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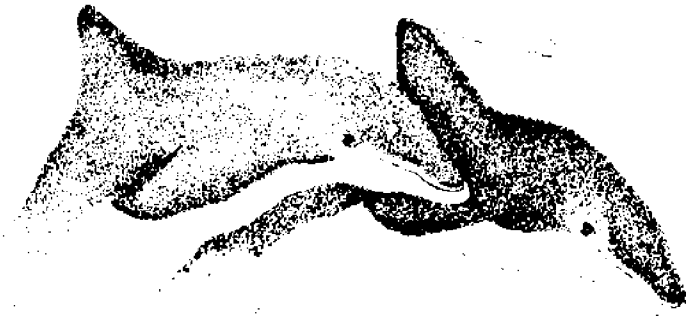
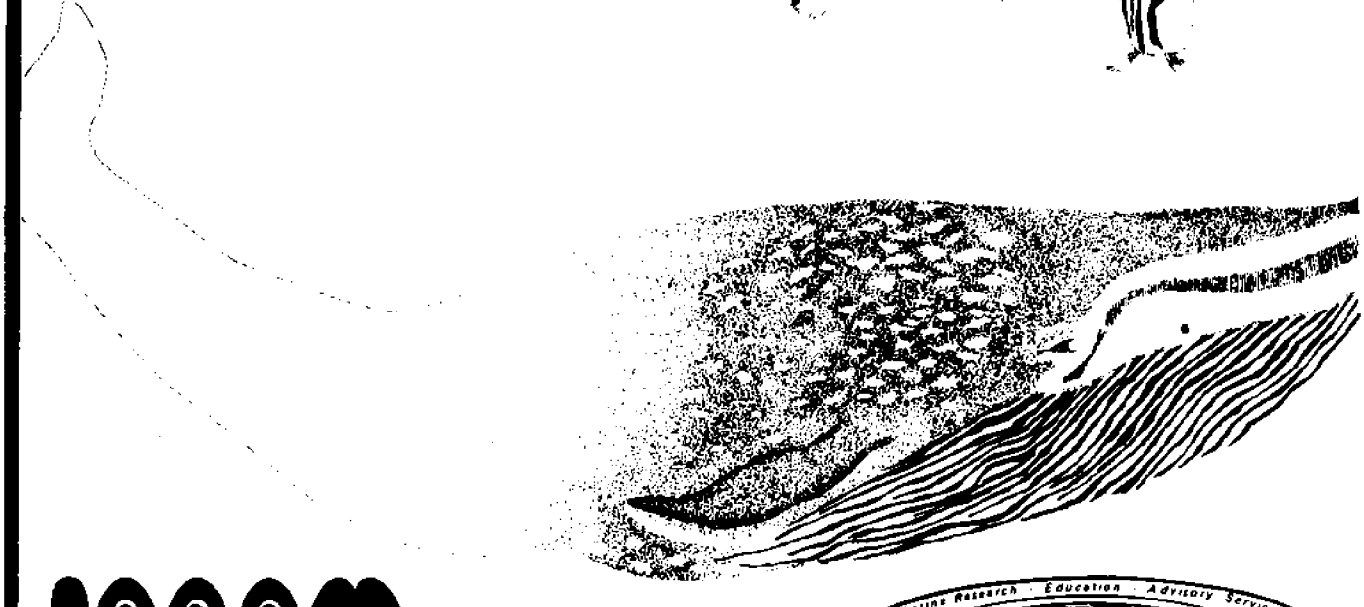


AQUATIC ANIMAL MEDICINE: A STATE OF THE ART

Conference Proceedings

Edited by:
Robert L. Jenkins & Joseph G. Halusky



REPORT NUMBER 32
March 1980

Marine Research Education Advisory Services
A Sea Grant Program for Florida

AQUATIC ANIMAL MEDICINE:

A STATE OF THE ART

Proceedings of a conference
held April 25, 1979 at
Whitney Hall,
Marineland, Florida

Jointly sponsored by the
International Association for Aquatic Animal Medicine
Florida Sea Grant
and
Florida Cooperative Extension Service, Marine Advisory Program

Edited by
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Report Number 32
State University System of Florida
Sea Grant College Program
March 1980

Cover art by: Robyn Smith
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FOREWORD

Aquatic Animal Medicine consists of disciplines brought together by common interests in both marine and fresh water forms. Involvement ranges from the aquarist, who maintains aquatic animal facilities, to the professional veterinarians and biologists, who treat and research aquatic animals. Traditionally, aquatic animals maintained in captive environments have been the focus of this field. Today, with the growing interest in wildlife husbandry, aquaculture, attractions and other commercial interests involving aquatic animals, the scope has, of necessity, been broadened to include the largest ocean mammal to the smallest crustacean. Hence, the field is no longer confined to the practice of medicine, but now encompasses all health disciplines.

In the past decade, legislative restrictions, increasing environmental awareness and greater use of aquatic resources have led to new demands to find solutions for aquatic animal health problems in the natural and confined state. Surprisingly, little discourse, save under informal circumstances, has been published on this subject. Other proceedings have typically been concerned with technical subjects, and have not documented the trends and philosophies. It appears as though these divergent disciplines need a forum for establishing lines of communication so they may facilitate research and health treatment priorities.

We hope these proceedings document this need and set the basis for such a forum through encouraging further discussion and action. These proceedings were designed not to judge nor to recommend. They report the attitudes, opinions and recommendations of the participants on the present state of the aquatic animal health field, and not necessarily a concensus of their opinions.

Topics were selected to cover the many facets of this diversified subject. The speakers were chosen on the basis of their reputation and experience in the selected area. The diversity of the conferees' experiences ranged through practicing veterinarians, researchers, naturalists, aquaculturists, businessmen, government officials, industry representatives and students. Through the statements and the observations made in Sections II, III, IV and V, the reader should be able to develop an awareness of the concerns, as outlined in the keynote address and the summary.

For a brief moment in time some looked beyond the limits of their own discipline and the state of their professional interest. We hope the readers, too, will perceive the extent of the aquatic animal health field and its problems, before returning to their own. It will be interesting to compare the concerns herein after a decade has passed.

The editors gratefully acknowledge those individuals and organizations who helped make this conference possible. We especially appreciate

the support of Florida Sea Grant, Florida Cooperative Extension Service Marine Advisory Program, the International Association for Aquatic Animal Medicine, Marineland, Inc., and the Whitney Marine Research Laboratory. Of particular assistance were Dr. Hugh Popenoe, Dr. Marion Clarke, Dr. William Seaman, Dr. John Gratzek, Dr. Richard Stroud, Dr. Murray Dailey, and Mr. Cliff Townsend. Our thanks to Ms. Joan Hersey for preparing the final copy for publication. Finally, a special note of appreciation to Ms. Julie Walker for her vitality in helping to organize both the Conference and these Proceedings.

Robert L. Jenkins
Joseph G. Halusky

January 1980

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Joseph G. Halusky is the Extension marine agent for Northeast Florida.

INTRODUCTION

William Seaman

The first portion of the International Association for Aquatic Animal Medicine Tenth Annual Conference was devoted to the presentation of technical papers. This overview co-sponsored by Florida Sea Grant and the International Association for Aquatic Animal Medicine will be a complement to it. We will step back from discussing highly technical things and look at some broad topics in this field.

Sea Grant encourages such overview, or "State of the Art," workshops to determine what is happening nationally in a variety of marine-related fields. Questions are asked as: who is working in aquatic medicine? how do differing programs merge and share information? how is duplication of effort avoided? and, who funds and sets priorities for aquatic animal medicine research?

Nationally, there are 26 Sea Grant programs capable of supporting meaningful activities which relate to aquatic animal medicine. The public law that created Sea Grant mandated that it "promote the wise use of all marine resources through research, education and advisory services." In generating such applied programs one must consider the needs of people interested in healthy aquatic animals. Those who live, work and play in the coastal zone ultimately affect the health of the aquatic environment. Therefore, many of our programs have approached the development of healthy aquatic animals through projects in estuarine management, coastal policy, fisheries research, aquaculture and advisory services.

Sea Grant was the "middle man" at this conference. You, the participant and reader, will be the real beneficiary from what has been learned here. You may assess some old priorities and establish some new ideas. You may even find funding sources which will enable you to pick up on priorities that have been identified.

Florida Sea Grant is enthusiastic about joining with the International Association for Aquatic Animal Medicine in co-sponsoring this first-ever conference. I trust it will help to unify and establish new directions for both the profession and the industry.

SECTION I: KEYNOTE ADDRESS

REFLECTIONS FOR THE FUTURE

Fred P. Meyer

I consider it both an honor and a privilege to be invited to address this particular conference. I appear before you with a variety of emotions. You see, a number of years ago I inquired about possible membership in this distinguished organization and was informed that I was not qualified -- perhaps after I conclude my remarks, you will understand why.

The letterhead on your official stationery bears the IAAAM logo -- very artistically presented in the form of five fish -- fish, if you will -- and yet, much of the practice of your membership deals more with aquatic mammals than it does with fish. What an interesting paradox! I asked a number of you who your organization served and more than one or two of you referred to yourselves as "born again dolphin chasers." That is interesting, especially since you have fish so prominently displayed on your logo. However, the chairman of this session informed me that it is not five fish but rather one copepod, three fish and one octopus. I'd say that that is even worse. Where the devil are the dolphins? I shall say more about this later.

As keynote speaker, I feel free to assume considerable license to meddle, interfere and intrude into domain that might otherwise be off limits to me. Throughout my deliberations in the areas I might address, it struck me that the name of your group might more appropriately be the "International Association of Aquatic Animal Health," rather than of aquatic animal medicine. Medicine implies the healing arts as practiced only by physicians and veterinarians. To a certain degree that is true, but you are not that kind of a group. You are a health oriented group. I offer to you that you should be the IAAAH, and I suggest such a change for your consideration.

Aquaculture, zoological preserves, parks and gardens, aquariums, fish farming, mariculture, fishery resources, and wildlife resources all involve aquatic animal health problems -- medicine problems, if you wish, but you are really talking about health. Medicines such as chemicals and drugs are used to correct errors of management. I have believed this all my life and throughout my career in fish disease work. I have heard nothing here in the past few days that changes my mind. This broad spectrum of private, state and federal activities spans the world. Included are such diverse animals as killer whales, seals, salmon, catfish, shrimp, oysters, pet fish, sea urchins and a host of others.

It is no wonder, then, that health services to the aquatic animal field are being provided from a variety of sources. In some areas, such service is provided by self-taught individuals lacking formal academic

training, but who, because of their long experience and close involvement with a given species, are considered to be authorities. Other areas have traditionally been serviced by veterinarians. All sorts of variations in credentials are found between these extremes. I have heard, to my dismay, parochial remarks to the effect that "they should not be doing so" or "get those guys out." At the present time, such an attitude is unwarranted. The IAAAM is an organization dedicated to the provision of health services, not just the practice of medicine.

When the various cultural or husbandry fields first began, trained and qualified expertise in the related health field simply was not available. There were no formal avenues through which academic and professional training could be obtained. Furthermore, the potential income from a private veterinary practice in subject areas was nonexistent so there was no impetus for Colleges of Veterinary Medicine to initiate and develop curricula that would train servicing professionals. To a significant degree, this situation unfortunately persists to this day, even though significant industries now exist in aquaculture.

As an example, consider my own situation. I chose fish health as my career field and set out to become trained for such work. My undergraduate training was in Biology with emphasis on a Pre-Med program. My graduate degrees are in Zoology with major emphasis on parasitology, having fishery biology and veterinary pathology as minor areas. My search (in 1956) for an appropriate school led me to Iowa State University because of existing strong programs in parasitology, fisheries, and veterinary science. Even so, a degree in fish health, per se, did not exist. It was only after much negotiation with the Dean of the Graduate College, the Deans of the various colleges and the involved department heads that I was allowed to put together a graduate program that would prepare me for the work I wished to do. Although I finally achieved the training I sought, my degrees were designated to be in parasitology, not fish health.

In addition to the administrative hurdles, my own graduate committee was concerned as to where I would find employment or establish a practice. Their concerns were well founded. Fortunately, at the time I received my degree the U.S. Fish and Wildlife Service was seeking a trained individual to develop a program of research in fish health at a new fish farming experiment station in Arkansas. That was to be the only professional fish health position to open in the next several years. During that time period, a few fish health positions in existence were at Leetown, West Virginia and Seattle, Washington -- both federal fish health laboratories. Like myself, the professionals at those stations had put together their own specialized training program in order to equip themselves for a career in fish health.

A similar situation existed at many zoos. Veterinary services were available if the animal species involved was one of the large herbivores. Exotic species, such as bears, turtles, snakes, and even monkeys, would not be considered by local veterinarians. You can realize how desperate the curator of the zoo in Little Rock, Arkansas had become when he called my laboratory to see if I would help him with disease problems among his

snake population. He had successively been turned down by local veterinarians, the State Animal Health Laboratory, the University of Arkansas Medical College and local physicians. There simply were no trained people available.

Professionals in aquatic animal health were few and far between -- and still are. The scientific meetings we attended and our membership in societies reflected related fields in microbiology, parasitology, zoology, human or veterinary medicine, fishery biology of wildlife biology. Usually, less than a dozen scientists interested in aquatic animal health of any area would be present at a given conference. Although we often presented papers at scientific meetings, we generally were speaking only to each other. Disease in aquatic animals was recognized as a problem but was largely ignored by the rest of the research community.

Initially, growth in the aquatic animal health field was slow -- so slow that some of us wondered if our field of scientific endeavor would ever be recognized. Perhaps aquatic animal health specialists were, in the words of the late Asa Chandler, " . . . like orchids, requiring long and careful nuturing, being slow to develop, but when they come to flower, they are rare and beautiful, scientifically speaking, and usually slow in going to seed."

Since the late 1950's, the situation has changed. Aquatic animal health has attracted top quality scientists in bacteriology, virology, parasitology, veterinary medicine, physiology, epidemiology and a host of other fields. As the interest and numbers grew, the seeds of professional organizations related to the several aspects of aquatic animal health were planted.

The IAAAM was formed in 1968 and embraced primarily specialists in zoological parks, zoos and related areas. At the outset, only DVM's (veterinarians) were accepted for membership. I am pleased to learn that this has recently been changed to permit membership by non-DVM's, if they are contributors to the field of aquatic animal medicine.

At approximately the time the IAAAM formed, fish health specialists were holding informal workshops around the country, where attempts were being made to organize their own professional group related to diseases of freshwater fishes. The Fish Health Section of the American Fisheries Society was formed in 1971. Membership required that potential members also belong to the American Fisheries Society. This requirement has become a significant stumbling block to development of the broad base of scientific expertise that should be reflected in the Fish Health Section. Efforts are under way to have this requirement removed.

Look around yourself today -- we've come a long way, baby!! In less than 20 years, professional organizations, such as IAAAM, now exist in relation to the several areas of interest. This organization and the Fish Health Section include several hundred names on their membership rolls who represent top expertise in their fields. Also, a number of

colleges and universities now offer courses related to aquatic animal health. Thus, the picture is rosier than ever before -- or is it?

It is understandable that original efforts toward organizing professional groups followed narrow, highly specialized interests. The time has come for a re-evaluation of the limits set when the several organizations were formed. The need for chemical and drug registrations for the specialized uses in aquatic animal health requires closer coordination between the several fields of use. Likewise, the relationship of aquatic animal health practices to federal and state Veterinary Practices Acts should be clarified.

Unfortunately, the very growth that fostered increased professional specialization has also created greater separations between aquatic animal health professionals. Your own IAAAM limited its membership to licensed DVM's, while the Fish Health Section required that its members also belong to the American Fisheries Society. Instead of a decrease in parochialism as the field of aquatic animal health grew, sharper demarcation and greater separation seem to have developed. It is time to put aside such isolationism; time to take full advantage of the expertise found among our colleagues; and time to overhaul the academic and bureaucratic barriers to the practice of aquatic animal health. All factions of aquatic animal health are involved, and probably equally guilty.

I have advocated for a number of years the broadening of curricula at universities and veterinary colleges to offer degree options in the fish health field. Only in the last two years has there been any indication that the concept may be realized. At the University of Georgia, veterinary students now have an option to include fish physiology, fish diseases and fish culture in their DVM program. Conversely, students in fish and wildlife management are permitted to enroll in selected courses at the veterinary college. To a lesser degree, exchanges and interactions of a similar nature are developing on several other campuses. I would hope that wildlife biology and veterinary medicine are working along similar lines. This sort of interaction can be accomplished with no increases in staff and no increases in budget, and yet would result in a distinct broadening of the curriculum if we will just remove some of the parochial lines that we have traditionally set.

Desirable as such developments and cross-fertilization may be, the situation is not without pitfalls. The potential for establishing a successful veterinary practice based solely on aquatic animal health is minimal at this time -- even if there were no federal, state or university services available. I have every confidence that the foreseeable future will provide opportunities for such a career, but it is still some time away.

On the other hand, non-DVM students who attempt to pursue a career in aquatic animal health may find themselves disenfranchsed by existing laws and regulations. Federal and state Veterinary Practices Acts clearly include aquatic animal health within their domain. If the laws were to be rigidly enforced, nearly all of the present fish health specialists and

many of the other aquatic animal health specialists would be enjoined from activities in diagnosis and treatment.

Professionals in aquatic animal health can thus be caught in a no-man's land between constraints, lack of adequate curricula to become trained and the lack of financial remuneration, despite the fact that they are probably the most qualified people to practice aquatic animal health. Currently-licensed veterinarians did not have opportunities when they were in school to study the peculiarities of fish anatomy and physiology, nor the unique environmental requirements of fish, nor the opportunity to learn about the culture systems required by the various types of fish and crustaceans. Veterinarians, merely because they hold the legal franchise, should not expect their fishery clients to bear the expense of mistakes made while they gain the experience and knowledge to satisfactorily treat aquatic animals. This deficiency, coupled with the lack of financial reward, has caused veterinarians throughout the country to be reluctant to become involved in fish health. Conversely, the parasitologists, virologists, bacteriologists and fishery biologists who have developed a special expertise in fish health could legally be denied the opportunity to provide the needed services.

While I have little knowledge about aquatic mammals, the same may be true regarding the physiologists, virologists, etc. who work in that field. Thus, we are caught in a situation where there is nothing to justify a veterinarian for putting his professional stature on the line when he can't get paid for doing so. On the other hand, people qualified to provide the needed service can be legally enjoined from doing so. A "Catch-22" situation exists. In the meantime, the aquaculture industry is crying for service but cannot afford to pay for it. I think that eventually the time will come when fees can be charged which will warrant veterinary service. In the meantime, a way must be found to answer the need.

What can be done to resolve these impasses? Certainly, this is not a time for isolationism or parochialism. All professionals, DVM's and non-DVM's alike, have much to contribute to the advancement of aquatic animal health. None of the papers presented here were out of place, whether they were on the anatomy of the retina of the dolphin, the treatment of mycotic diseases of turtles or diseases of fish. To me, they all belonged, and contributed to our professional growth. The need for exchanges of data is greater than ever before -- not just from a health services standpoint, but from many other standpoints. The requirement that all drugs and chemicals used on animals produced for food, or otherwise applied in aquatic environments, be property registered involves expensive and lengthy research efforts. It is imperative that duplication in research be avoided, and that the greatest use of generated data be provided. You heard Dr. Hewitt of the FDA say that their new philosophy on minor uses and minor species will allow the extrapolation of data back and forth between related species. This certainly should be encouraged at all levels, whether it be bacteria of dolphins, bacteria of crabs or bacteria of fish. We ought to be taking a look at how we do our research, how we can interact and how we can conduct the required studies in concert rather than along parallel lines.

Colleges, universities and veterinary colleges should explore ways to broaden their curricula to provide options to add aquatic animal health training in both DVM and graduate degree programs. In many cases, a degree in Aquatic Animal Health or a DVM with an Aquatic Animal Health specialization should be possible without the need for increasing faculty or budgets. I offer the program at the University of Georgia as an example of a start in this direction.

The questions of the apparent legal status of non-DVM aquatic animal health specialists must be resolved. Some years ago, I became involved in efforts to resolve this thorny question. Dr. Richard Stroud, your President-Elect, was then a student at Oregon State University and was involved in those same efforts. Initially, we were at the forefront of the two opposing forces, but eventually joined sides and pursued this problem at length. Dr. Stroud headed a committee who canvassed every state veterinary organization. The committee asked: (1) "Does the problem of non-licensed health specialists exist in your state?"; (2) "Are people who are practicing fish health in violation of the state Veterinary Practices Act?"; and 3) "What do you think should be done to resolve this problem?" I personally contacted the deans of veterinary colleges and presidents of state chapters of the AVMA (American Veterinary Medical Association) in 11 states seeking opinions, advice and counsel on how the problem could be resolved. Some respondents quoted chapter and verse of the Veterinary Practices Act; namely, "read the code to them, and get the Attorney General to prohibit such practices." Others said their state was indifferent and ignored the aquatic animal health field. A few, like the Dean of the Veterinary College at Purdue University, had sound, constructive suggestions. He suggested that states might issue temporary waivers of their veterinary Practices Act to qualified aquatic animal health specialists. Such waivers could be limited to perhaps five years, and given only to qualified individuals who were certified by a board of professional examiners. At such a time when DVM services were available, further issuance of waivers would cease. To me, this seems to be a rational, logical solution to the problem.

In response to requests from state fishery agencies for the identification of qualified personnel to perform inspections and to certify fish stocks as free of designated diseases, the fish health section developed and put into practice a certification program for such individuals. This is a rigorous program in which over 50% of the applicants have not passed. Although some complain that requirements are too rigorous, it is a very sound program. A similar professional certification procedure to develop certification of diagnostic and treatment capability is also being promulgated. If the latter program proves viable, it could provide a mechanism under which temporary waivers to the Veterinary Practices Act might be granted to certified aquatic animal health specialists.

The concept of closer coordination and possible integration of the aquatic animal sciences and veterinary programs should not be taken lightly or ignored. A recent survey entitled the Arthur J. Lyttle Report (1977) predicted a 20% overage in the number of trained veterinarians as compared to the anticipated openings. If this proves true, aquatic animal health may be a viable field for the excess students to consider.

In my opinion, professionals in the fish health field would not object to the assumption of fish health responsibilities by DVM's, if curricula were developed to provide for their proper training in the fish health field. Much of the concern I have heard from fish health specialists centers not on the ability of DVM's to diagnose and prescribe, but rather on their lack of knowledge and understanding of the significance and implications of the many environmental variables that affect the safety and efficacy of fish disease treatments. While some workers may fear disenfranchisement, it would see that only a summary action prohibiting their involvement would concern the majority of present fish health professionals.

This invitation to address the IAAAM conference, in my opinion, represents an important first step toward the sharing of data and knowledge of common interest, and toward bringing together researchers in the aquatic animal health field. It seems that the time is right to propose a national or international meeting in 1980 or 1981 at which all facets of aquatic animal health would be represented. The IAAAM, the Fish Health Section, the World Mariculture Society, the Wildlife Disease Association, the Fish Culture Section and perhaps others in microbiology, parasitology and virology might be interested in participation in such a meeting.

I compliment you on the successes that have been achieved, and on the very fine meeting you have had. I look forward to a mutually beneficial and exciting future through scientific interaction in aquatic animal health.

SECTION II: SELECTED VIEWPOINTS

THE BUSINESS MANAGEMENT AND ECONOMICS OF AQUATIC ANIMAL INDUSTRIES

Louis Garibaldi

This topic was awkwardly defined as a discussion of the issues faced by administrators of aquatic businesses, which rely upon aquatic animal medicine, with regard to personnel training, public relations, facilities and overall organization. In preparing to make this presentation I found it not exactly clear at all what the issues of the needs are. In fact it appears to me after some review, discussion and consideration that the major problem lies in the fact that the issues related to this topic have not been identified. Furthermore, by the end of this presentation they most probably will still be unclear.

I think before we try to identify issues we should start with a definition of terms for the sake of this presentation. Medicine, according to one of the definitions in the Webster Dictionary, is the science and art of preventing, alleviating or curing the disease. It is this definition which we will use in connection with the term "Aquatic Animal Medicine," which is then interpreted as the science and art of preventing, alleviating or curing the diseases of aquatic animals.

The International Association for Aquatic Animal Medicine is a very diverse group of individuals, of many different disciplines, representing many aquatic related industries and institutions. The one critical uniting factor is the medium in which we work, rather than a common academic training. Preventing, alleviating or curing the diseases of dolphins, penguins, turtles, guppies or lobsters, regardless of how diverse and unrelated, can be referred to as aquatic animal medicine. For the sake of this discussion and utilizing the definition from Webster, we shall refer to those who administer medicine in a wide spectrum, including but not limited to the professionally trained veterinarian and the professionally trained fisheries biologist, as well as the front line personnel at many institutions who have no formal training in medicine or graduate training in biology, but in fact do "administer" medicine to a great variety of organisms. Therefore, in our amorphous, so-called industry, medicine can be referred to as not only the formal practice and administration of medicine, but also to all aspects of environmental manipulation which is accomplished to the end of alleviating or curing disease as well. On top of all this discussion to identify the "who" in aquatic animal medicine, we must recognize that this so-called "industry" to which we refer ranges from multimillion dollar corporations down to backyard fish production ponds.

