser requerido que cada barco-buzo lleve una provisión mínima de oxígeno con un sistema adecuado de reparto y que incluya en su tripulación por lo menos una persona que sepa tratar accidentes relacionados al buceo y administrar oxígeno.

La creación de la reserva marina y su administración conducirá a la regulación y a la preservación del medio ambiente marino. Dadas la habilidad y la experiencia del Servicio del Parque Nacional de las Galápagos y la Estación Charles Darwin en el manejo del Parque Nacional Galápagos, las bases para realizar estos objetivos ya existen. Quizá estas experiencias pueden ser modificadas y aplicadas a las actividades dentro de la reserva marina. Las siguientes tareas están implícitas en este esfuerzo: la identificación y clasificación de sitios de buceo y una determinación de la frecuencia y magnitud de buceo permitido en cada sitio, la creación de regulaciones de control sobre la remoción de organismos y la delegación de autoridad para que se cumplan estas regulaciones.

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INTRODUCTION

I. The Island Setting

The Galápagos Islands, although primarily renowned for their terrestrial biota, are, in fact, at least equally a marine treasure. Situated 1,000 kilometers (600 miles) west of Ecuador's continental coast, the archipelago straddles the equator at 90°W, isolated in this huge expanse of the Eastern Pacific Ocean.

The archipelago rises from a relatively shallow platform which slopes from south to north. Water depths over the southern portion of the platform seldom exceed 500 meters but increase to the north. Depths of 2,000 to 3,000 meters are found in waters surrounding the platform. Shallow coastal areas created by uplifting of the ocean floor or by lava which spilled from volcanoes and flowed into the sea are common. Mangroves are prevalent in rocky coastal areas but small isolated beaches also exist. In other areas, land masses plunge steeply into the ocean.

The dominant currents are the periodic El Niño, which carries warm water and accompanying moist winds from the north; the Humboldt, with cool water and dry air, which flows from the south along Chile and Peru before sweeping through the islands and the Cromwell, a countervailing subsurface current that originates in the western Pacific.

The marine environment is essentially pristine, teeming with an unlikely assemblage of tropical and cold water marine life that rivals the onshore species in natural interest. Perhaps in no other area of the world, can one swim with gaudy tropical fish and, just a few kilometers away, see penguins and fur seals.

"Hosts of sally-lightfoots were the most brilliant spots of colour above the water in these islands, putting to shame the dull, drab hues of the terrestrial organisms and hinting at the glories of the colourful animal life beneath the surface of the sea" (William Beebe, 1924).

Several factors, such as the geologically recent volcanic genesis of the islands, their isolation from other land masses, the equatorial location, the convergence of contrasting deep and surface ocean currents and the prevailing wind direction combine to provide a unique underwater environment. There are

a number of different marine habitats, including rocky shores, vertical rock walls, lava flows, sandy bottoms, and patchy corals. Because of the various ocean currents and cold water upwellings, there are distinct ecological communities associated with different water temperature patterns. As on the land, many of the marine species are endemic to the islands. The majority of the species are closely related to those of the Panamic Province (Wellington, 1984), which includes parts of the South and Central American coasts and the Sea of Cortez. It is therefore possible to see open ocean pelagics such as whale sharks and pantropical species such as diodon (porcupine fish).

The Archipelago has long been the object of worldwide attention and interest. Since the visit of Charles Darwin in 1835, scientists have continued to use the Galápagos as a site for studies in comparative evolution. More recently, tourism has become an increasingly important use as Ecuadorians and visitors from all over the world come in growing numbers to experience this unique bioregion.

The government of Ecuador, recognizing this uniqueness, has acted to preserve the natural environment of the islands for scientists, educators and future generations. To this end, the Galápagos National Park (Parque Nacional Galápagos, PNG) was established in 1959 (Decreto-Ley no. 17) and over ninety percent of the Islands' land area was assigned to the PNG in 1979 (Acuerdo no. 297). In the early 1960s, the Charles Darwin Research Station was established on Isla Santa Cruz near the town of Puerto Ayora. The station serves as a laboratory and base facility for visiting scientists from all over the world and also plays a major role in assisting the the park authority (Servicio Parque Nacional Galápagos, SPNG) in conservation and education efforts. In addition to these preservation efforts, the Galápagos have been declared a World Heritage Site and included in the United Nations system of Biosphere Reserves.

II. The Marine Area

The PNG includes only land areas of the islands; however a marine component has been envisaged since at least 1973 (Robinson, 1983). It was as part of the planning for this marine reserve and to assist in dealing with problems of coastal zone management, that the Marine Policy Center (MPC) of the Woods Hole Oceanographic Institution (WHOI) became involved in providing cooperative studies and information to the Government of Ecuador. Since 1983,

staff and Fellows of the MPC have worked with the High Level Commission for the Formulation of a Galápagos Master Plan and other Ecuadorian agencies concerned with managing different aspects of the Archipelago.

In May 1986, the Galápagos Islands Marine Reserve was officially established to include all interior waters of the Archipelago plus a 15 nautical mile buffer zone ((Decreto Ejecutivo no. 1810-A), Figure I). This reserve will foster the protection of marine life as well as birds which nest on shore but feed at sea. Although the planning and implementation process is still underway, this is a major step in continuing the Ecuadorian government's established policy of protecting this unique environment.

III. Diver Safety Study

As is true for the land areas of the national park, a major function of the marine reserve will be to provide controlled access to this unique environment. Currently, public visitation to the park is restricted to designated sites and groups must be accompanied by a licensed naturalist or auxiliary guide. It is expected that a similar policy may be established for visitors to the marine reserve. If this is the case, access for tourists will be restricted to certain designated dive sites and parties will be required to be accompanied by a licensed diving naturalist-guide (or in some cases an auxiliary guide).

Thus far, there has been no authoritative planning or control of human intrusion into the underwater environment of the archipelago. "Diving in the Galápagos has developed without any organization. It has its origins in people who started diving here, found it fascinating, reported our findings and through those interested in development realized its economic potential" (Merlen, 1986).

In light of these considerations and the likely growth of scuba diving and snorkeling within the scientific community and tourist industry, the goals of this study are to examine current diver safety in the Islands, to address the potential environmental impacts of a growing tourist diving industry and to make recommendations to ensure that diving is both a safe and enjoyable activity.

On-site research was conducted during a visit to the Galápagos Islands in December, 1985. Using the Beagle III, and accompanied by a diver/naturalist-guide, the group, which included MPC Director and

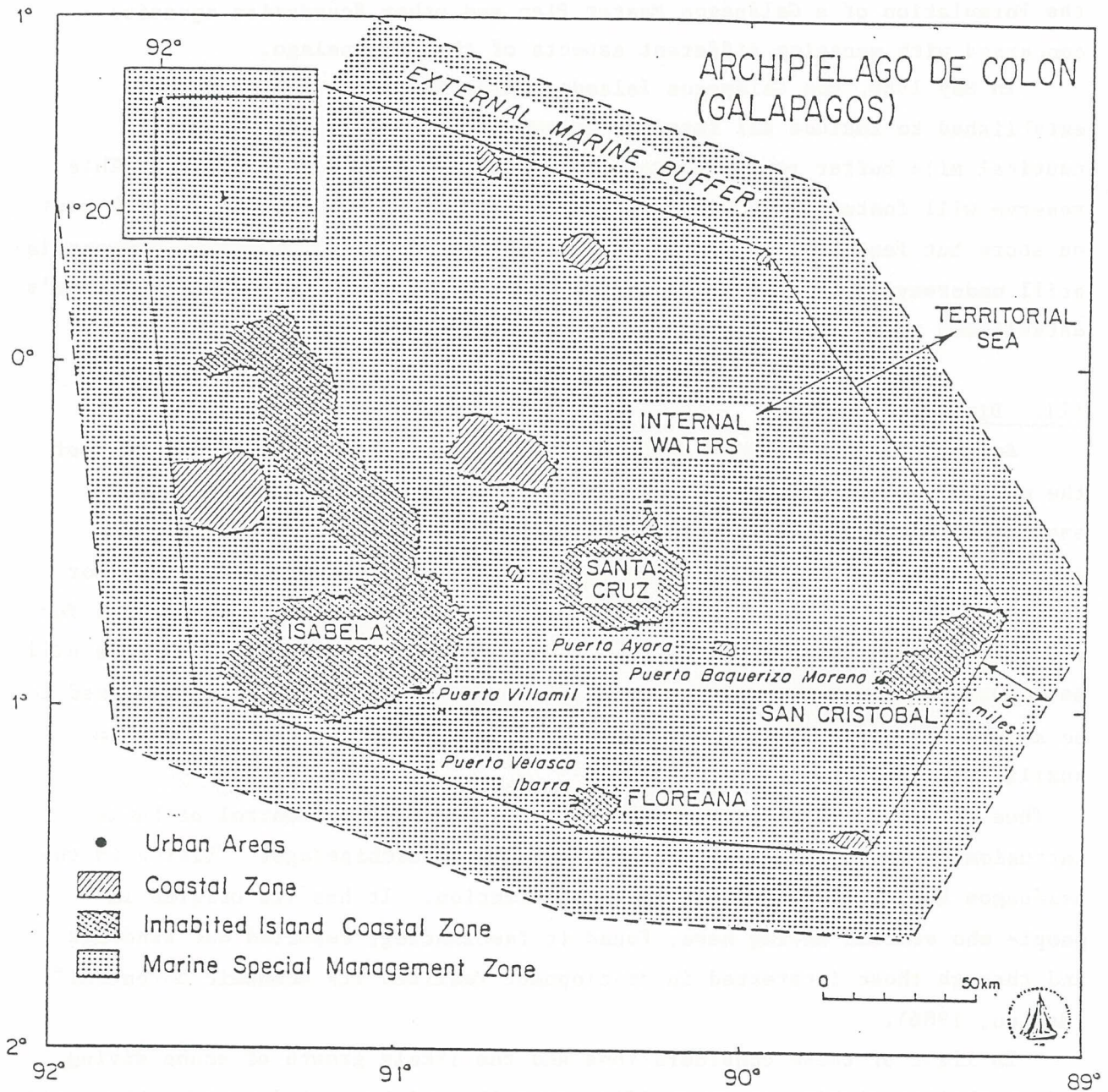


Figure I Map of the Galapagos Marine Reserve

Principal Investigator, James Broadus, the authors and Dr. Gunther Reck, Director of the Charles Darwin Research Station, visited several of the more popular diving sites, representing a variety of diving environments (Table I, Figure II). In addition, interviews and survey forms (Attachment A) were conducted by the MPC group with naturalist-guides, both diving and non-diving, and with persons having knowledge of diving and the island environment. The findings and recommendations which follow are a result of this on-site research as well as additional data gathered from outside sources, including diver training organizations, equipment suppliers, and touring companies.

Table I

Galápagos Dive Sites Visited by MPC Staff*
December, 1985

Identification Number	Name of Site
1	North Seymour
2	Daphne Minor
3	Cousin Rocks
4	Beagle Rock
5	Rábida
6	Champion
7	Corona del Diablo
8	Santa Fe
9	Gordon Rocks

* Some sites were visited more than once

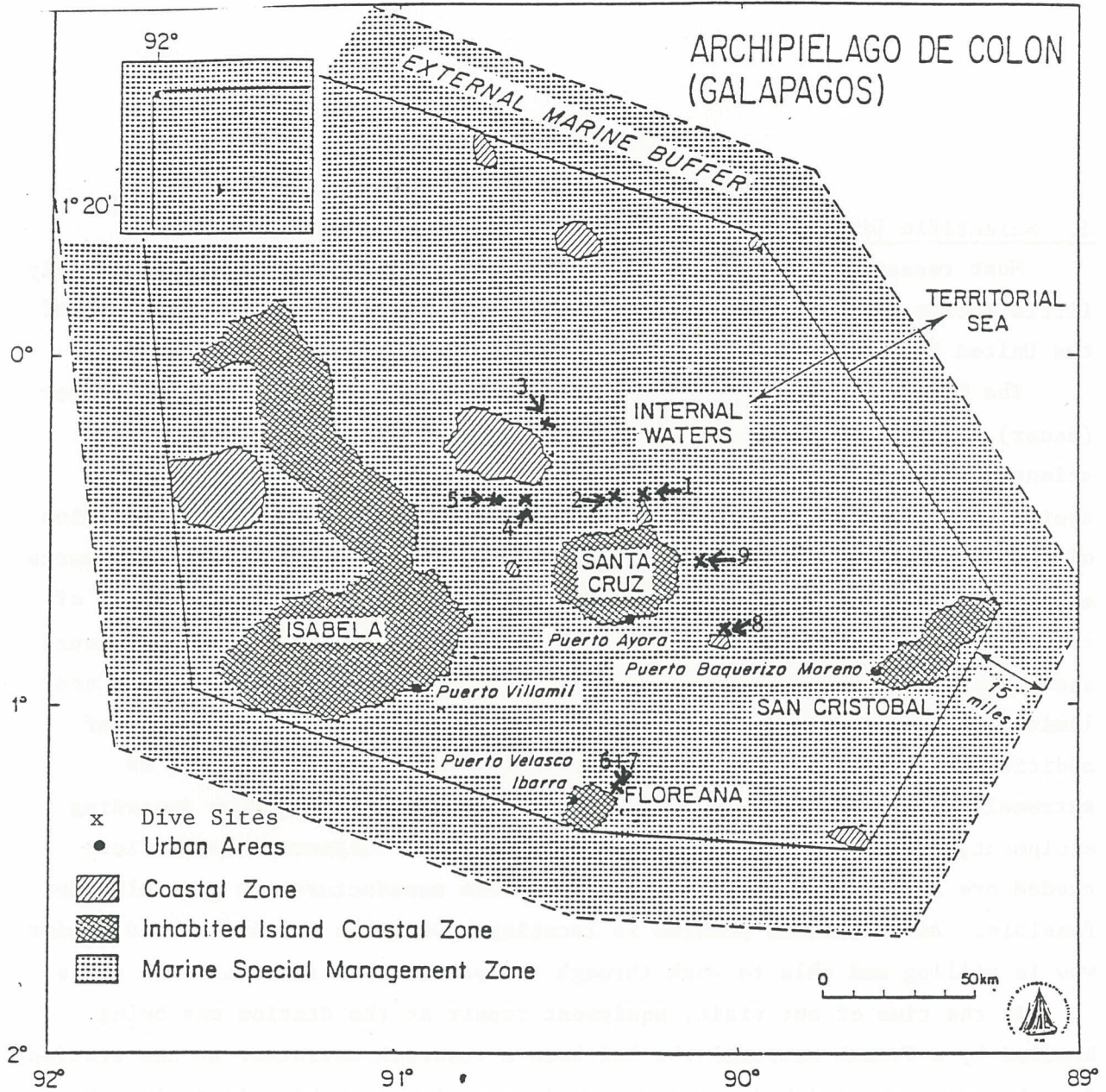


Figure II Dive Sites visited by MPC Staff.

OVERVIEW OF DIVING

I. Scientific Diving

Most research conducted on the islands is land-based. There is actually little marine research diving in comparison to that done in similar areas of the United States.

The Charles Darwin Research Station owns a high pressure air compressor (Bauer) and a small stock of diving gear, much of it donated by visiting scientists who conducted research while in residence at the Station. Equipment repair and replacement is a major problem because of the isolation of the Archipelago. Great difficulty is encountered in obtaining spare parts and new equipment. This may also contribute indirectly to the low level of research diving. The Station is legally allowed to import diving equipment and supplies directly, thus saving a major price markup; however, funds are limited and, in spite of the Director's personal interest, procurement of additional diving equipment cannot be given top priority. Also, it is extremely difficult to obtain information from foreign suppliers regarding equipment, prices, etc. and to arrange payment and shipment. Quantities needed are small so ordering directly from the manufacturer is generally not feasible. An additional problem is locating a reliable and interested vendor who is willing and able to work through the problems of international sales.

At the time of our visit, equipment repair at the Station was being handled by a French national who had been a research assistant at the station for the past year and had previous repair experience working in a dive shop. His primary maintenance responsibility is to keep the compressor operating well. The lack of readily available spare parts, uniform equipment, and repair manuals hinder his ability to maintain equipment properly (Manceau, 1985).

Visiting scientists desiring to dive under Station auspices are asked to show proof of certification (Reck, 1985). Other than this, there was no indication of a formal diving safety or control program, including equipment maintenance standards for investigators' personally-owned gear.

II. Diving by Island Residents

Although there is occasional recreational scuba diving by island residents, off-duty naturalist-guides or persons connected with the Station, most of the activity by residents is restricted to commercial diving for lobster, black coral, and other marine fauna, using hookah equipment consisting of a demand scuba regulator and hose connected to an air source, usually a small low-pressure compressor at the surface. Such divers generally receive little training and what they do receive is mostly informal. It appears that common safety procedures employed elsewhere for commercial surface-supplied diving, such as redundant surface air supply, routinely carrying a bailout bottle for emergency ascent, safety harness for secure attachment of the umbilical to the diver, and even in some cases, use of a surface tender, are not adhered to.

Although accidents and deaths have been relatively infrequent, this may be attributed mostly to luck. It was reported that one lobster diver died while penetrating a small cave: he became entangled, and because he was diving alone, was unable to free himself. Another death occurred when a diver was using a hookah rig with no safety harness: when the air line became snagged, the regulator was pulled out of his mouth and he was unable to relocate it. Unsafe practices, such as solo diving and entering caves without proper equipment and support are reported to be common among commercial divers in the Galapagos Islands.

The regulations of the newly-established Galápagos Marine Reserve may place some limitations on commercial diving by restricting the areas and game, such as lobster, which may be taken and possibly by completely halting the collection of black coral. However, whether the training and safety practices of commercial divers would be directly affected is open to question.

III. Tourist Diving

Most of the diving in the Islands is done in conjunction with the tourist industry. Numbers are not large by Caribbean standards, where thousands of divers annually visit the more popular islands. It is estimated that as few as 80 (Iturralde, 1986) to possibly as many as 200 diving tourists come to the Galápagos in a typical year for a stay of one or, more commonly, two weeks (Abrams, 1986; Baratta, 1986; Maldonado, 1985; Table II; Figure III). This

TABLE II
 Typical Two Week Diving Itinerary
 (Metropolitan Touring, Itinerary G, 1983)

Day	Number	Site	Day	Number	Site
Tuesday:	AM 1	- Baltra	Tuesday:	AM 9	- I. Daphne
	PM 2	- Caleta Tortuga		PM 10	- North Seymore
Wednesday:	AM 3	- I. Guy Fawkes	Wednesday:	AM 11	- Tower
	PM 3	- I.. Guy Fawkes		PM 11	- Tower
Thursday:	AM 4	- Plaza Island	Thursday:	AM 12	- Roca Redonda
	PM 4	- Plaza Island		13	- Vicente Roca
				PM 14	- Caleta Tagus
Friday:	AM 5	- Punta Suarez	Friday:	AM 15	- Punta Espinoza
	PM 6	- Gardner Bay		PM 15	- Punta Espinoza
Saturday:	AM 7	- Floreana	Saturday:	AM 16	- James Bay
	PM 7	- Floreana		PM 16	- James Bay
Sunday:	AM 7	- Floreana	Sunday:	AM 17	- Rabida
	PM 7	- Floreana		PM 17	- Rabida
Monday:	AM 8	- Puerto Ayora-CDS	Monday:	AM 18	- Bartolome
	PM 8	- Puerto Ayora- Los Gemelos		PM 18	- Bartolome

Source: Metropolitan Touring, 1983. Itinerary G

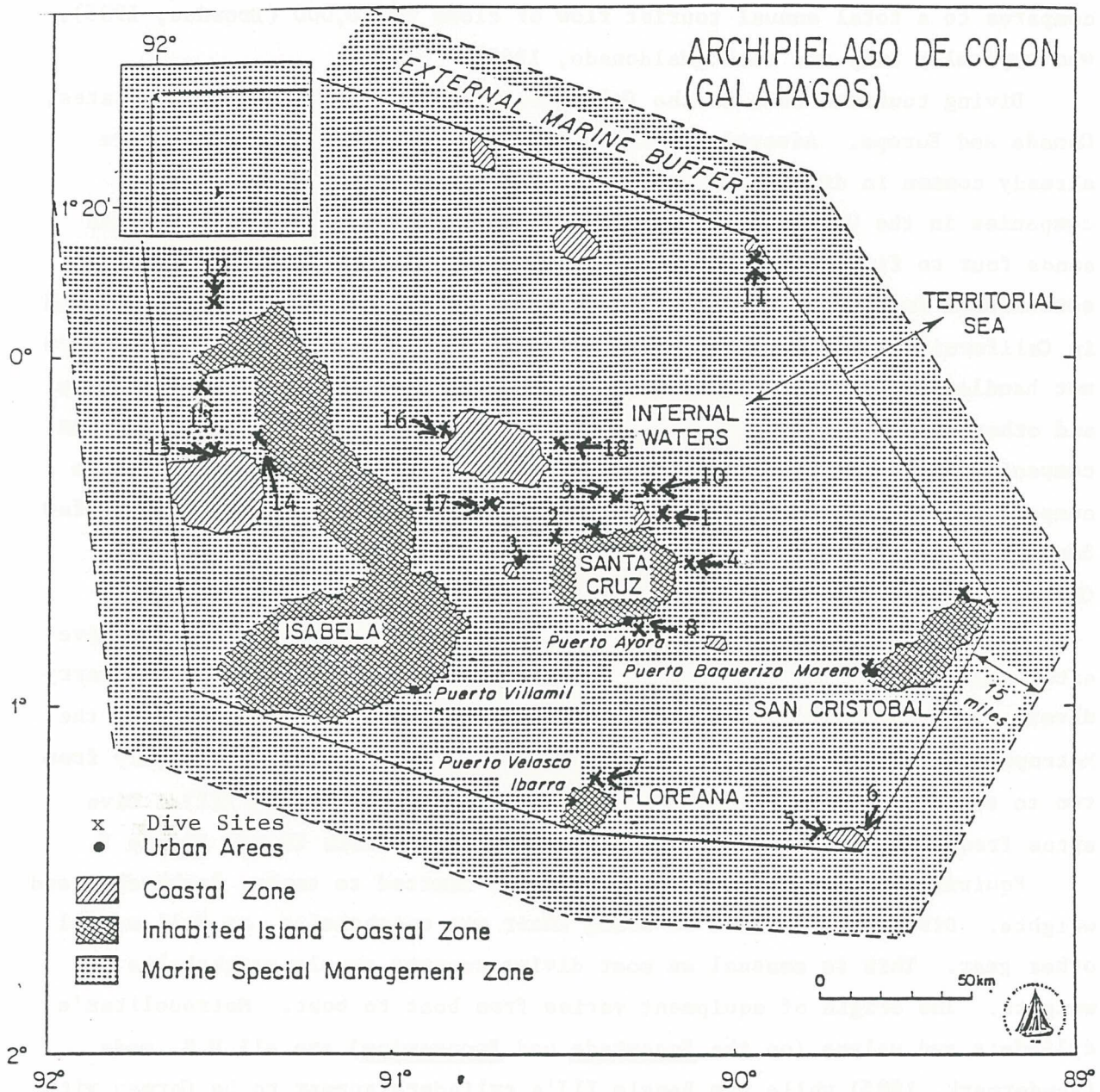


Figure III Dive Sites visited during a typical two week diving tour.