One of the problems that has been suggested is management's inability to procure adequately trained people. However, before we can discuss solutions for that problem we must identify the need. What type of "adequately trained people" are needed?

As in many other livestock businesses, a major factor in management's decisions relative to "medical therapy" activities is one of economics. This extends not only to the form or method of therapy, or whether to treat at all, but also to the hiring of professional personnel. There are very few aquatic businesses, for instance, that can afford the full-time services of a veterinarian, and in many others there is even little consideration given to hiring a trained zoologist. Historically, the requirements of many small facilities have been satisfied by an individual with good common sense, who learned by trial and error and self instruction within the system, thus acquiring much undocumented and often proprietary knowledge from experience on the job.

In-house training of front line staff rather than a formal education appears to be the rule rather than the exception. Even at major aquariums, the animal personnel that are hired frequently have only a basic education. They begin at entry level positions; if they show potential during their in-house training they are brought along in the system and may eventually attain managerial levels.

As in so many other industries, we must recognize that apprenticeship programs are vital to producing personnel knowledgeable in not only the academic but also the practical aspects of aquatic animal medicine. In some areas of the country, there are cooperative education programs between universities and businesses that allow undergraduates an opportunity to gain this vital experience. Such programs should be encouraged in the aquatic animal industries.

One of the corollary problems related to this may be the need to educate management as to the economic value of qualified personnel relative to the medical needs of aquatic animals. The managers of many ornamental fish farms, for instance, have begun to recognize how a program run by biologically oriented, well trained people can help to increase productivity, reduce mortality and thereby increase profits. Through a process of educating management as to the benefits, we may begin to see better educated and trained people on the production line.

The problem of proprietary knowledge will always be a touchy area. However, where animal health is a question there has been an evolution toward a more open sharing within the industry, between individuals, and especially at meetings and conferences such as the IAAAM's.

Proper facilities for aquatic organisms are essential to maintaining good health. There is a constant need for research into the design of facilities to fullfil the requirements of the many varied animals we keep for a variety of purposes. Good husbandry, as we all realize, is at the roots of preventive medicine. Public aquariums have spent a considerable amount of money on the design of new facilities to accommodate animals for display to their visitors.

There has been a considerable amount of money expended relative to the design and operation of fish hatchery facilities by the federal government. There has also been much support provided to the growing fish farm industry from state funded institutions. More research is needed in the areas of marine fish culture facilities, disease control, and especially in the area of ornamental fish, as demonstrated by the requests of the tropical fish industry in Florida. The aquatic animal industries are looking for guidance and assistance in these areas.

When does public relations become an issue facing management with regard to aquatic attractions and institutions? These facilities are usually under close scrutiny by the public eye. People often relate to individual specimens much the same as to their own pet. They will frequently spend $25.00 to save a $0.10 goldfish, and expect our institutions to do the same. Here public relations is required to educate the public that, in many cases, it is best for all, especially the suffering animal, that euthanasia be performed. In the majority of medical application cases, there are good public relations opportunities, as stranding programs. Exhibits of rehabilitated marine mammals by major aquariums and oceanariums, and promoting the public awareness of these programs have developed very positive public relations. This is a good example of where an economically unsound activity has very beneficial public relations aspects to go along with the benefits of research opportunities into the overall disease process.

In discussions with colleagues, I have received an impression that one of the biggest needs of management relative to aquatic animal medicine is served at conferences like the IAAAM's. People in management, regardless of their affiliation in medical fields, come to such meetings to learn the "state of the art" -- so they may know what is available relative to medical assistance for their animals. The primary feedback from this is the need for far greater dissemination of information. There is a tremendous amount of work being conducted in the fields of fish, mammal, and invertebrate medicine at various universities, many of them Sea Grant institutions. In addition, there is a large amount of work going on in both private and public institutions. Unfortunately, the collation, dissemination and availability of this information is not always the best. There is a large quantity of data being published, which few institutions can afford to subscribe. The abstracting services available are helpful; however, there is strong opinion that the collation of papers dealing with aquatic animal medicine would be a major service.

There is need for continued research, and I think that management, as well as the practitioner, in some cases needs to provide the direction for the research. Management needs to inform the researcher what are the major problems. This is difficult because there will be different priorities. So, these priorities need to be boiled down and defined as to what are the research needs relative to fish farming, aquariums and the other aquatic related activities. The IAAAM provides a format for individuals through our annual conference. It has been a tremendous asset to management to

know that its staff has at their disposal a large group of professionals with a broad and vast experience that can be used in a cooperative aspect.

The cooperation that has been experienced in many of the aquatic industries over the past ten years needs to be continued and amplified. We still have some people who are working on a day to day basis in this field who do not communicate. Communication is necessary for the professional to keep up with, and contribute to, the state of the art. What is needed is a continued commitment from all persons in the industry both to communicate and to cooperate.

LEGAL AND POLITICAL ISSUES WHICH AFFECT THE AQUATIC ANIMAL MEDICINE INDUSTRY

George E. Steele

We were recently shocked to learn that a renewal of our lease for office space in Washington, D.C. would cost us 45% more than we are currently paying. Much to our dismay, a quick survey of office space availability in Washington and current prices showed that our landlord was not out of line in his rent increase. The problem in Washington is not the cost of space but finding it.

You might well ask why so many people, so many professionals want to move to Washington, D.C. While it is a beautiful city, all of you who have visited us in Washington know that there are many areas in this country that are much more desirable.

The office space problem in Washington, D.C. is just another indicator that more and more professional and corporate leaders are reluctantly coming to the conclusion that their destiny as well as the day-to-day operation of their business or professional practice is becoming controlled from Washington, D.C. There was a time when only big business, big labor and large national organizations felt the necessity for a continued Washington presence. Oh! How times have changed! How many of you here today have really seriously inventoried the restrictions, the control that is manifested by Washington bureaucracy over your professional practice, and in many instances even your professional judgments?

Historically, many of us have been guilty of overgeneralizing as to the cause of our growing problems in Washington, D.C. We have oversimplified our criticisms by simply making only the government bureaucrat the scapegoat -- the fall guy for our Washington problems. This is not to say that in many instances it is the apathy, the inefficiency or lack of knowledge of the real world by individual bureaucrats that has caused

many of our problems. Fairness and equity demand that we look behind the scenes before, in many instances, we can really understand why bureaucrats do what they do, require unreasonable and redundant paperwork, and hand down decisions which you know are not based on good veterinary medicine and experience.

Much of the blame for many of the growing problems which face us in Washington must be laid squarely in the hands of the Congress. It appears that every day Congress becomes less willing to "bite the bullet" -- less willing to pass definitive legislation. Rather than face the hard decisions and express the courage of their convictions, more and more members of Congress would rather pass on the difficult decisions to the courts or to the individual regulators within the bureaucracy.

The Marine Mammal Protection Act is perhaps one of the best examples of congressional unwillingness to enunciate a clear, consistent and enforceable policy. One top congressional staffer called the Marine Mammal Protection Act "a lawyers' welfare act." It is a classic example of an ambiguous statute that seeks to partially please all parties of interest with the unfortunate victim being the very animals that the act purports to protect. Our friends in the bureaucracy find themselves immersed in a quagmire of conflicting pressures and interpretations. They must contend with the decisions of the courts, pressures of environmental groups, the needs and desires of the public display community, and the physical and biological requirements of the species involved. Unfortunately, as some members of this organization know, the physical and biological requirements of the animals have sometimes taken a back seat to the political and legal decisions which in some instances have even resulted in the needless death of animals.

For over three years, we have been trying to promulgate standards for the capture, transportation and maintenance of marine mammals. First of all it took over a year to get the Departments of Agriculture, Interior and Commerce to agree as to which agency should take the lead role in promulgating such standards. The Department of Agriculture has had the responsibility now for almost three years. Agriculture has held public hearings from coast to coast, received volumes of comments and suggestions from some of the finest veterinary and curatorial minds in the country, and legal and drafting services that could fill volumes. We have yet to receive the final proposed standards. (Eds. Note: these standards became effective September 20, 1979.) The bottom line as to why it has taken the Department of Agriculture so long to promulgate the standards is simply that the lawyers of the Department were more interested in securing regulations that could be absolutely enforceable than they were in drafting regulations that reflected the latest state of the art in the care, treatment and maintenance of marine mammals. However, in defense of the lawyers, we must recognize that Agriculture has been severely criticized by certain environmental groups and members of Congess for not writing black and white regulations so as to insure convictions in the various courts of the country.

I am sure that all of you would agree that it is virtually impossible to write regulations governing the best care and maintenance of any animal

without affording maximum input and the ultimate final decision to the attending veterinarian who is on the scene and knows better than anyone else the best procedures for a particular animal in a given situation. Unfortunately, there are some very influential people in Washington who have publicly questioned whether a veterinarian can be trusted to place his professional concern for an animal's welfare over the orders of the client that pays him. Not only has this lack of trust of the professional veterinarian been expressed in public hearings before Congress, it has even been incorporated in regulations. Until recently, for example, a veterinarian employed by an oceanarium could not sign off as to the adequacy of the facilities and animal care of an institution by which he was employed -- the clear inference being that the veterinarian lacked the professional integrity to place the best care of the animals above possible monetary concerns of his clients or employer.

Then there is the Endangered Species Act. I am sure that none of us questions the need and desirability for an effective program and law to protect species of wildlife from becoming extinct or endangered. Once again, however, we have seen that emotion and politics, rather than reason and fact, have prevailed and in many instances endangered species have become endangered as a result of a poorly written statute which obviously cared more for man and the body politic than the animals which desperately need protection. For example, we find it incredible that under the Endangered Species Act, if the Bronx in New York wishes to secure an endangered species from the San Diego Zoo in California for propagation purposes they must obtain a special permit which can take from 60 to 120 days and requires a detailed application; whereas, within the boundaries of any state, any institution or individual can give, sell or transfer any endangered species to another institution or individual without permits or restrictions. Once again, for over three years we have brought every conceivable pressure on the Department of Interior to simplify the exchange of captive-bred endangered species between and among qualified zoological institutions so as to enhance propagation of endangered species. We have been promised that these new regulations will be forthcoming within the next 60 days; however, we have heard that same story many times before.

We are all anxiously awaiting the release of a recently completed study by the U.S. General Accounting Office (GAO) on the Endangered Species Program. During the course of Reauthorization Hearings on the Endangered Species Act just last week, a GAO representative referred to the soon to be issued report, wherein he referred to the Endangered Species Program as "a complex, emotional environmental issue, deliberated and acted on by the 95th Congress."

The GAO representative told the House Committee that the study of his agency indicates that the Department of Interior suffers from "severe management problems." (I hope they didn't spend too much of our taxpayers' money determining this, because many of us could have documented this fact rather easily.) He went on to say that the GAO analysis of the Endangered Species Program indicates that it presently: (1) jeopardizes the existence

of some endangered and threatened species resulting in the possible extinction of others; (2) creates unnecessary conflicts between endangered and threatened species and federal, state and private projects; (3) delays Section 7 consultations with federal agencies to resolve conflicts; and (4) hinders efforts to protect and recover endangered and threatened species. Needless to say, once again I am sure the GAO report will result in additional expenditures of hundreds of man hours and thousands of dollars in efforts to resolve the political, emotional and factual conflicts -- many of which should have been settled by Congress when they passed the original act.

Time will not permit me to further address the topic assigned, "the Legal and Political Issues Which Affect the Aquatic Animal Medicine Industry." However, I hope I have given you some indication that these legal and political issues are many and complex, and that there is literally no end in sight to their impact either on you as a professional, or the health care of the animals to which you are so dedicated.

THE PROFESSIONALS IN AQUATIC ANIMAL MEDICINE

J. C. Sweeney

We are all certainly professionals in the area of concern that brought us here. I suppose, ultimately, we are all responsible and accountable in the legal sense, and although there are within our universities now certain programs which are designed to educate students in the various expertises, it is still the responsibility of this group (the IAAAM) alone to create that knowledge and expertise. So it becomes very important that the learning continues here and that we need to bring it forward here.

But the questions that I am addressing (as I am in a private practice now and need to make a living) are where are we going in this field, where is it leading us, and where should we be directing our primary effort in this field of aquatic animal medicine? I think we all know now that with the current onslaught of new veterinary schools, the arena in small animal medicine is going to be plugged, with the demand for veterinarians being used up. And there will be a resulting pressure for diversification of veterinarians within the field. That means going into new areas, and I think a lot of thrust will be applied to aquatic animal medicine. Certainly there is a lot of interest from students, both pre-vet and vet, in this area. The problem is: where are they going to go? Speaking primarily as a mammal person up to now, we have the tools, even in the marine mammal field, to divest our knowledge, experience and expertise into a variety of areas within the

aquatic animal field. Not just in mammals but into other areas, fishes as well. Certainly we need to make a living; it can't be done for free, and if we are going to enter this area of aquatic animal medicine in a large way there has got to be a market for it.

In this sense, if we are going to make it, it is important that we have some affiliate body for support. At the present many of us are affiliated with a university, or an existing practice, so we can make a living while we are entering the field. But I think we need to explore new areas. With the students in my area of the country, and in speaking at various schools, I have found a lot of interest in marine mammals. Certainly, this organization began as primarily a marine mammal organization. And yet, frankly, I do not see much happening in this field. There are more and more part-time consultant veterinarians, and when you really think of how many job opportunities do come along, with existing practitioners absorbing what positions do become available, I do not see much opportunity left in the marine mammal field. So, when we go to the veterinary school and university and inspire students in the area of aquatic animal medicine, I feel some guilt in allowing their interest to be turned toward the area of marine mammals. The point being, I think, that it is time for the aquatic animal veterinarian, or veterinarians in general, to explore and create the field, in a sense, in the area of fish medicine.

Fish medicine has evolved in a manner similar to the way in which avian medicine has been evolving for a long time. That is, the primary disease person in fish medicine is the fish culturist. At some point we are going to need to realize our responsibility to enter the field of fish medicine. Certainly the protein conversion factors in fish are going to lead this country, as has happened in other countries, into fish culture, and fish will become more important as a protein source. If we do not "jump onto the bandwagon now" and get into fish medicine, we will miss a "big bet." As we inspire students into the area of aquatic animal medicine, it has got to be in the area of fish disease work, because this is where opportunities are going to happen in the next ten or fifteen years.

When I accepted the idea of giving this presentation, I was ill-defined about the nature of the talk. So I sent around a questionnaire to some of the oceanariums, in fact all oceanariums housing cetaceans. I was interested at that time in assaying the field for a feel for (1) how we as professionals are doing and (2) where the field is going. Now I was looking primarily in the area of marine mammals, and it was just recently that I decided to expand the talk into the area of fish as well. I assayed the feeling by management for what is happening in the veterinary profession.

Briefly, the results of the questionnaire showed the following. Twenty-six questionnaires were sent out and I received twelve in reply. Interestingly, most of the twelve were from the smaller oceanariums. There were eight returns from profit organizations, with four from nonprofit organizations. There were slightly more returns from facilities with more than 20

animals. The first question addressed their relative satisfaction with their medical program; all answered that they were satisfied. Nearly all employed part-time veterinarians, so it is obvious that one veterinarian can go a long way, in some respects at least. This was true for both profit and non-profit organizations.

Most replied that their veterinary service was satisfactory, with a few replying that it was very satisfactory. I was interested in the concept of the paramedic, and how many institutions may be using such individuals to perform the major day to day functions versus having a veterinarian perform that function. Slightly more than half currently hire paramedics, thereby leaving the advisory capacity to the veterinarian. About as many felt that this was an important program.

In asking what direction these facilities/research institutions were heading, I tried to solicit comments from them as to whether or not we can look to the future for a more prosperous industry. Or, are things, as they appear, now in a fairly static position. I feel that research ongoing in these facilities might be an indicator for some of the vitality that was expressed by these oceanariums. As it turns out, many of these facilities housing cetaceans were now in fact conducting research. In less than half, however, the primary research person was a veterinarian. Most were soliciting research help from the outside. Interestingly enough, I found that very few of the oceanariums replying had received funding from the outside. Most were supporting their own research with most of the research not finding its way into publication.

There is a dire need at this time for some funding boost in the area of marine mammal research; it is difficult to get funds. The marine mammal commission has provided some funds to this time, but these funds are, it seems, dwindling, and it is getting more and more difficult to channel those funds into medical research.

Perhaps, if Sea Grant is going to become involved in the area of aquatics, this is an area that needs thrust and energy. If not in the area of marine mammal medicine, then certainly and most importantly in the area of fish medicine. I was interested if facilities would make their animals available for research, and most replied that they would. In the area of reproduction (because of the current interest and I think that this is an area of certain vitality in the oceanariums) most of the answering facilities replied that they were interested in reproduction; that they had reproducing animals on the facility and most were willing to make their animals available for trade and transfer for reproductive purposes. This is an area that we haven't explored in the marine mammal business. There has been some interest and something we can perhaps get into: that is trading animals for better and more successful reproduction.

In terms of facility expansion, certainly if there are going to be more veterinarians employed in the marine mammal area we are going to have to expand and multiply the facilities that use veterinary services. I found that most of the facilities that replied, especially the small

ones, indicated that they were expanding their facilities, but very few were expanding their facilities outside the current physical plant. So I see very little indication, at least in the marine mammal business, that there is going to be much more in the future than there is right now. Most of the facilities were applying for marine mammal permits, and so are obtaining more animals at their local sites.

Well, where does it all get us? I think what this is leading into is that the thrust of our interest now, as we are bringing along students, is into the area of fish medicine. I am currently developing an interest in that myself. But I am not sure, frankly, if there is a profitable business to be made in fish medicine. We need to explore and develop it. I know from what contact I have had with some of the fish culturists that yes, they need help; but much of the help is coming from biologists and university extensions. When you query them about whether or not they are willing to pay for the help, most say that they are not. (And let's face it, we are not in the business of this industry for free. You have got to support the industry with some funds.) The university extensions cannot handle the whole field, so we need to explore this potential.

In the area of exotic fish, I am not sure that the situation is any more encouraging right now. Having dealt somewhat with the large fish importers, they do not want medical services at all. Their whole business at this point is to bring the fish in and get them out as fast as they can. If those fish sit around long enough to need medical attention, they are holding them too long. They push them on and let the problems be absorbed by the next person. The retailer operates in the same mode; move them as quickly as possible so they do not need medical attention.

The need in the industry right now is to educate the public and to educate the industry, both the exotic fish and the aquaculture/mariculture area, of the need for veterinary service. We can increase their productivity and reduce their health problems to the point that what they pay the veterinarian will ultimately be a profit and gain for them. I think this is where the profession needs to go in the future and where much of our academic and intellectual thrust has to be directed.

RESEARCHERS AND THEIR NEEDS

William W. Dawson

In preparing this presentation, my first impulse was to get my leather couch on wheels, bring it in and free-associate on my research

problems for the time allotted. However, when the initial urge passed, I asked myself, "How can I provide some real data in this area?" Subsequently, I established three broad areas to examine. Also, I will attempt to provide tentative answers.

I have constrained my investigation to the general area of basic research, marine mammals and their health in general. The three general areas are:

1. How can we answer the questions "Is this animal healthy?" and "How healthy is he really?" To establish a frame of reference, we used an organization which was recently published by J. E. Saidla (1978) in the Journal of the American Animal Hospital who suggested a comprehensive data base for canine health evaluations and care.

2. What are the main problems of the basic researcher who relates to aquatic animals? Rather than inflict you with my own therapeutic needs, I wrote letters to twenty authors who have published in the general area of marine mammal basic studies in the last five years. These individuals represent workers in the United States, Canada England and Europe.

3. Is there data being published that is easily available on specific diseases, treatments and/or diagnostic problems in marine mammals? If it is available, what quantities are available? The easiest way to solve this is through a computerized search of the National Library of Medicine.

We simulated a harassed basic researcher with a marine mammal health problem and a need for more information. This was done with a senior veterinary student who was allotted one day to compare the available data on marine mammals with the requirements of the data base of Saidla (1978) In Table I, items appropriate for marine animals are listed using Saidla (1978) as a model.

The task of the simulated basic researcher was to seek marine mammal information from the library sources in the main categories considered clinically important (A-M, Table I). Typically, little was available on histories of diseased animals. Nothing was found concerning the general appearance and condition of the integument. Musculoskeletal data was poor. We found a few data sources dealing with the circulatory and respiratory systems. Data on the digestive and genito-urinary areas were not available. Only in the laboratory data area, including blood and chemistries, could we find a mass of data that is readily available and of clinical use. Thus, out of 15 categories identified as clinically important by Saidla, we have approximately 12 applicable areas in which one can find very little information from a library search of reasonable diligence.

In regard to question two, that is, "What are the basic researcher's problems?" I received 16 replies from 20 inquiries. Respondents were

asked to confine their "problems" to a hierarchy of five. I was interested most in hearing just those things that were topmost in their minds. Some of the replies were quite long with respondents apparently taking the opportunity to free-associate. The replies seemed to fall into two basic categories: (1) problems which were animal oriented and (2) problems which were researcher oriented.

Among the animal oriented problems, the respondents indicated that much more information was needed on anesthesia procedures. The present methods, although adequate, are extremely complex, dangerous, difficult to handle, expensive and even a little variable. Tranquilizers and hypnotics are needed for these animals but are very poorly understood although there is new literature available in the Russian language. The secondary pharacological effects upon marine mammals of various compounds and therapeutic agents are poorly understood. More information on simple methods for respiratory assistance was considered very desirable. Among diseases of these animals, it was thought that diagnostic tests for specific disease entities and normative values for various physiological variables were very important. While discussing these, most respondents indicated that there was a great need for improved data collection and dissemination. The "single source" textual material where one could look for answers to health problems does not seem to be available.

Several researchers felt that nutritional requirements should be better established. A very valuable adjunct would be a standard commercially available diet, particularly in terms of the current high cost of food fish for marine mammals. The existing food sources commercially available for feeding marine mammals appear to be relatively unpredictable. Depending upon the individual supplier, the type of food available next month may be quite different from that available this month.

The other category of answers which were received were in the area of research oriented problems. Most researchers, particularly those in England, responded that the financial problems of doing research in marine mammals are great. The few in the United States were somewhat less worried by money. Some comments indicated that the greatest amount of marine mammal research in progress is in the U.S.S.R. For independent researchers in the U.S.S.R., there is no great financial difficulty. There is, then, an ordered sequence (of sorts) of financial difficulty on an international scale. This will be shown later as a correlation with productivity. The second area of difficulty was in the animal collection/procurement area. Many thought that the present situation in the United States and Europe was one of great expense coupled with a serious administrative "overhead" problem. That is a very benign term which really deals with several difficulties relative to federal regulations, paperwork and the difficulties of actually obtaining and maintaining dolphins within a framework of legality. One worker pointed out that even if one has succeeded in obtaining the permit to take and maintain animals in the United States, the problems have only begun. There is a continuing drizzle of paperwork whose requirements change over a period of years and lead to continuing difficulty and confusion. Many of the respondents indicated that they would like to see these simplified if at all possible.

The next response group concerned the maintenance of animals. There was curiosity as to the stressful nature of captive maintenance relative to marine mammal welfare. How is the animal's physiology changed in response to captivity? It was pointed out that the cost of animal reproduction in captivity seems to be prohibitive, yet capture from the wild is also becoming prohibitive. Finally, many researchers stated that they were unhappy with the sincere cooperation of some exhibitors. That is, they felt that recent cost elevation in capture and maintenance has damaged the free access to animals at exhibitions. If marine mammal laboratory research is to survive, there is a need for some centralized, dedicated research facilities where a worker could use animals for research purposes and not presume upon the goodwill of the various commercial exhibitors.

The final question was on the availability of literature dealing with specific disease and research topics. The simplest way to accomplish this was to request a computerized search from the National Library of Medicine, which catalogs internationally all "major" biomedical research publications in the open literature. Our search covered the period between 1965 and 1978. We used the single inclusive term "dolphin." Without question, our sample was not all inclusive, but it was the sample most readily available to a searcher in a major library in the United States. It did not seem to be appropriate to cover widely all marine mammal species. Under "dolphin" in the international literature, we found 121 citations which reflects an average of 9.3 citations per year. It seems that 1965 to 1978 was a poorly productive period. These citations broke out by topic in the following manner (Fig. 1).

Much to our surprise, we found a single publication dealing with a specific disease and/or its treatment. Physiological data were treated as a normative group concept in three publications. The majority of the publications were in sensory physiology, and the balance of that majority was in the area of auditory research. The next most common group of research publications was in brain and complex processes. (These were heavily Russian.) In addition, there were 24 on blood and circulation, eight on respiration, two on muscle, two on skin, two on thermoregulation, six on visceral organs and one on nutrition.

Examining these 121 citations by geographic area of publication produced an interesting comparison (Fig. 2). During this twelve year period, the U.S.S.R. and the United States were the origin of most basic and applied publications on dolphins, but the balance of productivity shifted over the twelve years. This may be seen better in Fig. 3.