Source: Metropolitan Touring, Itinerary G, December 1983.

compares to a total annual tourist flow of close to 20,000 (Broadus, 1985), who typically stay one week (Maldonado, 1985).

Diving tourists come to the Galápagos primarily from the United States, Canada and Europe. Advertisements for diving tours in the Galápagos are already common in diver magazines (see figure IV). There are two travel companies in the United States which specialize in diving charters. Each sends four to five groups per year through Metropolitan Touring, a well established Ecuadorian company. See and Sea Travel Service is headquartered in California and La Mer Diving Seafari, Inc., in New York City. The divers not handled by these two companies appear to be from dive clubs, dive shops, and other individually-assembled groups which deal directly with Ecuadorian companies. The mix of national origins seems to coincide roughly with the comparative prevalence of diving in the various countries. For example, few South American groups, with the exception of well organized groups from Colombia, visit the Islands for diving.

All tourist diving is done from live-aboard boats which travel to dive sites throughout the Islands. Seven boats are, or can be, utilized to carry divers, with at least half the divers utilizing the Encantada, owned by the Metropolitan Touring Company. The remaining boats, ranging in capacity from two to ten divers, share the rest of the diving groups (Table III). Dive sites frequented by these vessels are presented in Table IV and Figure V.

Equipment available aboard the boats is limited to tanks, backpacks, and weights. Divers are advised to bring their own weightbelts, as well as all other gear. This is unusual as most diving resorts supply weightbelts and weights. The origin of equipment varies from boat to boat. Metropolitan's cylinders and valves (on the Encantada and Bronzewing) are all U.S. made (Vandermark, 1985) while the Beagle III's cylinders appear to be German with valves of Italian manufacture, but compatible with U.S. regulator yokes.

There are three compressors available to tourist diving groups. Metropolitan Touring owns one compressor, which is normally on the Encantada but which can be moved to the Bronzewing. (Note: Metropolitan's normal dive boat is the Encantada; the Bronzewing is used occasionally as a substitute in the case of a very small group, such as a professional underwater photographer or similar special charter.) The independently-owned Beagle III carries a Bauer compressor, and the third compressor is located at the Hotel Galápagos in Puerto Ayora.

Galapagos

Ecuador

Meeting of the Minds

If Charles Darwin was a diver, Galapagos would be as popular as the Caribbean. Start with a large helping of volcanic eruptions, patiently wait eons until an archipelago is formed, add finches, boobies, cormorants, noddy terns, frigates, lava gulls, land iguanas and tortoises above water. Underwater, take fur seals and penguins from the polar regions and from the tropics, add damsels, moorish idols, tuna, barracuda, sharks, marine iguanas, sea horses, batfish, mantas and a few other strange animals, wait until Darwin shows up to explain it and voilà – you have the Galapagos.

The 70' *Éncantada* with her 5 double cabins, large deck and friendly crew will take you on an unforgettable 14 day odyssey of 2-3 dives a day, snorkeling and exploring amongst the Enchanted Islands: Devil's Crown, Tagus Cove, Tower and Hood Islands, Punta Espinoza, Santa Cruz, Plaza Islands, Roca Rodonda and others. You'll discover the paradox of polar marine animals living on the Equator due to the Humboldt current's cool 55-72° water. Visibility's 40-120 feet, clear enough to see herds of sea lions heading your way for a day's romp with awkward humans. A native naturalist is on hand to lead you on daily nature walks to the sea lion rookeries and bird's nesting grounds. The trip has the perfect blend of ingredients for divers and non-divers alike.

For additional program information, see inside back cover.
per person, based on double occupancy, excluding all airfare **\$3000**

Best Diving Season: Feb-Jun and Aug-Sep	
1986	1987
Feb 24-Mar 12	Jan 26-Feb 11
Jun 30-Jul 16	Feb 23-Mar 11
Oct 27-Nov 12	Aug 17-Sep 2

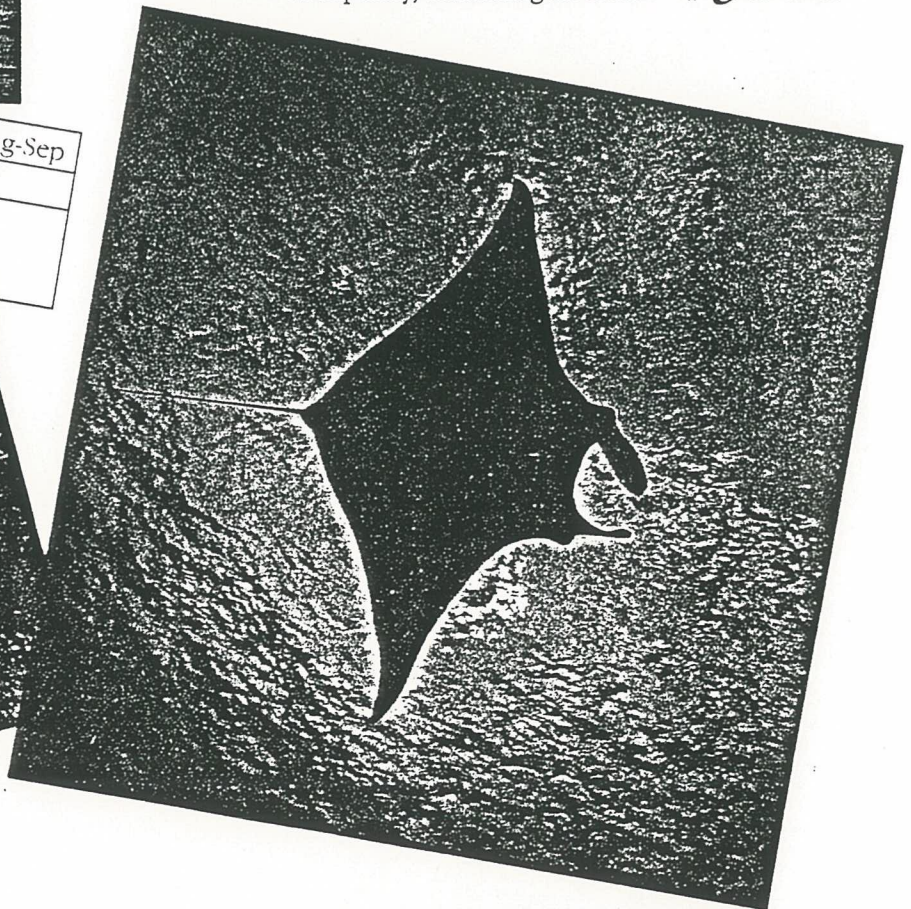
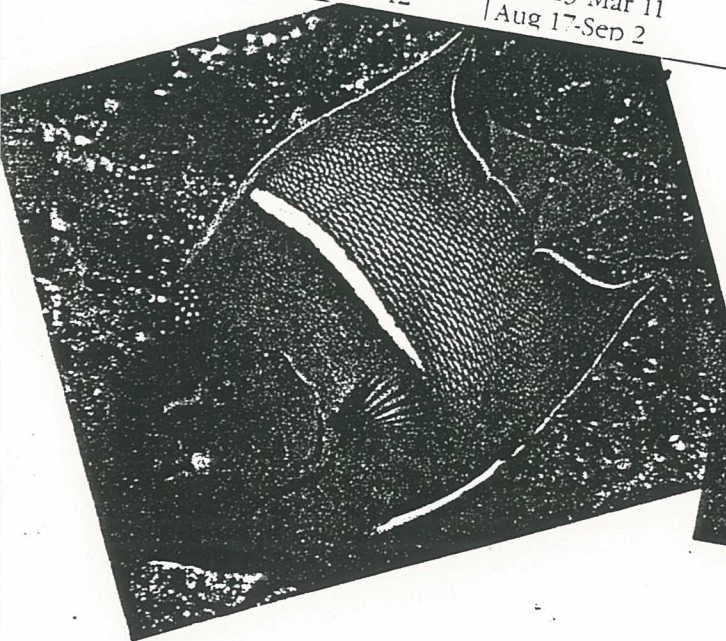
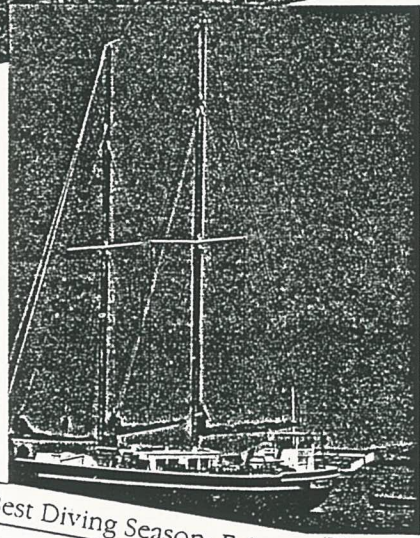
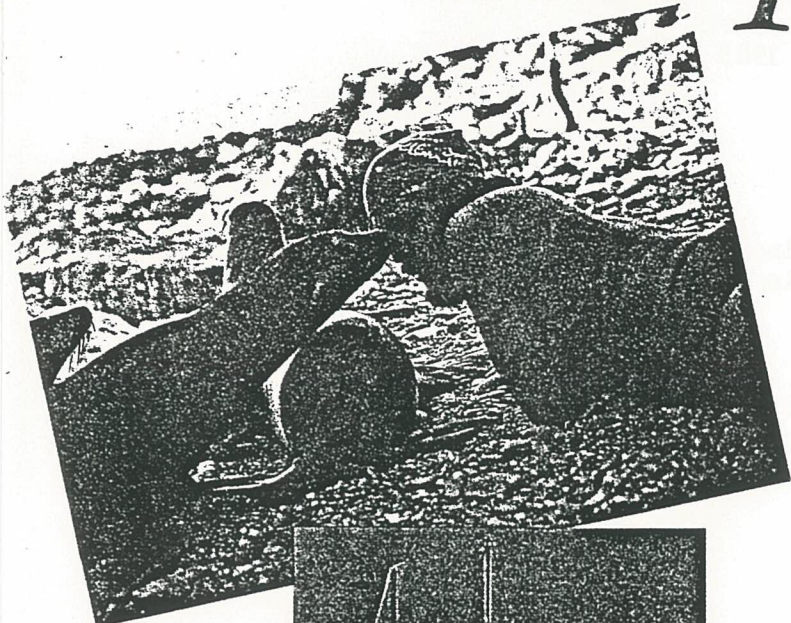


Table III

Boats Available for Diving Groups
December 1985

<u>Boat</u>	<u>Owner</u>	<u>Approximate Capacity</u>	
		<u>Divers</u>	<u>Total</u>
Encantada	Metropolitan Touring	10	10
Bronzewing	Metropolitan Touring	2	4
Beagle III	Rolf Sievers	10	10
Orca	Federico Angermeyer	6	8
Cachalote	Federico Angermeyer	8	10
Sulidae	Jose Salcedo	8	10
Inti	DeRoy family	4	4

Sources: Armas, 1985;
Davis, 1986.

TABLE IV

Seventeen Potential Dive Sites

1	Bahia James	10	Islas Marielas
2	Bahia Sullivan	11	Islas Plazas
3	Caleta Bucanero	12	Punta Espejo (Marchena)
4	Caleta Iguana (Isabela)	13	Punta Estrada
5	Caleta Tagus	14	Punta Fragata
6	Isla Albany	15	Punta Moreno
7	Isla Coamaño	16	Punta Vincente Roca
8	Isla Cowley	17	Punta Suarez
9	Isla Gardener		

Source: Garces, Fausto & J. Ortiz, 1983, "Diagnostico de la Actividad Turistica en la Provincia de Galápagos y sus Impactos Sociales y Ecologicos."

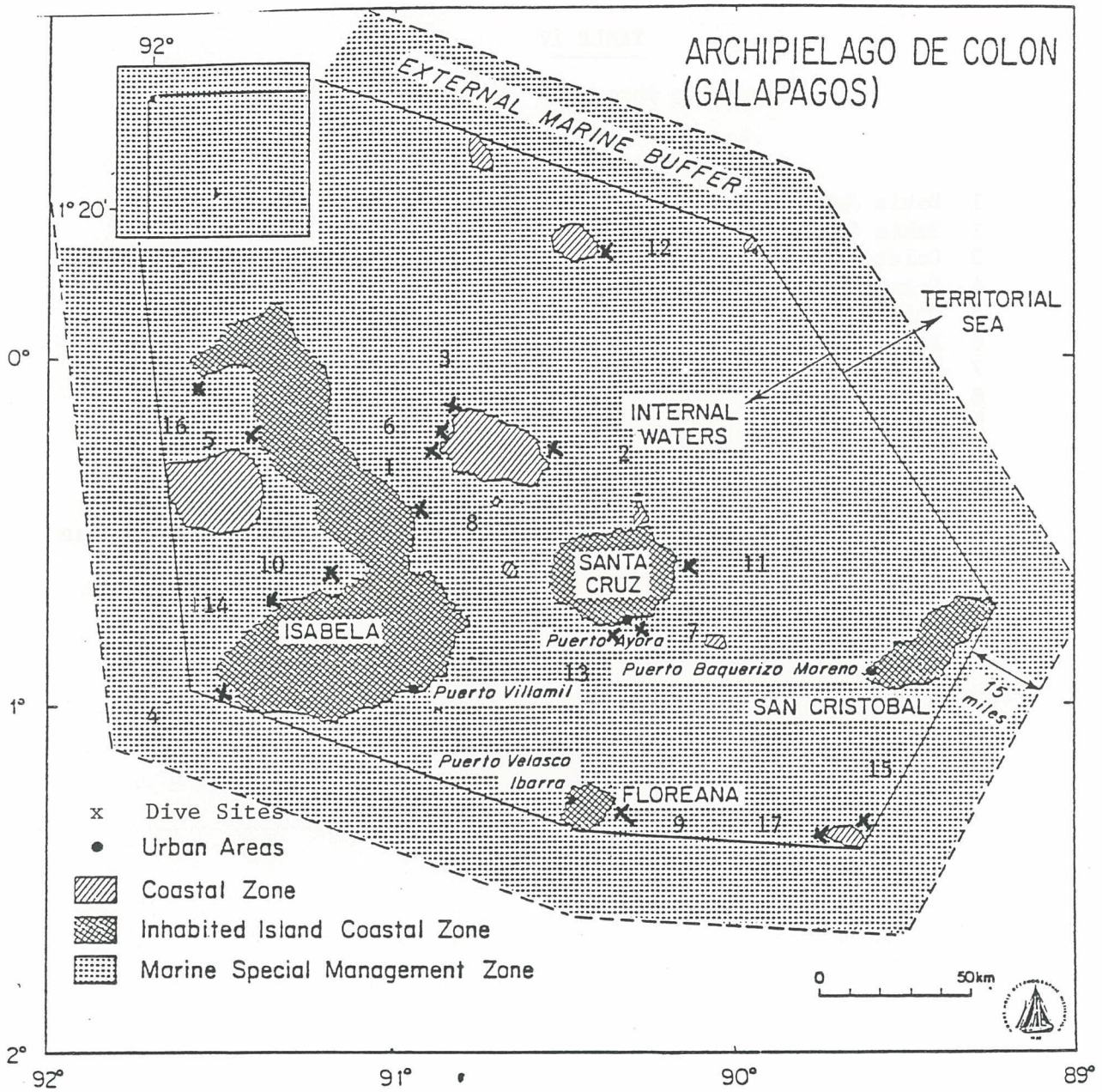


Figure V Seventeen Potential Dive Sites.

Source: Garces, Fausto and J. Ortiz, 1983, "Diagnostico de la Actividad Turistica en la Provincia de Galápagos y sus Impactos Sociales y Ecologicos".

IV. Qualifications of Tourist Divers and Skills Required

Unlike popular diving areas of the Caribbean, the Galápagos marine environment is not one suitable for novice or infrequent divers. The water temperature is relatively cool, 16-21° C. (60-70° F.), requiring the use of full wetsuits of 5-6 mm (3/16-1/4") thickness. At some sites, one may suddenly swim into an upwelling of cold water. Visibility is not the "gin-clear" quality of many popular diving locales, such as the Cayman Islands. One may see fifty to eighty feet or more, particularly during the warm season, December through June (Merlen, 1986). However, at times underwater visibility is much less. Sea swells, strong currents and surges may be expected. The "bottomless" vertical topography at many sites necessitates excellent buoyancy control and close monitoring of depth, time and air supply. Finally, large marine animals which may include sharks, rays, schools of pelagic fish, fur seals and sea lions and, of course, sea turtles are to be expected.

Many areas of the world popular among novice divers (e.g. the Caribbean) use large flat-bottomed dive boats which give a great deal of room for donning gear and provide easy access out of and onto the boat. In the Galápagos, such boats are not available. With occasional exceptions, gear must be loaded into a motor skiff and donned just before entry. The use of the small boat precludes the presence of the attendants prevalent on Caribbean dive boats so divers must be fairly self-sufficient in handling gear.

Most divers visiting the islands appear to have levels of experience and skills which categorize them as "intermediate" to "advanced" divers. Although diving guides mentioned the occasional diver who is afraid to jump directly into the water from the mother boat (a height of four to five feet) or who has a great deal of trouble with gear assembly, most of the divers appear at ease in the water and any problems are generally spotted in the first evaluation dive (Armas, 1985; Merlen, 1985; Vandermark, 1985).

There apparently is no screening of divers' qualifications by the independent boat operators or Metropolitan Touring, other than an initial evaluation dive conducted by the diving guide after arrival in the Islands. Any pre-trip screening must be done by the chartering party or by the travel company arranging the trip. We were unable to learn what, if any, pre-trip selection is done by non-U.S. groups, or by individually arranged tour groups;

however, this information was available from See and Sea and La Mer, which arrange the bulk of the U.S. diving in the Islands.

See and Sea screens the experience reported by applicants for their Galápagos cruises and strongly discourages inexperienced divers from making the trip. They consider conditions in the Galapagos to be the most difficult diving they offer (Baratta, 1986), and attempt to ensure that divers have the skill level required to enjoy it safely.

La Mer does not attempt to limit their Galápagos trips to experienced divers (Abrams, 1986). However, the company's application form does ask several questions regarding diving experience (La Mer Diving Seafari, Inc., 1985a) and the Trip Preparation Bulletin (Attachment B) mentions the cool waters, large animals, limited luxuries, and water entry maneuvers discussed above (La Mer Diving Seafari, Inc., 1985b).

A problem could arise if a tourist arrived on the islands and was judged not to be sufficiently skilled to dive Galápagos waters. In this instance, the companies booking and/or conducting the tour could be faced with having to refund the cost of the tour or with possible legal actions. Consequently, pre-screening is important in preventing such a situation from occurring.