Between 1966 and 1970, the productivity in the United States was considerably greater than that in the U.S.S.R. Productivity in the United States increased again between 1971 and 1975; however, the U.S.S.R. increased their output by three fold. Between 1976 and 1978, productivity in the United States dropped to 1/3 of its previous level while productivity in the U.S.S.R. held constant. I find this relative decline in output to be the most frightening aspect of our attempt to

assay the problems of researchers. It verifies that the research problems in the United States are sufficient to affect seriously our productivity on a comparative international level.

In summary, I would like to make three observations. The biomedical data base on marine mammals as readily available to the researcher is scarce with much old data, some dating to 1940.

Researchers have many problems. Happily, many of these can be solved by themselves. The most serious of these, over which the researcher has no control, tend to discourage research. These are cooperation, fiscal support, unnecessary controls and paperwork, and an ever increasing administrative load imposed by the universities and the state and federal governments.

Recently, western hemisphere productivity in "dolphin" research has declined significantly. Many causal factors are involved and some have been identified. A solution may exist in marine mammal research "centers" where the burden of maintenance, capture and administration is shared by several workers. Otherwise, research in this general area may find its place on some "endangered" list.

REFERENCE

1. Saidla, John E. Problem-oriented medicine for the veterinarian. Journal of the American Animal Hospital (May/June): 307-330, 1978.

Table 1. Abbreviated Clinical Data Base Modified After Saidla (1978).

A. Profile Usual activity Water quality	B. History Immunizations Diseases Origin of animal Medications	C. General appearance Swimming Body condition Weight change	D. Integumentary Skin
E. Musculoskeletal Swimming At rest Sleeping	F. Circulatory Palpatation Ascultation ECG	G. Respiratory	H. Digestive
I. Genito-urinary	J. Eyes	K. Auditory	L. Neural General Postural reactions Reflexes Cranial nerves
M. Lymph nodes	N. Mucus membranes	O. Laboratory and radiographic data	

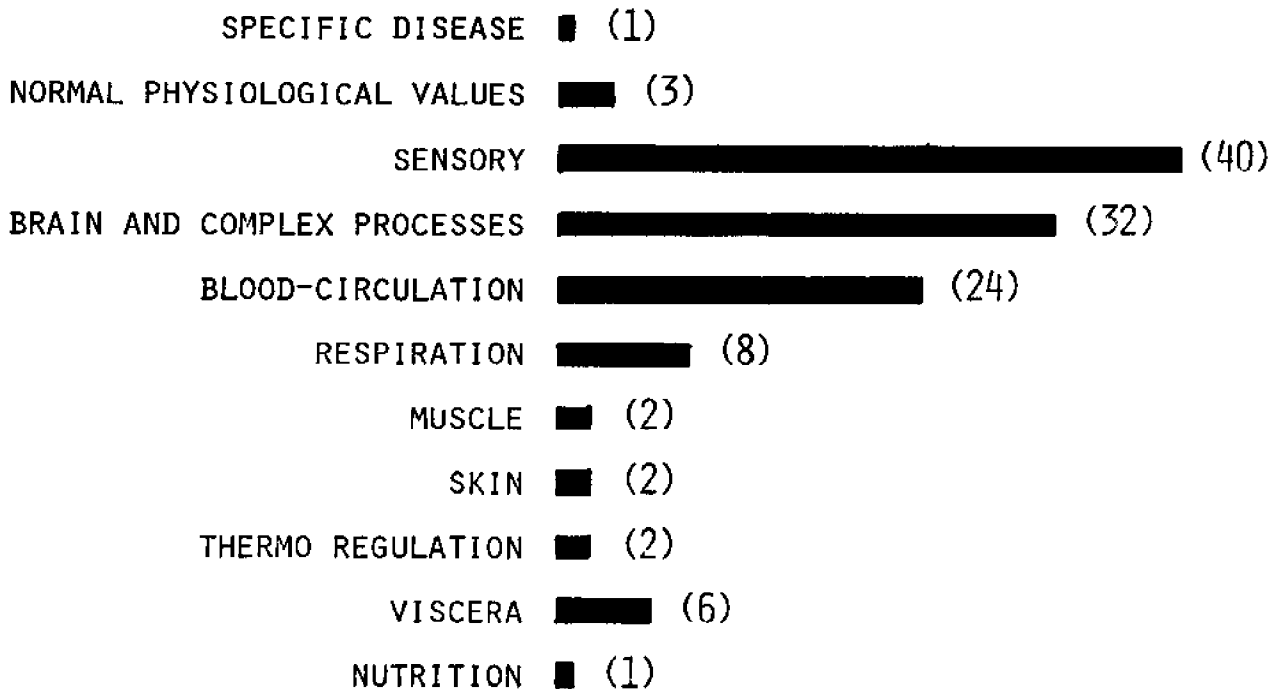

Fig. 1. Topic areas of research publications between 1966 and 1978 indexed under "dolphin" by the National Library of Medicine. Numbers are in parentheses. Total is 121.

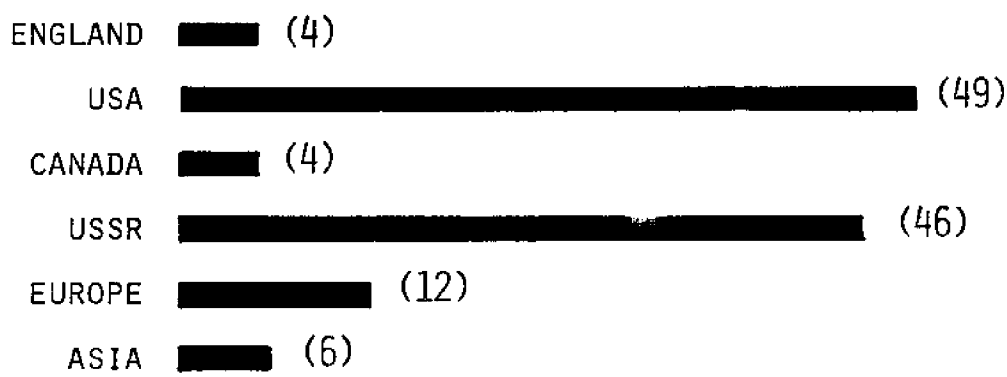

Fig. 2. Analysis of research publication numbers (in parentheses) by geographic area between 1966 and 1978. Total is 121.

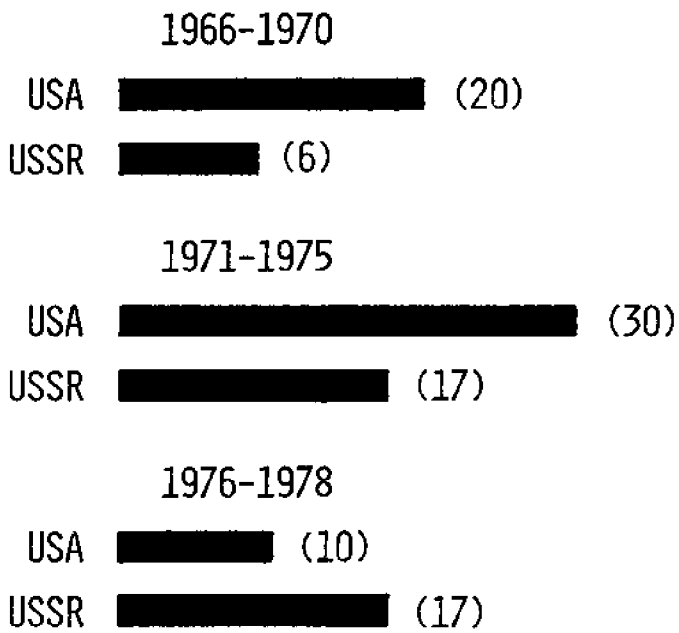

Fig. 3. Research productivity in the United States and the U.S.S.R. Comparison of number of biomedical publications (in parentheses) indexed by the National Library of Medicine and involving the index term "dolphin" between 1966 and 1978.

AQUACULTURE AND AQUATIC ANIMAL MEDICINE

Sterling K. Johnson

Aquaculture is the science or art of cultivating the water. There are many uses for the various animal products of aquaculture, but the potential of aquaculture is in the production of human food. Aquaculture production in this country is less than 2 percent of a total world production of 6 million metric tons.[1] In the United States, the major established industries for food production are represented by catfish, salmonid fish and crawfish. The production of oysters also figures significantly, but the methodology used in this country varies somewhat from what many consider to be true aquaculture. The United States has baitfish and petfish as established non-food industries.

Aquaculture has developed rapidly during the latter half of this century. As aquaculture commodities commercialized, they also intensified. Efforts to become more efficient in attaining maximum levels of production have been accompanied by crop loss from disease. Aquatic animal medicine has developed over the years in response. This specialized field developed as certain individuals decided to devote their careers to the study and management of diseases of cold-blooded animals.

Aquatic animal medicine is made up of a variety of professionals who serve aquaculture in many ways. Most specialists have a partial role in direct services; the remainder of their time is committed to research, teaching or other occupational activities.

A great variety of people also represent the aquaculturist. Although there are governmental researchers and hatcherymen, the most common aquaculturist is involved in some form of commercial culture. He may be the individual entrepreneur trying to make a living for his family on his own or rented land, a manager of a farm controlled by investor groups, a member of an aquaculture cooperative, a manager of a farm controlled by a large corporation, or a manager of a culture operation that uses leased public water. His background may range from being illiterate with invaluable practical experience and skill, to being well trained by years of study at the best schools of aquaculture. Aquaculturists have something in common -- they enjoy farming the water and have a love for aquatic life.

BASIC PROBLEMS

Growing Pains. As many have taken the opportunity to point out, losses due to disease (used here in its broadest sense) increase as animals are concentrated in unnatural environments. However, there are many facets of the disease problem that may go unmentioned. That is, the loss of aquatic animals from disease is very much the result of

growing pains in aquaculture. Animals are lost because of: pursuit of unproven culture methodology; pursuit of proven culture methodology for one set of circumstances, but not the one at hand; inexperienced or careless management; unpredictable natural events; contamination by toxins; and even holdups in the marketing or distribution process. Blended in with all of these are the familiar pathogen-host-environment imbalances that favor disease development.[2] It is important to understand that much of the disease loss experienced in aquaculture results from temporary imperfections in culture methodology and management. For example, imperfections in management could include inexperience in regulating water exchange or handling a common parasitic infestation.

Trouble Spots. Many disease situations stand out in overview, in the current practice of aquaculture. Many invertebrate aquacultures require a special culture period to rear larval stages. The fragile larvae may be overwhelmed by bacteria, fungi, viruses, or protozoa in the intensive rearing environment. The time of exposure to larval rearing is important. Marine shrimp, for example, are more susceptible to disease in hatchery culture than freshwater shrimp are, but the longer time of freshwater shrimp's larval rearing provides more opportunity for problem development.

Most invertebrate larvae will become infected with bacteria when poor nutrition or adverse environmental conditions cause larval weakening. Enriched culture water will support excess numbers of potentially invasive bacteria. In crustacean culture, even epibionts have been a problem.[3]

Crustacean larvae have also had problems with several genera of fungi. Once the invasion process begins, larval lots are merely discarded because no effective corrective measures are available. Discarding is also a practice used when bacterial or viral disease occurs. If a system is operating at its maximum effectiveness and mortality begins, most or all of the crustacean lot dies. This results from accentuated enrichment of the culture medium by tissue fluid released from dead animals, and a consequent sudden rise in bacterial numbers. The diseases that molluscan larvae experience are similar to those of larval crustaceans.[4]

Under normal cultural practice, juvenile and adult invertebrates are less prone to disease than the larval stage. Larger crustaceans fare very well where water circulation is maintained in grow-out ponds. A fungal disease (Fusarium) is commonly encountered in juvenile and adult marine shrimp, which are reared intensively in specialized systems.[5] American oysters are damaged by Dermocystidium on the Atlantic and Gulf Coasts of the United States.[6] This disease is considered to be related to atypical temperature and salinities.

The role of disease in finfish culture is greatest during the rearing of fingerlings for stocking purposes. In cold water fish, viruses and bacteria have been noted to play a major role, whereas in semi-tropical and tropical areas, parasites, particularly protozoa, have the major role.[7] The protozoan Ichthyophthirius, is a seasonal problem of fall and spring in United States catfish farming. Ichthyophthirius and other protozoans (Ichthyobodo, Chilodonella, Trichodina and Epistylis) are a global problem with fingerlings of all species.

Culture practices in which disease is a major factor in the grow-out phase have failed to become widespread in aquaculture. Fox example, bacterial infections cause serious damage in cage cultures of catfish and salmonids. The importance of disease during the grow-out stage varies among different aquacultures. Disease is considered of relatively little importance in crawfish, freshwater shrimp and tilapia, when these cultures are compared to grow-out of catfish, trout and oysters.

It is difficult enough to make aquatic creatures produce in an unnatural culture setting, but adding to this difficulty is the necessity for the stock to endure certain aquacultural practices which have particular potential for predisposition to disease. These practices occur when aquatic animals are hatched, handled, hauled or harvested. Guidelines are available for what animals can endure, but the variety of ways in which the practices are undertaken could be judged anywhere from advanced to backward.

Toxicity is a constant problem for animals living in aquatic environments. Pesticides and other forms of pollutants are of obvious concern in certain aquacultures, such as shellfish, where animals develop in natural environments. Certain pesticides are particularly toxic to fish and may severely affect normal growth. Toxaphene, a pesticide which is widely used in the southern United States, has been shown to act as a drain on vitamin C in channel catfish when the pesticide was present in sublethal quantities.[8] Because insects and crustaceans are both arthropods, insecticides can be a particular threat to crustaceans, where sensitivity is high because of similar body functions.

Perhaps of more practical concern to aquaculture are the toxins produced as biological wastes of animals and decomposition processes, and certain unidentified toxins that are produced by aquatic plant or microbial life. Knowledge of the adverse effects of simple compounds such as ammonia, carbon dioxide and hydrogen sulfide is well documented for most aquaculture species, but lethal and sublethal effects of certain chemical compounds, which are released into the water, remain mysteries.

BASIC NEEDS

Development of Management Plans for Prevention. Aquaculture's needs from aquatic animal medicine are greatest in the area of prevention. There is a great need to increase the resistance of stocks, so that they may overcome predictable and unpredictable exposures to sub-optimum conditions. The use of bacterins, vaccines,[9] improved diets and genetics are valuable in many instances, but a wide variety of disease management plans designed to increase resistance needs to be demonstrated and integrated into the broader management scheme. In addition, management plans to reduce environmental stress need to be derived and demonstrated with input from aquatic animal medicine professionals. Aquacultural engineering has much to offer, and we really stand at the threshold of the day where environmental parameters previously considered as limiting will be manipulated to provide opportunities for intensive culture far beyond what was considered possible several years ago. As this happens, aquatic

animal medicine must be ready to respond to keep disease as an unlimiting factor. For example, larval invertebrate aquaculture needs assistance in developing prevention strategies against opportunistic pathogens. Fingerling finfish aquaculture needs assistance in establishing probabilities of disease prodisposition where certain culture practices are undertaken.

Development of Disease Management Plans for Contagious Diseases. There is also the continuing need to develop plans to prevent and control contagious diseases. At present, there is much hope in the development of immunization, which should be approached as one tool among others. As is the case of other tools, immunization must be accepted by the aquaculturist. This will come about by the exposure to convincing demonstrations of effectiveness. The aquaculturist views his animals as a group or crop, and will judge the effectiveness of technique on its overall result. Several of the supposedly "uncontrollable" viruses can be partially controlled by environmental manipulation, but such practices need to be established as clear-cut guidelines.

In certain situations, it may be best for the disease agent to be totally eliminated. Stock destruction and system disinfection are always possibilities for elimination, but effective chemical control is the most practical method for certain disease agents (e.g., Ichthyophthirius). Procedures for screening new stock and monitoring existing stock should be developed and put into practice wherever needed. The procedures should be kept as simple as possible, and their benefits documented so that they will have the best opportunity to be integrated into the existing aquaculture plan.

Technology Transfer. Aquaculturists are constantly developing technology to fit their culture systems. They are also implementing management plans received from others. Aquaculturists have a special need for the disease specialists to share their disease management technology. It is also important that what is related as practical, is in fact practical. Furthermore, disease specialists have a role in assisting aquaculturists to attain and sustain competence in the awareness of, and the critical identification of, disease conditions in their stock. The contemporary aquaculturist is quite capable of personally handling most disease problems, once they are identified.

In order to accomplish these things, aquatic animal medicine's knowledge must include a comprehensive grasp of the aquacultures, and there are many, that we are dealing with. We will come closer to meeting the needs of aquaculture by being inside experts, rather than outside experts.

SPECIAL NEEDS

Drug Inavailability. Aquaculture is a small and growing industry which has the misfortune of developing in this country at a time when the nation is reassessing agricultural chemicals and drugs. What is presumed to be best or tolerable for the more important agricultural industries is not necessarily the fare for aquaculture; thus aquaculture has had to roll with the punches.

The present stage of transition in regulation places the aquaculturist in a position of either closing his operations, or being routinely dishonest about various legal restraints that he may or may not be familiar with, or more often, cannot understand. The result of this situation is a continuing erosion of credibility for regulation.

The development of aquaculture requires that the aquaculturist have at his immediate disposal certain agricultural chemicals and drugs that can be purchased over-the-counter. The cost of preventatives and correctives must be low enough to allow them to be usable. This is particularly the case for preventatives, and the recent inflationary trend has caused aquaculturists to take a second look at many chemicals. Aquaculture as an industry is relatively a low-user of chemicals and drugs, and has very little effect on the price of these products. Consequently, if the chemicals and drugs are too expensive, they will not be effective because they will be impractical.

Stock Introduction and Certification. The spread of disease by transporting stock from one area or country to another has been actively considered for many years. Society task forces and special conferences have developed lists of diseases of special concern. Those listed as highest priority are usually the ones with strong host specificity.[10] Typical examples are viruses of salmonid and cyprinid fishes, and myxosomiasis in rainbow trout.

Eradication of a disease in a geographical area must include eradication in both domestic and wild stock. In many cases, the status of the wild stock is unknown, and may present problems when certifying facilities as being free of certain communicable diseases. Certification most commonly refers to a statement on the disease-free status of a specific lot. Consequently, certification should be viewed from two perspectives: interfarm traffic, where avoidance is practiced as part of the recipient farm's management program; and international or interregional traffic, where the recipient geographical area is considered disease-free.

There is a need in aquaculture for a more comprehensive look into the spread of communicable disease. Actions based solely on the opinions of representatives of aquatic animal medicine can retard aquaculture's progress. Opinions and actions should reflect the desires of aquaculture representatives, aquatic animal medicine professionals, and others indirectly affected by stock transfer.

Diagnostic Services. People engaged in diagnostic service in this country commit only a fraction of their time to diagnosis. The remainder of their time is devoted to research, education, resource management or other occupational activity. Diagnostic services are most frequently utilized in the geographical concentrations of aquaculture. Mississippi, for example, has over 22,000 acres of aquaculture concentrated among twelve counties in the Mississippi River Delta (T. L. Wellborn, pers. com.). Larger aquacultural enterprises will support a staff large enough to have a biologist with some training in disease diagnostics. This person will conduct routine diagnosis for his farm, and will usually assist neighboring aquaculturists.

Although diagnostics is a critical part of training professionals in aquatic animal medicine, aquaculture's need for diagnostic assistance is often overstated. The major shortcoming of diagnostic assistance is not the limitations in equipment that prevent searching a case. Rather, it is the reduced competence of the diagnostician that results from a lack of exposure to concentrated diagnostic activity in the formative years.

RECOMMENDATIONS

Disease Management Plans Should be Developed. The more important disease conditions occur in intense rearing situations, such as the rearing of larvae and fingerlings. Because of the intense effort involved in these cultures, there is a high interest in implementing new preventative techniques. Too often the preventative techniques are inferior to others, because the aquaculturist or his disease specialist is unaware of the benefits of a superior method. The time is ripe for new prevention management plans in aquaculture, and their comparative evaluation. Methodology for control of contagious diseases should be developed by time tested results in the field. Too often the main flow of this information comes from the field to the disease specialist, who only acts as a sounding board. Aquaculture needs sound control methods for communicable disease, and is eager to respond to efforts of professionals in aquatic animal medicine.

Technology Transfer Should be Improved. The success of aquaculture requires that aquaculturists have specialized skills and experience.[11] A part of the role of aquatic animal medicine should be its extension. High priority must be given to assure that the aquaculturist or his advisor has more offered to him than a "fifth pass paraphrase." Information must be practical and should be transmitted in an understandable manner. Many of us have attended aquatic animal disease "workshops" with over fifty people, and listened to speakers who could be understood by not more than one or two. Unless effectiveness of practices can be demonstrated, practices will rarely be adopted by aquaculturists. Aquatic animal medicine's contribution to aquaculture will be measured by its ability to transfer research findings into actual aquacultural practice. Applied research and other services should be designed with this in mind.

Communication on Direction of Research Should be Improved. Applied research on diseases affecting aquaculture most often follows trends set by aquaculture research in general. This has its benefits, but the diversity of aquacultures makes it difficult for research to be directed in a practical manner. The diversity of specialization of professionals may add further complexity. We need a proper balance of research emphasis, and unbiased communication on aquaculture's primary problems.

The Importance of Availability of Treatment Chemicals Should be Recognized. Aquaculture's use of treatment chemicals is too slight to encourage manufacturer's expenditures on registration procedures. Governmental regulations usually blanket aquaculture and place many chemicals in

an illegal status. Professionals in aquatic animal medicine should recognize the importance of having certain treatment chemicals available, and where possible, encourage clearance for their use.

LITERATURE CITED

1. U.S. Congress, Senate 1978. Aquaculture in the United States. Committee on agriculture, nutrition and forestry. 95th Congress, 2nd session.

2. Snieszko, S. F. 1974. J. Fish. Biol. 6: 197-208.

3. Fisher, W. S. 1977. Pages 673-684 in J. Avault, ed. Proceedings of the Eighth Annual Meeting of the World Mariculture Society, San Jose, Costa Rica, January, 1977.

4. Loosanoff, V. L. 1972. University of Washington Publications in Fisheries, New Series, 5: 165-179.

5. Lightner, D. V. 1977. Pages 10-77 in C. J. Sinderman, ed. Developments in aquaculture and fisheries science. Vol. 6 Elsevier Sci. Publ. Co., Amsterdam.

6. Quick, J. A., Jr. and J. G. Mackin. 1971. Fla. Dept. Nat. Resources, Prof. Pap. Ser. No. 13, 55 pp.

7. Food and Agriculture Organization. 1976. FAO fisheries and report no. 188, Rome.

8. Mayer, F. L., P. M. Mehrle, and P. L. Crutcher. 1978. Trans. Am. Fish Soc. 107: 326-333.

9. Fryer, J. L. ed. 1977. Oregon State University Sea Grant College Program Publ. No. ORESU-T-77-012. 10 pp.

10. Food and Agriculture Organization. 1977. FAO fisheries report no. 192.

11. Pillay, T. V. R. 1972. University of Washington Publications in Fisheries, New Series, vol. 5. Pages 203-208.

MANUFACTURING AND SUPPLYING THE PRODUCTS USED IN AQUATIC ANIMAL MEDICINE

Donald F. Amend

It is becoming more difficult to make new vaccines and drugs available for general use because of increasing governmental controls by the Food

and Drug Administration (FDA), United States Department of Agriculture (USDA) and the Environmental Protection Agency (EPA). The substantial costs involved and the long delays make the economic incentive unattractive to most major pharmaceutical companies who consider the field of aquaculture. However, aquaculture is growing, and the future promises continued and rapid growth. In order to provide the products needed to keep this promise, the work to satisfy governmental controls must start now, and it must take the commitment of a major company to sustain the costs needed to complete the process. However, the benefits of this commitment must also be profitable. In this address, I will describe the efforts of one company's attempts to supply the products needed in aquatic animal medicine.

First, TAVOLEK is a new subsidiary of JOHNSON & JOHNSON. TAVOLEK's only business is the research, development and marketing of vaccines and pharmaceuticals for aquatic animals. In addition, we work very closely with Pitman-Moore. This is our base and our source of drugs and biological expertise. The scope of our work is worldwide on the economically important species of fish.

Although we have a broad interest, we are focusing on food fish due to the growing human populations, declining catches due to overfishing, restrictions such as the 200 mile limit, and the increasing need for protein. Because "hunting" of fish is becoming more limited in the ocean, the wave of the future has got to be aquaculture. Aquaculture is in its infancy, and there are many associated problems in making it a really flourishing business. What is needed for aquaculture to flourish are better techniques of fish culture, genetics, nutrition, and disease control. I also might add that we need an understanding and helpful government. The political and governmental bureaucracy can be more limiting in many cases than the biological problems. Excessive delays and unrealistic guidelines are problems which significantly limit progress. However, this presentation will focus on methods of disease control.

There are a variety of products needed to assist aquaculture in overcoming its disease problems. Among the products being developed are vaccines, antifungal compounds, antibiotics, anesthetics, tranquilizers, endocrine products for spawning induction and growth promotion, parasiticides, disinfectants, diagnostics and new delivery techniques. To make an impact in all these areas at one time is naturally impossible. Priorities must be set, and then one must move into those areas that show the most promise. TAVOLEK, in a little over two years, has developed vaccines for the control of vibriosis and enteric redmouth. Also, two new delivery techniques for the mass immunization of fish have been developed: the direct immersion method, and the shower method. Although many biologicals and antibiotics are available today, almost all chemicals and biologicals used in fisheries must be approved by the government, be it the FDA, USDA, or EPA, before they can be used for public use. This is the most time consuming and labor intensive aspect of supplying products for aquatic animals. Part of the problem is the unawareness and the uninformed officials in the government that deal mostly with

"higher" animals and do not relate to the problems of aquaculture. Furthermore, the regulations were designed for non-aquatic animals which present some very unique problems. The following will outline the procedures and difficulties in bringing a new product to market, in this case a vaccine. Because my experience is primarily with the USDA, I will briefly outline the process of what it takes to bring a biological to market for use in the fish area.

To develop a vaccine for an infectious disease, we must first ascertain the problem and its current status. Fox example, how serious is the mortality or morbidity? How easily is it controlled with current procedures such as antibiotics, or is it refractory to treatment? Is it feasible both from a practical and an economic standpoint? Also, ease of treatment is a major concern. Confirmation of the etiological agent and subsequent isolation of the organism must be made.

If we determine that the vaccination is a practical solution, then we must collect as wide a sample of isolates as possible. From this, tests including serological, virulence, biochemical, growth, inactivation curves, preservation studies, relative homology and heterology are made. By putting these results together, a working isolate is selected for vaccine preparations. In order to determine the efficiency and potency of a vaccine, we must have a suitable challenge system. Considerable time may be devoted to this problem, including species, route of administration, environmental factors, and dosage. The development of challenge systems requires a large expenditure of time and facilities, because it must be reproducable, reliable, and useful on several species.

Once a vaccine has been developed, effort is then concentrated on production and a suitable delivery method chosen. Serial lots are produced, followed by stability tests, sterility tests and finally tested for safety and potency. Evaluation of delivery systems includes injection, immersion, shower, hyperosmotic infiltration and oral. The data is submitted to the USDA for evaluation. If satisfactory, then you are ready for field tests.

Field tests are primarily safety tests to be sure that problems do not develop when large numbers of fish are vaccinated which cannot be detected under laboratory conditions. If this is not possible, then we bring representative samples of fish back to the laboratory to do experimental challenges. The control and vaccinated groups are carefully monitored, in either instance. Costs and time involved, management acceptance of the procedures, food conversions, mortality are all monitored very closely. Each serial lot is tested at a different location and when the data is completed it is re-submitted to the USDA for review.

If the data is accepted then a final label is submitted and, if approved, a license is granted to market the product. At this point, product marketing begins. However, all further production lots must also be tested for safety and potency, and the products must be released

by the USDA before it can be sold. In addition the research does not stop here, as further improvements may be needed. These can include further application procedures, shelf life, onset and duration of immunity effect on individual species. Cross-protection and serological tests are also conducted with other vaccine preparations or perhaps studies are made for application to other species of fish. In all cases, these changes must be stated on the label, and the USDA must review and approve all such changes. Any deviation from or additions to the approved label could result in the loss of our license.

This completes the process of licensing a product for the USDA. Similar but more detailed tests are required by the FDA or EPA. In these instances, more emphasis is placed on safety -- to the fish, the consuming public, and the environment -- and many more regulations are involved. It is apparent that such processes are time consuming and very costly.

For those interested in further details on the requirements needed to register biologicals and pharmaceuticals for fish, the following references and guidelines are presented:

1. FDA -- This agency is responsible for the clearance of drugs and chemicals that have therapeutic claims. New Animal Drug applications are reviewed by the director of veterinary medicine which is composed of two divisions -- non-food animals (pets) and food animals -- and the main responsibility is to assure that the sponsor has proven the safety of the drug to the treated animal, and that the drug is effective for the claims being made. In the case of food animals the Bureau of Foods is also involved, and their responsibility is to assure that no harmful residues are present in edible tissues.

    a. Federal Code of Regulations. 21. Food and Drugs. U.S. Printing Office, Washington, D.C.

    b. Lennon, R. E. 1967. Clearance and Registration of Chemical Tools for Fisheries. Prog. Fish Cult. 29(4):87-193.

    c. Bureau of Veterinary Medicine (FDA). 1978. Guidelines on Safety and Efficacy in Target Animal on the Minor Use of Drugs. 5600 Fishers Lane, Rockville, Maryland.

2. EPA -- The primary responsibility of this agency is the clearance of pesticides and herbicides. The mission is to protect the environment from harmful chemicals, and chemicals used on fish ultimately are released into the environment. If the primary claim is to disinfect or "treat" the water, this agency reviews the application. However, if the fish is treated, the FDA reviews the application, but the review must contain an Environmental Impact statement to assure that EPA concerns are covered.

This review also is to assure that the sponsor has proven safety to the target animal and non-target animals, as well as to prevent accumulation of harmful residues in the water or sediments.

a. Bureau of Veterinary Medicine (FDA). 1978. Guidelines on Environmental Considerations on Minor Use of Drugs and Environmental Impact Operational Directive of June 1977. 5600 Fishers Lane, Rockville, Maryland.

b. Environmental Protection Agency. 1975. Guidelines for Registering Pesticides in the United States. Federal Register. 40(123).

c. Federal Code of Regulations. 40. Pesticides Programs. U.S. Printing Office, Washington, D.C.

3. USDA -- Biologicals sold in interstate commerce must be licensed by the Animal and Plant Health Inspection Service, Bureau of Biologics and Standards. As discussed in this article, the responsibility of this agency is to assure the safety and efficacy of biologicals. Because biologicals are derived from naturally occurring products, residues are not required. However, chemicals used in the processing or manufacture of a biological must comply with the regulations of FDA and EPA.

a. Antipa, R. G. and T. R. Croy. 1979. Fish Vaccine Development and Testing. Prog. Fish Cult. 41(1):46-48.

b. Fryer, J. L., D. F. Amend, L. W. Harrell, A. J. Novotny, J. A. Plumb, J. S. Rohovec, and G. L. Tebbit. 1977. Development of Bacterins and Vaccines for Control of Infectious Diseases of Fish. Oregon State University. Sea Grant Program. Publication ORESU-T-77-012. 10 pp.

c. Federal Code of Regulations. 9. Animals and Animal Products. U.S. Printing Office, Washington, D.C. 859 pp.

AQUATIC ANIMAL MEDICINE AND THE NEEDS OF AQUATIC ANIMAL INDUSTRIES

John B. Gratzek, Jeannine Gilbert, and Emmett B. Shotts, Jr.

Wherever animals are produced for food or pets, there arises a need for professional expertise to solve problems associated with production.

The requirement for trained personnel is invariably proportional to the size and net worth of a particular industry. An important corollary is that as more trained individuals enter into animal production industries, more complex problems are uncovered. In some cases these problems are accepted by managers as "normal" attrition; in others, insidious production (disease) problems may not be overt -- for instance, diminished feed conversions may be the end result of chronic disease.

There are specific needs of various aquatic animal industries which can be satisfied by some phase of aquatic animal medicine. A basic service which can have an immediate positive effect on aquaculture is a complete diagnostic laboratory staffed by personnel who can legally recommend effective therapy regimens. Presently (as well as historically), many state and governmental agencies offer diagnostic services to fish farmers. These include: U.S. Department of Interior laboratories, state-supported diagnostic veterinary laboratories, and university-associated fish disease laboratories. The reason for the initial existence of U.S.D.I. laboratories was that diagnostic services were not available for federal trout hatcheries. Recently, federal laboratories were instructed to restrict diagnostic activities to federal hatcheries. If this directive is strictly adhered to, diagnostic assistance to the public will be limited to several university-associated laboratories, a few state veterinary diagnostic laboratories and a very few privately operated laboratories. The continued rendering of services to the fish farmers by tax-supported laboratories will continue to depress the emergence of private full service laboratories.

Specific problems of aquatic animal industries are covered in the following pages. Comments will be limited to ornamental fish, channel catfish, goldfish and trout.

Ornamental Fish

The ornamental fish industry is largely restricted to an area in Florida south of a line drawn directly across the state from Tampa. Two types of production are used. In the Tampa area outside production ponds are used, while in the Miami area fish are reared in flow-through tanks. Hatcheries in both areas have extensive numbers of individual small aquaria for spawning and rearing fry.

Water. Ornamental fish production requires different types of water for propagation of various species of fish. Hard water areas are suitable for platies; however, reproduction of tetra species requires softer water, high in humic acid and with a lower pH. Many farmers will haul "humic" water from some distance. Clearly, there is a need to define an artificial method of water conditioning which will duplicate the desirable characteristics of "humic" water.

Diagnostic services. Unlike trout or channel catfish farmers, the tropical fish industry has not had federal support for disease diagnosis. Few Florida fish farmers have resident trained biologists; however, some

managers have the competence with a microscope to identify common parasites. Many Florida fish farmers encounter problems which could easily be diagnosed by microscopic examination and treated.

A suitable diagnostic laboratory should be equipped for water quality analysis, parasitology and bacteriology. Toxicological, virological and histopathological service should be available either within the laboratory or through a backup facility. Most states already have an excellent skeleton structure for veterinary diagnostic assistance with the reservation that services are usually provided to practicing veterinarians. A scenario which would provide a maximum service would be to have a licensed veterinarian qualified in fish disease diagnosis and aquaculture conduct diagnostic services on a private basis. This could be done as part of a veterinary practice. Diagnostic backup assistance could be provided by state veterinary diagnostic laboratories.

Transportation. The movement of ornamental fish to wholesalers throughout the country from fish farmers is almost totally by air freight. Higher air freight charges could be compensated for by packing more fish per volume of water; however, any increase in packing densities will require additional technological advances in maintenance of water quality during shipment. The problems encountered are mortalities which occur in transit as well as post-shipment. Research should be directed towards maintaining life-sustaining levels of oxygen while reducing carbon dioxide and ammonia in shipping cartons.

Competition with the Far East. Many tropical species propagated in Hong Kong and Singapore present a formidable competition for the Florida tropical fish industry, especially in regard to fish size, color and grading. There is a definite need for further nutrition and reproduction research, particularly regarding induction of ovulation in species which are difficult to breed.

Disease. Gratzek et al. (9) have reviewed the disease incidence in imported fish. Ornamental fish are subject to as many disease problems as any other cultured species. In fact, on any one tropical fish farm there are likely to be a diversity of problems encountered because of the variety of fish species, increased handling of fish and because of the need and use of closed culture systems leading to water quality problems. There seem to be no major classes of parasites or bacteria in ornamental fish which are not found in fish cultured for food. It appears that some ornamental species of fish are much more susceptible to specific parasites or bacterial infections. Basically, the diagnosis and treatment regimens are identical to those used for other fish, the notable exception being that in the tropical fish industry medicants -- especially antibiotics -- are placed directly in the water rather than with the food.

Service to the home aquarist. It is estimated that there are 50 million aquarists in the United States. Presently, most fish health care is done by retailers who stock a wide variety of medicants. The majority of retailers have neither the training nor the time or equipment to offer diagnostic

services. For the past seven years, the College of Veterinary Medicine has offered a unique elective course in fish health management to senior veterinary students. The objective of the course is to develop competence in closed system water chemistry, disease diagnosis, and therapeutic approaches. Reports from graduates suggest that this training has enabled them to establish pet fish fanciers as part of their clientele. We believe that this elective program is well suited to equip veterinarians to work with fish in closed culture systems.

Channel Catfish

Channel catfish production has been progressing for years with a minimum of direct aquatic medical services. However, catfish producers have been assisted by many short courses, conferences and workshops primarily sponsored by Land Grant Colleges in the South and Southeast. Over the years attendance of these courses by managers has increased their awareness of disease problems, diagnostic acuity, and provided therapeutic approaches. The objectives of these courses are to provide practical information on management, diagnosis, stress related problems, predacious insect control, basic limnology, and the proper use of medicants.

The catfish industry has also had the advantage of a considerable amount of U.S.D.A. funds which have been and are being expended at various Land Grant Colleges for research on various phases of catfish production, including disease. Diagnostic services are readily available to the catfish farmer by state universities in Alabama, Georgia, Mississippi, Louisiana and Texas. The catfish farmer who seeks assistance can readily find it.

Specific Problems

Intensive culture. Productivity of catfish production ponds is limited by the availability of water. On a square acre basis, maximum production is considered to be approximately 2,500 to 3,000 pounds of fish with feeding and fertilization but without supplemental aeration. Pond production can be increased to 7,000 to 10,000 pounds per square acre by aeration which essentially avoids late summer and fall oxygen depletion problems. In aerated ponds water quality other than oxygen levels becomes a problem. It is probable that increased crowding of catfish even in the presence of ample oxygen levels creates many types of stress problems which could include excessive amounts of ammonia, nitrites, carbon dioxide, bacterial populations, as well as a lowered oxidation-reduction potential. Such stressors are well described in closed culture systems (12). It appears that more attention to water quality will have to be given to aquatic systems as intensive methods develop. Research is required to identify those accumulated toxicants, stressing levels and the direct and indirect results of these stressors.

Disease Problems

Channel catfish can be afflicted with external protozoans, monogenetic trematodes, helminths, sporozoans and various bacteria following stress conditions. A herpes virus, which is warm-temperature dependent (78F and

above) as well as age dependent -- affecting young of the year -- has been reported (7). This disease has been called channel catfish virus disease (CCVD). Nothing can be done to treat the occasional CCVD epizootic, nor is there any treatment for the sporozoan Henneguya. There is apparently no reason to treat channel catfish for the ubiquitous tapeworm Corallobothrium, since studies have shown that normal infestation levels apparently have no effect on growth.

The major disease problems in catfish production are external protozoan parasites. Monogenetic trematodes, while usually present, rarely induce clinical disease. Various chemicals have been used for treatment of external protozoal problems -- unfortunately, none are absolutely safe and effective under all conditions.

Malachite Green has been used as an antifungal and antiprotozoal treatment for years, but its use is illegal since it has been shown to be carcinogenic.

Formalin at a 25 ppm concentration in ponds has been shown to be an effective protozoicide. At higher concentrations (250 ppm), short-term baths will effectively remove protozoans and monogenetic trematodes. Formalin cannot be used during warm weather periods because its use leads to oxygen depletion due to a direct combining effect with oxygen as well as an increased biological oxygen demand (BOD) as a result of killed aquatic life. The FDA has not given final clearance for its use in food fish.

Potassium permanganate is cleared for use as an oxidizer in pond usage. It has been used to kill excessive algal blooms; however, the result of this algicide activity results in an increased BOD. Without supplemental pond aeration, an oxygen depletion can result. Potassium permanganate used at 2 or 3 ppm is an effective parasiticide. The effective use dosage depends on the BOD of the water. In effect, the organics of the water must be satisfied before the chemical has any effect on parasites. Conversely, the use of the drug in low organic water may result in severe burning of the fish. An accurate reliable pond-side test is needed to determine quickly just how much chemical is required to overcome the organic load in the water. Potassium permanganate is exempted from registration for food fish use.

Copper sulfate is another effective antiprotozoal chemical which is effective but can be dangerous to use. Hard water (over 250 ppm as $CaCO_3$) will tend to chelate the chemical by formation of insoluble copper salts. Softer water (less than 50 ppm as $CaCO_3$) results in more free copper ion, which can result in toxicity. Dosage levels, therefore, are determined by the degree of hardness of the water in the pond or raceway to be treated (4).

Monogenetic trematodes in channel catfish are common and occasionally can reach populations on gills which result in disease. Organaphosphates under a variety of trade names have been used successfully in ponds at .25 ppm as a parasiticide; however, there are some unpublished reports of undesirable side effects associated with use of organophosphates such as hyper-excitability and other central nervous system disturbances. It is not known if continual use of organophosphate in channel catfish farming will lead to drug resistance as reported in goldfish farming (8). As of this writing, organophosphates are still the drugs of choice for controlling anchor

worm (Lernea) infestations in channel catfish rearing ponds.

The chemical which has an absolute killing effectiveness for external protozoans yet which is absolutely safe and effective has yet to be discovered. Research is required designed to seek that elusive miracle "drug" which is effective, non-toxic, and which degrades into products which are non-carcinogenic and non-polluting. Chemical companies have a large backlog of untested chemicals which should be screened for their effectiveness. This screening task may be approachable by a recently devised in vitro test for synergistic action of chemicals.

Treatment of bacterial diseases in channel catfish is legally limited to sulfamerizine and oxytetracycline. There is more than ample evidence that continual use of one type of antibiotic in aquatic animal medicine leads to the development of antibiotic resistancy of various types of bacteria associated with fish disease (11). Complicating the problem of simple bacterial resistancy is the widespread occurrence of so-called resistance factors -- "R-factors" -- which are extra chromosomal segments of DNA which can be transferred amongst bacteria by conjugation and which carry genetic information for antibiotic resistancy (1, 2, 3, 11). Obviously, emergence of antibiotic resistance can be minimized by judicious use of antibiotics; however, there appears to be enough scientific data and clinical experience to warrant development of additional antibiotics for food fish use.

Tadpoles

Many warm water fish farmers complain about excessive numbers of tadpoles, which compete for food. A specific chemical is needed to control tadpole populations.

Goldfish Production

Major goldfish farms are located in Maryland, Pennsylvania, Indiana, Missouri, Georgia, Alabama and California. Many goldfish production units have competent biologists who are capable of assessing parasite problems as well as water quality problems associated with production.

One problem in goldfish production which has a marked effect on fish health is the necessity of crowding in order to maintain a salable size of fish -- about 2 inches long. Under such conditions, external protozoans and monogenetic trematodes are a continual problem. Lernea and Argulus are summer problems which are controlled using organophosphates. Goven et al. (8) have shown that the apparent continual use of organophosphates has led to an apparent resistance of Gyrodactylus to the chemical. An alternate treatment is needed to remove external trematodes.

In the past four years many goldfish farmers have reported a disease of goldfish which is now termed ulcer disease. The disease is caused by an achromogenic strain of Aeromonas hydrophila (5, 6, 10).

The disease signs include ulcerations and infection of capillaries of the fins. Mortalities are common. While A. salmonicida initiates the

lesion, A. hydrophila apparently is the direct cause of mortalities. Ulcerations can occur on fish farms or in wholesale or retail establishments. Usually, larger fish develop ulcers. Intraperitoneal injection of ulcerated fish with 25 mg/kg chloromycetin has proved to be effective on an individual treatment basis.

Goldfish producers would welcome an effective bacterin for ulcer disease, especially if it could be administered orally with the food. Initial experiments at the University of Georgia using killed bacterins suggests that additional basic research on the antigenicity of Aeromonas strains is required prior to development of a bacterin.

External Parasites

Examination of goldfish received at wholesale establishments suggests that preshipment treatment of some lots of fish is either not done or that treatments were not effective. The protozoans Costia, Chilodonella and monogenetic trematodes are most commonly found in batches of apparently sick fish. In general, fish shipped during the winter months arrive in a healthier state than those shipped during the warmer months. The differences in the health of various lots of fish appear to be related to effective preshipment treatment of the fish.

A safe and effective chemical which can be used as a preshipment bath treatment is needed. Formalin or potassium permanganate can be used; but injuries due to overtreatment can occur, which adds to the stress of shipment. Research is needed on antibiotic dips with special reference to the effect of pH and total hardness on antibiotic absorption by the fish.

Trout Production

Profitable trout production is dependent on an ample amount of cold water. Insufficient water flow in raceways leads to water quality changes such as high ammonia, BOD and bacterial levels which are stressors. Good hatchery managers are aware of management practices which lead to stress and disease. Manuals on loading factors in relationship to flow rates, feeding rates and treatment schedules are available. Purchase of eggs from certified disease-free hatcheries is an excellent practice if the disease organisms already present in a hatchery can be circumvented by effective disinfectant procedures. Specific needs of the industry are included below.

Bacterins. Presently, trout hatcheries in the western United States vaccinate fry for enteric redmouth disease, which is caused by Yersinia ruckerii. The bacterin is administrered by an immersion technique or by a spray technique. It has been shown that the bacterin is effective but it also appears that the methods of administration are stress inducing There is no doubt that a bacterin which could be administered as a feed additive would be welcome since a great deal of stress would be avoided.

Aeromonas salmonicida, the causative organism of furunculosis, is a continuing problem and ranks second to Y. ruckerii as a bacterial disease agent. Presently there is no bacterin available for the agent nor are

bacterins available for the Aeromonas hydrophila complex organisms.

Antibiotics. Oxytetracycline, although passed for use in food fish, has been used for years as treatment in bacterial disease. This extended use has led to the emergence of resistant strains (1, 2, 3). It is well recognized by fish biologists that other antibiotics are needed for therapeutic purposes.

Virus vaccines. Endemic virus diseases which affect trout are infectious pancreatic necrosis virus (IPN) and infectious hematopoietic necrosis virus (IHN). Both of these viruses can be the cause of high mortalities in trout hatcheries; IPN virus mainly affects fry to fingerling sized trout while IHN virus can kill market size fish. There are no vaccines available. The apparent reason for this is that the release of a modified live virus may not be ecologically tolerable. Water-administered vaccines have been developed for various virus diseases of poultry. It would seem that selection of attenuated vaccine strains for IPN and IHN could be easily done using available technology. The problem of environmental contamination could be circumvented by ultraviolet light disinfection of hatchery water just after vaccination.

References

1. Aoki, T., S. Egusa, T. Kimmura, and T. Watanabe. 1971. Detection of R. factors in naturally occurring A. Salmonicida strains. Applied Microbiol. 22(4):716-717.

2. Aoki, T., S. Egusa, V. Ogata, and T. Watanabe. 1971. Detection of resistance factors in fish pathogen Aeromonas liquefaciens. J. Gen. Microbiol. 65:343-349.

3. Aoki, T., S. Egusa, and T. Watanabe. 1972. Studies of drug resistance and R. factors in bacteria from pond cultured salmonids. Japan. J. Microbiol. 16:233-238.

4. Brown, E.E., and J.B. Gratzek. 1980. Fish farming handbook. Avi Publishing Co., Westport, Conn.

5. Elliott, D.G., and E.B. Shotts. 1980. Aetiology of an ulcerative disease in goldfish (Carassius auratus). Diagnostic study of diseased fish from seven locations. J. Fish Diseases, Vol. 3(2), March.

6. Elliott, D.G., and E.B. Shotts. 1980. Aetiology of an ulcerative disease in goldfish (Carassius auratus). Experimental induction of the disease. J. Fish Diseases, Vol. 3(2), March.

7. Fijan, N.N. 1968. Progress report on acute mortality of channel catfish fingerlings caused by a virus. Bull. Off. Int. Epizoot. 69: 1167-1168.

8. Goven, B.A., J.P. Gilbert, and J.B. Gratzek. 1980. Apparent drug resistance to the organophosphate (2,2,2-trichloro-1-hydroxethyl) phosphonate, by monogenetic trematodes. Accepted for publication, J. Wildlife Diseases.

9. Gratzek, J.B., E.B. Shotts, and J.L. Blue. 1978. Ornamental fish: diseases and problems. Marine Fisheries Review 40(3):58-60.

10. Shotts, E.B., D.G. Elliott, D.H. McCarthy, and F.D. Talkington. 1980. Aetiology of an ulcerative disease in goldfish (Carassius auratus). Characterization of the causative agent. J. Fish Diseases, Vol. 3 (3), May.

11. Shotts, E.B., V.L. Vanderwork, and L.M. Campbell. 1976. Occurrence of R factors associated with Aeromonas hydrophila isolates from aquarium fish. J. Fish. Res. Bd. Can. 33:736-740.

12. Wedemeyer, G.A., F.P. Meyer, and L. Smith. 1974. Diseases of fishes. Book 5: Environmental stress and fish diseases. T.F.H. Publications, Inc., Neptune City, Md.

ADMINISTERING THE LAWS AFFECTING AQUATIC ANIMAL MEDICINE

Henry C. Hewitt

How did the Food and Drug Administration (FDA) get involved in Aquatic Animal Medicine?

Food, Drug and Cosmetic Act provides for the regulation of drugs for all animals. The Bureau of Veterinary Medicine regulates the marketing of all drugs for animals other than man. This includes aquatic mammals and fish. We have a historic problem in terminology in this area of medicine. I noticed when I first wrote this down I differentiated between aquatic animals and fish, which is just not the case, as the term aquatic animals is all-inclusive.

There are certain drugs that have been traditionally used with aquatic animals and are considered by many to be "not new animal drugs." However, as defined in the Food, Drug and Cosmetic Act, the majority of drugs used in aquatic mammals and fish are new animal drugs. The Act defines a new animal drug as any drug not generally recognized among experts qualified by scientific training and experience to evaluate the safety and effectiveness of animal drugs, as safe and effective for use under the conditions prescribed, recommended or suggested in the labeling.