The primary assurance that divers visiting the Galápagos Islands are not novices is attributed to the nature of the trip itself. Travel times are quite lengthy, the boats are comfortable but not luxurious, there are no night clubs, the cost is relatively high, and most trips are two weeks in length. Novice divers are more likely to try their wings in a less isolated and expensive location, usually with warmer water and less challenging conditions. Novice divers also are unlikely to commit themselves to a two week trip where the only major activities available are scuba diving and hiking. If the logistics of the trip were to change markedly (such as direct flights from the U.S. or the building of Caribbean-style dive resorts), a much more thorough pre-trip screening would be necessary to ensure that the divers have the requisite skill level.

V. Qualifications of Diving Guides

The Galápagos naturalist-guide, one of whom accompanies each group of visitors into the park, is the key to environmental preservation and visitor safety. Likewise, the diving guide is the key to underwater preservation and diver safety. The diving guides must check diver qualifications, ensure that

all have adequate and safe equipment, observe and evaluate the divers' skills, guide the group to safe and interesting sites, prevent the taking of "souvenirs," and be prepared to deal with any emergency, no matter how serious, in an extremely remote location.

All of the diving guides of whom the authors have knowledge are licensed naturalist-guides. All are divers with training and certification from a variety of agencies world-wide. In length of experience, they resemble the rest of the naturalist-guide population, with a very few having been active as guides for several years and the remainder ranging from two or three years' diving experience down to novice.

Other than being a licensed naturalist-guide and a certified diver, there are apparently no other formal requirements (such as level of diving experience) for the position of diving guide (Armas, 1985; Iglesias, 1986; Maldonado, 1985; Salcedo, 1986). Training is limited to learning the locations, depths and other information about the various dive sites. This knowledge is usually obtained by assisting another diving guide on a cruise and/or by talking to other guides and crew members.

To our knowledge none of the diving guides (as of December 1985) have formal training in diving leadership (such as divemaster or instructor) or in diver rescue and accident management (other than incidental courses). These types of training are not available in the Islands. The guides do, however, pass information along to each other. The Guides Club serves as a vehicle for dissemination of information, particularly through their newsletter, La Garua. For example, a recent issue contains an article by diving guide Alison Prideau on diving first aid (Prideau, 1984). (Note: Ms. Prideau describes a NOAA (U.S. National Oceanic and Atmospheric Administration) short course on diving first aid in which she participated. The course was conducted by a NOAA employee who was in the Galápagos to replace tide gauges (Davis, 1986))

The problem of insufficient diving equipment, technical information and spare parts also affects the diving guides. Guides, due to their leadership role, require up-to-date information on gear. Each year, new items are introduced and others dropped from production. Guides should, therefore, be familiar with the characteristics of a wide variety of equipment, especially given the international character of Galápagos tourism. They must also be able to identify unsuitable or unsafe equipment in order to avoid accidents. For example, duct tape (a fabric adhesive) was noticed during our visit

attached to a diver's regulator. Several layers of tape were wrapped around the first-to-second stage intermediate pressure hose at the first stage insertion fitting. Upon removing the tape, it was found that the two outer layers of the hose had been cut through by excessive wear, thus severely weakening its strength. If the hose had burst while diving, a potentially dangerous situation could have resulted. The diver had been given this hose, complete with duct tape, by a "dive shop in Guayaquil".

The boat crew is also important to the safety of the divers. The captain's role is obvious as he is in charge of the vessel. Most diving is done from a small motor skiff launched from the cruise vessel. The skiff operator is vital to the safety of the operation as he is responsible for following the divers' exhalation bubbles and for picking up divers when they surface. It can be very difficult to track several pairs of bubbles in a swell or chop while simultaneously avoiding having the skiff smash into the face of a cliff. "Often it is his careful vigilance of the bubbles that keeps everyone safe" (Merlen, 1986). Further, an experienced skiff operator may know more about the currents and other conditions at a particular dive site than the diving guide, who may be relatively inexperienced.

VI. Rescue and Emergency Treatment Procedures and Facilities

There have been no diving accidents involving tourists in the Islands of which we are aware. This is not surprising given the general safety record of recreational scuba diving. For example, the U.S. death rate for non-occupational scuba diving in 1982 was three fatalities per 100,000 active divers (McAniff, 1984), while the U.S. Divers Alert Network reports a typical annual rate for non-fatal injuries requiring recompression treatment of less than 24 incidents for 100,000 active divers (Wachholz, 1985). When compared to the very low numbers of divers (80 - 200 visitors per year) and dives made in the Islands, the odds of an accident are quite small (assuming the same rates as in the U.S.); however, the consequences of an accident are much more serious due the lack of available treatment facilities.

Immediate recompression in a medically-staffed chamber is the only effective treatment for serious cases of decompression sickness and air embolism (Attachments C and D). A chamber which is able to deliver 100% oxygen to the patient is preferable (United States Navy, 1985) when treating these conditions.

There are no facilities for hyperbaric treatment of diving injuries in the Galápagos Islands. The closest recompression chambers are located in Guayaquil, on the mainland, and are operated by the Ecuadorian Navy (Attachment E). There are two: one is a stationary, double lock unit manufactured by Drägerwerk, West Germany. The outer lock has a two person capacity and the inner lock, six persons. It has been in use since November, 1977. This chamber can be pressurized to an equivalent depth of 50 meters (Pinto, 1986). The other is a one person portable chamber manufactured by Galeazzi, Italy. The depth capability is 19 meters so the chamber is of limited value.

Information concerning oxygen availability was ambiguous. One source stated that both chambers could deliver oxygen (Pinto, 1986) while the other claimed "no oxygen is available" (Padilla, 1986). There was also conflicting information regarding the qualifications of chamber personnel. There are apparently four chamber operators and six assistants. However, one source stated that there are no physicians specialized in treating diving-related problems while the other listed "one medical personnel" but failed to qualify the term. The chamber facility is operational on a 24 hour basis. Emergency treatment is available to civilians with related costs charged to the patient.

Little information regarding the Guayaquil compression facility has reached the islands. The general impression in the Galápagos is that the facility is not properly equipped, adequately staffed or otherwise available for treatment of civilians (Armas, 1985; Koster, 1985; Vandermark, 1985). Given this, the chamber of choice is said to be in Panama, approximately 1,700 kilometers (1,000 miles) away. It was reported that the Panamanian facility is "best equipped" and an airplane is available in emergencies (Iglesias, 1986). We were unable to learn the specifics of the Panamanian facilities or whether a plane was available for emergency evacuation from the Galápagos and, if so, whether it could be pressurized to a safe level for a barotrauma patient while in flight (i.e., at an altitude of less than 800 feet, compared to 8,000 feet for normally-pressurized commercial aircraft).

We were able to obtain only general knowledge about the Panamanian chamber's operating authority and procedures for contacting the chamber and initiating transportation and treatment (Attachment E). The Director of Tourism for Metropolitan Touring, interviewed in Quito, stated that they have a written protocol for dealing with diving accidents, including procedures for

accessing the recompression chamber in Panama (Maldonado, 1985). We requested, but have not received, a copy of this protocol. Diving guides interviewed in the Islands did not indicate an awareness of policies or procedures.

Even given prompt contact with the proper authorities and the ready availability of a plane on the mainland, it could be twenty-four hours or more before a patient reached a recompression chamber since the dive boat would have to proceed to the airport at Baltra or at San Cristobal, possibly from a remote corner of the Archipelago, and the patient would then have to be flown a considerable distance. Island-based emergency transportation for diving casualties is generally not available. There is at least one regularly scheduled commercial jet flight daily, except Sundays. However, a special low-altitude evacuation flight would have to be chartered from Guayaquil to safely transport the patient. Flight time each way is approximately four hours. The chamber facility is located approximately ten minutes from the Guayaquil airport.

Another potential concern is the medical competency of the flight crew. According to one source, "The air crew has no knowledge of transporting patients with diving related illnesses " (Padilla, 1986).

Medical facilities for treating non-diving injuries or injuries to island visitors appear to be reasonably adequate. A clinic is located in Puerto Ayora, and San Cristobal has a small hospital. Daily air transportation is available to and from Guayaquil and Quito. Boats carry minimal first aid supplies, and dive boats usually carry a supply of medical oxygen, although not enough for the many hours needed to get a patient into hyperbaric treatment.

PRINCIPAL OBSERVATIONS AND DISCUSSION

Despite the lack of organization and the remoteness of the area from necessary facilities, both tourist and scientific diving operations currently seem to have been well-conducted and safely carried out. This safety record is probably the result of the low volume of diving and individual efforts by naturalist guides and scientist. The observations which follow are not intended as criticisms of what has been done in the past, but rather as directions in which to move in order to make a safer future for diving in the Islands.

I. Role of the Newly-established Marine Reserve in Protecting the Diving Environment

In order to protect the marine environment in the same way in which the land environment is now protected, and to enable uniformity of standards and regulation of diving activity in the islands, the Government of Ecuador should use the authority of the new Galápagos Islands Marine Reserve to regulate diving and ensure environmental protection.

While diving activity currently represents only about one percent of the tourist traffic through the Islands, there is every reason to believe it will increase, at least in absolute numbers. Diving is essentially unregulated, although the touring companies and boat operators have done quite well to date in enforcing their own standards and conducting their diving safely. In addition, the naturalist-guides who also serve as diving guides have extended their concern for the land environment to the water. While this has worked well with small numbers of divers, safety and environmental protection become increasingly difficult to maintain in the face of larger numbers of divers which dictates the need for standards for diving practices.

Many areas of the world, such as the Caribbean, have faced a situation similar to that which the Galápagos Islands may face in coming few years. In particular, the Cayman Islands have been confronted with a tremendous

increase in diving and tourist activity over the last fifteen to twenty years. While the Cayman Islands are much more accessible to the North American and European tourists than the Galápagos, and the diving is generally much less demanding, the Cayman experience can provide a point of comparison for diving regulation in the Galápagos.

Cayman Island diving is regulated, not by a national park or by the government, but by the Cayman Islands Watersports Operators Association (CIWOA), a voluntary organization composed of all but one or two of the diving service operators in the islands. These operators, recognizing that a serious accident caused by one operator's negligence would harm all of their operations and that a rich and healthy underwater environment is their most valuable resource, have banded together to set standards for safe operations and environmental protection. The CIWOA statement of Safety Regulations and Precautions includes requirements for equipment to be carried on board dive boats, standards for working Divemasters, maximum dive depths, and a prohibition against spearfishing and the collection of marine life (Attachment F). Because of the danger of damaging fragile coral reefs, the CIWOA has even promoted the placement and use of permanent moorings at the most popular dive sites. Their continued conservation efforts have culminated in the pending establishment of a marine reserve for Grand Cayman (Cayman Islands Watersports Operators Association, 1986).

While the establishment of the Galápagos Marine Reserve is at the beginning of such a process, the need for diving safety and environmental protection is similar. The administering body of the marine reserve should be given the authority to set training standards and certification requirements for diving guides, to set minimal training and experience standards for incoming recreational divers, and to require certain safety equipment on boats engaged in scuba diving operations. The reserve authority should also regulate the ratio of in-water guides to divers and control the types of diving that are done (e.g., no stage decompression diving, maximum depth limits). The reserve authority might also regulate or prohibit the taking of marine life and habitat destruction. While diving operations have been well-conducted in the past, there is no guarantee for the future, and the impetus for ensuring diver safety must come from the Government of Ecuador.

II. Information for and Pre-Screening of Visiting Divers

In order to ensure that incoming divers have the proper skills and expectations for Galapagos diving, the dive boat operators and touring companies, in cooperation with Park/Reserve authorities should prepare a briefing packet for prospective visiting divers and set minimum training and experience levels for incoming divers as well as for required equipment. Screening of divers should be an on-going process beginning with pre-trip screening using the information packet and continuing through review of divers' credentials by the diving naturalist-guide and an initial evaluation dive.

Diving in the Galapagos Islands is not for everyone: a skill level above that of novice is required in order to dive safely and enjoyably. Some of the skills required are small boat experience, the ability to handle all gear easily and independently, full wetsuit experience (6 mm. or 1/4 inch) with hood, ability to handle oneself in currents and surge, flawless buoyancy control, lack of anxiety at the thought of diving with large animals (sea lions, sharks, etc.), and willingness to enter the water by jumping from a moderate height. Prospective divers should be aware of what is required and have the level of training and experience to handle these conditions easily, both for their own enjoyment as well as for the safety of themselves and their diving companions. The preventive emphasis becomes especially important in view of the Islands' remote location from the closest recompression chamber facility.

While the briefing materials of the U.S. touring companies do indicate that these skills will be called into play (Baratta, 1986; La Mer Diving Seafari, Inc., 1985b) and pre-screening by these companies is considered important (Roessler, 1986), pre-trip diver information can be strengthened and its use by all dive boat operators and touring companies could be made mandatory by the Park/Reserve Authority. A complete diver briefing packet should be prepared by the Park/Reserve Authority, describing the skills needed and special environmental conditions to be encountered in detail, as well as the special wonders to be seen underwater in the Galapagos. This briefing packet could then be distributed to all prospective divers by all boat operators and touring companies which send divers to the Galapagos.

In addition, a standard level of training and experience should be required of all visiting divers, either through cooperative agreements among dive operators or mandated by the Park/Reserve authorities. These requirements should be included in the briefing packet and enforced through dive guides' inspection of certification cards and log books prior to allowing divers into the water. (An enforcement alternative would be for the Park/Reserve authorities to inspect the incoming divers' credentials upon arrival and to issue a diving admission certificate to the Park/Reserve: no one would be allowed to dive without this certificate.)

Minimal diving standards should be objective and easily verifiable to avoid problems of interpreting credentials and to prevent subjective judgements by non-diving authorities. A reasonable and convenient standard would be to:

- (1) require an internationally-recognized certification as a scuba diver (issued, e.g., by the British Sub-Aqua Club (BSAC), Confederation Mondiale des Activities Subaquatique (CMAS), National Association of Scuba Diving Schools (NASDS), National Association of Underwater Instructors (NAUI), Professional Association of Diving Instructors (PADI) or the Young Men's Christian Association (Y.M.C.A.)).
- (2) require at least ten dives to have been made in the past twelve-month period, at least two of which must have been in the last six months.
- (3) At least two career dives should have been made in a full wetsuit (6 mm. or 1/4 inch, including hood), and at least two from a small boat (skiff or other boat under 20 feet). All of these experience requirements should be verified by logbook.
- (4) If a diver has certification from a training agency which does not provide training in "buddy-breathing" (sharing air from a single regulator), the diver should be required to be equipped with an alternate air source ("octopus") and should be limited to diving with a buddy similarly equipped (Such divers should be advised in the briefing packet described above to be sure they are accompanied by an octopus-equipped buddy with whom they can dive, or to bring a spare regulator second stage which can be installed on a buddy-diver's regulator prior to diving.).
- (5) Dive operators and Park/Reserve authorities may also wish to require a licensed physician's statement approving the visiting diver's health for scuba diving.

Equipment requirements should also be set and enforced without exception. All divers should be required to wear buoyancy compensators, with power inflators recommended. Submersible pressure gauges, watches or bottom

timers, and depth gauges should also be required for all divers. An alternate air source (octopus) should be recommended for all divers, but required for both members of a buddy pair if one of the divers is not trained in buddy-breathing (see above).

These minimal requirements should be strictly and objectively enforced with no person allowed in the water on scuba unless it has been previously verified that all requirements are met. The first dive should also be an evaluation dive and diving guides should have clear authority to restrict or forbid diving by any person they consider hazardous to themselves or others because of either skill level or poor attitude. Provision could also be made for changing and updating these standards as international "community standards" for safe diving change due to improvements in equipment, techniques, etc.

While these requirements may seem restrictive, they reflect the levels of skill which are necessary for safe and enjoyable diving under Galápagos conditions. If the standards are widely disseminated and all prospective divers understand that the requirements are absolute, there should be minimal problems with enforcement. Tour companies and charter groups would be required to pre-screen their divers using these standards; however, having the authority of the Park/Reserve and/or boat operators behind them should assist them in enforcing the diver standards they themselves also believe are warranted (Roessler, 1986; Pitcairn, 1986).

III. Standards for training diving naturalist-guides

In order to provide a safe and enjoyable diving experience , and to provide for efficient and effective group evaluation and management, as well as effective handling of any emergencies, a special class for diving naturalist guides could be conducted and minimum uniform entry-level standards established. In addition, a training course should be designed and implemented for all diving naturalist-guides, which would be required for licensure, and which might include cardiopulmonary resuscitation (CPR), first aid training, diver rescue, accident management, group leadership and management, and diver evaluation, (Attachments G to I) as well as an orientation to the underwater biology and dive sites of the islands. Only naturalist-guides who have successfully met the minimum requirements and

completed the special training course should be permitted to lead diving groups in the Islands.

Diving guides should possess skills above and beyond the ability to scuba dive. They need to be experienced in their diving to the point of its being "second nature" in order to devote their attention effectively to the needs of the group they are leading. Although as naturalist-guides, they are trained in leading groups on the surface, many additional factors come into play underwater. The type of training received by dive group leaders in the United States which leads to certification as a Divemaster would, with some modifications to reflect prior training and special environmental characteristics, be highly appropriate for prospective Galápagos diving naturalist-guides (Attachment J, "NAUI Divemaster Course Standards").

The suggested minimum prerequisite to qualify for special training are at least one year's experience as a naturalist-guide, an internationally-recognized scuba diver certification, and at least one year of diving experience, with a minimum of twenty-five logged open water dives within the preceding two years. This is equivalent to that required for entry into the NAUI Divemaster training course.

A special curriculum could be designed by experienced diver-trainers, Park/Reserve authorities, Research Station personnel, and diving operators. The curriculum should be similar to that outlined in Attachment H, with CPR, first aid, and rescue training emphasized and shore diving eliminated. Group evaluation and management should be emphasized. The course could be offered each year in coordination with the regular naturalist-guide training course. Instructors for the course should be experienced scuba instructors working in cooperation with Park/Reserve authorities and Research Station personnel.

There may be several options available to reserve authorities for conducting a diver guide training course. It would likely be rare that a qualified diving instructor would be on staff to teach such a course. It would, of course, be expensive to send guides abroad for training and there would also be costs associated with the hiring of an instructor. However, with some ingenuity, planning and cooperation from tour companies, reserve authorities and the Darwin Station, it may be possible to devise a low cost solution to the problem. For example, it is likely that certified dive instructors travel to the Galápagos each year on scheduled tours. If

qualified instructors were offered a significant reduction in fare and/or lodging or several extra days of diving, it is probable that they would compete for the opportunity to donate time to teach the course (Hendrick, 1986).

IV. Protocol for emergency medical care and evacuation to recompression facility

In order to ensure prompt medical treatment in the event of accidents, protocols should be developed to provide emergency medical care, access to recompression facilities, and evacuation to the appropriate facility. Minimum requirements for emergency equipment to be carried on board all tourist boats must be established and enforced.

While diving is a safe sport (Wachholz, 1985), the possibility of accidents still exists. In the event of a diving accident (embolism or decompression sickness), prompt initiation of treatment will be required and given the remoteness of the Archipelago, it is vital that delays in accessing a recompression facility and initiating transportation be avoided.

The Park/Reserve authorities in conjunction with the Darwin Station and the diving operators could negotiate agreements with at least two recompression chamber facilities to provide emergency treatment for Island diving casualties. The Ecuadorian Navy chambers in Guayaquil and the chamber in Panama are the most likely candidates. Such agreements should include procedures for contacting each chamber and a commitment by the chamber authority to obtain transport to fly to the Islands to evacuate the patient. Local procedures should also be standardized to enable the dive boat to contact the authorities at the Navy, SPNG headquarters or the Research Station in order to initiate contact with the recompression chamber and to instruct the boat to proceed without delay to the nearest appropriate airport. Attachment K, Chapter 6 of the Woods Hole Oceanographic Institution Diving Safety Manual, is an example of such a protocol for obtaining emergency medical service for a diving injury in the United States.

All diving boats should be required to have a least one crew member besides the diving naturalist-guide who is trained in first aid, including CPR, as well as in recognition of diving injuries. In addition, boats might

carry a minimum supply of oxygen, including regulators, masks and/or other appropriate oxygen delivery systems. The amount of oxygen would depend upon several factors, such as the number of divers, the remoteness of sites visited, etc. Of course, there is always a limited amount of storage space on a small vessel. As the bare minimum, a 2,000 liter oxygen supply, which could support a patient for approximately four hours (at a flow rate of 10 liters per minute) should always be carried on board. This could be in the form of a single 2,000 liter (U.S. "M" size) cylinder, three 682 liter (U.S. E size) or five smaller 420 (U.S. D size) cylinders. The smaller cylinders are easier to store and handle and advantageous as the patient can be supplied with oxygen during the entire evacuation operation.

Both the naturalist-guide and an additional crew member should have training in oxygen administration. (These requirements might also be considered for extension to all tourist boats, since accidents and illness to non-divers, including heart attacks, are quite possible: boat crews and guide should have training and equipment which enables them to render proper assistance.)