The courts have ruled that general recognition of safety and efficacy must be based upon data from adequate and well controlled studies, not from the opinion of "experts." However, in reviewing basic information on

the safety and efficacy of some of these drugs, there were no data per se to support this.

There are few approved drugs for fish and none for aquatic mammals, and most drugs used for treatment of diseases in species such as aquatic animals are considered minor use drugs by FDA. The cost of research and development of minor use drugs is often greater than the profits which can be obtained from sale of aquatic animal drugs. For this reason, not many companies are willing to sponsor new animal drug applications for aquatic animal medicine. There just isn't enough demand for the product. As there are few approved drugs for application to aquatic animal disease problems, there is high usage of unapproved drugs.

The use of approved products in non-food animals seldom creates a public health problem, but they may be neither safe nor effective for the subject being treated. The user of the drug is basing his application on his own or another's judgment that it is probably safe and effective. "Safe and effective drugs," as determined by use experience, is often based on small samples involving uncontrolled studies in which the treated animal did not die, or show any apparent toxic reactions, and appeared to get well or improve.

The requirements of the Act are very stringent and have made research expensive and apparently prohibitive. The term fish includes so many species that testing for all species is virtually impossible. For example, five fish species were proposed as models to demonstrate safety of specific drugs for all fish species. An attempt was made to select the most sensitive species. It is, however, very presumptuous to say that the safety of a drug for these five species is such a good model that we can apply this across the board. When tests are proposed, many questions arise, such as:

- what environment should the fish be placed in?
- should the water be hard or soft water?
- is pH important?
- is it safe in both oviparous and viviparous?
- is it usable in both salt water and fresh water?
- what is the effect of temperature?

Application of drugs to food fish raises new problems. There are additional requirements on food fish. It must be demonstrated that when using the product there is no residue of the drug in the edible tissues of the animal (fish) at the time it is intended to be used, or that the level of the drug (residue) is, in fact, safe for man. To further complicate matters, this requirement applies to the major metabolites of the drug also. If the data is to be species specific, then the generation of data and its analysis become a more difficult problem in the generation of data.

Due to such problems, we have developed a Minor Drug Policy in the Bureau of Veterinary Medicine. The policy says that data generated in

closely related species and other animal models may be extrapolated to the target species in drug application. This may allow for greater flexibility; if the metabolites are the same in "x" numbers of species, then there won't be any need of further demonstration of the safety of that metabolite when it is used in target species.

In the FDA the human drug residue question is controlled within the Bureau of Foods (BF). Although the apparent dual jurisdiction can cause some problems, they (BF) have the ability to determine if the safety level of tissue derived from food fish would be safe for man. The cost of data gathering here too is also high.

Because of these problems, there is a need to share data. Aquaculture groups such as yours, for example, could sponsor a "new animal drug application," and pool data. This would decrease the expenditure of resources for a single sponsor and still allow for generation of significant data.

At a future time, if you desire to obtain approval for a new animal drug, I strongly recommend that you consult with the Bureau of Veterinary Medicine before initiating any studies that will involve the expenditure of significant resources. We can and will review any protocols submitted to us. Through the cooperative efforts of groups like yours, the drug industry and the federal government, I only hope that more safe and effective drugs will be available for aquatic animal medicine.

If you have a question relative to the new animal drug status of a particular product, you are invited to write to the:

Bureau of Veterinary Medicine
Food and Drug Administration
5600 Fishers Lane
Rockville, Md. 20857.

YOUR REGULATORY WORLD -- CHANGES IN AND INFLUENCING IT

Robert B. Brumsted

Mr. Steele offered a valuable insight into the world of government when he said that bureaucrats in the real world work in a "quagmire of conflicting pressures." This certainly can be true for people like myself who work in the regulatory arena and who would welcome making the quagmire as habitable as possible. But bureaucrats can't do it alone and, in fact, it can be done only with individuals like you and groups like yours whose interests are affected and who possess the essential background for changing the habitat.

If we are really interested in making our particular quagmire less hostile we must recognize some facts concerning and factors contributing to it. First among these is the fact that both the bureaucracy and its regulatory regimes are creatures of legislation passed by Congress in response to some perceived public need. Once in place, it is generally very difficult to have such legislation rolled back or significantly modified. In the case of the Marine Mammal Protection Act, most observers of the Congressional scene would agree that there is little likelihood that the Act might be changed in any significant way in areas of interest to IAAAM members. I suspect the same may be true of the Animal Welfare Act.

If we accept the first fact that there is little possibility of going back to the days prior to extensive legislation affecting marine mammals, then we should have little difficulty recognizing the second one. Regulations governing your activities and our relations are and will continue to be a way of life. Further, because they do exist, these regulations tend to proliferate and to help in promoting other regulations of which those recently issued by the Department of Agriculture covering care and maintenance of captive marine mammals under the Animal Welfare Act are an example.

If we accept both facts -- that legislation, and regulations in potentially increasing number are a way of life we will have to share together -- it seems to me that our next step should be to determine how this way of life can be influenced so that the quagmire effect is minimized. That this can be done is, at least to me, also a matter of fact. Examples demonstrating this come immediately to mind.

The first example is the change in my agency's interpretation of veterinary certification in applications for permits to maintain captive marine mammals. Here, an individual's "pressure" resolved "conflicting" views in favor of that individual's approach. As a result, certification is now done by the veterinarian responsible for the animals, as reasons would require, rather than by an outsider, as had been the case dictated by concern over the validity of insider certification. What made the change possible was a factual presentation of relevant information that enabled us to set valid, but emotionally based, opinions aside. The first point for successfully influencing regulations should be apparent in this example. It is -- Communicate -- and, where possible, make it fact rather than opinion.

A second example of influences on regulations is the impact that implementation of the Animal Welfare Act marine mammal standards will have on Marine Mammal Protection Act permits for captive wild animals. As a benefit of this implementation, I expect that about 75% of the information we now must ask for will no longer be required. Thus a positive improvement has come from additional regulations. From this, point two for influencing the regulatory world can be derived. It is -- recognize that regulations are (or should be) non-emotional, not necessarily either good or bad, but simply requirements over which some measure of control can be exercised. As is apparent, substantive communications and in-depth

involvement can produce positive results as they did in this case where a lot of careful thought and effort on your part and that of the agencies has improved operations in our joint area.

An area that is not directly related to the facts we've discussed thus far but is relevant leads to my final point on how to influence your regulatory world. It is -- "Watch the store." Regulations and/or legislation in areas other than those you believe will affect you can do just that. For example, I'm sure that most of us did not suspect that non-endangered, non-threatened, small marine mammals were likely candidates for listing under the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Nonetheless, that is exactly what happened at the last meeting of the parties to the Convention and so an additional permit will be required for some of your activities. I'm not suggesting that such a requirement is not needed but only that changes in the regulatory world can be sudden, rapid and virtually permanent. "Watching the store" is obviously the only way to influence such changes at the most important time -- inception, and this thought is basic to my summary as to how to make regulations work in all of our best interests. Simply, we need to recognize that regulations do and will continue to exist; that they are not necessarily bad; and that to insure that they have a positive effect, you need to provide factual guidance and help to the regulatory agency as early and completely as possible.

Although I hadn't expected to be one of the speakers during this session, I am happy to have had these few minutes to update you on the Marine Mammal Protection Act regulatory world and to provide some thoughts on influencing it. As usual it is a pleasure to attend your meeting because it gives me a chance to improve my own lot in the quagmire as well as to express my own and my agency's thanks for the many valuable contributions of the IAAAM and its individual members.

SECTION III: A NATIONAL AND INTERNATIONAL OVERVIEW OF AQUATIC MEDICINE

THE UNITED STATES

D. O. Beusse

Speaking from my experience as practitioner of aquatic animal medicine in the southeastern U.S.A., I can state that such practices involving aquatic animals are becoming more sophisticated, especially in the past few years, and involve a greater variety of animals.

I think when you become involved in aquatic animal medicine, one of your highest priorities is acquiring good personnel (e.g., personnel adept at handling the animals, familiar with the normal state, and who, through keen observation, can greatly assist in diagnosis of medical problems). The training of personnel is now accomplished mainly in-house at a considerable expense. Hopefully, in the future training institutions can assist in this education.

The number one goal in medicine should be the extension of the life expectancy of an animal. This can be accomplished in marine parks by control of the environment in which the animal lives. Water quality, nutrition, vaccinations and medical prophylaxis are all necessary tools in the prevention of animal disease.

Prevention of disease starts with the arrival of a newly acquired animal. Isolation is necessary, not only for its health, but for the health of the existing collection. This procedure is necessary for all groups of animals, be they fish or mammals. Periodic examination, involving both external and internal parameters, is an important part of disease prevention. Finally, post mortem of every expired animal provides needed learning experience that can be applied to future situations.

Successful treatment of disease starts with diagnosis of the problem. This is greatly helped through the adequate observation by well-trained personnel. If restraint is required, the properly designed and handled equipment is a must. Clinical pathological analysis, whether in house or outside, needs to be both accurate and rapid as aquatic animals have a tendency to "sink" quickly. Adequate and extensive nursing of the animal is one of the major elements in the success or failure of any treatment.

Research is as important a part in aquatic animal medicine as in any other branch of medicine. However, it is often difficult to "pay your own way." Much research is currently being carried out through the U.S., and more could be accomplished by utilizing available grants from different agencies.

Much can be learned from both alive and expired specimens, be they captive or wild, but how can this be accomplished? The basic requirement

is communication and cooperation between the aquarium/oceanarium, universities, and research personnel. We need to adequately train more personnel, possibly by including such in veterinary technician programs. There is a great need for elective courses dealing with aquatic animals in veterinary schools so that potential DVM's may be exposed to the unique problems of aquatic animals.

In conclusion, a look at aquatic medicine is fascinating. A great deal has been accomplished in the last ten years -- even the last two years. But where will we be in twenty years? One must foresee greater utilization of the oceans and the ocean's animals, so we must continue to improve the state of the art. Some recommendations to accomplish this are:

1. Continued research in husbandry.

2. Continued research in disease prevention and treatment.

3. Development of equipment for handling of animals.

4. Development of educational and training facilities for professional and lay personnel.

5. Development of food resources for aquatic animals that are nutritious and economical.

6. Research into animal behavior to better understand the animal's wants and needs.

7. Extensive communication within the aquatic animal field so each may benefit from another's experience.

Let us all, private industry, universities, state and federal governments, and countries, work together to the benefit of our aquatic friends.

THE ORIENT:

INFORMATION -- THE KEY TO OUR FUTURE

D. D. Hammond

Several years ago a colleague veterinarian told me that she had never successfully treated a cetacea: once the clinical signs were observed the disease was generally terminal. I can personally state that I have at times felt the same way.

However, as a result of information exchanged through organizations like IAAAM, diagnostic methods have considerably improved the art and science of aquatic animal medicine over the past several years. For example, the research conducted by a variety of organizations and agencies has made it possible to establish normal blood values for many species; generally speaking, this information is freely available to all scientific institutions. In my opinion the "weak link" at the moment is the great lack of qualified pathologists to assist in the interpretation of histology. To the best of my knowledge, there are no laboratories which offer their services on a "business" basis. Histology is commonly conducted by the personal friends of people in our profession -- associates who are inclined to be interested in marine mammals.

While testing is usually done as a favor and at no cost to the practitioner, the "turn-around" time for histology reports can vary from six months to one year. Speaking for my own organization, I know we would be more than happy to pay for laboratory work if we could receive reliable information in two to three weeks' time. Free service, done on a basis of mutual interest and friendship, may be acceptable for general, long-term research, but it is of little comfort or value to the practitioner in the field who is experiencing an epidemic in his animals and requires laboratory reports as a basis for treatment.

This situation is compounded by the confusion surrounding the United States "Marine Mammal Protection Act" -- which prohibits the importation of marine mammals, "in any form," without special certification. While this provision can be circumvented by mislabeling samples, such action is demeaning and forces the ethical practitioner to flaunt the letter -- if not the intent-- of the law. More recently, authorities are permitting biological samples to be imported, but this aspect of the act hangs like Damocles' Sword over the research of the very animals the act is intended to protect.

The relationships between the veterinarian, oceanariums, marine life and the general public have always been in flux but never so much as in the last few years. Oceanariums now find it necessary to react to the public awareness which they, themselves, originally fostered. They are no longer merely a facility for recreation. Now, more than ever before, oceanariums are becoming a source of vital scientific information and a positive influence on youth and conservation organizations.

As the competition for the fish supplies of the sea increases, the likelihood of marine mammals being pushed to extinction is not beyond the realm of possibility. For example, there are approximately 5,000 Australian sea lions left in the world. The numbers of dugong and manatae are showing annual decreases.

I can appreciate that small organizations cannot afford to maintain detailed records or finance research programs. But as professional practitioners -- whether associated with large or small organizations -- we have an obligation to advise and a responsibility to fulfill roles in

scientific research, animal husbandry, company management and public opinion. These roles must be fulfilled simultaneously; our unemotional input is important to the public's and government's decision-making process.

I'll refer to the aspect of public opinion in a moment but I'd like first to comment on the value of scientific information exchange. Initially I'd like to state that the prestige of an individual or the size of the organization for which he works has little bearing on the value of information. Within reason, observations, evaluations or even theories from a handler working in a small organization should be sought, exchanged and evaluated with the same care as a thesis one of us might prepare. The important thing is the free exchange of ideas and information.

Early diagnosis is always difficult in cetacea. And in certain pinnipeds -- particularly the Stellers -- blood sampling, in itself, can be a bit of a challenge. At Ocean Park we routinely draw blood every 30 days on all cetacea to establish the normal blood values of Tursiops aduncus. This sampling also provides an "early warning system" of pending disease. There are several blood tests which I have been unable to correlate with disease but yet seem to indicate a pending clinical problem. One, in particular, is the test for alkaline phosphatase levels. Our laboratory records incidate values exceeding 1,000 units are not uncommon and are generally found in a healthy animal. Values below 300 are usually associated with disease.

I have not yet ascertained the importance of this observation, but I believe the observation and the cause could be significant. The mere fact it has been mentioned could be the initial step in the creation of a new diagnostic method. Access to this kind of information -- and the application of this organization as a forum -- has already provided beneficial returns: the NBT test, which provides non-specific monitoring examination, was first described by Greenwood at a meeting several years ago. This method has been used in our laboratory for the past two years. As an extension of the basic test, I also require our trainers to observe and record the type of feces and smell the breath of each cetacea as part of their daily routine. If there is any foul or unusual odor to the breath, a culture plate is made of the expired air. Of 300 samples taken we were able to isolate pure cultures of Staphlycoccus aureous and confirm three cases of Staph. pneumonia before clinical signs were observed.

Our laboratory is also working in conjunction with Scripps Institute of Oceanography on research involving a gasflow meter placed over the blow hole of the dolphin. Since there is a rapid and large tidal volume in the forceful respoiration of cetacea, its flow can be readily measured. If pneumonia or another airway-blocking disease exists, there is a resultant reduction in the tidal volume. We have also trained the sea lions to participate in a similar test by placing the machine over the nose of the animal. This early detection system is still indevelopment and it will probably be quite some time before normal values are established. However, these examples show that the state of the art is constantly being developed.

They also make the point that the exchange of information is important if not vital to our growth, and that these meetings -- and organizations such as IAAAM -- provide the conditions for such work to prosper.

Now, if you'll bear with me through a rather oblique lead-in, I'd like to address myself to the question of public opinion. The breeding of marine mammals in captivity is in its infancy. There are several publications out on the subject and the seminar held on dolphins in the United States at San Diego two years ago grouped together many of the observations made by a variety of facilities. Having read the difficulties of neonatal dolphinology and the low percentage rate of success, I was able to prepare my company in advance for the cost and difficulties involved in trying to set up a breeding colony for cetacea.

In S. E. Asia one of the most obvious areas of research is fish mariculture. Fish farming is a substantial part of the economy in certain countries -- particularly in the Philippines, Thailand and even in the New Territories of Hong Kong. Generally speaking, all aspects of fish farming benefit more from preventive medicine than from trying to contain a disease once it is started. This is due in no small part to the large number of fish involved, and the cost and difficulty of medication. For the same reason, we use preventive medicine on behalf of the mammals and fish under our care -- and preventive knowledge in our relationships with management. We must also begin to apply more preventive attention toward our role in forming public opinion.

There is probably no marine facility which does not require some aspect of governmental approval for the acquisition and keeping of marine mammals. Geographically isolated facilities such as Ocean Park in Hong Kong may deal with seven or eight different governments a year concerning the acquisition and transport of animals. As a consequence, governmental recognition of one's facility and expertise is frequently vital. The nature of our business often requires us to receive animals after normal working hours. Such late shipments can create difficulties with governmental officials unless our problems are understood. Our lack of real involvement in the formation of the Marine Mammal Protection Act has created problems which, I am certain, none of us could have foreseen. Yet we, of all people, should have been spearheading the legislation. For the sake of our professional reputations and -- let's be honest -- for our livelihoods, we should have better guided this legislation so it reflected both our concern and our self interests.

The point I am trying to make is that we must utilize every opportunity to develop a good rapport with the public and with pertinent governmental departments before a problem presents itself. The IAAAM has been instrumental in establishing guidelines which, although not always applicable to every facility, certainly have provided a framework and a starting point for effective marine mammal management. The art and science of collecting, keeping, and in many cases breeding aquatic animals is certainly a specialized occupation.

We cannot afford to ignore the public and political climate in which we work. Time must be spent in preventive public relations. In the case

of aquariums in S. E. Asia, there are many unusual husbandry requirements which are not found in Europe and the United States. For example, Ocean Park has had to assume the role of a research center for marine mammal diseases in S. E. Asia in order to maintain its own marine mammal inventory. This is particularly true because of the contamination of our water system by Pseudomonas pseudomallei. This bacteria can be freely cultured during the typhoon season and is literally everywhere. Our laboratory has grown the bacteria from sea water, the roof tops of our buildings, school playgrounds and along surfaced roads. In addition, we have isolated the bacteria from the intestines of fish caught off Australia, Hong Kong and Japan. The presence of this bacteria has required our organization to develop a research vaccine program against Pseudomonas pseudomallei and, at the same time, explain what we are doing to the public.

Ocean Park is fortunate. We have a marketing staff who keep themselves abreast of my department's problems, work and objectives. With an average of 6,000 visitors a day -- every day of the year -- we have found it impractical and often detrimental to try and keep troubles to ourself. From our Board on down, all aspects of our operations are attuned to preventive medicine. In the field of public relations we have created a reputation for being overtly candid. And, in the long run, this has worked remarkably well: the public is sympathetic to any troubles (the media handle our problems in their true context rather than exaggerating); everyone takes delight in our successes; government respects our integrity and provides utmost cooperation.

Each locality has its own degree of public awareness towards aquatic animal medicine. The public, in general, can be quite emotional -- particularly when dealing with cetacea and pinnipeds. Public awareness can be nonexistent one day and a volatile issue the next. Therefore, it is good common sense to develop a preventive medicine approach in regard to relations with the general public. Every event, no matter how big or small, should be analysed for its effect on public opinion and, whenever practical, should be exploited to create public confidence in the oceanarium and, in particular, confidence in the veterinarian and his staff.

It is my opinion that where there is liaison between government officials and the aquarium or oceanarium, plus a balanced exposure in the news media, the chance for adverse publicity can be greatly reduced or possibly even eliminated. Certainly, as professionals, our advice is more likely to be sought. We will be better able to influence our own destinies if we have established a reputation for candidness and availability.

Information can work for or against our best interests. On a scientific level, the free exchange of information can make our jobs easier and our treatment success rate higher. We have the ability to develop the state of the art beyond our wildest dreams. Information can -- and must -- be used as a tool of management to influence public opinion and governmental legislation. Unless we want the "tail to continue to wag the dog," we had best sit up and take note. Abused or ignored, information will hurt us when and where we least expect it. And if we don't take an interest in all fields of animal medicine -- even those beyond our immediate sphere -- we leave ourselves open to speculation or, worse, to exploitation by unqualified "experts."

All of us have a deep respect for our profession and, as a consequence, we all work to the best of our abilities. But it is not enough to do good; we must be seen to be working in tandem toward the good of all -- if we wish to realize our potentials as professionals both individually and as a group.

THE WEST INDIES

Nicholas R. S. Hall

In defining a disease entity, it is possible to gernalize from what has been learned about terrestrial animals to their aquatic counterparts. Cellular reactions to pathogens are similar enough that descriptive studies can be conducted with relative success. But in addition to describing the pathologic process, it is equally important to be able to assess the impact that the particular lesion or disease has upon the animal in question. Such an assessment cannot be made without an understanding of how the diseased organ system functions in the non-diseased state. Despite several ongoing research projects being conducted in various parts of the world, there is still a paucity of information concerning the normal behavior and physiology of marine mammals.

There are two primary reasons why this information deficit exists. First is the limited availability of suitable animals and the lack of research facilities. When marine mammals are made available by oceanariums for research purposes, we have been told that the scientist often feels like a fifth wheel since oceanariums are primarily recreational facilities. Limited funding is another reason why so little is known. One cannot blame granting agencies for being reluctant to spend the taxpayers' money on marine mammal research when there are inadequate facilities where such work can be conducted. When facilities are available, data that is based upon a population sample of one or two animals is often statistically meaningless and precludes proper interpretation. Conversely, the investigator will argue that the reason well-designed studies cannot always be conducted is because of inadequate funding. A possible solution to both of these problems is to be found by crossing international boundaries.

Instead of transporting marine mammals to a research laboratory where maintenance can be a logistical and financial nightmare, the investigator should consider the transporting of the research laboratory to where the animals are readily available and to where they can be maintained at relatively low cost. As a consequence, experiments could be better designed and a larger population of animals could be sampled for more meaningful interpretation of the results.

I cannot speak for all areas of the world, but I will briefly summarize some of the advantages of conducting cooperative studies in small developing nations in the Caribbean. First, no less than 12 cetacean species have been identified in the waters of the Lesser Antilles. Pilot whales and bottlenosed dolphins are routinely harvested by the fisherman on St. Vincent, and occasionally on Grenada. These animals are captured using small gaff rigged sailboats and modified shotguns firing harpoons. A skilled whale collector with a fast boat would be expected to have no great difficulty in getting close enough to capture live animals for research purposes.

The cooperation that one receives in these developing nations is remarkable. In the case of my own research program in St. Vincent, I have been able to enlist the cooperation and assistance of local government agencies including the police, who supervise some of the logistical aspects of the research. Many of these island nations depend upon the sea as a source of food. Consequently, the governments of these nations realize the advantage of bringing people into their countries who have expertise related to the marine environment. In order to attract this expertise to the island, the governments of both St. Vincent and Grenada have agreed to waive the import duty on equipment taken into the island, have exempted investigators from having to have work permits, and have agreed to provide some facilities for conducting the research. The governments of both Grenada and St. Vincent have also granted special permission to enclose lagoons in order to create marine mammal holding facilities. These enclosures could be made out of piled volcanic rocks between which sea water could readily pass. Such enclosures could be cleaned by tidal action so there would be no requirement for pumps and expensive filtration systems. Food fish would be obtainable from the local fishermen at prices that are considerably lower than in the United States. A final advantage is the capability to conduct research year round under almost constant conditions. St. George's University in the Grenadines has established a new campus in St. Vincent, Kingstown College of Marine Sciences, for the express purpose of providing research and training facilities on the island.

There are certain disadvantages that have to be considered. Transportation of equipment and personnel has to be budgeted for. There can sometimes be political complications with the local governments and there can be delays in transporting tissue from endangered species back to the U. S. All of these problems are solvable. The cost of transporting equipment and personnel is more than offset by the savings in maintaining experimental animals. Political complications generally occur as a consequence of misunderstandings, but these can usually be resolved by better understanding of the native way of doing things. Delays in transporting tissue can be due to not always knowing the port of entry into the U. S. in sufficient time to notify the appropriate agency. This is not the fault of the agency. It is instead due to the inefficient way in which some of the small airlines in the Caribbean operate. The solution to this particular problem would depend upon the individual circumstances.

Only certain types of research projects are adaptable to the setting that has been described. Especially well suited are investigations

concerned with behavior and those that depend upon fresh tissue samples. During 1978 and 1979, a study of the cetacean nervous system was successfully conducted in St. Vincent and Grenada. To be of histologic value, brain tissue must be sampled and preserved within a very short time after the animal's demise. This was possible since fresh brains from a variety of cetacean species were purchased directly from the fisherman when the animals were brought onto the beach for marketing. Fixation and gross examination of the tissue were performed on the island. Permits were acquired with relative ease to enable samples to be sent to the U. S. for histologic study.

Whether the advantages of conducting other types of marine mammal research outside of the United States would be offset by some of the inherent disadvantages would have to be assessed by the investigator. However, the potential for considerable cost reductions and the availability of more meaningful population samples justifies the consideration of cooperative ventures with foreign governments.