If the number of tourists, including diving tourists, expands significantly, consideration might be given to establishing an air-sea rescue facility for the Islands which would enable pickup of a patient by helicopter from a tour boat at sea, or from a nearby island, for rapid transportation to a medical facility or airport. In the case of a diving accident victim requiring recompression therapy or a non-diving patient requiring skilled medical care or emergency surgery, this could significantly reduce the time required to receive appropriate treatment. Flight crews should include persons trained in emergency medical skills relevant to diving casualties.

V. Equipment availability

In order to ensure a supply of diving equipment in good repair which is adequate to serve the needs of the diving guides and Darwin Station scientists, as well as cylinders and spare parts for visiting divers, the diving operators, Reserve and Station authorities could form a diving association or consortium in order to meet these needs. This might include negotiation with a reputable full-line equipment supplier in either the United States or Europe as well as possible consortium subsidy of an equipment

maintenance/repair person and facility for the Islands to be physically located at the research station.

The Galápagos Islands are six hundred miles from the nearest dive shop/repair facility and thousands of miles from the nearest full-line equipment supply company. Divers and dive operators in the Islands need a ready source of equipment and spare parts which they can trust fully, as well as a source for routine maintenance and repair of equipment which is readily accessible. Mainland dive shops are not close enough nor properly equipped to serve Island needs, and U.S. and European equipment companies and dive shops are difficult to deal with on an small scale basis because of distance and difficulties with international sales.

A consortium of all parties in the Islands engaged in tourist or research diving could provide the buying power to negotiate successfully with a full-line supplier for reasonable prices and service. Although it will be difficult, adequate sums must be included within diving operators, Reserve and Station budgets for equipment and spare parts in order to ensure that equipment is in safe condition to use.

The diving association might also cooperate to support a central equipment maintenance and repair facility. The person staffing this facility should be able to repair most or all brands of regulators, buoyancy compensators, and valves, as well as repair and modify wetsuits and perform internal visual inspections and cleaning of scuba cylinders. The most appropriate location for this facility would be in Puerto Ayora as it is centrally located and a focal point for the tourist industry, reserve and park authorities and the Charles Darwin Station. The consortium should also contract with a facility in Ecuador or elsewhere to perform regular hydrostatic testing of cylinders and should provide a standard procedure for shipping cylinders to that facility through the consortium maintenance/repair station.

The diving association described above could, in conjunction with Marine Reserve and National Park authorities, provide the framework for establishing and enforcing the policies and standards described above as well as for obtaining qualified instructors and conducting the annual diving guide training course.

VI. Environmental protection

In order to protect the Galápagos submarine environment, the Park/Reserve authorities should establish policies for visitors which would prohibit the taking or harming of any artifact or organism, living or dead, while diving, snorkeling, or swimming. In areas where bottoms are fragile, anchoring should be prohibited and securing of boats limited to permanent moorings set out by Reserve authorities.

It is extremely important that visiting divers do not harm the environment they have come to enjoy, especially in an area as special as the Galápagos Islands. The establishment of the Galápagos Marine Reserve is a major step towards ensuring that, just as the harassment of animals and the taking of "souvenirs" on the land is forbidden, so will it be forbidden in the water. The information package described above should clarify all regulations so divers do not come to the Islands with the expectation that spearfishing and collecting are acceptable activities. Regulations might also control the collection of organisms for sale to visitors (e.g., turtles, black coral, lobsters).

The Reserve authorities might also designate twenty to twenty-five locations throughout the Archipelago where tourist or resident diving is permitted and declare all other marine areas off limits to other than research divers. This is similar to the current land system. Sites accessible to diving tourists could include those currently visited and should also provide for a variety of diving environments and experiences. Any areas where the mere presence of divers or boats would damage a fragile ecosystem, such as the breeding or nursery area of an endangered species, should be closed to visitors.

In many parts of the world, fragile coral reefs have been damaged by careless anchoring of tour and dive boats. In some areas such as the Florida Keys in the United States and Grand Cayman in the Cayman Islands, permanent mooring sites have been established in popular areas to prevent such damage. If designated dive sites have bottom topography which Reserve authorities or Station scientists believe could be damaged by anchors, the Reserve authorities might consider setting permanent moorings. Visiting boats could

then be required either to remain unanchored or utilize the mooring.

Careless diving techniques are responsible for damage at many popular areas. Heavily-dived areas often show significant damage to fragile animals and structures from poor diver buoyancy control and careless placement of hands or fins. While pre-screening for diver skills will help, the Reserve/Park authorities might also give consideration to establishing enough dive sites so that sites can be closed periodically in order to avoid excessive visitation, protect spawning and nursery areas, and to allow recovery periods for the environment.

Consideration should be given to setting limits on the numbers, group sizes, frequency and locations visited by divers. Given the present number of divers, there is certainly room for growth. However, in order to conserve the unique environment and preserve the special experience found in the Galapagos, large groups (ten or more) and overuse of certain sites should not be encouraged. Among the limiting parameters to be studied are the number of divers per site per unit of time, the number of divers or boats at a site at the same time, the number of divers per boat and the number of vessels allowed to participate in diving tourism. There is not sufficient information at the present time to set such limits. A data collection system could be established by park authorities to process diving statistics which could then be correlated with observations made by naturalist guides and researchers. In this way, the impact of divers on the environment could possibly be detected before irreparable damage is done.

Divers have the opportunity to enjoy the best of the unique marine environment found in the Galápagos Islands. "There is no place in the world where one can see penguins and sea lions, sharks and grouper along with rays and fur seals in a relatively small area. A Galápagos holiday which includes diving and land excursions is an exceptional experience" (Merlen, 1986). It is an experience worth protecting.

References

- Abrams, Warren, La Mer Diving Seafari, Inc. 1986. Personal communication. January 18.
- Acuerdo no. 297 of July 12, 1979 (Min. Agriculture and Min. Industry and Commerce), R.O. 15, August 31, 1979: Establishing the demarcation of the Galapagos National Park.
- Armas, Jennie. 1985. Personal communications. December 10 - December 17.
- Baratta, Debora, See & Sea Travel Service. 1986. Personal communication. January 18.
- Beebe, William. 1924. Galapagos World's End. New York: G.P. Putnam's Sons.
- Broadus, J.M. 1985. "Poor Fish of Redondo!: Managing the Galapagos Waters." Oceanus, vol.28, no.1: Spring 1985.
- Broadus, J., I. Pires, A. Gaines, C. Bailey, R. Knecht and B. Cicin-Sain. 1984. "Coastal and Marine Resources Management for the Galápagos Islands", Woods Hole Oceanog. Inst. Tech. Rept. WHOI-84-43.
- Cayman Islands Watersports Operators Association. 1986. Splash '86. Grand Cayman B.W.I.: Cayman Free Press Ltd.
- Davis, Gayle. 1986. Personal correspondence. Undated, received July 17.
- Decreto Ejecutivo no 1810-A of April 29, 1986, Registro Oficial no. 434, May 13, 1986: Establishing the Galapagos Marine Resources Reserve.
- Decreto-Ley no. 17 of July 4, 1959, Registro Oficial no. 873, July 20, 1959: Declaring the Galapagos archipelago a national park.
- Garces, Fausto & J. Ortiz. 1983. "Diagnostico de la actividad turistica en la provincia de Galapagos y sus impactos sociales y ecologicos."
- Hendrick, Walt, Sr. 1986. Personal correspondence. February 12.
- Iglesias, Jimmy. 1986. Personal correspondence. April 6.
- Iturralde, Macarene. 1986. Personal correspondence. Undated, received June 11.
- Jeppesen. 1976. Sport Diver Manual. Denver: Jeppesen Sanderson, Inc.
- Koster, Friedmann. 1985. Personal communication. December 14.
- La Mer Diving Seafari, Inc. 1985a. application form.
- La Mer Diving Seafari, Inc. 1985b. "Galapagos Island Trip Preparation Bulletin."

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- Maldonado, Luis, Metropolitan Touring. 1985. Personal communication. December 17.
- Manceau, Jean-Paul. 1985. Personal communication. December 15.
- McAniff, John J. 1984. US Underwater Diving Fatality Statistics, 1970-82 Kingston: University of Rhode Island National Underwater Accident Data Center.
- Mebane, G. Yancy & A.P. Dick. 1985. DAN Underwater Diving Accident Manual Durham, N.C.: Duke University.
- Merlen, Godfrey. 1985. Personal communication. December 17.
- Metropolitan Touring. 1983. "Itinerary G - (Diving Two Weeks)," issue date December 13, 1983.
- National Association of Underwater Instructors. 1984. "NAUI Divemaster Course Standards."
- Padilla Mera, Patricio, Capitan de Fragata-EM, Armada del Ecuador. 1986. Personal correspondence. May 6, 1986
- Pinto, Alfonso, Tapia, Director General de Intereses Maritimos, Personal correspondence. October 7, 1986
- Pitcairn, Feodor. 1986. Personal correspondence. March 19.
- Prideau, Alison. 1984. "Diving." La Garua, July 1984.
- Reck, Karl-Gunther. 1985. Personal communication. December 15.
- Robinson, Gary. 1983. "A Marine Park in the Galapagos." Noticias de Galapagos, 37: 9-13.
- Roessler, Carl, See & Sea Travel, Inc. 1986. Personal correspondence. March 31.
- Salcedo, Jose. 1986. Personal correspondence. Undated, received July 17.
- United States Navy. 1985. U.S. Navy Diving Manual, NAVSEA 0994-LP001-9010, Revision 1, 1985.
- Vandermark, Carolina. 1985. Personal communication. December 14.
- Wachholz, Chris. 1985. "How Safe is Recreational Diving? An Estimate of the Incidence of Non-Fatal Scuba Diving Injuries." Alert Diver, Vol.2, No.2, Fall 1985.
- Wellington, G.M. 1984. "Marine Environment and Protection" in Key Environment Series: Galapagos Islands, J.E. Trehane and R. Perry, eds. Oxford: Pergamon Press.
- Woods Hole Oceanographic Institution. 1983. Diving Safety Manual.

Statistics

1. How many groups of divers have you personally led in the past 12 months? in your career as a Galápagos guide? How many divers per group? How many divers total?

In the past 12 months I have led only one group of divers, a party of four.

Although I haven't been in the Galapagos for the last 10 months. Before that I have led 3 groups of divers of 8 each. All of them divers.

So, totally I have led 28 divers, during my career as a Galapagos guide.

2. How many divers do you think come to the Galápagos per year? How many diving guides are there? Can you tell us if the numbers of divers have changed over the years, and by how much? How are they divided between tourists and scientific divers?

I would say that at the most there are 80 divers coming to the Galapagos

in a year. In the present time there are about 9 diving guides. I really

can't say if the number of tourist divers have changed in the past years

some years are better than others, but it is very unpredictable. I think

El Niño year scared a lot of divers away.

A 20% of the divers are scientists.

3. How many dive sites are visited by tourists now? Can you list them? Which ones are dived the most? Are there now any rules governing where tourists can go to dive?

There are 15 dive sites commonly visited by the tourists now. They are:

Devil's crown, Champion Is. (Floreana), Gardner Island (Española), Kicker

Rock (San Cristobal), Gordon Rocks, North eastern point of Santa Fé Is., Daphne

Minor and Mayor, Cousin Is. (of the north eastern point of James Is.), Albany

Is., Rábida Is., Darwin Bay (Tower), Beagle Rocks, Baimbridge Rocks., Punta

Vicente Roca, and Roca Redonda. The most commonly visited are:

Gordon Rocks, Devil's Crown, Champion Is., Cousin Is., Darwin Bay, the point at Santa Fé, Rabida Is., and Beagle Rocks.

So far there are no rules about where to dive, in fact it is up to the guide to choose best diving sites, accordingly to water conditions.

Along the western shore of Isabela Island there are fantastic places for diving, but there aren't all that known as most boats avoid to travel long distances.

Impact on the Environment

4. Does anyone allow their groups to spearfish or collect specimens of any type? Are there any special permits available for specimen collecting by scientists?

As far as I know non of the guides allows collections of any type of under water organisms while diving. Also spearfishing is completely prohibited. The only way a collection can be done is with special permits given by the National Park Service and the Darwin Station, and only with scintific purposes.

5. How would you handle the situation if a person or group insisted on spearfishing or collecting ("but it's only one" or, "but it's dead", etc.)?

My answer will always be NO, no matter if it is only one or dead. Even if regulations in that respect haven't been established yet, I always let the group know what my own regulations are, and that they have to respect them if they want to dive.

6. Have you observed any changes or differences at the most common dive sites which could be due to the presence of humans underwater?

No, I haven't observed a single change underwater due to humans diving, yet there are obious changes due to water pollution, mainly plastic garbage.

7. Have you ever seen or known anyone injured by a marine organism in the Galápagos? What types of injuries were suffered (bites, cuts, stings, etc.)? Has anyone ever become panicked by the presence of a marine organism (such as sharks)?

I have observed few minor injuries caused by marine organisms such as hydroids stings, sting rays, and moray eels. Few coral and lava cuts occur.

Preparation of the Tourist Divers

8. Can you tell us something about the strengths and weaknesses of the divers you have guided? Did they know what to bring, what to expect? Did they have any problems with equipment, either not knowing how to use it or having something fail? Were most of them very experienced, or were they novices or very out of practice? Please share with us any specific experiences you may have had with tourist divers.

~~Most divers that come to the Galapagos are quite experienced. I think that the agencies in charge of organizing a dive cruise are acquainted with the type of diving that goes on in the Galapagos Islands. So, in my experience as a dive guide, I haven't had any problems with novices, nor people that didn't know what to bring with them. Most divers I have had have been very sure of what they are doing underwater; otherwise it is better not to let them dive.~~

9. What advice would you give divers about conditions in the Galápagos?

What makes the Galápagos different, if at all?

I always advice people about strong currents, lots of big sharks, and the fact that we always have to dive under the safety measures to avoid any accidents, due to the lack of a recompression chamber.

Galapagos offers very unique diving, most places are shear walls, at the open sea.

Also, sometimes one has to encounter big schools of sharks, that are curious and also even the unexpected appearance of whales and dolphins.

10. Are there divers from any country or who have been trained by an agency who are significantly better or worse than average? Why do you think this is so?

we all know that different agencies train divers differently. My experience has been that colombians are very well trained, at least the ones that come. Americans are either trained by PADI or NAUI are competent divers, and really I couldn't say anymore about it.

11. Did any or most groups have a leader? Were the leaders competent?

Most groups do have a leader, they are competitive people but can be over pushy. Lots of leaders that my colleagues and I have experienced want to dive three times a day, and some times that is not possible.

12. Why do you feel most divers come to the Galápagos? Is it just another exotic place, because of the unspoiled or deserted image, connection with Darwin and the history of evolution, large or exotic species to be encountered? Were most diver's expectations realized? ...any disappointments?

I think that divers come to the Galapagos for all of the reasons metioned above.
Some people, have heard of the unincness of the marine life and the fact that they can see sharks, photograph them and not have to fear them. OF COURSE THE FEAR IS ALWAYS THERE. I had an experenced with a group that got very disappointed at their expectation
but that happened in 1983, during El Niño, and that time there was nothing to see that was very spectacular, ~~except~~ death.

13. Have you encountered many problems with difficult personalities or poor attitudes? How did you solve these problems? Were most people careful of the safety and environmental rules?

Yes, I have encounter difficult people, but that was in 1983, once again, and they had reasons to be unsatisfied. As far as solving the problems there isn't much to do, besides being patient and if needed make them do what they want to do to prove them wrong. Most people are careful of safety underwater, some marine photographers tend to forget times and depths, but that is why the guide is there.

Most people do obey rules with no complains.

14. Are there any color diving guide books or cards for underwater Galápagos, such as are found in the Caribbean? What types of educational materials would you recommend to make it easier for divers to identify organisms, to describe dive sites, and to make the underwater Galápagos more enjoyable for the visitor (and perhaps easier for the guide)?

So far there aren't any of those color plastic cards, nor easy field guides for the diving tourist. I will always recommend those people that are very interested in the fish life, the field guide written by Grove and Lavenberg, that should be published next year by Stanford University Press. Besides that there isn't anything else available.
I often use the plastic card "Guide to the Fish of the Sea of Cortez", the "Guide to Hawaiian Reef Fish", and "Fishwatcher's Field Guide". They are helpful for some of the fishes.

Diving Guides

15. How are diving Naturalist Guides chosen? Are there definite procedures and standards for training/certifying dive guides and if so, who is responsible for administering these standards?

The dive guides are not chosen by anybody else than the boat owners that operate in Galapagos. They always look at your dive certificate and your experience as a diver. There is no training what so ever occuring in the Galapagos. Most divers have been trained overseas.

16. What is the average level of experience required for the guides? How many dives, what type of training? Is some lifesaving, first aid, or scuba accident management needed? What training would you like to have, if any?

Any basic scuba diver can be a diving guide in Galapagos, of course the experience diving in Galapagos waters counts a lot and if there is experience of diving someplace else, even better. Most dive guides know the basics of First Aid, but lots more is needed. In my case for instance, before I started working as a diving guide in the Galapagos, I had already dive in California, at Catalina Island, and in the Galapagos a number of 12 times in different places. I will like to learn more about lifesaving and how to handle

17. a scuba accident. How many dives have you done in the past year? Total in the Galápagos? Total for your diving career?

In the past year I have only dived 6 times. Total in the Galapagos 38 times. And total 45 times, since 1981 when I started diving.

Safety

18. How would a case of embolism or decompression sickness be managed? How many hours would it take to transport a diving casualty to a chamber from Baltra? From Tagus Cove? Do you feel the flight crews would have oxygen and be competent to stabilize a victim en route to the chamber? Personally in case of embolism or decompression sickness occurs in the Galapagos,

I will try to keep the person completely still until it can be taken care by a competent doctor, for the embolism. In case of the bends, with the lack of a recompression chamber close by I could only try to keep the person still until he/she can be transported to the nearest one. This thing about a plane will be the only resource, yet, not the most advisable. From Baltra it will take 2 hours at least to fly to Panamá or Guayaquil, and from Tagus Cove, at least a day on the boat and then 2 hours for the transport.

19. Are there any written policies for the conduct of dives or for accident management? Are there any diving first aid manuals available at the Darwin Station, or elsewhere, for the guides? How many oxygen units are there, and where are they located? How long would the available supplies last?

There are no written policies on how a dive should be done, nor for accident management. A dive tourist is completely aware of that since the first day of the cruise all is his own responsibility. As far as I know there is just an article written by a guide which was published in "La Garua", (a newsletter of the guides) in 1984.

I think that there are 3 oxygen units in the Galapagos, and they are located at the medical centers in Baltra, Puerto Ayora and San Cristóbal. The boats as the M/V Santa Cruz and the M/V Bucanero have them too. Several guides have told me that

20. the chamber in Panama would be the chamber of choice, even though there is a Navy chamber at Guayaquil. Why is that so? Do you know the exact location, how large the chamber is, the personnel involved, etc.?

I do not know anything about the chamber in Guayaquil, nor the one in Panamá.

21. Are there any unusually dangerous diving areas in the Galápagos? Unusually strong currents, unpredictable conditions, sudden storms, tsunamis (tidal waves caused by underwater earthquakes), unstable rock formations, areas where marine life may be unusually dangerous? Are there dangerous times of the year to dive? What are the best times of the year to dive? Does anyone dive in the 'off' season, and, if so, how are the conditions different?

There is one place which I will say is the most dangerous for diving in the Galapagos, that is Roca Redonda, specially for the unusual currents and unpredictable conditions. As far as currents go and rather unpredictable conditions, the Galapagos is in general that way. We really don't get sudden storms unexpectedly, normally it can be noticed previously to a dive. The rainy season is probably the best time for diving, the waters are calm and warmer. As far as visibility goes it is unpredictable, but there are less upwellings than and so it can be clearer than in the Garua Season.

22. One of the tourist brochures states that "diving groups are responsible for their own safety." Is this a workable or sensible policy? How safe do you as a guide feel about leading strangers from all over the world? I personally think that so far it is the most workable thing to make every single individual responsible for his life while diving in the Galapagos. With no safety measures near by we don't have any other choice and so far it has worked alright. Myself, I first do a check dive before we go anywhere dangerous or too deep and after that I can judge as far as people's confidence underwater and then I can decide who are safe divers and who aren't letting them know in advance about it. So, I actually feel quite safe about leading strangers underwater.

23. Do you feel it is wise to actively encourage increased diving tourism in the Galápagos? What do you feel would be the best way to manage increased numbers of diving visitors?

Yes, I think it is wise to encourage more diving tourism to the Galapagos. It will be an step towards the protection of the marine reserve. I think that there are enough boats in the Galapagos that could take and lead diving tourist very well as it has been happening in the last years. The need of better trained dive guides and mainly safety

Statistics

1. How many groups of divers have you personally led in the past 12 months? in your career as a Galápagos guide? How many divers per group? How many divers total?

Only one during last year as I have been busy preparing a fish guidebook!

7 groups altogether. 46 divers.

2. How many divers do you think come to the Galápagos per year? How many diving guides are there? Can you tell us if the numbers of divers have changed over the years, and by how much? How are they divided between tourists and scientific divers?

I really don't know pr./yr. 100 pr./yr.?

Number of guides changes each year, perhaps 6-8.

I do not think the numbers have changed much over 4 years.