THE UNITED KINGDOM AND EUROPE

A. G. Greenwood and W. H. Dudok van Heel

There is extensive interest and expertise in aquatic animal medicine throughout Western and Central Europe, and the Mediterranean basin, but effort is largely confined to fish and invertebrates in response to the importance of aquaculture and the fishing industry. The countries of Scandinavia and Eastern Europe are the leaders in the field of aquaculture, but Israel, Italy and the United Kingdom, in particular, are rapidly expanding their interest. Culture of marine fish, fresh water fish and invertebrates for the table and restocking programs is the subject of an intensive research effort. In Britain, species such as rainbow trout (Salmo gairdneri), sole (Solea solea), turbot (Scophthalmus maximus) and oysters are farmed on a production or experimental basis. Cyprinid fish are farmed in Central Europe and Israel, whereas the Salmonids are the chief subjects in Scandinavia and Iceland. There are problems in the development of aquaculture as a viable industry, particularly related to marketing and economics, and, in Britain at least, growth has not been as rapid as expected. Nevertheless, research is extensive. One of the leading European centers is the Unit of Aquatic Pathobiology at Stirling University, whose research into fish and invertebrate disease is led by veterinarians. The Ministry of Agriculture has fish disease laboratories and several major corporations undertake their own work in nutrition and medicine. Similar centers exist in most European countries. In October 1979 an attempt will be made to create a European Association of Aquacultural Pathologists out of an existing working group of fish pathologists.

The industry has complained that the numbers and ability of pathologists have not been matched by active health workers in the field. There is undoubtedly considerable dispute as to whether aquaculture medicine is a field for veterinarians or biologists. It is likely that the government and commercial veterinarians, with new extensive laboratory support, will maintain their lead in this field over the private practitioner. But there are a number of practitioners and university consultants in Europe who have made good progress, by effort and commitment, in both fish farming and tropical fish medicine. Particularly important publications in this field are Roberts' Fish Pathology, the Journal of Fish Biology, and the Journal of Fish Diseases.

There is no major work on aquatic reptiles in Europe, except for the interest of some individuals in pet turtle medicine. Turtle farming is not practiced in our region, although it may be expected to develop in the Mediterranean area. Aquatic birds, on the other hand, have been the subject of extensive study. Oiled sea-bird research and rescue centers exist in Britain (University of Newcastle), Holland (Netherland Institute of Sea Research) and Scandinavia. Birds are also used as monitors of less obvious marine pollutants. The Marine Pollution Bulletin co-ordinates much of this and other work on marine environmental damage. Continuing studies are devoted to disease in aquatic birds, especially related to human disease, including botulism and influenza viruses.

Marine mammal medicine and related studies are not as widely pursued in Europe as in North America. Most work is incidental to the three areas of interest -- whaling (confined to Spain, Iceland and Norway), population biology of indigenous species, and commercial oceanarium display. Legislation specific to marine mammals is considerable, although generally not restrictive to medical work. Most European countries are signatories to CITES (Convention on International Trade in Endangered Species), which now covers most marine mammals, and an E.E.C. convention on marine mammals is under discussion. Britain and Holland have specific legislation protecting indigenous cetaceans and pinnipeds -- that in Britain having existed for some 700 years. Pinniped culls occasionally take place in Britain and Norway, although in most other countries emphasis is on rescue and rehabilitation of stranded seals, and the effects of pollution on declining populations. Public interest in seals and their welfare is very high throughout Northern Europe, and much effort is being expended to bring about similar attitudes to the Mediterranean Monk Seal (Monachus monachus) in its home range. The latter culminated in the First International Monk Seal Conference, held in Rhodes in 1978.

Live capture operations for cetaceans are limited to Iceland (killer whales and dolphins), a small area of Italy (dolphins) and the Black Sea (dolphins). These operations are closely monitored by veterinarians. Networks of scientists to monitor cetacean strandings are extensive in France, Holland and Britain. Increasing study is made of the pathology of stranded animals, cetaceans and pinnipeds, although little public attention is directed to these efforts. In general, live stranded specimens are not clearly covered by the law, and are consigned to the closest competent

facility for care. The authority of the veterinarian on the spot to recommend care of such an animal is usually accepted by officials without argument.

Pinniped research effort is high in Britain, Holland and Scandinavia, the latter concentrating on pollution studies. In Britain, work by the government's Sea Mammal Research Unit relevant to medicine includes comparative blood studies of captive-reared and wild seals, serum, fat and milk polymorphism in seal populations, and pathology in seal colonies.

Research and medical work on small cetaceans is limited to oceanaria, which are numerous but generally small in this region. Most research is incidental to the keeping of animals for public display, although much effort is now being put into improving breeding and calf survival. There is little or no government or university backed work in this field, with the notable exception of the USSR, about which little information is available. The European Association for Aquatic Mammals represents the industry and holds annual conferences. Most information is collated by this organization and is usually published in the journal Aquatic Mammals. Medical work by the authors and colleagues includes clinical care and pathology of captive animals, with specific current research in the areas of protein polymorphism in Tursiops, causes of still birth and neonatal death, thyroid function, toxicity of chemicals used in water treatment, and continual improvements of clinical and therapeutic techniques.

One major new feature of international effort in this region must be mentioned -- the extraordinary Action Plan for the Mediterranean, which, with all 18 countries surrounding the Mediterranean Sea agreeing to co-operate, must represent a unique political and scientific endeavor. It is hoped that efforts under the Action Plan to improve the marine environment will take into account aquatic animal disease studies.

Note:

Journal of Fish Biology - Academic Press, London.
Journal of Fish Diseases - Blackwell Scientific Publications, Oxford.
Fish Pathology - ed. R. J. Roberts - Bailliere & Tindall, London.
Netherlands Foundation For Aquatic Marine Research, Netherlands.

CANADA

A. Hoey

There is a great concern among people in Canada like ourselves and those of the Canadian Association of Zoological Parks and Aquaria about legislation in Canada in the overkill fashion that you in the U. S. are

faced with. We have modified the existing legislation so that it is not too tough to live with. So far, the government is withstanding considerable pressure from environmental groups, and is using their own research and that of the scientific community. However, there is definitely a concern and a need for the scientific associations to feed the government data that will keep such legislation in the middle-of-the-road.

A quick overview shows conditions to be similar to that of the country itself; small areas of population with great gaps in between. Canada is a country with a large amount of natural resources, and management of these resources seems to be the avenue that is pursued. Aquaculture hasn't really come into its own as yet, and as such is more a management of resource by the government rather than farming. However, there is some fish farming on the prairies in Manitoba. Interestingly, there have been a couple of private farms started on Vancouver Island with moderate success, along with a government funded aquaculture program for the native indians.

In the marine mammal situation in the oceanaria, there is almost no movement of marine mammals across Canada. Larger cetaceans are primarily housed in Niagara Falls, Vancouver and Victoria. There is a moratorium on killer whales with a permit system that allows for their taking by licensed exhibitors only on a replacement basis.

There are rumblings from commercial fishermen, due to the rather significant increase in protected mammal populations, putting pressure on the government to allow for the harvesting of sea lions.

Government austerity has shut down research on whales, while the increase in value of animals has shut down exhibits from doing reserach, especially on animals that may be hard to replace. Valuable animals will probably only be worked on when they are sick, with case histories and post mortems as the only "research" being done. There is limited research at some universities.

SECTION IV: CONFERENCE FLOOR DISCUSSIONS

(Editors' Note: Open discussion was encouraged to promote speaker-audience dialogue, and to provide the opportunity for additional insights. These discussions occurred throughout the conference and are organized on the basis of topics.)

Discussion I: The Veterinarian and the Biologist

T. Gornall: I would like to ask -- why don't we look to the area of biology where we all started? We all started biologically, very basically, in the womb of our parents. We have many roles in governmental agencies that are being filled by biologists that could just as adequately be filled by veterinarians, like many areas of field research, population dynamics and things of this sort. We must consider the whole animal -- its disease aspects as well as its biology and medicine. But we don't have many veterinarians filling biological roles!

M. Dulin: I would like to say that we shouldn't go out and take everything from biologists. And I don't think most vets would be willing to start out at $12,000 per year, which is what most of those jobs pay.

R. Eckberg: I think the veterinary schools are too busy trying to train veterinary students to emulate M.D.'s, and that has always been a big bone with me. When we have our meetings in California we always have to go to USC or UCLA and it really makes me fume. I think that the average veterinarian who makes presentations that I have seen is far better than any M.D. presenting the same subject. In fact, a veterinarian trains the intensive care nurses at the Medical Center, as they cannot get a doctor (M.D.) to present the material adequately. And I feel that the schools are very much at fault in not presenting to the student that he is treating the animal as a whole, as a biologist as well as a veterinarian. They get the students at the California Institution of Veterinary Medicine so conceited that unless they can start out at about $2,000 per month they are not doing what is necessary. I feel that if they keep doing this, they (the schools) are just going to strangle themselves. I think that if they are really going to develop veterinary programs the school itself is going to have to start teaching the students to get out there and work with the public and render a service. When the service is rendered, then the veterinarian himself is automatically going to be taken care of.

W. Evers: I am a veterinarian who has been in private practice, a surgical practice, for 11 or 12 years, who is trying to get into the marine area, especially fish. I think that, in my travels and talking with people, students in schools today are being told that possible positions for veterinarians in the field are available. But the general practitioner in the field, unless he is reading very specialized literature, does not know what is going on and he does not know what is needed. I would think

that maybe this might indicate to the industry that they are interested in getting veterinarians involved. That some sort of information be brought forward. Because, as Dr. Sweeney said, the "dog and cat" business is getting saturated. There are veterinarians on every street corner, and they are starting to cut each other's throats. If they are smart, they are going to be looking for different avenues in areas in which to practice.

R. Stroud: I guess that we all are talking about personal opinions, but the idea that the veterinarian is looking for other areas, because he is going to get crowded out of the dog and cat thing, is really not the individual veterinarian that should be in aquatic animal medicine. It is my opinion that the veterinarian should be a dedicated professional who has come up with this interest all along. Perhaps one who has had the background, training and experience all through school, and has had the interest in wildlife or fisheries, and can talk the language of the hatcheryman. Not one that wants to go into this area as a second thought. I think that veterinary training has a great deal to offer in comparative medicine and can help. But the people who go into this and will contribute most are perhaps those that are dedicated to the idea that these wildlife resources are perhaps interesting for their own sake and should be dedicated along that line.

E. Skoch: As a non-veterinarian and a professional biologist, and a member of the organization, I should point out that there is going to be, and is, a movement afoot of biologists getting into this field. Not necessarily as medical personnel, or medically oriented, but as corollary personnel who can be utilized by the veterinarian in the field. So you are going to run into some competition as veterinarians from the professionally trained ecologist, marine biologist, invertebrate or fish man, or what have you from the university.

D. Amend: I would like to make one comment as a non-veterinarian involved in this. I have come up through the fisheries with medical training along the line. I am a past president of the Fish Health Section of the American Fisheries Society, and have dealt with the Professional Standards Committee on this. It is a problem that is dealt with on the other side of the fence with the fisheries person feeling threatened by the veterinarian entering their field, which I feel is unfounded. It think it is an area that, I can reasonably say, is one of the reasons the veterinarian has not made an impact on it, because he has not been able to prove that he can contribute anything to it. You look through the line at who the leaders in the field are. And what is happening? It is the non-veterinarian who is leading the way. What I think it is going to take is a contribution between the two fields. The veterinarian is going to have to understand fish, that a fish is different from a mammal. He has to understand the physiology of the fish, what is going on in it, and make his impact through this direction in the same way the fisheries person is medically trained and is really in some ways inaequately prepared to do the job he is doing. It is going to take a marriage of the two disciplines to really make an impact in this field. The veterinarians who come through this field and want to make their impact have to understand fish, and they have got to be willing to accept a lower salary to get into it and make it. They have got the wave of the future to do it, but this is what I believe it is going to take to make it.

N. Vedros: I would like to make one brief comment in terms of what Dr. Sweeney said about expanding the area with marine mammal medicine. In our laboratory each year we have to raise about two million dollars in grant money, and since this is my responsibility in that organization, I can tell you my experience in trying to raise money to work with marine mammals. If anybody has put in an application to NIH and listed two sea lions, rather than one thousand mice or what have you, and think they are going to get it funded, it is not so simple. But there were some interesting aspects to this. We have found that NIH (National Institute of Health) is very interested in funding work for marine mammals if it has human implication, and I think Dr. Polto was the only one I know of who got a large grant, which covered trying to set up the whole facility. The intramural program in NIH is willing to fund this. The other is NSF (National Science Foundation). We have had very little success with Sea Grant in looking, at least, at infectious disease. So I think that one of the best expansions is to have people look at the marine mammal, at least in trying to apply basic biology to human medicine, which is where the money is. I think this is opening up more every year.

Discussion II: Publishing and the Literature

J. Sweeney: I have some comments relative to Dr. Dawson's presentation regarding the state of the art of research on marine mammals. It was well done, and the points made were well taken. I think that the state of the art in marine mammal medicine concerning the state of the publication set-up is perhaps, as he said, incomplete and inadequate. However, the use of computerized research mechanisms for preparing this kind of survey in the field is inadequate. There is in fact a large number of publications in the literature dealing with aquatic animal medicine and the subject areas as listed in the first part of the presentation are indeed covered in the literature through various publications, some by myself, Geraci, Ridgway, Smith, etc. Many of the publications are in the Journal of the American Veterinary Medical Association, the Journal of Wildlife Diseases, the Journal of Veterinary Research, as well as in major texts. I think that it is necessary to point this out before we leave, demeaning our efforts of publication in our own field. Make no mistake, we need to do more and it is well taken that much of the research currently ongoing in oceanariums does not wind up published. There is, currently, an existing body of knowledge in the literature and it should be pointed out.

W. Dawson: Dr. Sweeney is quite correct and I am aware of most of the publications he is talking about. The game we were playing here was to attempt to model the average researcher who has an immediate marine mammal problem and who is looking for a source of information upon which to base its solution. This is what we were trying to get at, using information which was rapidly available to that particular type of individual, who does not have years of experience as a curator or professional veterinarian in an oceanarium, and who has worked around such animals for a long period of time. Perhaps still, the workers including myself (I should say that some of my publications were not included in that particu-

lar document either, and one or two of those were in Science) who do work in the area don't do a proper job in making sure that the journals in which we write are either prestigious enough, or have enough national recognition, to be included in the National Library of Medicine files, which really are still the definitive source of biological research, at least in this hemisphere and also probably on an international basis. I would like to ask Dr. Greenwood, who appears to have more travel experience in marine mammals than most of us, about what I felt was a noticeable absence of comment on the situation for research for cetacean study in Russia. I am very impressed with the amount of work that appears to be coming out in Russian sources, and I am hoping that you, or someone here, could comment on the facilities and apparent investment in marine mammal research in Russia, and possibly tell us why they are doing it.

A. Greenwood: I deliberately left the Russians out, as I don't really know much more than any others. I read the titles in the abstracting journals and some of them appear very interesting (such as anesthesia of dolphins without positive pressure ventilation). I send off to get the translations, hoping to get them back in about a year's time. We did have Russian observers at the inaugural meeting of the European Association. But I think that when they found we were not intentionally physiological and were somewhat primitive at that stage, they went away and did not come back. We know that there is an oceanarium at Batume on the east coast of the eastern shore of the Black Sea, which has bred a bottlenosed dolphin. There is a small oceanarium at Constanze in Romania which keeps solely Black Sea Common Dolphins, and they don't see anything extraordinary in maintaining and training these animals at all. (That's all they ever had.) We know from the literature that there are various stations around the Black Sea and in the north of Russia dealing with marine mammal physiological research. Every effort we have made to get in there and find out about it has been rebuffed. We actually tried to hold a meeting in Moscow, or somewhere in Russia, for our European Association, through Dr. van Heel, who has good relations with them over walrus and such. But it has never really looked as if we would get any useful information out of them. It is obvious that they are working in fairly sensitive areas, and the things they are interested in have application in areas other than oceanaria.

N. Vedros: I would also like to comment on what Dr. Sweeney just said, because we went through the same procedure. On our campus we have about three or four computer literature searchers. They charge you about $7.00 per month for the National Library of Medicine and the Scientific Information Exchange. Then there is a computer in Stanford you can look into for biological literature, which is an independent search. But I would like to throw out a suggestion and give you an example of how it can work. Perhaps this society or several of its senior members can coerce the Marine Mammal Commission to fund such a project. In 1962, some of us were coerced to get back into the Navy when there was an outbreak of meningitis. The first thing we asked for was a literature search, since some of us had been working in other highly specialized areas. What they did was contract to the Independent Computer Retrieval Service in Washington, D. C., where there are several. For $45,000 per year, I believe was the funding, they

actually distributed this to three or four hundred people for about $1.00 per month. So, I think that perhaps in such a highly specialized area such as marine mammals and aquaculture, and due to the fact that several of the journals mentioned are certainly not in the Library of Medicine search, maybe we can do a better information retrieval by getting someone to contract this out. It can easily be done and several groups have done this, as small societies. Perhaps this society (IAAAM) can provide some pressure to fund this.

Discussion III: IAAAM Goals and Functions

Dr. Black: I just want to make some comments as to what I perceive the goals of this organization to be. I myself do not feel clear what the direction of this organization is. It seems at this point in time we have four different functions in the organization, and four things the members are involved with; hence, there are four factions, basically.

One is the marine mammal medicine as practiced in oceanariums. In my perception this seems to be limited by the needs and the resources of these institutions. It seems that marine mammal medicine developed as a support of the exhibit industry, and as a means to protect the health of these animals that were in these particular exhibits.

I feel that there is a second component to marine mammal diseases and medicine, which has implications in the field of wildlife biology. I feel that there are few persons in this group that are involved with that. I don't feel that there is as much emphasis there (on wildlife biology) as is placed on the institutional needs.

In aquaculture it seems that we are somewhat split. Some are in support of the fish/aquaculture/food industry, and to a lesser extent in the exhibit fish. Then there is the group involved in basic biological research, whose problems are somewhat compounded by trying to prove to national agencies that their work has applicability to human health.

I am looking at this organization, wondering how these types of things may be brought together in a manner to have a continuum between these factions.

J. Gratzek: First of all, it (the IAAAM) is necessary. I frankly like to come here and, although I don't work with marine mammals, I love to hear about them. I frankly like the diversity.

R. Stroud: I would agree very much with Jack (J. Gratzek). I find that this organization is refreshing in that it is so diverse. I think we learn, and this is what comparative medicine is all about. We learn from one species to another. One animal group has certain problems, which may be discussed as a marine mammal problem that involves research, basic medicine, basic physiology, etc. This is probably the only group where the fish people, who are involved more in the medical treatment of fish, may derive out of their group comparative information which will stimulate

new ideas in approaching problems they have encountered. I think that the one thing we do have in common, of course, is the aquatic environment. Because this environment is a situation where stress plays such an important role, both in mammals and fish, this is the main thing that holds it all together. We have the commercial people here who are providing entertainment services through the commercial aquaria. We have the food producers who are starting more and more to attend these meetings. They all have the economics in mind, the economics of health and medical care. Perhaps this adds another dimension, in that we can come back down to earth. Sometimes scientists get together who have basic research projects going on. But then we mix this through the strata of practicing veterinarians (whether in marine mammals or fish) or practicing fish health specialists, when then brings it down into the realities of the economics of treatment and prevention. This gives a homogeneous base to start from to put the whole thing together and produce something for the society (IAAAM) and a useable product for the society in which we live.

T. Gornall: So far as the cohesiveness of this group goes, I like to compare it to a stew. Occasionally you bite a piece of potato, a piece of meat, a water chestnut and you crack your tooth. We have many individuals from many different fields. I don't think that if you go to the microbiology meeting or veterinary meeting you will get this kind of broad spectrum. We are all sort of cooking in the same water. I think that is our cohesiveness -- we are all water oriented. I don't think we need anything else to pull us together. Basically the earth has more water on it than anything else. This is, I think, a direction we will end up going. The organization (IAAAM) can grow, by getting these different ingredients (I don't like to consider them factions!) on an international scale; get some foreign "spice" into this as well! I think it is going to grow and anything that grows too fast is not good. I think we have a good basis for growth, and that is what brings us together.

Discussion IV: Alternate Funding

E. Skoch: I have a question to pose to the veterinarians of this organization. You have all complained that you have a lack of reserach funds and cannot locate funds for research. I think that is pretty well true in any of our fields, whether you are a biologist at a university, a practicing veterinarian, an M.D. or what-have-you. However, there is a way in getting some basic research done on marine mammals by using the universities, small or large, which do not have veterinary colleges. I think we all have, those of us interested in aquatics, at least students looking for projects, funds and laboratories which at times just aren't busy enough. There are many small schools, as a whole group in Ohio, interested in marine problems. I am sure we could, with your cooperation, very easily get involved with the basic research and answer some of the questions that you are having trouble getting funded because we have small funds available. So, if you have problems, I would suggest you contact the smaller, local universities. And don't forget the inland schools, because you don't have to be on the coast to be doing

marine research. There is an association in Ohio of marine biologists at Bowling Green, John Carroll, Akron, Kent State, Ohio State, and even a Sea Grant Program. So, this is another way you can get your research done, and it isn't that difficult.

Discussion V: Drug Usage and Enforcement

T. Gornall: I would like to make a point about drug usage and usages of various medications in a research mode. In the needs of researchers outlined by Dr. Dawson pertaining to marine mammals, some reference was made to the needs of anesthetic drugs relative to cetaceans. In some areas of this kind of work we have usages of drugs that, by the FDA, have on the label for use by a specific individual only, with certain kinds of licensing and qualifications. In many instances this kind of drug usage is abused, and the information derived from the research conducted in that quarter is inappropriate. Because of this, we find that a lot of drugs that could very possible be used in some areas, aren't. I will take for an example the sea otter as an individual. For many, many years there was some early field work done by individuals who did not understand the usage of drugs; hence a lot of sea otters were lost in tranquilization and things like that. Then, a fellow working on his own, Tom Williams, along with a number of others, developed a mode of anesthesia for sea otters. This was a long time in coming, and I think that it was this way because there were a lot of individuals in the field using drugs which they should not have been using and were not licensed to use. What kind of teeth do the federal people have to regulate this kind of drug useage, because a lot of it goes on, even in their own federal community?

H. Hewitt: I am not quite sure of the question, but let's try it. Number one, there are two categories of drugs -- prescription and non-prescription. There is no other, other than some prescription drugs limited to a certain type of practice or regimented research. I know that a lot of drugs are improperly used, and some may be illegally used. The prescription status refers to the sale, as those that can only be sold to a licensed veterinarian. If you read the prescription legend, it says it is restricted for use by, or on, the order of a veterinarian. The illegal sale we do get involved in. Normally that is regulated by the state in which the people are practicing.

There is a catch to all prescription legends; one little catch. There is a provision in the regulations of the Food, Drug and Cosmetic Act, which says that certain people with police authority can use prescription drugs. If you have a complaint that is specific, please make it. We will look at it, and will probably follow the normal federal procedures.

Anonymous (directed to H. Hewitt): I know you have the "teeth" to regulate aquarium pharmaceuticals, but I also know that in the real world a firm could put a product out in the pet shops and not follow the procedures you outlined. How is this situation monitored?

H. Hewitt: Is it legal? No! However, for all things to be enforced, it takes people and priorities.

Anonymous (directed to H. Hewitt): What I want to know is, can you give us an estimate of how far down the line such laws will be enforced?

H. Hewitt: I can give you an estimate. It is according to the amount of interest that is given by the industry that has approved drugs. The priorities will be set according to the amount of complaints. . . This (enforcement of aquarium pharmacuticals) is low on the priority list.

Discussion VI: Education in Colleges, or Industry?

F. Hoff: I am one of the few mariculturists that I gather are here. After talking to most of the people here, it seems as if most of you are oriented to either an aquarium or some other veterinarian stiuation. We came here as members for the first time, and I would like to give you sort of my overall feeling of what I have seen. There is a definite need for you people in the mariculture field. I have been in it for twelve years approximately; marine aquaculture and not fresh water. We run a salt water tropical fish farm in Dade City, Florida, which I believe is the first one in the world. But we are stymied by a lot of problems. We feel like loners out there. Thanks to Dr. Gratzek, who is our only hope in many of our problems. Which seems a shame, because he is in Georgia, and is supposed to be taking care of some of my problems. I don't get the connection. It should be the state of Florida who should provide this service to us, especially with 250 fish farms in the area.

I would like to say that I would like to see you (the IAAAM) continue to have the split interest, not only in marine mammals, but also in fish. But don't forget invertebrates. There are very, very large amounts of money being spent on the mariculture of invertebrates, as by the Coca-Cola Company, General Mills, Ralston-Purina; millions of dollars are being spent. There is also a need right here for aquatic animal medicine. We are talking about food application in these cases.