Most are tourists. Scientific divers mostly work with CDRS and are independent.

3. How many dive sites are visited by tourists now? Can you list them? Which ones are dived the most? Are there now any rules governing where tourists can go to dive?

One can dive when one wishes but in certain areas such as Champion and Devils Crown it is not permitted to anchor boats because of damage to corals.

* Champion

* Devils Crown

Gardner Island

Sleeping Lion Rock

Whale Rock

Five Fingers Rock

Darwin Bay-Tower Island

Marchena

Vicente Roca

Targus Cove

Punta Espinosa

Rabida

James Bay

Sombrero Chino

* Bertolome

* Cousins Rock

Daphne Major and Minor

Guy Fawkes Rocks

South Coast Hood Island

* Dive Most

Impact on the Environment

4. Does anyone allow their groups to spearfish or collect specimens of any type? Are there any special permits available for specimen collecting by scientists?

I cannot answer the first. I certainly do not allow spearfishing or collecting. Yes permits can be obtained but only on specific projects.

5. How would you handle the situation if a person or group insisted on spearfishing or collecting ("but it's only one" or, "but it's dead", etc.)?

The main problem is a lack of a Marine National Park system. One must use one's influence on the grounds of safety to others and the concepts of preserving the natural systems.

6. Have you observed any changes or differences at the most common dive sites which could be due to the presence of humans underwater?

Little damage can be observed and because of lack of control stations its impossible to correlate abundance of fish etc. to intensity of diving. Physically some damage is done by people grasping lumps of barnacles which break very easily but at the moment there is limited diving and therefore the accumulated effects are not great.

7. Have you ever seen or known anyone injured by a marine organism in the Galápagos? What types of injuries were suffered (bites, cuts, stings, etc.)? Has anyone ever become panicked by the presence of a marine organism (such as sharks)?

Stings by physalia (portuguese man of war) are not uncommon but we try to avoid areas where these occur (This abundance is sporadic and geographically variable). Some people are not happy in the presence of sharks but I have never had anyone panick. We do warn people not to panick. If I feel someone is not sure, I will dive with them.

Preparation of the Tourist Divers

8. Can you tell us something about the strengths and weaknesses of the divers you have guided? Did they know what to bring, what to expect? Did they have any problems with equipment, either not knowing how to use it or having something fail? Were most of them very experienced, or were they novices or very out of practice? Please share with us any specific experiences you may have had with tourist divers.

On the whole I believe that a number of divers think they are more experienced than they are. Very few problems with equipment. Many do not know what to expect especially in relation to diving conditions in Galapagos waters.

9. What advice would you give divers about conditions in the Galápagos?

What makes the Galápagos different, if at all?

There may be strong currents, poor visibility, large animals. Steep dropoffs. Perhaps people should do a few dives before coming to Galápagos to refresh themselves as many divers have not been diving for a year or more before arrival.

10. Are there divers from any country or who have been trained by an agency who are significantly better or worse than average? Why do you think this is so?

My feeling is that in general the bits of paper awarded by many agencies are not very valuable and give people a false sense of security. I have found that some divers are not happy when exposed to sea conditions and deep waters.

11. Did any or most groups have a leader? Were the leaders competent?

Some yes and some no. My experience tells me that whether the leader is good or not becomes irrelevant when a large group is diving. It's very difficult to keep 10 divers together and every diver and his buddy must be self sufficient should they become separated.

12. Why do you feel most divers come to the Galápagos? Is it just another exotic place, because of the unspoiled or deserted image, connection with Darwin and the history of evolution, large or exotic species to be encountered? Were most diver's expectations realized? ...Any disappointments?

All the above reasons. The only problem sometimes is to find good visibility and this rests on experience and local knowledge.

13. Have you encountered many problems with difficult personalities or poor attitudes? How did you solve these problems? Were most people careful of the safety and environmental rules?

Some divers are very aggressive toward the world they dive in but on the whole the reaction of the other divers helps to control difficult people. It is very important for the local guide to have a positive strong attitude and not allow poor behavior.

14. Are there any color diving guide books or cards for underwater Galápagos, such as are found in the Caribbean? What types of educational materials would you recommend to make it easier for divers to identify organisms, to describe dive sites, and to make the underwater Galápagos more enjoyable for the visitor (and perhaps easier for the guide)?

There is no material available. I have put together a small book of about 100 fish species to help people get more out of their experience. On the whole the guides have to learn for themselves what is what and this is sometimes a disaster!

Diving Guides

15. How are diving Naturalist Guides chosen? Are there definite procedures and standards for training/certifying dive guides and if so, who is responsible for administering these standards?

The requirement center around economics. Companies want guides who speak languages. Who have the National Park Guide license (terrestrial) and if they have a dive certificate (from whomever), so much the better.

16. What is the average level of experience required for the guides? How many dives, what type of training? Is some lifesaving, first aid, or SCUBA accident management needed? What training would you like to have, if any?

I think there should be an orientation program for divers given at the same time as the guides course. To explain the limitations of any rescue operation and to advise on immediate first aid.

17. How many divers have you done in the past year (a)? Total in the Galápagos (b)? Total for your diving career (c)?

a. 7. b. 146

Safety

18. How would a case of embolism or decompression sickness be managed? How many hours would it take to transport a diving casualty to a chamber from Baltra? From Tagus cove? Do you feel the flight crews would have oxygen and be competent to stabilize a victim enroute to the chamber?

It is impossible to give these details. It depends on radio communication on speed of aircraft, on speed of boat, weather conditions and on who pays for what. I doubt the ability of the flight crew to deal with the situation.

19. Are there any written policies for the conduct of dives or for accident management? Are there any diving first aid manuals available at the Darwin Station, or elsewhere, for the guides? How many oxygen units are there, and where are they located? How long would the available supplies last?

First aid manuals are available. oxygen is available at CDRS and Metropolitan Touring Office in Galápagos.

20. Several guides have told us that the chamber in Panama would be the chamber of choice, even though there is a Navy chamber at Guayaquil. Why is that so? Do you know the exact location, how large the chamber is, the personnel involved, etc.?

I think that people doubt the chamber in Guayaquil because they know nothing about it. I also am ignorant of its efficiency and it is a subject which should be investigated.

21. Are there any unusually dangerous diving areas in the Galápagos?

Unusually strong currents, unpredictable conditions, sudden storms, tsunamis (tidal waves caused by underwater earthquakes), unstable rock formations, areas where marine life may be unusually dangerous? Are there dangerous times of the year to dive? What are the best times of the year to dive? Does anyone dive in the 'off' season, and, if so, how are the conditions different?

Stong currents, no storms or tsunamis--large numbers of sharks and sea lions. Some areas have more than others. Often poor visibility especially at the surface. Diving can be done all year but water tends to be clearer during the warm season; December-June.

22. One of the tourist brochures states that "diving groups are responsible for their own safety." Is this a workable or sensible policy? How safe do you as a guide feel about leading strangers from all over the world?

Given that a guide informs a group carefully of what to expect and does not allow people to dive in conditions beyond anyone's capabilities, I think that divers should be responsible for their own actions and not hold a guide responsible. However, who is in charge of diving compressors, quality of aid and any supplied equipment is another problem as a guide is often assigned to a group and equipment that he or she is not familiar with.

General

23. Do you feel it is wise to actively encourage increased diving tourism in the Galápagos? What do you feel would be the best way to manage increased numbers of diving visitors?

Under present arrangements I do not think increased diving tourism is to be recommended.

I appreciate the fact that you are asking me to comment on this matter. I have been asked to comment on this matter many times in the past and I have always given the same answer. I do not think that increased diving tourism is a good idea for the Galápagos. The Galápagos is a unique and fragile environment and it is important to protect it for the benefit of future generations. Diving tourism can be a source of income for the local economy, but it can also have negative impacts on the environment. Increased numbers of divers can lead to increased pollution, damage to coral reefs, and disturbance to the local wildlife. I believe that the best way to manage the Galápagos is to focus on conservation and sustainable development. This means limiting the number of visitors, enforcing strict rules for divers, and investing in education and research. I do not think that increased diving tourism is a wise idea for the Galápagos.

June 8, 1987

Dear Ms. Rioux,

I apologize for not completing this earlier but I have been on an extended journey through the North Pacific and my mail has taken months to catch up with me.

Diving in Galapagos has developed without any organization. It has its origins in people like myself who started diving there and finding it fascinating reported our finds and those interested in economic development relayed its potential! There is no place in the world where one can see penguins and sea lions, sharks and groupers, rays and fur seals in a relatively small area. A holiday there which includes diving and land excursions is an exceptional experience. For myself it has been a little different from most guides in that I have maintained our own compressor, etc. We never supply anything except air, weights and tanks. All the rest is the responsibility of the diver. We do not have fixed itineraries and therefore will charge them as suits the capabilities of the divers and the prevailing conditions in the water. Other organizations keep a fixed route come what may and this to me seems unfortunate and does not offer the best. The dive guide needs to be in total charge of the operation but in close cooperation with the captain of the vessel (and agreement as he is in charge of the vessel). Also, since much diving is done in deep water and steep dropoffs it is the reliability of the tender operator that is of the utmost importance, often his careful vigilance of the bubbles that keeps everyone safe. It is impossible for one guide to monitor 10 divers and since all have different capabilities some will surface before others. Therefore a splitting of the group becomes necessary.

I ask that all dive with a buddy and that we do not exceed no-decompression dives to which purpose I use PADI dive computation tables. I restrict myself to a maximum of 3 dives a day, but I know of divers who have completed 5 in a day. It is extremely easy to dive to 100'+ on the steep dropoffs. We use 80 cu. ft. tanks but do not use doubles to help reduce risk of over staying ones dive.

I have found divers who although with certificates have to be trained (again?) to use dive tables.

Please communicate if you wish for more information.

Yours sincerely,

ATTACHMENT B.

Galapagos Islands

trip preparation bulletin

THE FOLLOWING IS A PREVIEW OF LA MER DIVING SEAFARI'S TRIP PREPARATION BULLETIN FOR THE ABOVE SPECIFIC DESTINATION. THE FULL PREPARATION BULLETIN IS DISTRIBUTED ONLY TO GROUPS AND INDIVIDUALS WHO HAVE PLACED A DEPOSIT ON A LA MER DEPARTURE.

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That's 1-800-DIVE NOW



La Mer Diving Seafari, Inc

LA MER SCUBA ADVENTURE TO GALAPAGOS

FORWARD

Welcome to LA MER's Galapagos Expedition.

Your enjoyment of this trip is important to us, and in order to help you prepare properly, the following bulletin has some important preparation information based on our experience over dozens of trips.

So that we may relay last-minute information to you rapidly, it is of great importance that you advise our office of any change of address or telephone at your home or office. If you will not be at the address listed in our files the last few weeks prior to departure, please inform us promptly of the address and telephone number where you can be reached.

UPDATED JANUARY 1985

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La Mer Diving Safari, Inc

LA MER TO GALAPAGOS
PREPARATION BULLETIN

BOAT DIVING

For those of you who will be diving from a live-aboard vessel for the first time, we would like to point out that there are many advantages to boat-based diving vacations.

However, in comparison to hotel-based vacations, there are situations that some people may consider disadvantages. Since the boat is your floating hotel, restaurant, and diving center all in one, the environment, at times, can be noisy--especially during the daytime. Privacy is at a minimum, since you will be sharing your cabin with another person and bathroom facilities are shared.

Supply and variety of food is dependent on the availability of items found in the local markets. Storage space and fresh water are available but limited. Activity on board the vessel such as meals, diving, briefings, etc. are by necessity on a group basis.

Special consideration must also be given to the crew itself. They do not have a relief staff and therefore are on duty virtually 24 hours a day for the entire duration of the diving portion of your vacation. Their rest time is limited and therefore precious. Nighttime activity is limited and up to you and the group as a whole.

Since our main interest is the quality of diving exploration and comfort, the live-aboard vessel is the ideal vehicle to accomplish these goals. On board the boat, you are a member of an intimate group which basically share the same interests as you--diving, photography, etc.--but each member has his or her own special background and personality to contribute to the overall uniqueness of such a diving vacation. We have found that due to the close living arrangements and the diverse background of our participants, long and lasting relationships have begun on LA MER's diving expeditions.

Your personal logistics of diving, usually complicated on a shore-based operation are simplified on board the vessel. Your diving and camera equipment are always on board and protected. You do not have to waste your energy transporting it daily. Transportation time between dive sites is drastically reduced and since the traveling range of our vessel is great, you will be able to dive remote and secluded sites impossible to visit from a land-based operation. Last, but certainly not least, more dives can be conducted from a live-aboard vessel.

DIVING CONDITIONS IN GALAPAGOS

Each diving area in the world has its own advantages and disadvantages, the Galapagos is no different in this respect.

Diving in the Galapagos Islands is unique for a variety of reasons. First and foremost, the Galapagos waters offer encounters with marine mammals (seals, sea lions, dolphins, and more) and ample opportunity to witness pelagics i.e. schools of silver tuna, manta, and eagle rays. Secondly, because of the Islands location on the Equator and being supported by the polar Humboldt Current, a rare coexistence has occurred here between cold weather animals and tropical species, and in some cases rare species can be found in these waters. For the sport diver, it is comforting to know that the best of your diving experiences are at the shallow depth from 0-60 feet. There is no need to dive any deeper. Furthermore, at any deeper dive than 40-60 feet, you are likely to encounter the cold current which is usually 55-60°F--as opposed to the comfortable 76°F on the surface.

You should be aware that most of your diving will be wall dives. Most reefs are simply a continuation of massive land formations which plunge down to depths of 200 feet or more. Due to these topographical conditions, it is impossible for any vessel to anchor on such sites during our diving or overnight. Only a few of the diving sites have a suitable anchoring area for a vessel. On those occasions we provide the opportunity to go ashore for fascinating land exploration or for additional diving.

On those especially interesting diving sites where anchorage is not available, the vessel must keep constantly moving along the various reef walls. In these cases, entry to the water will be made either by jumping over the side of the vessel or you will be transported to the specific dive site with your diving and camera gear aboard one of the two dinghies on board the ENCANTADA.

The constant maneuvering of the vessel is both involved and demanding for the crew. Despite this fact, we are committed to providing you with rewarding diving experiences on these remote reefs. However, please note that you will be asked to cooperate with the crew and follow their instructions on how to prepare for your diving, as preparation for these dives will be on a group basis.

2-3 dives per day will be scheduled by the naturalist dive guide, each at a specific time in the day. 2-3 night dives will be arranged according to weather conditions and the areas you are visiting. Land excursions will be arranged in accordance with the diving activity in order to take advantage of the surface interval between dives.

All diving activity and land excursions are group oriented as individual activity is not permitted on the Islands in order to keep the natural habitat safe.

Safe anchorage at night will be arranged in a protected bay.

We have made special arrangements with the hotel in Quito for you to store all your city clothing and hard suitcases for the duration of the voyage, and to pick it up on your return--as we stay one more night at the same hotel before departure to the U.S.

FACILITIES AND COMFORT: The Galapagos Islands are in many ways at the end of the earth--many (50) islands, few people, and fewer facilities. Supply lines for repair parts, etc., are very long and difficult. We have chosen the very best boat and other facilities available there. They are in some ways not up to the standards we normally offer. But because the wildlife we encounter above and below the water is so magnificent, it is worth a certain Spartan level of accommodation or service inconvenience. Our main concern is that our boat be sturdy, serviceable, and comfortable, while not being represented to you as luxurious. Our vessel is the 70' ENCANTADA, with five relatively small double-bunk cabins. From our past experience, though, we can tell you that you will be so busy diving or going ashore at the many islands that you'll spend only your sleeping hours in the cabins. Participants should be prepared for simplicity in the accommodations and a yacht lifestyle where fresh water is limited (one ton of water). Baths are generally taken in the sea. We want you to be honestly informed, and feel that as long as we truly represent the vessel's accommodations, there will be no disappointments, and that you will all enjoy one of the most beautiful adventures of your lives.

DIVING ITINERARY

The proposed diving itinerary stated in our brochure is merely a selected sampling of the diving sites available among the Galapagos Islands.

During each voyage, according to weather conditions and the makeup of each group and their ability to safely cope with local conditions, the boat skipper and the dive master will have sole responsibility for adding to or omitting dive sites from our published itinerary.

It is important for you to note that LA MER and the crew of the ENCANTADA will make every effort to provide you with opportunities for a safe and memorable diving experience.

On board you each of our trips there is a naturalist dive guide. Your dive guide will inform you each morning of the day's diving plan so you may pace your diving activity accordingly.

If a majority of the group wishes to repeat a specific dive site that was especially enjoyable, we encourage the group to discuss the possibility with the dive guide.

Traveling between dive sites will be at night whenever possible in order to save the daytime hours for diving. We want you to have as much dive time as possible.

DIVING GUIDE AND EQUIPMENT: The vessel will carry its own compressor, two air tanks per person, ladder exit to the water, and two dinghies. A local naturalist expert will escort your trip. He or she will arrange the day's diving and land exploration after consulting the group as to its interests.

ELECTRICITY: On board, the electrical system provides 110 V. Please bring an international electric plug package, which includes four different plugs, in order to have the correct plug for use on board. These are available for purchase at your own local electrical shop.

FOOD PREFERENCES: If you have any special dietary requirements, please let us know in advance and we will do our best to accommodate your needs.

DRINKS: The vessel is well-stocked with soft drinks and beer, which are available for purchase. Popular U.S. diet drinks (such as Diet Coke, Fresca, etc.) are not available. It is recommended that you purchase your own alcohol at the duty-free shop, especially if you have a preference for brand and quality, as the vessel's bar is not always equipped with our tastes and quantities in mind.

TIPS: While tipping is appropriate at the end of your voyage, it is totally at your discretion. From our past experience, we recommend a tip of \$.75 per crew member per day from each guest. 5 crew members are on board and the trip duration is 14 days. For the naturalist guide, you may consider a separate tip of \$1.00 per day per guest.

IMPORTANT: The following itinerary is a suggested itinerary. The final itinerary will be updated and confirmed 21-30 days prior to departure. Individual travel arrangements made not in accordance with the confirmed itinerary and prearranged group flight arrangements may be subject to surcharges.

GALAPAGOS TRIP ITINERARY

Day 1 Upon arrival in Quito and in accordance with your flight you will be transferred to the Colon Hotel (Deluxe). Upon the arrival of all group members, LA MER has scheduled a welcome dinner in the evening, where reservations and menu selection have been prearranged. A local guide will accompany you to dinner.

PLEASE NOTE: We recommend that after your evening activity you make check-out arrangements with the hotel, and pay your bill (if you have one). Arrange for a wake-up call. Now is the time to rearrange your luggage for the flight tomorrow to the Galapagos Islands. Please refer to the section concerning baggage allowances in the Preparation Bulletin. Remember, hard suitcases, clothing, and equipment which are not essential can be stored at the hotel. Consult your guide for group arrangements about storage.

Days 2-15 This morning you are on your way to the Galapagos Islands. According to your departure flight to Baltra, your guide will ask you to be in the hotel lobby 1 1/2 to 2 hours after breakfast (prepaid), and to be carrying only the equipment you need to take on the diving trip. (Presumably you have stored the rest away.)

PLEASE NOTE: Your luggage will be transferred on a separate van. Please check and make sure that your luggage has been put on board. At the crowded airport you are advised to watch out for your belongings, and to be patient with the "speedy" South American bureaucracy. Each of you will weigh your own luggage, unless otherwise advised by the guide. Sometimes it is possible in South America to avoid overweight charges by checking in as a group, or by slipping "a little something" to the right person. This has worked on previous trips, but, of course, is not condoned by the airlines.

Your flight from Quito to Guayaquil is 30-40 minutes. In Guayaquil you will change planes. By the way, both airports have many shops, banks, and a post office. T-shirts and hats are very good buys at the airports.

Your flight to Baltra/Galapagos is 1 1/2 hours on board a Boeing 727. You will land on Baltra Island. The airport is only a landing strip and one terminal building. You will be greeted by your naturalist guide, and pass through the Park Authority, where you will receive some printed materials on the Galapagos Islands. Your luggage will be transferred from the plane to a public yard, where there will be

many tourists and local residents. Please watch out for your baggage! The naturalist guide will instruct the crew to pick up your luggage and transfer it separately to the boat. For the next two weeks your companions will be the sea and the sun, your new friends on the boat, and any sea lions you meet.

During the two weeks on board, we have planned a unique, in-depth experience in this fascinating part of our world with diving, snorkeling, and land excursions. During each week you will visit different parts of the archipelago. In the first week, you will explore the eastern part; the second week, the northern and western parts. After the first 6 days and before departing on the second part of the trip, one day will be spent on the main island, Santa Cruz, to visit the Charles Darwin Research Station and to see some of the Island's highlights. During this time, the boat crew will prepare the vessel for its next week's trip and resupply with fresh food, water, and fuel.

We trust that this combination of east and west exploration, complimented with a visit to the Darwin Station, is a well-rounded experience.

Day 16 Flights from Baltra to Quito with stopover in Guayaquil. You will be transferred from the airport in Quito to the hotel, where you will have a free afternoon. Now is the time to pick up the luggage that you left behind at the hotel. In the evening LA MER invites you to a farewell dinner at the La Choze restaurant (serving local food) at 7:00 p.m. You will need to take a cab to the restaurant (taxis are available in front of the hotel). NOTE: Those of you who have early-morning flights should finalize check-out arrangements this evening.

Day 17 According to your flights, transfers have been arranged for you. Please check and confirm the exact time with your local guide on the day before you leave.

PLEASE REMEMBER: All flights are booked rather heavily both to and from Ecuador. We will write your ticket and itinerary with enough time to receive positive confirmation. Airline schedules, however, sometimes change without notification. Although you are holding a confirmed ticket, bumping on flights is not uncommon in South America. We recommend that you remind your guide to reconfirm your flight home on the night before departure. Although this matter is taken care of by our tour operator (METROPOLITAN TOURING), it is a good practice to reconfirm again in order for you to be sure.

ATTACHMENT C

DAN Underwater Diving Accident Manual

Early Treatment Approach

All symptoms of air embolism and decompression sickness are considered together in the early management of a diving accident. It is more important to use proper early treatment than to attempt to distinguish between the two conditions because the initial management for both conditions is the same until recompression therapy is started.

Mild Symptoms

The injured diver may experience mild symptoms at first and ignore the warning signals until serious symptoms have developed.

Fatigue or unusual tiredness and itching are considered mild symptoms and may respond to treatment with oxygen. Joint pain has sometimes been considered a mild symptom, but requires recompression and therefore is handled as a serious symptom. No symptoms should be ignored as the progression from mild to serious can occur rapidly.

If a diver experiences mild symptoms on surfacing, place the diver on his left side with his head down and give oxygen. Oxygen treatment may relieve the symptoms or prevent them from getting worse. If the symptoms appear relieved after an interval of oxygen treatment, do not remove the oxygen immediately as the symptoms may recur. The victim should continue to receive oxygen for at least thirty minutes for mild symptoms, and then the Flow Chart should be followed for further instructions.

Serious Symptoms

Any symptom such as pain, weakness, numbness, dizziness, nausea or decreased consciousness can be a symptom of a serious diving accident. When these symptoms occur shortly after a dive, a serious diving injury is the likely cause.

Serious symptoms are a medical emergency which requires urgent medical evaluation and treatment at the nearest hospital, followed by emergency evacuation to an appropriate recompression chamber. Calling the DAN physician from the emergency room helps establish an early, accurate diagnosis and speeds transfer to a recompression chamber if needed. If a person shows any serious symptoms within 24 hours after a dive, place the victim in the left-side-down position and provide oxygen during transport to the nearest medical facility. Monitor pulse and respiration and follow the instructions in the Flow Chart until evacuation to a recompression chamber has been accomplished.

Diving accident victims who receive oxygen immediately after their injury have a much better recovery than if no oxygen is used. The crucial value of early oxygen breathing must always be emphasized, particularly for sport diving injuries not occurring near chambers.

DO NOT ATTEMPT IN-WATER RECOMPRESSION

In-water recompression of the diver usually ends with the diver forced to the surface by cold or inadequate air supply. This causes incomplete treatment and further nitrogen uptake by the diver. If a victim has mild signs and symptoms of decompression sickness, the usual result is a much more seriously injured diver. If the initial symptoms are serious, the result is usually disastrous. In-water recompression should never be attempted.

Immediate Care

In a suspected diving accident the first question is "Did the victim take a breath underwater?" from a SCUBA tank, hose, bucket, submerged car, or any compressed air source, regardless of depth.

If the answer is no, give CPR and oxygen if needed and evaluate at the nearest medical facility as a problem not related to diving.

If the injured diver did breathe underwater and only mild symptoms are present (fatigue and itching only), place the patient in left-side-down-head-low position and administer oxygen, oral fluids and two aspirin while maintaining close observation.

If these mild symptoms clear totally within thirty minutes have the person contact a diving physician at his earliest convenience.

If the symptoms do not clear, seek medical advice and treat as a serious injury.

If the injured diver did breathe underwater and has serious symptoms, do the following:

1. Administer CPR if required.
2. Keep airway open and prevent aspiration of vomitus. An unconscious diver should be intubated by trained personnel if possible.
3. Keep victim in left-side-head-low position if possible...
4. Administer oxygen by tight-fitting double-seal mask at the highest possible oxygen concentration. Do not remove oxygen except to reopen the airway or if the victim shows signs of convulsions.
5. If convulsion occurs, do not forcefully restrain. Turn victim on side (supporting head and neck), maintain airway, sweep away any vomitus. Hold victim loosely to prevent self-injury and do not force airway or tongue blade. Resume oxygen administration.
6. Protect the injured diver from excessive heat, cold, wetness, or noxious fumes.
7. Give conscious patients non-alcoholic liquids such as fruit juices, or oral balanced salt solutions, e.g. Gatorade.

Attachment C

Page 3

8. Give two aspirin, as an anti-platelet agent, as a one time dose to a conscious diver only.
9. Evaluate and stabilize patient at the nearest hospital emergency room prior to transfer to a recompression chamber if needed.
10. Intravenous fluid replacement with electrolyte solutions is preferred for unconscious or seriously injured victims. Ringer's lactate, normal saline, or 5% dextrose in saline may be used. Do not use 5% dextrose in water. (professional medical care)
11. If there is evidence of involvement of the central nervous system, give steroids, hydrocortisone sodium succinate, 1.0 gm i.v. or dexamethasone, 20-30 mgm. iv. (professional medical care)
12. Contact a physician experienced in diving medicine and DAN.
13. If air evacuation is used, it is critical that the patient not be exposed to decreased barometric pressure at altitude. Flight crews must maintain cabin pressure at sea level or fly at the lowest safe altitude in unpressurized aircraft.
14. Contact Hyperbaric Trauma Center or chamber before transporting the injured diver.
15. Send this manual and recorded history with the patient.
16. Send all diving equipment with the patient for examination. If that is not possible, arrange for local examination and gas analysis.

Trendelenburg Position

The modified Trendelenburg position suggested for victims of diving accidents places the head down and feet up at an angle of about 30 degrees with the entire body turned on the left side. This position is for breathing victims only. It is intended to encourage a bubble in the brain circulation to dislodge itself and migrate to a less damaging area. This phenomenon has been demonstrated in animals, but not in man. The disadvantages of this position are the incompatibility with CPR and the difficulty in maintaining an open airway in an unconscious victim. A backboard with proper strapping is almost a necessity in order to maintain proper position and it is very difficult to contrive a system in an emergency situation. Transportation in aircraft and rescue vehicles in this position is not usually possible. Therefore this position should not be viewed as an absolute necessity.

Oxygen Treatment

Supplemental oxygen is a valuable adjunct in CPR, near-drowning, and serious accident or injury which impairs the body's ability to transport oxygen to the tissues. Breathing an increased concentration of inhaled oxygen improves the tissue oxygenation. Oxygen administered immediately after a diving accident is also important for several reasons. A diving accident

(decompression sickness, or air embolism) usually does not interfere with oxygen transport except at the site of injury. Therefore, oxygen administration will increase the amount of oxygen only slightly if at all. However, breathing oxygen in high concentration will eliminate some of the nitrogen from the body producing a pressure gradient from the nitrogen in the problem-bubble to the surrounding tissues. This favors resolution of the bubble because there will be a driving force to cause the nitrogen in the bubble to dissolve in the bloodstream and be eliminated through the lungs. Any increase in the oxygen supply to the injured area will also be beneficial especially if brain tissue is involved. The concentration of inhaled oxygen should be as near 100% as can be reached in order to achieve maximum benefit. A tight-fitting double seal mask and adequate oxygen flow rates are necessary in order to deliver the required concentration. The usual method of oxygen delivery by nasal canula or loose mask will not be adequate.

The equipment necessary to deliver oxygen in this manner is very similar in principle to SCUBA equipment. There is a cylinder containing high pressure oxygen which is delivered through a pressure regulator (first stage) to a demand valve (second stage) which furnishes oxygen when the victim breathes spontaneously. The oxygen concentration inhaled will be 90% or more with good technique and the operation is simple.

Administering oxygen to a conscious, spontaneously breathing person with this equipment is not difficult and is usually safe. However, if the victim is unconscious or not breathing spontaneously, oxygen administration becomes more complicated. In this situation the rescuer must have a thorough understanding of airway management and the use of adjunctive equipment. In addition there may be various state laws dealing with the use of oxygen and the rescuer should be aware of pertinent regulations. Just as in CPR, this manual can do no more than suggest how to obtain training. The individual who wishes to learn this skill should be expert in CPR and have received additional instruction in the use of oxygen equipment. Many dive clubs have members who are para-medics, nurses or physicians qualified to give instruction. Basic Emergency Medical Technician courses (EMT) are open to the public in many community colleges and offer advanced training in many aspects of pre-hospital care. The textbooks used in these courses have complete information on airway and oxygen management.

DAN advises that oxygen and people trained to use it should be available at all dive sites. The diver should insist that oxygen be available on any boat that will be used for diving.

The use of oxygen in the early stages of a diving accident may reduce or totally relieve the symptoms within a short time. If this happens, do not be deceived into thinking that the problem is solved. Oxygen therapy should be continued and the victim transported to the nearest medical facility and a diving physician consulted. Oxygen therapy must not be considered a substitute for recompression treatment if such is indicated.

Cardiopulmonary Resuscitation (CPR)

CPR is an essential skill for everyone and especially for divers. Practically anyone can learn, but it does require a few hours of training. The illustration on the back cover of the DAN Manual demonstrates the essentials of CPR including the head-tilt method of airway clearing which can be learned from this picture. The other skills of CPR require instruction and practice under certified instructors. Contact a local chapter of the American Heart Association for information on locating a course and become a "heart-saver."

Source: Mebane, G. Yancey, and Arthur P. Dick. 1985.
DAN Underwater Diving Accident Manual

(30410)

Cardiopulmonary Resuscitation (CPR)

CPR is an essential skill for everyone and especially for divers. It is a life-saving technique that can be learned by anyone. The American Heart Association (AHA) provides the most up-to-date information on CPR. The AHA's CPR course is the gold standard for CPR training. The course covers the basic life support (BLS) techniques, including CPR, first aid, and the use of an automated external defibrillator (AED). The course is designed to be completed in a few hours and is available in both classroom and online formats. The AHA's CPR course is the most widely recognized and accepted certification for CPR. It is a requirement for many professions, including healthcare, education, and public safety. The course is also a requirement for many recreational activities, including scuba diving. The AHA's CPR course is a valuable investment in your safety and the safety of others. It is a skill that can save lives.

Source: American Heart Association, CPR and First Aid, 2020.
AHA's CPR course is the gold standard for CPR training.

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ATTACHMENT D

DAN Underwater Diving Accident Manual Recognizing Diving Related Injuries

An awareness of the symptoms and signs of underwater diving accidents and other common underwater disorders is necessary to recognize a serious accident. The following pages describe the common symptoms and signs that divers may experience. An explanation of their causes is also given to help the reader understand some of the basis for prevention and management.

AIR EMBOLISM

Cause

As a diver surfaces without exhaling, air trapped in the lungs expands and may rupture lung tissue releasing gas bubbles into the circulation which distributes them to the body tissues. The ascending diver is normally in a vertical position and the bubbles tend to travel upward to the brain, eventually reaching a small artery and blocking circulation. The effects of halting circulation to the brain are critical, often leading to unconsciousness and paralysis, and require immediate treatment.

An air embolism can also cause minimal symptoms of neurological dysfunction such as numbness or tingling of an arm or leg, weakness of a body region, or vision, speech or hearing loss, without loss of consciousness.

A diver may ascend without exhaling as a result of any of the following:

- Inadequate training
- Careless ascent technique
- Careless depth control
- Heavy work or distraction on ascent
- Panic (not the most common cause)

Air embolism sometimes occurs unexpectedly in divers who ascend normally but have lung conditions which result in local air trapping. Although most lung diseases can cause this problem, some common conditions are the following:

- lung infections
- lung cysts
- tumors
- scar tissue from chest surgery, radiation therapy, lung disease, etc.
- mucous plugs
- obstructive lung diseases

The diver may not be aware of the risk because some of these conditions are undetectable even with a medical examination. There are no breathing maneuvers which will decrease the risk of embolism if the diver has one of these disorders.

All smokers have a slightly increased risk of having an air embolism even during normal careful ascents.

Symptoms

1. Dizziness
2. Visual blurring
3. Chest pain
4. Disorientation
5. Personality change
6. Paralysis or weakness
7. Bloody froth from mouth or nose

Signs

1. Bloody froth from mouth or nose
2. Paralysis or weakness
3. Convulsions
4. Unconsciousness
5. Breathing may stop
6. Death

Note: Symptoms and signs usually appear during or immediately after surfacing and may resemble a stroke.

Prevention

1. Always relax and breathe normally during ascent.
2. Get a periodic medical examination by a physician knowledgeable in diving medicine.
3. Divers with a history of lung problems should be evaluated by a diving physician.

Treatment

Early management of air embolism and decompression sickness is similar and is covered on pages 8-12. Note: see Attachment C. Although a diver with an air embolism requires urgent recompression for definitive treatment, patient stabilization and early medical management at the nearest medical facility should be accomplished before transportation to a chamber.

Early oxygen therapy is vital and may reduce symptoms substantially, but this should not change the treatment plan. Symptoms of air embolism and serious decompression sickness (bends) often clear after initial oxygen breathing, but may reappear later. Therefore always contact DAN or a diving physician.

Recompression therapy of an embolism can be effective even if delayed. Successful treatment has occurred as much as two days later, although early treatment is easier and more effective.

DECOMPRESSION SICKNESS

Cause

Decompression sickness (bends, caisson disease) is the result of inadequate decompression following exposure to increased pressure. While immediate recompression is not usually a matter of life and death as in air embolism, serious injury does occur and the quicker recompression starts, the better the recovery.

During a dive, the body tissues absorb nitrogen from the breathing gas in proportion to the surrounding pressure. As long as the diver remains at pressure, the gas presents no problem. If the pressure is removed too quickly, the nitrogen comes out of solution and forms bubbles in the tissues and blood stream. This commonly occurs as a result of violating or approaching too closely the diving table limits. It is wise to stay away from the very edge of the table limits and use the tables conservatively.

Bubbles forming in tissues near joints cause the pain of a classical "bend." When high levels of bubbles occur, complex reactions take place in the body. Blood clotting in the veins around the spinal cord causes numbness and paralysis. Diffuse activation of the inflammatory system in blood leads to congestive symptoms in the lung as well as circulatory shock.

The great individual variation between divers caused by age, difference in physical fitness, body weight and other unknown factors, sometimes results in the sport diver developing decompression sickness in spite of correct use of the tables.

Symptoms

1. Unusual fatigue or weakness
2. Skin itch
3. Pain in arms, legs, or torso
4. Dizziness
5. Numbness, tingling and paralysis
6. Shortness of breath

Signs

1. Skin may show a blotchy rash
2. Paralysis, weakness
3. Staggering
4. Coughing spasms
5. Collapse or unconsciousness

Note: Symptoms and signs usually appear within 15 minutes to 12 hours after surfacing; but in severe cases, symptoms may appear sooner. Delayed occurrence of symptoms is rare, but does occur especially if air travel follows diving.

Prevention

The United States Navy Dive Tables should be used conservatively by sport divers. The standard procedure is to select the depth in the table equal to or next greater than the actual depth. However, experienced navy divers usually select a table depth 10 feet deeper than called for by standard procedure. This practice is highly recommended for all divers, especially in cold water or dives requiring heavy exertion.

Hard exercise or hot showers immediately after a dive can provoke decompression sickness. Flying within 24 hours of a dive increases the risk of decompression sickness.

Treatment

Just as in air embolism, decompression sickness requires urgent recompression for complete treatment. However, patient stabilization and prompt medical care at the nearest medical facility should be accomplished before transportation to a chamber. See pages 8-12 Note: see Attachment C.

Early oxygen therapy may reduce symptoms substantially, but this should not change the treatment plan. Immediate oxygen breathing by the injured sport diver must be emphasized as a vital and highly effective measure. Divers treated with early oxygen have a considerably better treatment outcome.

Recompression treatment of all forms of decompression sickness can be effective, even if delayed. Successful treatment has occurred as much as four days later, although early treatment is easier and more effective.

NITROGEN NARCOSIS

Cause

The effects of nitrogen on the diver have been compared to those of alcohol. Just as alcohol impairs judgement and coordination, nitrogen affects the diver as he reaches depths of about 100 feet. Everyone is affected although there is great individual variation. The effects are often unrecognized as the diver becomes overconfident. This is especially true of the "experienced" diver who may have made dives beyond 100 feet without incident.

While experiencing narcosis, most divers will be able to perform routine tasks with some impairment, but they may not be able to handle an emergency because of the rigid thinking and decrease in mental abilities.

Nitrogen narcosis often has unrecognized warning symptoms and can be deadly. Nitrogen narcosis plays a major role in many diving accidents and divers should be aware that all are affected.

Symptoms

1. Rigid and inflexible thinking
2. Loss of judgement
3. False sense of security
4. Lack of concern for task and own safety
5. Tendency to panic rather than to cope constructively
6. Near unconsciousness at great depth

Signs

1. Inappropriate behavior
2. Repeating but not obeying hand signals
3. Stupor and coma

Prevention

Sport divers should avoid depths greater than 120 feet.

Treatment

Ascend until symptoms clear, preferably returning to surface with controlled ascent and replanning the dive.

OXYGEN POISONING

Cause

Although oxygen is required for life by all living creatures, it can have toxic effects when breathed at above normal pressures. The diver using regular SCUBA equipment at reasonable depths will not encounter this problem, but gas density and heavy exertion can cause carbon dioxide retention which makes divers more sensitive to oxygen. This can produce oxygen convulsions at depths past 140 feet.

Divers using modified gas mixtures with concentrations of oxygen higher than air are at risk at much shallower depths. A diver breathing pure oxygen can have convulsions as shallow as 25 feet.

Symptoms

1. Nausea
2. Dizziness
3. Abnormal vision
4. Confusion
5. Ringing ears

Signs

1. Decreased consciousness
2. Convulsion
3. Unconsciousness

Prevention

Avoid the dangerous situations of deep diving and do not use breathing gases with high oxygen concentrations.

Treatment

Early symptoms should be treated by surfacing. There is no satisfactory treatment of underwater convulsion that avoids air embolism or drowning. Use prudence and planning to avoid this catastrophe.

CARBON DIOXIDE EXCESS

Cause

Carbon dioxide buildup in the sport diver using conventional SCUBA equipment is caused by skip breathing, overexertion, or equipment malfunction. This problem is more common in divers using rebreathing equipment with carbon dioxide scrubbers. However, the high gas density of compressed air at depths over 100 feet can cause normally adequate regulators to perform poorly and lead to carbon dioxide buildup.

Heavy exercising divers deeper than 100 feet are at risk for carbon dioxide buildup.

Symptoms

1. Labored or rapid breathing
2. Short of breath feeling
3. Headache
4. Dizziness, nausea
5. Confusion and unclear thinking

Signs

1. Slowed responses
2. Muscle twitching
3. Unconsciousness

Prevention

Avoid the causes of carbon dioxide buildup and do not skip-breathe. If breathlessness occurs, a diver should stop, and rest until breathing is normal. If breathing troubles persist, the diver should surface and rest.

Treatment

The symptoms clear quickly after the cause is removed, although a headache may persist for hours. The diver who does not stop and rest during the early symptoms risks unconsciousness at depth which has no satisfactory management and commonly leads to embolism or drowning.

OTHER LUNG PRESSURE PROBLEMS

Overinflation of the lungs is the common cause of a number of disorders. A local pressure buildup in part of the lung may damage it and allow air to escape from the lung into the circulation leading air embolism. Air can also escape from the lung into other nearby tissues and cause three other disorders, pneumothorax, mediastinal emphysema and subcutaneous emphysema. These disorders can occur separately or along with air embolism, depending on the exact nature of the lung injury. The occurrence of any of these disorders means that the lung has been injured and an air embolism should be suspected.

All of the causes of air embolism mentioned previously may cause lung overpressure problems as well.

PNEUMOTHORAX

Cause

The lungs are not attached directly to the chest wall, but are kept expanded in the chest cavity by negative pressure between the lung and the chest wall. A lung can collapse if damage to the lung allows air to enter the chest cavity and alter the negative pressure that normally keeps the lung expanded.

Symptoms

1. Shortness of breath
2. Pain in chest

Signs

1. Rapid shallow breathing
2. Blue skin, lips, fingernails

Prevention

Breathe properly during ascent.

Treatment

A person with a pneumothorax does not need recompression but needs medical treatment. A physician may insert a chest tube, withdraw air from the chest cavity, and reinflate the lung if necessary. A chest tube is needed if recompression therapy is used for other reasons. This condition is not usually life-threatening, but requires care at a hospital as soon as possible.

MEDIASTINAL EMPHYSEMA

Cause

Air may escape from a damaged lung into the space between the lungs which is called the mediastinum and contains the heart and various large blood vessels. This space extends from the diaphragm to the neck.