Ours is obviously not for food, but for the pet business. We would like to see more interest directed to us. There was a statement also made that we cannot pay the fees; the fish farmers just don't have the money. Well, I don't think it is all that way. What can you (the veterinarian) provide me? Can you provide me a service, or am I going to have to train you how to take care of marine fish? I am not in a training position! I cannot afford to train you! Therefore, I would rather see people being taught in schools how to take care of marine fish. There is no practical experience in colleges that I can see, except for a very few, as Auburn and a few other places. Most people coming out of colleges know absolutely nothing about taking care of their own product. They can apply medicine to them, and so forth, but they really can't keep one alive themselves. That's bad, right there from the start. So, I would like to see those on the college level trying to develop a more practical teaching program. I am toying with the

idea, after listening to you people, of considering if it is possible (this is in private industry, where it is not always possible) to support a temporary situation for the summertime veterinarian student to tackle a single problem of ours, and we will partially pick up the bill. I am thinking about this, and I would like to invite students to maybe outline what they can do for us, or what they would like to pursue in marine fish. I will entertain this, and possibly will pass it on to other people in the mariculture field. Also (I do not know if you are aware of it), the World Mariculture Society has about three to five hundred members, all dedicated to the culture of aquatic animals. You, the IAAAM, might consider looking into this, as well as the catfish industry and of course the Florida Fishfarmers Association.

J. Gratzek: The IAAAM is trying to set up an education committee, and during the business meeting we established an educational program. It looks as if we can get some money from people like you and others; that we might have a fund available through this organization (the IAAAM). This would be for special educational projects. Hopefully this year we will be instituting such a program. I would like to ask you, as well as the tropical fish farmers association, to kick in some of that cash to the educational fund. Possibly we can get students to work on specific projects. There are at least four or five from the veterinary colleges that know fish and have a good basis of medicine, which will arm them to do something positive for us. This is the kind of activity we need.

R. Stroud: In reference to the comments by Mr. Hoff concerning crustaceans, I could not agree more with the broad concept of medicine, since it belongs in all groups. In fact, we have had in this organization papers on crustacean diseases. I again tried to solicit a specific, broad-view paper on shrimp diseases this year. Unfortunately, conflict with the speaker's other responsibilities arose. We will endeavor in the future to include this aspect in our programs. We did have a turtle paper at this meeting, and I think this is another area, even if a slightly different species. Many of the problems are all similar in the aquatic environment, and I think this broad facet is very important.

SECTION V: OPINION SURVEY AND QUESTIONNAIRE

Robert L. Jenkins and Joseph G. Halusky

The participants in the State of the Art Conference and other IAAAM members not in attendance were requested to complete a ten statement opinion survey and questionnaire. The opinion statements were selected from discussions the editors had with IAAAM members and the speakers prior to the conference. They intentionally focused on issues which were thought to be controversial in order to inspire open, frank discussion and encourage an opportunity to document differences of opinion among aquatic health specialists. The questionnaire was designed to survey the conference audience so that it could be characterized with regard to its experience in the aquatic animal health field.

The audience polled consisted of veterinarians, researchers, biologists, government officials and representatives from fields closely related to the aquatic animal profession (aquaculture, manufacturing, oceanariums/aquariums, etc.). The apparent trends and opinions in these results must not be considered a consensus of opinion among the aquatic animal medicine, or health, professionals. Rather, they can be considered indicative of the thinking of a select group of highly specialized professionals about a highly specialized and diverse subject.

We the editors are hopeful that the following will inspire further discussion between potentially conflicting areas, which should lead to a continuing communication and an eventual consensus of opinion for the good of the aquatic animal health field.

OPINION SURVEY: RESULTS

(Eds. Note: The following are the results from the opinion survey circulated at the conference and from a supplementary mail-out. There were 124 forms distributed at the conference, with an additional mail-out of 75 to IAAAM members not in attendance. Of the 199 possible responses, 24 were returned as undeliverable. A total of 79 survey forms were returned, giving a 45% response. Results for each statement are given as a percent of the whole (79). Although unsolicited, comments were written on the form usually describing reasons or conditions for the indicated answer. These comments follow each statement in their original form and are grouped according to the four response categories.)

	Agree	Disagree	Undecided	No Ans.
1. Persons who provide health services for aquatic animals should be licensed and/or certified by the state in which they practice.	45%	36%	15%	4%

Agree

-- Should fall under Vet Practice Acts and does in some states.

-- I agree if you delete "certified by the state . . ."

-- Need to resolve problem of how to certify qualified non-DVM persons who service fish health field.

Disagree

-- Opens door for politicians. Poor idea unless a broad gray area is considered. Just another method of pseudo-experts to be a success through drinking parties.

-- Beyond the established licensing for educational standards, any further regulations by government agencies should be avoided, though self-regulation within the field is desirable.

-- Mammals and Birds -- Yes! -- Fish No!

-- Only in the resident state. Licensing in one state is sufficient.

-- Regarding people who provide health care, I firmly believe that individuals other than veterinarians should be included. The maintenance of animals in captivity requires more than medical services. People versed in husbandry, nutrition, behavior and natural history of animals should be included.

-- Fishes and cold blooded invertebrates represent a group which needs separate consideration from mammals.

	Agree	Disagree	Undecided	No Ans.
2. Facilities utilizing aquatic animals and aquatic animal medicine are best managed by trained administrators with business backgrounds.	28%	56%	14%	2%

Agree

-- Provided the chief administrator is guided by a governing board and the goals and objectives of the institute are outlined and followed. Otherwise, I disagree.

-- Such management would be desirable provided there is excellent communication between business managers and biology managers.

	Agree	Disagree	Undecided	No Ans.
3. Regulations regarding aquatic animal medicine should be administered by a single governmental agency.	69%	15%	13%	3%

Agree

-- The profession is faced with severe pending legislation which will affect all of us. An international organization representing our interest is a primary problem.

Disagree

-- Should be under State Practice Acts.

-- No government agency in medicine.

Undecided

-- May be too out of touch.

	Agree	Disagree	Undecided	No Ans.
4. The bulk of research costs should be absorbed by the industry utilizing aquatic animals and not government grants.	19%	59%	19%	3%

Agree

-- Research costs for the aquaculture industry should be borne by that industry, though research for protecting, managing and maintaining wild populations might be financed by the government.

Disagree

-- Government should lead.

-- Additional industries must be developed.

Undecided

-- Jointly.

-- If there is no economic benefit to an industry sponsor.

No answer

-- Research costs should be covered by the industry for all research into

providing for the better care and well-being of animals in captivity; but other kinds of research should receive general support from other agencies.

	Agree	Disagree	Undecided	No Ans.
5. The direction of research in aquatic animal medicine is limited to too few species at the present time. It should be broadened to encompass more species and focus on disease as a phenomenon instead.	69%	18%	10%	3%

Agree

-- This is a rhetorical statement and everyone must agree, just as if motherhood and apple pie were good things.

-- Need to consolidate various aquatic animal health fields to provide cross-fertilization between specialists (immunologists, parasitologists, virologists, etc.) in mammalian, fish and crustacean health.

-- Availability of species.

-- Aquatic animal medicine must retain its divisions into mammal and non-mammalian medicine. The two types are related solely through their interest in similar environments, but the whole medical approach is completely different.

-- Financial support for basic research on the diseases and parasites of free-living marine mammals (including stranded animals) should be available. This should take priority over research concerning captive animals.

-- The industry and veterinarians should make a concerted effort to understand the habits and environmental conditions in which the animals live in the wild. Thus more funding for the ecological approaches to investigation of disease and physiology.

-- All veterinarians practice a form of environmental physiology but report information with little reference to the environmental conditions which set up stress.

-- Major priority: develop these animals as an experimental model; e.g., hematology and clotting; phylogenetic evolution.

Disagree

-- A more concentrated effort to collectively pursue baseline data is desperately needed.

-- Focus should be on management of aquatic animal health!

	Agree	Disagree	Undecided	No Ans.
6. Aquaculture should be given the highest priority for project funding for aquatic animal medicine.	45%	33%	21%	1%

Agree

-- For the present.

Undecided

-- Within reason.

	Agree	Disagree	Undecided	No Ans.
7. There is no need for a journal or abstract index dealing specifically with aquatic animal medicine.	6%	82%	12%	0%

Agree

-- No journal; yes to abstract index. Need to consider joint meeting and/or publication between IAAAM, Wildlife Disease Association, Fish Health Section, Mariculture-Crustacean Health groups, etc.

-- At this time.

Disagree

-- Too broad a category.

-- Strongly.

-- The association (IAAAM) should start a data bank on all marine mammal articles -- research and treatment. State by state encourage reprints of all research to be sent in and filed. Then a library would be formed to correlate the information. Other countries should be encouraged to send in articles.

-- The organization should assume responsibility and thereby obtain recognition and the lead role (which it should have) in all phases of marine medicine.

-- No need for journal -- need an abstract service, i.e. Bias.

-- Too much information (normal values, observations, etc.) is held by individuals in oceanaria, etc. More cooperation and effort needs to exist to compile normal value data for marine mammals.

	Agree	Disagree	Undecided	No Ans.
8. The field of aquatic animal medicine should be considered a distinct and separate profession.	32%	56%	10%	2%

Agree

-- It already is.

-- Agree!

-- More cooperation between the veterinarian and the scientist. Why cause the same gap that did occur in human medicine and physiology.

Disagree

-- It is veterinary medicine.

-- Encompasses a variety of disciplines.

Undecided

-- Delete word "medicine," substitute word "health" in the statement.

	Agree	Disagree	Undecided	No Ans.
9. On occasion it is economically more feasible to replace a diseased specimen rather than to medically treat it.	76%	15%	9%	0%

Agree

-- But it gets you nowhere -- down the line the same thing occurs.

-- On occasion (Eds. note: there were two such responses.)

-- . . . economically more feasible . . . but ethically?

-- Almost always true. But this is not humane nor feasible.

-- True of all species except man.

Disagree

-- At our institution we have never put monetary value on any of our animals and we try to provide all with the best care according to our abilities.

-- Strongly.

Undecided

-- Marine mammal or fish? (two such responses)

	Agree	Disagree	Undecided	No ans.
10. All of the above statements represent the priority needs faced by the aquatic animal medicine profession and industry. If not, please list your recommendations on reverse side.	13%	28%	24%	35%

Disagree

-- O.K., but you will have to wait awhile-- at least for as long a time as it took to think up and create this questionnaire (opinion survey).

-- Recommendations:
1) Controlling introduction and spread of exotic fish pathogens is a top priority need.
2) Development of new and efficacious biologics and vaccines for fish diseases, and getting these products licensed is a top priority need.
3) Quality diagnostic services are still not available to many areas of the U.S. Fish farmers deserve the same quality of diagnostic services that are available to other livestock species.

-- Effect of hunting and fishing and collection on genetics of wild populations.

-- 1) Artificial environments
2) Nutrition
3) Preventive medicine.

-- This field is too broad to categorize in a brief questionnaire. (Eds. Note: The writer illustrated relationships between Animal Health and categories of aquatic species as mammals, fish, turtles, invertebrates and their research needs. Briefly he divided "needs" into Diagnostic Services, Education and Research. He further subdivided Research needs into Therapy, Prevention, Stress and Environment, Nutrition and Management and Husbandry.)

-- Medicine and disease should extend to field studies, and stock and number studies.

-- Improvement in the education of the aquatic veterinarian -- the present acquisition of training is a difficult (unnecessarily) process.

-- More effective utilization of the experience and knowledge of laymen in a manner which esteems them, rather than belittles.

-- More programs needed to educate the industry personnel regarding aquatic animal medicine.

-- Aquatic Animal Diagnostic Service needed.

-- Aquatic animal education in veterinary curricula.

-- Support of IAAAM by industry and commercial sources. Possibility of obtaining institutional, industrial and/or commercial memberships . . .

-- Need public relations of aquatic animal medicine and/or IAAAM.

No Answer

-- Who said so? The big problem on the horizon is (i.e., 18 to 36 months from now) the EPA (Environmental Protection Agency).

-- "Aquatic animal" requires definition -- to me, it is any animal, single-celled or multicellular, living predominantly in water. IAAAM's interests are: mammals, birds, poikilotherm vertebrates and questionably the higher multicellular invertebrates.

-- Involvement of disease in wild populations.

QUESTIONNAIRE: RESULTS

(Eds. Note: The following are the results from a questionnaire circulated at the conference and from a supplementary mail-out. There was a total of 124 forms distributed at the conference, with a mailing of 75 additional forms to IAAAM members not in attendance. Of the 199 possible responses, 24 were returned as undeliverable. A total of 78 questionnaires were returned, giving a 45% response. These were divided into four main groups, designated as: Veterinarians (Vet), Researchers (Res), Directors or Curators of an aquarium or oceanarium (Dir/Cur), and Non-Professionals (Non), those who answered "no" to question one. Individual responses were then tabulated for each group and appear as the total number of responses (not per cent!) under their respective heading, with N/A denoting "No Answer." Written responses are direct quotations, except where paraphrasing was necessary for the sake of brevity.)

1. Are you professionally involved in aquatic animal medicine?

Yes: 92% (71) No: 9% (7)

How?

Veterinarians	total 25	Researcher	total 30
Consultant	14	University	15
Staff veterinarian	7	Industry	8
Research	2	Consultant	1
Instructor	2	Government	3
		Misc.	3

Director/Curator of Aquarium or Oceanarium total 16

Director	6
Curator	10
Keeper	0

Involvement of Non-Professional total 7

As an interest	5
Seeking future employment	2

2. What is your primary interest in aquatic animal medicine?

Veterinarians:		Researchers:	
Marine Mammal Health	19	Marine Mammal Health	5
Fish Health	0	Fish Health	11
Marine Mammal and Fish Health	4	Marine Mammal and Fish Health	3
Educating Professionals	2	Aquaculture Practice	8
		Aquatic Chemistry	1
		Drug Research	2
Directors/Curators:		**Non-Professionals:**	
Marine Mammal Health	4	Comparative Animal Medicine	1
Fish Health	6	Fisheries	2
Marine Mammal and Fish Health	5	Access to Knowledge/Field	2
Education/Exhibits	1	Marine Mammals	1
		Marine Mammal and Fish Health	1

3. How long have you been associated with aquatic animal medicine?

	Number	Total years	Average years
Veterinarians	25	231	9.24
Researchers	30	313	10.4
Directors/Curators	16	188	11.8
Non-Professionals	7	46.3	6.61

(Eds. Note: Non-Professional involvement is as interest and was not given as active or direct involvement. One individual in this category has been interested for over 25 years.)

4. What is the most pressing need of aquatic animal medicine today?

(Eds. Note: Due to the extreme diversity of the responses, we felt that it was impossible to categorize them further without diluting their content. They are not organized in any order of relative importance.)

Veterinarians: N/A -- 2

-- Meeting the medical needs of the mariculture and aquaculture industries and marketing these services.
-- Clinical treatment and public relationship.
-- Coordination of information gathering; public oriented approach.
-- Simple and safe means of restraint; and the approval of new drugs for use in fish and aquatic mammals.
-- The unification of the professionals of aquatic animal medicine in order to provide progressive direction in all aspects of aquatic medicine (fish and mammals).
-- Increase in basic biological areas / Reproduction (2 such responses)
-- To cross the barrier between so as to aid biologists in the field.
-- Research (2 such responses)
-- More specimens to work on.
-- More research in problem areas as well as establishment of normal parameters as a resource.
-- Study diseases occurring in captive aquatic animals.
-- Improved management for exhibit and propagation.
-- Fish -- Training clinically oriented people to provide service to the producer or hobbyist
-- Mammal -- Recognition of the effect of disease processes on wild populations by those responsible for administration of those populations.
-- More involvement in regulatory agencies. It will be a short time before governmental agencies will be regulating the field.
-- Diagnosis and therapy. Effect of EPA on aquatic animal medicine.
-- Accumulation of literature for clinical uses, i.e., anatomy, physiology, medicine
-- husbandry and preventive medicine of captive animals. Causes of death research in wild marine mammals.
-- Pooling of all available information.
-- Stable artificial environment and constant supply of adequate and known nutrition. Take care of these two and you'll have less need for medicine.
-- To train more veterinarians.
-- Define and develop the specialization for the needs of industry, education and government.

Researchers: N/A -- 3

-- Diagnostic procedures specific for the dolphin which allow detection and evaluation of the 10 most serious health problems.
-- Basic and quantitative information.
-- Diagnostic services.
-- To establish veterinarians as a resource in aquaculture.
-- Prevention and control of disease of fishes and invertebrates used in aquaculture.

-- Unification of the diverse interests; a single voice for those interests and demonstration of since professional leadership.
-- Prevention (of disease).
-- Money for research equipment and personnel (2 such responses)
-- Adequate registration and/or approval of drugs and chemicals by EPA/FDA for use in aquaculture.
-- Basic research in aquatic animal medicine.
-- Standards for physical diagnosis and accepted treatments.
-- Development of new, efficacious therapeutics and immunizing agents. Instigation of control measures to prevent further introduction of exotic pathogens and interstate spread of these pathogens.
-- Communication between professionals in aquatic animal medicine and between aquatic animal medicine professionals and the industries they serve.
-- A clear definition of what a drug does, how it works, and under what environmental conditions it works best (examples: pH, sal., temp., etc.)
-- Improved diagnosis and drugs developed for fish specifically.
-- Less competition between administrations of the public park industry and more open sharing of information and less denials of problems.
-- Financial support for basic research on wild and captive marine mammals.
-- Baselines!
-- Meetings such as this with exchange of ideas and identification of major problems. Also, federal financial support for additional research.
-- Dissemination of information.
-- Certification of fish health specialists to diagnose and prescribe. Registration of drugs and chemicals for aquatic animal health use.
-- New compounds and their approval by federal agencies.
-- Less governmental, or a more responsive government in, licensing or approving biologicals and pharmaceuticals.
-- A more effective communication link between workers; i.e., journal, newsletter.
-- Determination of the norm.
-- Diagnosis, understanding stress and methods of control.

Director/Curators:

-- Probably preventive treatment through improving the environment, diet and natural immunological responses of these animals.
-- Communication.
-- Knowledge of drug idiosyncracies. Social interaction (considering the potential of T. truncatus). Standardization and implementation of holding quality.
-- Research in breeding, dietary and general husbandry techniques to take care of the animals that are now in captivity.
-- Trained fish medicine people; training course for fish medicine.
-- More information / knowledge (2 such responses)
-- Financed research -- animal husbandry and medicine.
-- Probably control of aquaculture disease.
-- Money for research.
-- Organization.
-- The most pressing need of our institution is a better way of treating stranded seals and dolphins so more live than die.

-- A published index of works already accomplished would be invaluable.
-- Recognition, diagnosis and treatment of marine and freshwater fish diseases that can be accomplished easily by the amateur and professional fish keepers.
-- Preventive medicine.

Non-Professionals:

-- Basic research on these animals.
-- Cooperation among those in the field; effective dissemination of information.
-- Central data bank (2 such responses)
-- Educational programs for "aspiring young talent."
-- Baseline data and communication.
-- For tropical fish: more factual or scientifically determined treatments rather than some of the "witchcraft" dispensed by fish stores.

5. What research is needed in this field?

(Eds. Note: "Highly Specific Program" in this section and in #6 denotes precisely defined and highly specialized topics for research, and usually reflects the individual's own interests.)

	Vets	Res.	Dir./Cur.	Non
Preventive Medicine	2	1	0	0
Disease Control/Diagnosis	7	5	1	0
Baseline Data/Basic Biology	4	3	4	1
Aspects of Wild Populations	3	2	0	0
New Drugs/Vaccines	1	5	1	0
Environmental Problems of Captivity	0	3	1	1
Highly Specific Program	0	5	6	1
Nutritional/Biomedical	6	0	0	0
N/A	2	6	3	4

6. What are the educational needs of aquatic animal medicine?

	Vets	Res.	Dir./Cur.	Non
Continuing Education Programs	6	5	2	1
More Practical Experience	1	1	0	1
Dissemination of Information	2	0	1	1
Expand Existing Programs	9	12	3	2
Better Use of Existing Programs	3	4	0	0
Highly Specific Program	1	1	5	0
N/A	3	7	5	2

7. Is there a need for an association based upon aquatic animal medicine?

	Vet	Res.	Dir./Cur.	Non
Yes	24	26	15	7
No	1	0	0	0
Maybe	0	0	1	0
N/A	0	4	0	0

If so, how would such an organization meet your expectations?

Veterinarians:

-- The IAAAM is currently meeting the needs. (11 such responses)
-- The IAAAM has lost its original momentum and direction. It is not an international association dealing in clinical medicine.
-- Biology precedes medicine; this aspect should be integrated (into such an organization).
-- The IAAAM is adequate for these purposes, but in fact has no international vision at all. It is totally U.S. oriented, which is a defect. (2 such responses)
-- . . .The IAAAM should take the leadership in this field -- by better spreading information on the advancements in the field . . . . Association with the organization should carry some credibility. (4 such responses)

Researchers:

-- Publish reports, communications and interaction among professionals. (4 such responses)
-- Locate and distribute information on available job positions.
-- More emphasis on fish diseases.
-- IAAAM is working well. (4 such responses)
-- IAAAM meets my expectations for marine mammal medicine. The Fish Health Section of the AFS (American Fisheries Society) meets my expectations for fish medicine.
-- . . . I feel you may want to consider a closer relationship with the World Mariculture Society.
-- I believe that IAAAM is moving towards it (my expectations; perhaps (through) the addition of non-veterinarians such as professional biologists and chemists and behavioral scientists.
-- The organization should include both medicine and biology of marine animals.
-- With the development of commercial farming of aquatic animals, the need for a more sophisticated association may increase.
-- Yes . . . if it combines IAAAM, fish health and crustacean health groups, also the wildlife disease groups.
-- We need more cooperation among the interest groups -- perhaps even consolidation of groups into a single group.
-- Could expand it (the IAAAM) to more activities.
-- By providing a professional forum for the allied interests, by speaking with a unified voice for those interests, and by fostering professionalism in all aspects of those interests.

-- The present one is O.K., but is too oriented towards mammals. We need a broader approach and larger membership input. We need to overcome the vet vs. non-vet confrontation. I think it's getting better, but it still exists.
-- Yes, provided such an organization could do more than duplicate existing groups such as the FHS/AFS (Fish Health Section/American Fisheries Society); that it include all aspects of aquatic animal medicine including marine aquaculture; and that its membership be open to all, including non-veterinarians.

Directors/Curators:

-- By dealing with specific programs and research in this field and not vague generalizations.
-- All seminars and lectures could be sent to members unable to attend meetings.
-- Standardization of treatments and dosages for the more common diseases.
-- Possibly, or shift and merge with American Association of Zoo Veterinarians.
-- By providing a focal point for the profession through correspondence, conferences, journals, and possibly abstract services. (5 such responses.)
-- An association . . . should provide up-to-date information on the state-of-the-art.
-- If an organization is based primarily upon the clinical medicine needs of aquatic animals, I believe the outlook is too parochial and I do not believe my organization would be a participant.

Non-professionals:

-- The IAAAM is meeting my expectations. (2 such responses)
-- Information dissemination (2 such responses)
-- By coordinating the dispensation of knowledge and findings; instigating and assisting training programs; lobbying the veterinary viewpoint in animal protection and other legislation; guiding the profession in diplomatically assisting the laymen while calling on their knowledge, rather than replacing them.

8. Is there a need for an aquatic animal medicine journal?

	Vet	Res.	Dir./Cur.	Non
Yes	18	14	13	6
No	5	7	3	0
Maybe	2	6	0	0
N/A	0	3	0	1

Veterinarians:

-- JAVMA (Journal of the American Veterinary Medical Association) can serve this need.
-- . . . probably is still a little premature . . . (2 such responses)
-- This field is adequately provided for by veterinary and wildlife disease journals.

-- Also an index of resources (is needed).
-- (Should be) practice related and to give out information similar to the American Association of Zoo Veterinarians Journal.
-- On the international level.

Researchers:

-- Marine mammal yes; Fish, no need.
-- Useful if sectionalized (Mammalia, Aves, etc.)
-- Maybe. The new Journal of Fish Diseases has filled a place but a journal for all aquatic animals might have a place.
-- Numerous journals are already available and provide this format for for information exchange. (4 such responses)
-- No, but one would be useful.
-- I don't think there would be enough quality articles to support a journal on aquatic animal medicine.
-- Yes, to lessen the problems of searching many different journals.
-- AVMA wildlife issue supplies (this) need.
-- A central source of information is essential in a field as sporadic and diverse as aquatic animal medicine.
-- No, but there may be a need to participate in abstracting services.

Curators/Directors:

-- This could integrate the much scattered literature on the subject.
-- Not necessarily; reprint service more comprehensive.
-- Yes. Unfortunately limited by interested parties.
-- Would be useful.
-- Yes. A published index of works already accomplished would be invaluable .
-- Yes, though the need has been partially met by the Journal of Fish Pathology.

Non-professionals:

-- It would assist dissemination of knowledge and potentially improve communication.

9. Should the field of aquatic animal medicine be considered an industry?

	Vet.	Res.	Dir./Cur.	Non
Yes	7	6	4	0
No	11	17	6	3
Maybe	2	2	3	3
N/A	5	5	3	1

Veterinarians:

-- Perhaps the food producing area -- not the marine mammals.
-- A professional subspecialty or subspecialty of many professions.
-- Is human medicine considered an industry?