Symptoms

1. Pain in chest, usually under breastbone
2. Shortness of breath
3. Faintness

Signs

1. Difficulty in breathing
2. Change in voice

Prevention

Breathe properly during ascent.

Treatment

A physician should examine the diver for other signs of lung overpressure accident and observe for 24 hours. Do not recompress the patient unless air embolism or decompression sickness are also present.

SUBCUTANEOUS EMPHYSEMA

Cause

Air escaping from a lung may also be trapped under the skin, usually around the neck.

Symptoms

1. Feeling of fullness around the neck.
2. Change in voice

Signs

1. Swelling at base of neck
2. Difficulty swallowing
3. Crackling sound when skin is pressed

Prevention

Breathe properly during ascent.

Treatment

This is usually not an emergency and no treatment is needed. The patient should be examined by a physician and observed for other problems.

EAR DISORDERS

Cause

The commonest dive related ear problem is infection but this is seldom part of a serious accident. Serious ear injury is usually caused by inadequate ear clearing on descent. Rupture of the ear drum or a similar smaller membrane covering the round window inside the ear can result from descending over 4 feet with blocked ears or from forceful clearing attempts once the ear is blocked.

These problems occur most commonly in inexperienced divers who are also least able to cope with the severe dizziness which these injuries cause. This can lead to a more serious problem.

Ear clearing injuries are rare on ascent because the shape of the inner ear passages allows gas to exit easily. Dizziness on ascent or shortly after a dive can be caused by decompression sickness in a serious diving accident.

Symptoms

1. Dizziness
2. Nausea
3. Ear pain
4. Jaw or neck pain
5. Hearing difficulty

Signs

1. Nystagmus (rapid back and forth eye movement)
2. Traumatic ear drum damage
3. Hearing loss
4. Loss of balance

Prevention

Cautious, nonforceful, clearing technique beginning immediately on descent avoids these injuries.

Divers should begin clearing their ears immediately upon leaving the surface and should never use excessive force in attempting to clear. If unable to clear, ascend a few feet until clearing is possible and then resume a slow descent while clearing continually. It is helpful to descend feet first down a weighted line when that is possible. The use of decongestant medications is of doubtful benefit.

Treatment

Physician assessment determines the proper medical care. Serious ear damage should be treated by an ear, nose and throat (ENT) specialist consulting with an experienced diving physician. If serious signs are present, a diving medicine physician or DAN should be contacted immediately

while the diver is placed on bedrest with head elevated and advised not to cough, sneeze, attempt forceful bowel movements, or any forceful breath-hold maneuver.

MOTION SICKNESS

Cause

Motion sickness is a common complaint of divers who often spend hours on a dive boat traveling to dive sites. The most distressing symptom of nausea is caused by overstimulation of the vestibular balance organs of the inner ear and a mismatch between the sensory input of the eyes and the vestibular inner ear balance mechanism. Closing the eyes or sitting where the rocking motion of the boat is clearly seen helps prevent the problem.

Motion sickness itself is not a serious medical problem, but may cause a more serious accident. Loss of buoyancy control while vomiting through a regulator underwater can lead to an air embolism. If the diver removes his regulator to vomit, the reflex inhalation which precedes vomiting may cause drowning.

Mild nausea from motion sickness must also be differentiated from dizziness and nausea which may signal a more serious injury. This may be difficult as motion sickness can often recur and persist several hours after returning to land.

Symptoms

1. Nausea
2. General ill feeling
3. Mild headache

Signs

1. Sweating
2. Palor
3. Vomiting

Treatment

Persistent or unusually severe nausea needs to be evaluated by a physician, especially if other symptoms are also present.

Drugs to treat motion sickness are available, but should be used with caution during diving as all these drugs cause mild drowsiness and a decrease in mucous secretions. Since both effectiveness and level of side effects varies between individuals, no single drug is clearly recommended. Divers should try any new medication on land, long before a planned dive, to avoid the occurrence of unknown side effects at sea.

Note: Although mild motion sickness is often relieved by diving, severe nausea in a diver should be handled with extreme caution. Cancelling a planned dive in this situation may be a wise decision.

Source: Mebane, G. Yancey, and Arthur P. Dick. 1985.
DAN Underwater Diving Accident Manual

ATTACHMENT E

Summary Information on Recompression Chambers and Emergency Evacuation from the Galápagos Islands

ECUADOR

Two recompression chambers are located ten kilometers from the Guayaquil airport, approximately 600 miles from the Galápagos Islands. Both are available on a 24 hour per day basis year round.

The first is a two chamber stationary Dragger, manufactured in West Germany, constructed in 1975 and in use since 1977. The pre-chamber has a two person capacity whereas the main chamber holds six. The diameter is 180 cm and the length 360 cm and it is capable of pressurization to an equivalent depth of 50 meters. The second is a portable Galeazzi, of Italian manufacture, with a depth range of 19 meters that is capable of holding one person. There are conflicting reports as to whether oxygen is available.

Four persons, supported by six assistants, are qualified to operate the chambers. It is not obvious that a physician specially trained in treating patients suffering from diving related illness is available.

Anyone requiring recompression treatment will receive it. As of October, 1986, five persons had received treatment. The patient is liable for all costs including materials and personnel.

With the exception of commercial flights by TAME, daily except Sundays, and SAETA, three times per week, and one weekly naval logistics flight, emergency air transport is not available in the islands. In the case of an emergency, a plane would have to be chartered from Guayaquil. Port Captains in the islands, upon notification, can contact San Eduardo Air Base in Guayaquil to arrange transportation and admission to a chamber. Round trip flight time is at least seven to eight hours. A Douglas C-130 and Arava are capable of low altitude flights. Plane crews have not received training in the transport and treatment of victims suffering from diving related illnesses.

PANAMA

The Industrial Division of the Panama Canal Commission operates a recompression chamber in the zone intended for the sole use of navy and commercial divers working on the canal but authorities acknowledged that recreational divers would be treated in emergency situations. The recompression chamber is designed for one person but could possibly accommodate two and can be pressurized to the equivalent depth of 50 meters (165 feet). Oxygen is always available. A staff comprised of doctors and technicians specially trained in the treatment of diving related illnesses are available upon demand.

Initial contact would have to be arranged by phone from Ecuador but radio contact could be established as soon as pertinent information regarding frequency, time, etc. was relayed to authorities in Panama. Arrangements for emergency air evacuation would have to be made through Howard Air Force Base or a commercial or charter air service.

ATTACHMENT F

Cayman Islands Watersports Operators Association Safety Regulations and Precautions

Code of Ethics

The dive operator member of the Cayman Islands Watersports Operators Association (CIWOA) recognizes the importance of underwater activity for sport, recreation, public service, education, research, and commercial purposes and the necessity of engaging in underwater activity with safety. The dive operator further recognizes the right of mature persons with requisite skills and physical capacity to receive instruction/diving services without discrimination as to race, sex, creed, and pledges to practice the profession according to the highest ethical standards.

The dive operator acknowledges the nature of the responsibilities of providing services to customers in skin and scuba diving and exposing them to a potentially hazardous environment and is committed to improving safe diving.

Section 1

Commitment to the Diver

The diver operator's first duty is to the safety of all divers. The dive operator is obligated to stimulate the acquisition of knowledge, understanding, physical skills and fitness and the formulation of safe personal diving practices. The dive operator is pledged to promote "Safety, Education, and Conservation." In fulfilling this obligation, the dive operator shall abide by the following:

1. Assure the safety of divers and all diving activities.
2. Individually follow all safe diving principles, recognizing that influence by example is the cornerstone to the development and promotion of safe diving practices.
3. Maintain a level of professional competence equal to standards established by the Association.
4. All vessels operated commercially by a member of the CIWOA must comply with the Marine Code and Conservation Laws of the Caymen Islands.
5. Surface support personnel are recommended for all diving activity.
6. Rogue divers should be reported to all appropriate dive operations.
7. Resort courses, Certification courses, Open Water Training dives and any other instructional activities must be conducted by a current, active Instructor in accordance with training agency standards.

8. Resort course graduates and resort divers must dive with a current, active certified Divemaster, Assistant Instructor or Instructor and their activities must comply with training agency standards.
9. Any vessel taking customers out for scuba diving must be equipped with:
 - Oxygen kit
 - First Aid Kit
 - Tiltboard
 - VHF 2 way radio
 - Displayed dive tables
 - Float line (current line)
 - Dive Flag
 - Flotation devices--one for each person aboard
10. That the Red/White dive flag must be flown when diving activities are in progress. At all other times (running or moored at night) the flag must be rolled or taken down.
11. Vessels involved in night diving activities must have adequate boat marker lights above water and an in-water working strobe marker effective September 29, 1984.
12. The recommended maximum depth limit with customers is 100 feet. The required maximum depth limit with customers is 110 feet with an exception made for dive sites on East End to 120 feet.
13. No individuals, staff or otherwise may make dives in excess of 110 feet if customers are on board.
14. Planned Decompression Diving is not allowed for customers or with customers on board. Employees or member operators who are on duty may decompress at their own discretion.
15. Hang tanks (hookas) must be in the water at 10 feet during all dives below 60 feet.
16. The recommended in-water Divemaster/Customer ratio is 1 to 10 for wall diving; as conditions dictate for shallow dives.
17. Divemasters should not be required to endanger their own safety or the safety of other customers by chasing a run-away diver.
18. No spear guns or spearfishing activities are allowed. In addition, the taking of any type of marine life, dead or alive, is strictly prohibited on boats engaged in scuba diving activities.
19. VHF Channel 16 shall be used for initial contact or in emergencies in accordance with standard practice.

20. Refresher courses and/or refresher dives should be recommended if customer experience and/or performance indicates a need.

Personnel

21. Working Divemasters must have formal training and current certification as Divemaster, Assistant Instructor or Instructor and C.P.R. Individual operators are encouraged to hold First Aid and Rescue Review sessions for their staff.
22. Boat handlers/Safety support personnel must have current certification in C.P.R. and training in First Aid and Rescue procedures.

Customers

23. Divers must present a certification card or positive proof of such certification (BSAC LOG).
24. Divers must have a buoyancy compensator as defined by Training Agency Standards. A timing device and depth gauge per buddy team is required as of January 1, 1985. Octopus regulators are recommended for all divers.
25. Individual CIWOA members are obliged to fully disclose to the prospective customer all reasonably anticipated costs, charges and assessments before enrollment or obligation is established.
26. Dive sites with or without permanent moorings should be governed by the following rules of etiquette:
 - a. If a mooring is occupied, the second boat should attempt to establish radio contact from at least 200 yards away.
 - b. Extreme caution is advised when approaching a dive site with divers in the water.
 - c. When a divemaster is entering the water with a group, and there are other groups in the water on that same site, both the briefing and the divemaster's directions in the water should emphasize staying with his group and avoiding getting mixed up with the other groups.

Section 2

Commitment to the Public

The CIWOA member is responsible for the support and development of sound public policy relating to diver education, the use and conservation of natural waters, marine life and bottom lands and for the promotion and encouragement of programs and policies directed at such use and conservation.

Section 3

Commitment to the Profession

The CIWOA member recognizes that the quality of his/her services influences the attitudes of other water users, the public in general and governmental bodies.

Section 4

Commitment to the Association

The CIWOA member, by virtue of his/her voluntary membership in CIWOA, recognizes the responsibility and obligation to promote the Association and support the official decisions and policies of the Association.

In fulfilling this obligation to the Association, the CIWOA member shall:

1. Publicly support CIWOA, its leadership, and its members.
2. Bear in mind that CIWOA is unique in the worldwide recreational diving industry, in that it is a truly democratic organization with a leadership directly elected by the membership. This democratic structure is the best possible mechanism for ensuring that (1) Association activity meets the needs of the majority of the members, and (2) every member has the real opportunity, if he/she wishes, to lead the Association at the highest level.
3. Make every effort to bring about necessary changes in a professional manner by direct personal contact with those fellow members who are in positions of authority and responsibility.

Source: Cayman Islands Water Sports
Sports Association. Splash '86.

ATTACHMENT G

Bibliography of Underwater Medicine and Physiology

- Bennett, Peter B., & D.H. Elliott, ed. 1982. The Physiology and Medicine of Diving. London: Belliere Tindall (in USA: Carson, Calif.: Best Bookbinders).
- Clarke, Dick. 1984. Medical Aspects of Diving Accident Management: Baseline Standards for the Diving Supervisor. Wilmington, Calif.: College of Oceaneering.
- Davis, Jefferson C. 1981. Hyperbaric and Undersea Medicine. San Antonio, Texas: Medical Seminars, Inc.
- Dueker, Christopher W. 1985. Scuba Diving in Safety and Health. Menlo Park, Calif.: Diving Safety Digest.
- Dueker, Christopher W. 1983. Scuba Diving Safety. Mountain View, Calif.: Anderson World Books, Inc.
- Edmonds, Carl, C. Lowry & J. Pennefather. 1981. Diving and Subaquatic Medicine, 2nd ed. Mosman, Australia: Diving Medical Centre (in USA: Carson, Calif.: Best Bookbinders).
- Hamilton, R.W., & E.W. Pierce II. 1983. "Hyperbaric Oxygen in Emergency Medical Care" in Proceedings of a Conference, 27-28 January 1983 at Bronx Municipal Hospital Center, N.Y. Bethesda, Maryland: Undersea Medical Society.
- Schilling, Charles W., C.B. Carlston & R.A. Mathias, ed. 1984. The Physician's Guide to Diving Medicine. New York: Plenum Press.
- Schilling, Charles W., M.F. Werts & N.R. Schandelmeier, ed. 1976. The underwater Handbook. New York: Plenum Press.
- Struass, Richard H. 1976. Diving Medicine. New York: Grune & Stratton, Inc.
- United States Navy. 1985. U.S. Navy Diving Manual, NAVSEA 0994-LP001-9010, Revision 1, 1985.

Attachment G

Page 2

National YMCA Center for Underwater Activities
Oakbrook Square
6083-A Oakbrook Parkway
Norcross, GA 30092

Naval Experimental Diving Unit
Panama City, FL 32407

Royal Life Saving Society Canada
64 Charles Street East
Toronto, Ontario, CANADA M4Y 1T1

South Pacific Undersea Medical Society
P.O. Box 120
Narrabeen, New South Wales 2101
Melbourne
AUSTRALIA

ATTACHMENT H

Bibliography of Rescue and Accident Management

- Bergeron, David J. 1982. First Responder. Bowie, Maryland: Brady Communications, Inc.
- Boehler, Ted. 1978. The Divemaster Manual 2. Crestline, Calif.: Deepstar Publishing.
- Brylske, Alex, ed. 1984. PADI Rescue Diver Manual. Santa Ana, Calif.: Professional Association of Diving Instructors.
- Daugherty, C. Gordon. 1983. Field Guide for the Diver Medic. Houston, Texas: National Association of Diver Medical Technicians.
- Mebane, G. Yancy & A.P. Dick. 1985. DAN Underwater Diving Accident Manual. Durham, N.C.: Duke University.
- Miller, James W., ed. 1979. NOAA Diving Manual. Washington, D.C.: United States Government Printing Office.
- Smith, Robert W., & H.C. Allen, ed. 1978. Scuba Lifesaving and Accident Management. Key West, Florida: National YMCA Underwater Activities Program.
- Pierce, Albert L. 1985. Scuba Life Saving. Toronto, Ont., Canada: The Royal Life Saving Society Canada.

Bibliography of Research in Accident Management

Seeger, David L. 1981. First Response to Accidents, Maryland: Brady Communications, Inc.

Shuler, Ted. 1978. The Underwater Mark II. Crestline, Ohio: Crestline Publishing.

Skyler, Alan, ed. 1984. SABE Rescue River Manual. Denver, Colorado: Professional Association of Diving Instructors.

Wagberry, C. Gordon. 1983. Field Guide for the River Mark II. Bethesda, Maryland: National Association of River Medical Technicians.

Waters, G. Jerry & A.E. Dick. 1983. RAM Underwater Diving Incident Manual. Durham, N.C.: Duke University.

Miller, James W., ed. 1979. RAM Diving Manual. Washington, D.C.: United States Government Printing Office.

Smith, Robert W., & E.C. Wilson, ed. 1978. Design, Manufacturing and Assembly Management. New York: McGraw-Hill. RAM Underwater Diving Incident Manual.

Steele, Albert L. 1981. RAM Mark II. Toronto, Ontario: "RAM" the River Mark II Diving Society.

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ATTACHMENT I

Sources of Information Pertaining to Diving Safety, Rescue and Medical Treatment

British Sub-Aqua Club
16 Upper Woburn Place
London, United Kingdom WC1H 0QW

Confederation Mondiale des Activites Subaquatiques
34 rue du Colisee
75008 Paris
FRANCE

Dive Rescue Incorporated/International
2619 Canton Court
Fort Collins, CO 80525

European Undersea Biomedical Society
Congress Secretariate
National Defense Research Institute
FOA Naval Medicine Division, MDC
S-130 61 Harsfjarden
SWEDEN

Federation of Australian Underwater Instructors
P.O. Box 246
Tuart Hill, W.A. 6060
AUSTRALIA

Lifeguard Systems, Inc.
25 West 43 St., Suite 920
New York, NY 10036

Professional Association of Diving Instructors
1243 East Warner Ave.
Santa Ana, CA 92705

National Association of Diver Medical Technicians
5709 Glenmont
Houston, TX 77081

National Association of Scuba Diving Schools
641 West Willow Street
Long Beach, CA 90806

National Association of Underwater Instructors
P.O. Box 14650
Montclair, CA 91763-1150

National Oceanic and Atmospheric Administration
Diving Program, N/M 015
6001 Executive Blvd., Room 304
Rockville, MD 20852

APPENDIX 1

Source of information pertaining to Diving Safety, Rescue and Medical Treatment

British Sub-aqua Club
18 Upper Mount Place
London, United Kingdom WC1R 0DU

Commissariat Maritime des Antilles
14 rue de la France
97000 Fort-de-France
FRENCH GUIANA

U.S. Navy Medical Research and Development Command
1015 Gannett Court
Fort Collins, CO 80522

U.S. Navy Medical Research and Development Command
National Defense Science and Engineering Graduate Fellowship
1015 Gannett Court
Fort Collins, CO 80522

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Department of Australian Antarctic Expeditions
P.O. Box 144
Russett Hill, N.S.W. 2058
AUSTRALIA

Lifequest Systems, Inc.
15 West 41 St., Room 910
New York, NY 10018

Professional Association of Diving Instructors
1541 East 9th St.
Santa Ana, CA 92705

National Association of Diver Instructors
1700 Elmwood
Houston, TX 77061

National Association of Scuba Diving Schools
441 West Wilson Street
Long Beach, CA 90802

National Association of Underwater Instructors
P.O. Box 14450
Houston, TX 77245-0450

National Oceanic and Atmospheric Administration
Diving Program, RM 013
6001 Executive Blvd., Room 304
Rockville, MD 20852

NAUI Divemaster Course Standards

I. General

- A. The NAUI Divemaster rating is the highest NAUI leadership-level certification with the exception of Instructor. The program is designed to train experienced and knowledgeable divers to organize and conduct safe and enjoyable open water dives for certified divers. NAUI Divemaster certification is a highly recommended step in the progression to NAUI Instructor. The Divemaster must renew certification annually, and receives various benefits and authorizations so long as current.

II. Course Objectives

- A. To afford a means of training and qualifying suitable divers to organize and conduct open water diving activities for certified divers.
- B. To afford necessary training for divers progressing through the recommended steps to NAUI Instructor status.

III. Qualifications of Graduates

A current NAUI Divemaster:

- A. May organize and conduct dives for certified divers and assist Teaching NAUI Instructors in the open water training of students provided:
 - 1. The diving activities approximate those in which the Divemaster is trained.
 - 2. The diving locale approximates that in which the Divemaster is trained. Additional training or experience is necessary for Divemasters who desire to organize highly specialized activities, such as wreck penetration, cave, or ice dives.
- B. If all other prerequisites are met, may enter a NAUI Instructor Training Course (ITC). Attendance at a NAUI Instructor Preparatory Course (PREP) prior to attending the ITC is recommended but not required.
- C. If insured for liability, may organize and conduct NAUI Recognition Programs, such as International Diver, and award appropriate recognition materials to participants.
- D. May not sign or issue any diving certifications and may not teach NAUI-Sanctioned certification courses independently. At no time may a Divemaster assume full responsibility for dive class training.

- E. A NAUI Divemaster may renew certification annually by accomplishing the following:
1. Maintain a current mailing address with NAUI Headquarters
 2. Pay current annual dues
 3. Complete and submit the current renewal form
 4. Organize and conduct at least two openwater diving experiences during the preceding 12 months.
- F. A NAUI Divemaster is a member of the NAUI Diving Association (NDA) and entitled to all benefits of that organization and, while not being a voting member of NAUI, still receives:
1. NAUI Divemaster card, certificate and emblem
 2. Monthly publication (NDA News)
 3. Instructor discount on publications
 4. Option to purchase liability insurance through NAUI (required to conduct NAUI Recognition Programs).

IV. Who May Teach

The NAUI Divemaster Course may be directed only by a Teaching NAUI Instructor who has been so certified for at least one year or has authorization (from the Branch Manager or NAUI Headquarters, as applicable). It is strongly recommended that more than one such Instructor be involved in presenting the course. Authorization is only required to conduct the first such course. Registration materials for all Divemaster courses are to be sent to NAUI Headquarters in accordance with current procedures.

V. Prerequisites for Entering Course

- A. Minimum age for course entry is 18.
- B. Verification of good physical condition as indicated by a medical examination for diving within the preceding 12 months.
- C. Provide own dive gear suitable for open water.
- D. Certification in the NAUI Diving Rescue Techniques Specialty Course is required. Preferred minimum additional certification level to enter Divemaster training is NAUI Assistant Instructor or NAUI Master Scuba Diver. Individuals not possessing either of these two certifications may be accepted for training only if they meet all of the following criteria:
1. Certified as openwater scuba diver or any more advanced level by a nationally recognized agency.

2. One year or more of diving experience since receiving entry scuba certification with a minimum of 25 logged open water dives of no less than 20 hours bottom time within the preceding two years.
3. Water skills and ability equivalent to that of a NAUI Assistant Instructor. It is recommended that all such skills from the Assistant Instructor Standards be used as screening prerequisites by the Instructor teaching the Divemaster course when he or she is not aware of the student Divemaster's water skill level.

VI. Required Course Minimums

NOTE: The course outlined by these minimum requirements is designed to be conducted easily within three weekends for small classes (1-6). Large classes will require a longer schedule to allow individual students to actually perform in the required leadership roles.

- A. Classroom/openwater site lectures - 16 hours, including 2 hours of registration and orientation and 2 hours for the administration and review of the written examination.
- B. Confined water - None required, except that water skill screening for students not certified as NAUI Assistant Instructors may be conducted in confined water.
- C. Open water - 14 hours; involving on-site instruction, demonstrations and student performance. In addition, each student may expect to spend time outside class hours researching dive sites, organizing notes and generally preparing for dive briefings and activities. A total of seven open water dives is required.

VII. Skill Performance Objectives

- A. Students are to demonstrate satisfactory open water skills and perform in Divemaster roles for practice and evaluation during the planning and conduct of the required open water dives. All such activities are to be performed under the supervision of an Active Teaching NAUI Instructor. The purpose is to evaluate the candidate in both knowledge and the ability to apply it in the performance of practical work. The evaluated activities also further the student Divemasters' training in dive management.
- B. Minimum evaluated activities are to include the following:
 1. Rescue another diver in open water during a skin dive.
 2. Perform scuba diving skills as listed below during an open water dive. The staff will also utilize this dive to demonstrate the organization and conduct of a day dive for certified divers. Skills are to include:
 - a. Pre-dive gear check for self and buddy

- b. Entry, buoyancy check, swim to and from dive area, exit
 - c. Distance swim - 880 yards total during the dive
 - d. Descents, underwater swimming, ascents
 - e. Weight belt removal and replacement on surface and bottom
 - f. Scuba unit removal and replacement on surface
 - g. Recover and bring to the surface from 20-25 feet of water a ditched wight belt of at least 10 lbs.
 - h. Make a simulated decompression stop at 10 feet for 5 minutes.
 - i. Clear mask and regulator
 - j. Retrieve regulator
 - k. Buddy breathe on bottom not using alternate breathing source
 - l. Make an emergency swimming ascent from 20-25 feet of water using Pro Manual techniques only
 - m. Maintain proper buoyancy using weights, breathing and BC [buoyancy compensator]
3. Complete a night dive as a diver. During this dive the staff will demonstrate the organization and conduct of a night dive for certified divers. The dive is to be conducted in an area previously dived by the class during daylight.
 4. Performing as a Divemaster using safety divers and assistants, control a satisfactory rescue of a diver simulating an underwater accident in open water, including organizing a search, transport of a victim to shore or boat, victim care and accessing emergency systems.
 5. Prepare and present at least one 10-15 minute pre-dive briefing for practice and one for evaluation. The briefing is to be evaluated on depth of coverage as well as safety and control measures. Evaluators are to remember the student is not an Instructor and may not possess polished instructional skills.
 6. Performing as a Divemaster assisting an Active Teaching NAUI Instructor, organize and assist during an early openwater experience for a class of student divers. This may be accomplished by having the Divemaster class act as entry-level divers and individually rotate through the Divemaster role during a single dive. To be evaluated for record.
 7. Performing as a Divemaster, organize and conduct a beach dive for certified divers. To be evaluated for record. The student Divemasters should, if at all possible, organize and conduct their own evaluated boat dive with a minimum of direction from the staff. If this is impossible, a new setting may be substituted.
 8. Performing as a Divemaster, organize and conduct a dive for certified divers in a significantly different setting from that of the previous dives (e.g. boat vs beach). To be evaluated for record.

9. Organize and conduct a night or limited visibility dive for certified divers. To be evaluated for record. The student Divemasters are to organize and conduct their own night dive with the staff evaluating. If night diving is not possible a simulation should be utilized.
10. The student Divemasters may run multiple dives on the same day up to a maximum of three scuba and one skin dive. The greatest possible variety of diving situations should be used. Open water dives should follow pre-dive briefings as closely as possible. After each dive, the student Divemaster is to conduct a debriefing. All diving activities are to be logged.

VIII. Required Curriculum Subjects

The intent is to provide the students the knowledge needed to organize and conduct safe open water dives in a group leadership role. Practical, on-site demonstrations by the instructor or staff are to be presented wherever possible.

- A. **Divemaster Duties:** This presents the techniques involved in planning, organizing and controlling a group dive. It is to cover the analysis, selection and pre-dive evaluation of a dive site, pre-dive meetings and briefings, debriefing. Divemaster checklists and logs, safety divers, Divemaster responsibilities, divers flag and diving platform use. Special procedures for working as a dive guide, leading trips and working with instructors on initial open water training dives are to be covered in detail.
- B. **Divemaster Legal Responsibilities:** This explains such legal concepts as Negligence, Standard of Care, the necessity for liability insurance, Waivers and Indemnity Agreements, the taking of artifacts and game, and the legal relationship between boat owner, Captain, Instructor and Divemaster. NAUI information may be included.
- C. **Shore Diving:** This is to cover the organizational problems of shore diving in salt and fresh water environments. Included are the problems of entry and exit point selection, hazards, signals, flags, floats, surface support stations, current, tides, wind, sunburn, chilling, crowd control, small boat and other aquatic traffic.
- D. **Emergency Procedures:** This area includes the actions which are to be taken if an emergency occurs while a dive is in progress. Included are safety diver and equipment use, underwater communications, diver recall methods, search techniques, assists and rescues, victim care and handling, emergency and first aid equipment, accessing emergency systems and accident reports.
- E. **Boat Diving:** The techniques involved in small and large boat diving, including navigation and Rules of the Road, boating etiquette and safety, refueling, anchoring, docking, weather conditions and

broadcasts, as well as charts, navigation aids and sources of information. The Captain/Divemaster relationship, diver management from a boat-based operation, ladders, platforms and safety lines, boat diving etiquette, equipment stowage, safety procedures and boat rescue techniques. Small boat diving (2-6 divers) versus large boat diving operations are to be discussed, as well as required boat equipment and licensing.

- F. Night and Limited Visibility Diving: To present the procedures used and the problems which can arise. Day reconnaissance of the night dive site is to be emphasized, as well as planning and safety procedures, underwater, surface, shore and boat lights, special equipment, typical and local hazards, buddy lines, rope signals, diver recall, underwater communications, diving limits, lost diver problems, checklists and problems associated with limited visibility diving both underwater and on the surface.
- G. Open Water Resuce: To cover the proper techniques and problems associated with open water resuces. Areas to be covered include rough water rescue considerations, conducting search and recovery operations and treatment, care and handling of unconscious divers.
- H. Deep and Decompression Diving: The problems a Divemaster must avoid or deal with in an emergency decompression situation. It is to be emphasized that the need for decompression diving should be avoided. Included are the planning, concepts, methods and equipment used in such diving. The student Divemaster is to have a thorough knowledge of decompression and repetitive dive tables and to know the treatment and transportation techniques for emergencies involving decompression sickness and suspected lung overpressure problems. Altitude considerations and restrictions on flying after diving are to be covered.
- I. Underwater Environment: The physical and biological aspects of the diving environment with emphasis on the local area, including plant and animal life, the importance of fostering a regard for ecology and conservation, pollution, water movement and characteristics, tides, currents, waves and surf, shore and bottom conditions, surface hazards and wind effects.
- J. Equipment: Common equipment problems, recognition of unsafe or improperly assembled equipment, variations in types of gear and incorrect wear and handling; pre-dive equipment checks.

IX. Learning Objectives

- A. The student Divemaster is to exhibit appropriate knowledge and skill levels in the conduct of all diving, lecturing and briefing activities during the evaluated portions of the course and is to perform satisfactorily in graded exercises involving recorded evaluations of:

1. Personal diving skills and proficiency
 2. Pre- and post-dive lectures and briefings
 3. Dive planning, management and control
 4. Pre-dive equipment and diver checks
 5. Response to simulated emergencies as a diver and as a Divemaster
- B. The candidate must score a minimum of 75% on the NAUI written examination for Divemasters. The examination is to be reviewed with the candidate following completion and scoring.

X. Certification Requirements

- A. A person may be certified as a NAUI Divemaster upon satisfactory completion of the following requirements:
1. All portions of the course in accordance with these standards.
 2. All NAUI administrative and financial requirements.
 3. Scoring 75% or higher on the NAUI written examination for Divemasters.
- B. Upon completion of all requirements the Course Director will complete and endorse a Divmeaster entry in the student's NAUI Training Record and register them with NAUI as Divemasters.

Source: National Association of Underwater Instructors. 1984.
"NAUI Divemaster Course Standards."

- 1. Personal diving skills and proficiency
 - 2. Pre- and post-dive lectures and briefings
 - 3. Dive planning, management and control
 - 4. Pre-dive equipment and safety checks
 - 5. Exposure to student and emergency at a diver and as a Divermaster
- The candidate must score a minimum of 75% on the BADI written examination for Divermaster. The examination is to be reviewed with the candidate following completion and scoring.

Certification Requirements

- A. A person may be certified as a BADI Divermaster upon satisfactory completion of the following requirements:
 - 1. All portions of the course in accordance with these standards.
 - 2. All BADI administrative and financial requirements.
 - 3. Scoring 75% or higher on the BADI written examination for Divermaster.
- B. Upon completion of all requirements for course approval will complete and endorse a Divermaster entry in the student's BADI Training Record and register class with BADI as Divermaster.

(BLANK) National Association of Behavioral Instructors, 1984
BADI Divermaster Course Standards

ATTACHMENT K

Woods Hole Oceanographic Institution Diving Safety Manual
Section 6.0

EMERGENCY PROCEDURES FOR WOODS HOLE OCEANOGRAPHIC INSTITUTION DIVERS

6.1 GENERAL POLICY

6.1.1 Introduction

1. Development of exact procedures to cover all possible emergency situations cannot be accomplished in this manual because of the immense number of variables involved (e.g., differences in diving location, personnel, available medical facilities, transportation, etc.).
2. This Section is intended to serve as a planning guide for Institution divers to formulate specific procedures for their operations. Supervisory personnel, under direction of the DSO, must use judgment in selecting procedures which best suit the nature of their operation.
3. Detailed accident management and first aid techniques may be found in the NOAA Diving Manual, Red Cross Manuals, and many other approved publications.

6.1.1 Preparedness

1. All supervisors and team members must be prepared to respond properly in the event of an accident. Prompt emergency procedures can reduce the residual effects on the victim and can possibly save a life.
2. Periodic retraining and routine practice are essential elements in emergency preparedness; emergency drills are encouraged.
3. The importance of prevention through operations planning, following safety regulations, and using common sense cannot be overemphasized.

6.2 ON-SITE ACCIDENT MANAGEMENT

6.2.1 Rescue/First Aid

1. The person nearest the victim (in SCUBA, usually the buddy), will initiate rescue/recovery procedures.
2. The rescuer will signal for assistance (voice, whistle, flare, etc.).

3. If the victim is not breathing, the rescuer immediately will start basic life support in the water. Resuscitation must be continued with a minimum of interruption while removing the diver from the water to the rescue platform (boat, shore, etc.), and not be discontinued until the victim resumes breathing, is pronounced dead by a physician, or is turned over to a higher authority.
4. The Dive Master (or next senior diver in the team) will take charge of the scene and delegate tasks to other responsible individuals. Other team members, if available on site, will be dispatched by the Dive Master to assist in the rescue efforts.
5. If an air embolism or the bends is suspected and the victim is breathing, immediately begin prescribed first aid (30° feet up position (left side down), treat for shock, administer pure oxygen, keep under constant observation). See Appendix D, Diving Accident First Aid Manual.
6. Send for aid.

6.2.2 Summoning Aid

1. Woods Hole Oceanographic Institution pier, immediate Woods Hole area:
 - (1) call the Falmouth Fire Department Rescue Squad: 548-2323;
 - (2) if telephone assistance is needed, call the Institution Switchboard: 0;
 - (3) Oxygen resuscitator location at Woods Hole Oceanographic Institution:
 - a. Machine Shop, Iselin Building, first floor.
 - b. Diving Locker, Iselin Building, first floor.
2. Small Boat, Buzzards Bay or Vineyard Sound area:
 - (1) radio Coast Guard, VHF Channel 16 (CB Channel 9 may be used as a last resort but is unreliable);
 - (2) the Port Office can monitor Channel 16, but must be notified in advance of the diving operation;
 - (3) if unable to contact the Coast Guard or Port Office, hail another vessel to relay the message, or proceed to the nearest inhabited dock;

(4) if in a remote area, use smoke, flares, etc., to attract attention.

3. At Sea

Immediately advise the vessel's Master of the situation and request what is needed for assistance (generally communication and rapid transport to shore).

4. Proper Radio/Telephone Protocol:

(1) keep calm;

(2) declare the situation an emergency (e.g., "This is an emergency. I have a diving accident victim needing treatment in a recompression chamber.");

(3) be prepared to give detailed information regarding location (e.g., distance and direction from prominent landmarks, coordinates, etc.), name and description of vessel (never assume the pilot will recognize you), the status and number of victims (state of consciousness, etc.), pertinent environmental conditions (road/sea) or any unusual circumstances;

5. A checklist of persons/organizations who may need to be notified:

(1) emergency aid/transportation (rescue squad, Coast Guard);

(2) physician, hospital;

(3) recompression chamber facility;

(4) law enforcement authorities (police);

(5) Institution authorities (DSO, Safety Office) - MANDATORY FOR ANY DIVING ACCIDENT;

(6) victim's family.

6.2.3 On-Site Care of Diving Casualty

1. Follow the Accident Management Flow Chart (Appendix D).

2. If time and circumstances permit, administer an initial neurological examination (Appendix D).

3. If an asymptomatic emergency is managed at the scene and hospitalization or professional medical attention is not required (emergency ascent, water accident where resuscitation is not required, etc.):

- (1) provide victim with emergency identification, telephone numbers for diving physician, local medical facility, etc.);
 - (2) do not let the victim drive or be alone for the next six (6) hours.
4. Any person resuscitated at the dive site must be transported to a medical facility for follow-up examination/treatment, preferably by a rescue squad with trained emergency medical personnel.

6.2.4 Additional On Site Procedures While Awaiting Aid/Transport

1. Recall all divers in the water; terminate all diving operations; secure equipment; be certain all dive team members are accounted for.
2. Non-involved dive team members shall stand by and not interfere with emergency efforts.
3. Designate dive team members to control crowds or bystanders; keep non-essential personnel away from the victim and first aid personnel; instruct dive team members not to mingle with bystanders and not to discuss the accident with anyone (this is especially necessary in a beach operation); do not allow any dive team members to leave until dismissed by the Dive Master or DSO (in serious or fatal accidents authorization from local enforcement authorities will be required for dismissal of witnesses).

6.3 EMERGENCY EVACUATION GUIDELINES

6.3.1 General Guidelines

The following medical evacuation information should be forwarded with the patient. If possible, take time to explain the following steps to the physician or paramedic. Do not assume they understand the reasons why procedures such as administration of oxygen to a diving casualty must be performed. Call the National Diving Accident Network (919-684-8111) for medical consultation if doubt exists that the physician/hospital possesses the competence to handle a diving casualty.

1. Maintain breathing and heart functions, ensure airway remains open. If CPR is being administered, there must be an absolute minimum of interruption during transfer; any method of transfer requiring interruption of CPR should be used only as a last resort.

2. Keep patient on oxygen and incline head downward (30° angle), left side down, during transportation (See Appendix D).
3. Ensure paramedics/physician understand why paragraph 2 above, is necessary.
4. Ensure paramedics/physician understand why the patient must be taken to a recompression chamber instead of a hospital.
5. Do not stop giving oxygen to a diving accident patient even if patient is breathing normally unless there is a need to reopen the airway, or the patient shows signs of oxygen convulsions (without pure oxygen bubbles will reload with nitrogen and aggravate symptoms).
6. Keep patient out of hot sun and watch for shock and protect patient from environmental factors, e.g., sun, cold, etc.
7. Do not give any pain killing drugs (See Appendix D).
8. Instruct flight crews to fly or pressurize aircraft below 800 feet, or as low as possible.
9. Provided aircraft can handle the extra weight, the diving buddy should also be transported with the patient, because he/she also may require recompression and can provide information, comfort, and contact with the patient's relatives.
10. A complete history of all events leading up to the accident and evacuation must be forwarded with the patient.
11. Depth gauges, tanks, regulators, and other diving equipment should be forwarded with the patient and should be properly tagged, or at least set aside without tampering, especially if the accident was fatal.
12. Be aware that a well-trained diver may be the most knowledgeable person on the scene regarding diving accidents and must, therefore, make a continuing effort to insure that proper treatment is given.

6.3.2 Evacuation By Air

Each helicopter evacuation presents unique problems. Knowing what to expect and the procedures to follow, however, can save time, effort, and perhaps a life.

1. Request a helicopter with a medic crew and oxygen. In your request, follow the guidelines in 6.3.1.

2. Try to establish communications with the helicopter. If your boat does not have the necessary frequency, try to work through another boat.
3. If possible, maintain a speed of 10 to 15 knots; into wind about 20 degrees on port bow.
4. Put all antennas down, if possible, without losing communications.
5. Secure all loose objects on or around the decks because of the strong winds generated by the helicopter.
6. Make sure the patient is ready in advance of the transfer, because time is critical both to the victim and the hovering aircraft.
7. Signal the helicopter pilot when all is ready, using hand signals by day and flashlight at night.
8. DO NOT SECURE THE TRAIL LINE, BASKET, OR ANY CABLE FROM THE AIRCRAFT TO THE BOAT. ALWAYS LET THE LIFTING DEVICE (STRETCHER) TOUCH THE BOAT BEFORE HANDLING IT, TO PREVENT ELECTRIC SHOCK.
9. Place life jacket on patient.
10. Tie patient in basket, face up.
11. Attach personal information such as name, address, age, what happened, and what medication has been administered.

6.4 LEGAL CONSIDERATIONS

6.4.1 Responsibility

Serious accidents and fatalities often lead to legal actions. Each diver has a responsibility as a representative of the Institution, to act in a responsible manner, both for the benefit of the Institution and him/herself.

6.4.2 Guidelines for Serious Accidents

1. Contact local law enforcement authorities if this is a fatal accident.
2. Be polite but firm regarding interviews and questions. If approached, simply indicate that information will be made available through the Institution Public Affairs Office. Remember that any statement made under stress may later cause considerable problems for members of the dive team, the Institution and the victim.

3. The Dive Master should serve as spokesman for the dive team at the scene.
4. Give only factual information to law enforcement authorities such as name, address, Institution affiliation, persons or supervisors to contact at the Institution, the exact location of the accident, a brief description of the occurrence, whom to notify in the victim's family, etc. Avoid expressing opinions or conclusions under stress.
5. The Dive Master will prepare a complete file on the diving operation/course including outlines, memos on procedures, records for the Diving Control Board of all personnel, etc.
6. Have each dive team member prepare detailed statements of facts. Do it the day of the accident, not a week later. These statements should be given to the DSO.
7. The Dive Master should record the name of each team member/student who was in attendance including name, address, their involvement (if any). Inform them that they may be asked for facts as they recall them only. Ask them not to discuss opinions with bystanders, etc.
8. Complete the "Accident Report" (Appendix E) for the DCB.

Source: Woods Hole Oceanographic Institution. 1983.
Diving Safety Manual

DOCUMENT LIBRARY

November 21, 1986

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REPORT DOCUMENTATION PAGE	1. REPORT NO. WHOI-87-22	2.	3. Recipient's Accession No.
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7. Author(s) Margaret A. Rioux and Terrence M. Rioux		6.	
9. Performing Organization Name and Address Woods Hole Oceanographic Institution Woods Hole, Massachusetts 02543		8. Performing Organization Rept. No. WHOI-87-22	
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