-- Medicine and disease are a branch of biology.
-- Yes -- so that a unified effort can be put forth to improve and develop the state of aquatic animal medicine.
-- Yes -- if doing so heightens the awareness of both the public and the government of the magnitude of the field's contributions and needs.
-- It may be a part of the industry, not the industry itself.

Researchers:

-- It already is -- fish especially.
-- Not necessarily; there are many university and government programs in aquatic animal medicine and (they) cannot be called an industry.
-- "Industry" does not seem to be an appropriate term for the practice of medicine. (2 such responses)
-- Not at this time. The need is adequately met by veterinarians specializing in this field, and through cooperation with research at universities.
-- Not in the classical sense of industry, but as a specialty field of professionals. (3 such responses)
-- It is a profession and industry.
-- It is a service/support industry. (2 such responses)
-- It is not and should not become a commercially packaged product.
-- Aquaculture (includes the culture of all aquatic animals) is an industry indirectly supported by our expertise.
-- No. It is a group of allied professions.
-- A part of it is industry or business.
-- Absolutely consider aquatic animals as an industry. Aquatic animal medicine should be considered a profession.

Directors/Curators:

-- On the level of aquaculture as a business, yes. For public aquariums, no.
-- It is a profession.
-- There is certainly a need for one, however marine mammals represent only a small fraction.
-- Definitely; world food production will eventually depend on ocean sources.
-- It should include pure research findings and not be termed an industry.

Non-professionals:

-- No. No medicine is an industry. Aren't aquatic animals already an industry, and should we call it what it is?

10. What are the moral or ethical considerations that aquatic animal medicine should be concerned with?

	Vet	Res.	Dir./Cur.	Non
Same as any other medical/ veterinary practice	9	6	1	1
N/A	5	9	10	4

Veterinarians:

-- Sharing new and workable information.
-- Its major concern should be to supply humane care to the animals in holding facilities, and in the transporting and capture of animals.
-- Humane handling, treatment and breeding and the willingness to "hang out" mistakes.
-- Medicine should (only) be practiced by experience and qualified veterinarians in this field.
-- Providing food material, conservation, environmental protection, and assist in policy for governmental agencies.
-- The welfare of captive animals and the environmental significance of their capture. Ensuring that wildlife biologists do not harm wild animals through inadequate medical techniques. Comparative medical aspects.
-- Extending the studies of aquatic animals to their fullest so they cover all aspects of a given species.
-- That professionals in the industry should place forth the health care of aquatic animals as the foremost objective. The individuals should exhibit the highest standards of professionalism in dealing with each other in regard to health care problems and exchange of ideas, data and solutions concerning these problems.

-- Capture and captivity of animals. When do the economics of the situation dictate euthanasia vs. continued treatment
-- Supporting industries which use aquatic animals only for personal gain. More data should be used in wildlife management.
-- The proper care and uses of marine mammals. To remove an eye from a dolphin merely to determine the optic pathways is a bit in question and should be reviewed.

Researcher/Biologists:

-- Removing quacks from the aquaculture/health area.
-- Veterinarians should not attempt to exclude biologists from the field.
-- Certification of non-DVM specialists in aquatic animal health to resolve potential and actual conflicts with Veterinary Practices Acts.
-- Close cooperation with wildlife biologists. These individuals often function at salaries not acceptable to veterinarians and serve to identify problems and monitor effectiveness of programs.
-- The moral and ethical issues of allowing endangered marine mammals to be used for display and tourism industries should be carefully examined.
-- Animal health should be of more concern to the park industry than a pure cost basis.
-- If aquatic food animals are concerned, considerable care should be taken in applying any medication.
-- I don't think that only veterinarians should be allowed to practice fish medicine and I don't think that a fish practitioner should have

to pass a licensing exam for each state in which he might want to practice. I do think that qualified individuals should receive a certificate stating they are qualified fish and/or marine mammal practitioners and I am leaning toward favoring some state control over quack practitioners.

-- Disease control in wild populations of aquatic animals. Conservation of wild stocks . . . . Humane husbandry and health care for captive aquatic animals.
-- Honesty in packaging of drugs by manufacturers.
-- There has to be a hierarchy; porpoises would be dealt with differently (a higher level) than fishes. Fishes more so than oysters, etc.
-- Don't condemn non-veterinarians in the field since veterinarians are reluctant to fill the available niche.
-- Concern for the individual animal, the individual species, and the interaction with man.
-- Conservation of disease-free stocks of aquatic animals. Humane treatment of captive animals at oceanaria. Good modern health care of captive animals. Building a foundation of knowledge concerning wild aquatic animals.

Curators/Directors:

-- Preserving life of captive and wild aquatic animals.
-- Early detection of the symptoms of disease.
-- Control of exploitation of sentient species.
-- Maintain credibility.
-- Long range effects of medication on micro-fauna and flora, and effects on the aquatic habitat. Responsibility of concerned individuals for the future environment -- macro and micro.

Non-professionals:

-- Expendable animals vs. humane treatment of disease in captive animals. Offending the layman.

-- The importance of conservation of the organisms should remain a priority, instead of just economic feasibility. This is why vets and non-vets should work together to combine knowledge and experience for the organisms' best interests.

11. Please list over major concerns that aquatic animal medicine should have.

	Vet	Res.	Dir./Cur.	Non
N/A	15	14	9	7

(Eds. Note: The following are those responses to this question which were not given as an answer to any preceeding question and thus provide additional material for thought. It is interesting to note that over 57% of the individuals polled had no response.)

Veterinarians:

-- Central organizational structure for education and development of the profession.
-- Ecological concerns. (2 such responses)
-- Retrain professionals; supervise lay involvement to prevent misinterpretation of disease and diagnosis as was evident at this meeting from the presentations.
-- There should be more involvement by the organization in federal legislation.
-- To determine the relevance and impact of disease in wild populations. To improve longevity in captive marine mammals.
-- To ensure that research workers using aquatic animals are using "normal" specimens.
-- Meshing the knowledge of biologist and other professionals in the field to assure the fullest understanding of the species.

Researchers:

-- Working with the National Marine Fisheries Service and other agencies to see that the best interests of marine animals are maintained.
-- Joint programs with other fish groups to avoid duplication of effort.
-- Ways to encourage research and involvement of industry in the proper registration of drugs and chemicals needed in aquatic animal health.
-- Identification of problems limiting development of additional aquatic animal farming and attempting to develop control programs.
-- An awareness of the total needs in the area of conservation and legislative action on endangered marine mammals.
-- . . . the field of Environmental Medicine is becoming more and more prevalent (in human medicine). In the field of animal medicine this has not yet occurred . . .
-- Pathophysiology of beachings (stranded marine mammals).
-- Prevent the introduction of exotic species and diseases into the United States -- their transmission throughout the world.
-- Sponsoring procedures for collecting animals (international), husbandry, and medical care. Working with other groups to achieve these goals.
-- Public education about the health and husbandry requirements of aquatic animals.
-- A greater exchange of data among members or interested parties. No sense in everybody floundering around in the dark by themselves. Let's all flounder around together.
-- Help to aquaculture industry, giving assistance immediately -- let's educate the industry as to our abilities.
-- A concise definition of what animals are included in the term aquatic animals. As it stands, the term includes any animal -- e.g., Amoeba proteus -- and that, although zoologically correct, is most unrealistic.

Directors/Curators:

-- Oversaturation of professionals.

-- Concern over diseases that can be transmitted by aquatic systems to other surrounding areas -- even to terrestrial animals. Production of mutant or resistant life forms, to antibiotics and methods used to treat aquatic systems (i.e., ozone, UV light, other radiation).
-- . . . it is important that our work is an asset to the continuation of the wild populations and that we not contribute to their overall depletion.
-- Aquatic animal medicine should be concerned with the total quality of animal care that animals in captive or cultural systems require. The term "aquatic animal medicine" is agin too restrictive and cannot solve all of the problems associated with the cultural propagation and survival of aquatic animals as wild or captive populations.

Discussion

The goals of the opinion survey and questionnaire were to determine what general or specific areas of agreement existed within this diverse field. A secondary goal was to help provide some direction for the field as a whole. The opinion and questionnaire forms were designed to develop categories from the respondents' answers.

Several trends can be identified, although these do not represent a consensus of opinion. The most interesting, and predominant, is that there is a general lack of agreement regarding most topics. For example, the answers to the question about the ". . . most pressing need . . . research and education" tended to be highly specialized and usually slanted towards the respondent's own area of interest. Very few individuals used an overall approach to the field, thus making it difficult to establish any priority needs.

One of the most frequently mentioned "needs" was concerned with too restrictive legislation and regulation. Most felt that laws, particularly those concerned with drugs, their registration and application, were too restrictive, and stifled growth. Many felt that simplification of governmental administration of these laws was necessary and greater participation by aquatic health specialists in the legislative process was much needed.

Almost all felt there was a need for an organization like the IAAAM. Although the IAAAM was often cited as doing a good job, some people expressed a need to improve on professional certification, professional credibility and more legislative involvement.

Several individuals with greater tenure felt that this organization (IAAAM) had "lost its original momentum" and should return to clinical medicine. Many of the researchers, however, were concerned about this attitude, feeling they should be allowed a fair chance at continued and open participation.

Finally, it was generally apparent there was a lack of agreement about the definition of key terms. The words professional, industry, field and medicine seemed to create some conflict and/or confusion, with little agreement about their usage.

The vast majority supported the need for a journal or abstract service dealing with aquatic animal medicine. However, many qualified their opinion by saying either that the need was met through existing journals or that establishing such a publication now would be premature.

SECTION VI: A NEXUS

Robert L. Jenkins and Joseph G. Halusky

The expression aquatic animal medicine gives little hint about the very diverse and sometimes discordant field it covers. The single unifying factor which joins its many interests is the medium -- water. Beyond that, the type of animal studied ranges from the lower invertebrates through the higher mammals. Aquatic medicine encompasses more than just the preventing and curing of disease. Unlike most terrestrial animal medicine, it generally involves the manipulation of the entire medium, as well as the diseased organism. Such inherent diversity in application and background makes it difficult to establish a consensus of thinking among aquatic health-oriented professionals. However, several trends may be identified based on the comments in these proceedings. These trends do not reflect all of the attitudes or ideas contained herein, nor do they necessarily reflect the editors' opinions.

Historically, there have been few or no formal avenues open for individuals pursuing a career in aquatic animal medicine. Rather than having formal academic curricula to follow, the trend has been to follow a more informal piece-meal program or gain knowledge through on the job training. Individuals educated in this manner often have fixed attitudes reflecting the facility in which they were trained and may lack depth in their experience. Presently, the primary disease person in aquatic animal facilities appears to be more corollary or paramedic in nature than veterinary. Traditionally there has been a lack in appeal for individuals to enter this field. University curricula, both in veterinary and graduate programs, have often neglected the inclusion of the aquatic animal health field. In addition, financial aspects are often cited as a primary problem since remuneration in this field does not compare to other areas of animal medicine. It has been estimated that in the coming years there will be an overage of graduate veterinarians; hence, there will be greater pressure for them to enter other specialized fields, such as aquatic mammals. However, little growth involving veterinarians is anticipated in the marine mammal area, so there is now a growing interest in entering aquaculture and other fish related fields. This has, however, created some disharmony between veterinarians and the biologists who have traditionally serviced the fish oriented industries. These biologists involved in husbandry or research often perceive veterinary involvement as potentially threatening to acceptance of their expertise. Whether or not such fears are valid, the union between the biologist and the veterinarian, both specialists, will help to provide a greater overall understanding into the animal's needs, be it wild or captive. The industry needs to be educated about the vast potential that this union holds for the future of aquatic animal medicine.

The major factor adversely affecting aquatic animal industries is that their problems have not been adequately identified so as to provide for their solutions. The managers and administrators of these industries should help establish research priorities in concert with the biologist and veterinarian. The more complex problems can be identified and solved, as more and better educated professionals are encouraged to enter the field of aquatic animal health. It is therefore necessary for these industries to play a greater role in encouraging such involvement. Communication, cooperation, and coordination between the industries would greatly resolve common problem areas. For example, new drugs (antibiotics, vaccines, etc.) are needed for all aquatic animals, especially in the area of aquaculture aimed at human food production. Unfortunately, legal restrictions may be too restrictive and could be stifling to growth. Legalities, then, can have a profound effect on aquatic animal industries and aquatic animal medicine practices.

One bureaucrat has said " . . . if the government perceives a vacuum, it will move to fill that vacuum": that businesses and professions are being more controlled by government. This has serious connotations, since there is a trend to pass less definitive legislation and pass the interpretation and regulation to the courts and bureaucrats. At times, such problems in the legislative process appear to be more limiting to aquatic animal health than the biological problems. Admittedly, legislation is designed to satisfy the majority, thus creating pressures on those persons responsible for its interpretation and enforcement. It is therefore important for the aquatic animal health field to enter and work in the legislative system affecting it. The government also needs good, worthwhile input from qualified persons to help it function better in its regulatory capacity. Hence, closer coordination between the various groups in aquatic animal health is necessary so that they can address the legal problems in a more effective manner.

A special area of concern here is that of the states' Veterinary Practices Acts, which define the medical activities of veterinarians and non-veterinarians. While veterinarians have been given the legal franchise to practice medicine, they often do not in several areas because of background, financial aspects, or disinterest. These areas often involve aquatic animal health and are typically serviced by non-veterinarians due to the need for such services. As the veterinarians may be entering these areas as discussed earlier, the legal status of many qualified aquatic animal health specialists will have to be clearly defined.

Another example would be the need for the development of new drugs mentioned above. New drugs are difficult to get approved for use, especially since the courts have ruled that studies (i.e., research) rather than expert opinion are necessary for their approval. Such restrictions have driven up the cost of drug development to the point where it may not be lucrative to develop them. Legislation and regulation conceivably can hinder the development of industries as aquaculture and may even hinder research as well.

The existing legal framework appears to limit research in two ways. It requires one to follow many regulations regarding items as specimen acquisition, holding facility quality and professional ethics. It also inherently carries burdensome financial loads, which are usually in the form of administrative overhead, paperwork, and frequent progress reports. These all require large amounts of those two things precious to most researchers -- time and money. Simplification and avoidance of duplication in the legal and regulative process were often cited as the most pressing needs in aquatic animal medicine today.

Several other areas of concern to research can be identified in spite of the general lack of agreement regarding research priorities. (Needs or priorities oftentimes reflected the individual's own particular interest -- few individuals offered an overview for the entire field.) There was agreement that research should be concerned with establishing baseline data, clearly defining the norm for an individual animal. It was also generally felt that more research in disease diagnosis and preventive medicine was necessary. Such work would be greatly assisted by developing single source textual materials regarding health problems, and through the compiling of such resources. However, due to the many legal problems encountered earlier, such individualized research investigations can be severely hampered. The establishment of research centers housing groups of animals difficult to maintain due to costs and legal restrictions is strongly recommended. Such centers could be the focal point of cooperative national and international studies, and replace the more restricted and costlier methods.

Finally, the aquatic animal health professionals need to fulfill the necessity of applying preventive medicine to the formation of a well and correctly informed public. They have a further obligation to advise and share technical knowledge with their peers for the betterment of all.

It is desirable that an attempt be made by the aquatic health professionals to reach a consensus of opinion regarding the research, education, legislative and industry needs for aquatic animal health care. Some formal method for communicating this consensus of thinking should be established so as to effect the future of the field in a positive and progressive way.

As Dr. Hammond stated, " . . . it is not enough to do good; we must be seen to be working in tandem toward the good of all."

APPENDIX A:

IAAAM CONFERENCE AND WORKSHOP ABSTRACTS

(Ed. Note: The following are the abstracts from the technical presentations delivered on April 24 and 25, preceeding the State of the Art session.)

"FRIDAY," THE HAWAIIAN MONK SEAL: A CASE HISTORY

J.F. Allen, D.B. Mackay, L.R. Taylor, T.R. Sawa,
W.G. Gilmartin and G.C. Whittow

A Hawaiian Monk seal, Monachus schauinslandi, was kept in captivity at the Waikiki Aquarium from December 13, 1963, till his death on December 13, 1978. Results of various clinical tests are presented and postmortem findings, including organ weights and measurements, are discussed. While diagnoses of subacute nephritis and hepatitis were made, general senescence is suspected.

THE PARTIALLY-CONSENSUAL PUPILLARY LIGHT REFLEX OF THE DOLPHIN

M.C. Barris, W.W. Dawson, C.K. Adams and C.A. Litzkow

Humans and other primates exhibit a consensual pupillary light reflex, i.e., when a light is presented to one eye, the pupils of both eyes constrict equally. Rodents and birds, however, do not have a consensual pupillary light reflex, i.e., the pupil of one eye is not affected by light presented to the other eye. We have simultaneously imaged the pupils of both eyes of two dolphins (Tursiops truncatus) with two independent infrared-sensitive videotape systems. When a light is presented to one eye, the pupil of the stimulated eye constricts more than the pupil of the contralateral eye. This partially-consensual pupillary light reflex has never been reported in other animals. We correlate this reflex with the unusual anatomy of the dolphin midbrain (Jacobs, M. S., Morgane, P. J. and McFarland, W. L. Degeneration of visual pathways in the bottlenose dolphin. Brain Research, 1975, 88, 346-352). This research was supported by NSF grant no. BNS 75-20147-A01 and NIH training grants 1 T32 EY 07012 and 1 F32 EY 05180.

ELEVATED CERULOPLASMIN IN A PILOT WHALE WITH GASTRITIS

J.E. Beal, Jr. and P.T. Cardeilhac

Ceruloplasmin (CP) is a blue copper containing plasma protein with oxidase activity. Plasma CP levels decrease in humans due to low copper absorption, intestinal and renal protein loss, chronic copper poisoning, Wilson's disease and abnormalities of protein metabolism. CP levels increase in a wide variety of pathological conditions and pregnancy. A radial immunodiffusion (RID) assay was developed by preparing a CP isolate from pilot whale serum and raising an antiserum to it in a rabbit. The antiserum showed no cross reaction with sera from chicken, fish, manatee, elephant seal, human, bovine, equine, porcine, caprine, ovine, lapine, or Brydes (baleen) whale. The antisera did cross react with Pacific pilot whale, Atlantic bottlenosed dolphin, pigmy sperm whale, and Pacific white-sided dolphin indicating specificity for odontocete cetacea. Precision of the procedure was measured by running RIDs in quadruplicate for 8 samples; the standard deviations were less that 7% of the sample CP level. Serum samples were obtained from 2 aquariums. Of 61 samples, 32 were considered to be from normal, healthy animals and the mean CP level was 86 mg/dl with a standard deviation of 23 mg/dl. Serum samples were collected from a pilot whale with gastritis (assigned cause of death) believed to be chronic in nature. CP levels were elevated in all samples (mean 130 mg/dl; s.d. 24). (Aided by Marineland of Florida.)

RESULTS AND PROGRESS OF A SALVAGE PROGRAM DIRECTED TOWARD *Trichechus manatus*

D.J. Black, D.J. Forrester, and C.P. Spencer

The East Indian Manatee, *Trichechus manatus*, is an endangered species with fewer than 1,000 animals remaining in Florida. The information reported here is generated from a salvage program designed to utilize free ranging manatees which are found dead to not only determine cause of death, but gain information regarding some of the animals' biological functions. Topics such as anatomy, developmental osteogenesis, and gross and microscopic pathology will be addressed.

Radiographs of the right flipper have demonstrated the progressive ossification of the bones of the manus, carpals, radius, ulna, and humerus as the manatee increases in length. The interaction of man and manatee accounts for many of the lesions observed, which include superficial scars and collision-related trauma. Infectious diseases, congenital deformities, as well as parasitism may also be the cause of some deaths. The production of a pictorial anatomical guide as well as a tissue reference set will be presented.

MECHANISMS OF COPPER TOXICITY TO MARINE FISH

P.T. Cardeilhac

Cupric ion (copper) is added to marine culture systems to control parasitic protozoans and algae. Mass fish kills from copper poisoning have occurred and the safe upper limit of copper concentration is reported to be 0.2 ppm. Mechanisms of intoxication, other than hypoxia, have been proposed but not identified. In an accidental copper poisoning, 610 cultured pinfish and other marine teleosts were exposed to an average copper concentration of 3.3 ppm over a 23 hour period. Signs of intoxication began 6 hours after introduction of copper. Deaths stopped 11 hours after copper concentration decreased to 0.2 ppm, and signs of intoxication stopped 6 hours after the last death. High K^+ levels with failure of osmoregulation was found in dying fish. The possibility that potassium intoxication followed copper poisoning was further investigated in a controlled experiment by exposing sheepshead to 8.5 ppm copper for 12 to 17 hours. Stages of intoxication were defined based on behavior and posture. Fish were sacrificed at different stages of intoxication and blood and tissues collected. Twenty-one clinical values were measured and correlated with severity of intoxication. Increases in serum K^+, $PO_4^{\equiv}$ and total intracellular ion values correlated best, and the intoxication appears to be a potassium intoxication produced by cell damage and failure of osmoregulation by gills and kidneys. (Aided by Marineland of Florida.)

PARASITIC DISEASES OF THE HAWAIIAN MONK SEAL (*Monachus schauinslandi*) FROM THE NORTHWEST HAWAIIAN ISLANDS

Murray D. Dailey

During the period of 20 April to 17 May 1978 an investigation on Hawaiian Monk Seal mortality was conducted.

This report concerns the findings dealing with the parasites of this investigation.

Necropsy material was examined from sixteen animals. Two animals were necropsied during the island visit while the remainder (fourteen) were in the form of preserved material recovered previously by two National Marine Fisheries Service Observers (Brian and Patti Johnson).

A total of five species of helminths and one species of acarine were recovered. The helminths were represented by one acanthocephalan (*Corynosoma rauschi*), three Cestodes (*Diphyllobothrium cameroni*, *D. elegans*, *D. hians*) and one Nematode (*Contracaecum turgium*). The single species of acarine (under study for identity at present) was recovered from a single host infesting the nasal and throat area. Heavy infections of all helminths were found with *C. turgium* being the most prevalent (in fourteen of sixteen animals) followed by *D. cameroni* (nine), *D. hians* (eight), *C. rauschi* (seven) and *D. elegans* (three). In addition, thirty-nine stool samples were collected

and examined from six of the islands. The ova found were representative of the adults identified with the exception of a capillarid nematode-type egg from Lisianskiis.

ANAPHYLACTIC-LIKE REACTIONS IN FISH

Beverly Goven and Donald L. Dawe

Anaphylactic type reactions occurred in channel catfish (Ictalurus punctatus R) and goldfish (Carassius auratus) following immunization and challenge with several protein antigens. The reactions were specific for the sensitizing antigen and could be passively transferred to non-sensitized recipients with serum from sensitized fish. In channel catfish the reaction consisted of disorientation, vertical swimming, increased opercular movement and gasping. In the goldfish the reaction consisted of clamping of the fins except the pectorals, loss of equilibrium, and increased defecation. Some deaths occurred in the channel catfish, but none occurred with the goldfish.

SOME SPECIALIZATIONS OF THE DOLPHIN EYE

W. W. Dawson

Specializations were found in the cornea, ciliary body, lens, retina and optic nerve of the Tursiops eye. Light and interference contrast microscopy disclosed cornea thickness nearly 2 x human. Zonular insertions on the lens capsule are more complex than in human, but specific stains disclosed no significant accommodative musculature in the area of the ciliary body. Golgi stain disclosed both "rod" and "cone" recptor types in the retinal outer layer. Complex specializations of the amacrine cells provide "feedback" pathways across the plexiform layers. Most unusual are giant ganglion cells and their giant axons as seen in optic nerve cross section. These provide for unusually rapid communication between the eye and brain. This research was supported by National Science Foundation grant BNS 75-20147-A01.

DO WE NEED VITAMIN/MINERAL SUPPLEMENTATION?

W.H. Dudok van Heel

After more than ten years of consistent vitamin/mineral supplementation, supplementation was suspended in three dolphinaria in March 1978. The heamatological results in particular in November '78 and February '79 are the same or better than before, the Killer Whale included. The recovery of a beached Harbour Porpoise is remarkable. The only supplementation is Vitamin B1 and Calcium. It is argued that the addition of this mineral is essential. The animals are fed five different species of fish including squid.

INTRODUCTION TO FISH MEDICINE

M.P. Dulin

This slide presentation is designed to give the audience a brief panorama on the subject of fish medicine. Representative cases of the more prevalent diseases of marine and freshwater tropical fishes will be projected. Of the infectious diseases afflicting exotic fishes, the following six categories will be discussed: 1. Bacterial 2. Viral 3. Fungal 4. Protozoan 5. Helminthic and 6. Crustacean. Of the non-infectious or environmental diseases, cases will be projected that depict anoxia, nitrite toxicity, malnutrition, gas-bubble disease and a few examples of poisoning such as cyanide toxicity and ichthyoacanthotoxism. Some basic therapeutic concepts will be mentioned and the importance of ante- and post-mortem diagnostic procedures will be emphasized.

PARASITES OF MANATEES (*Trichechus manatus*) IN FLORIDA

D.J. Forrester, D.J. Black, D.K. Odell, J.E. Reynolds,
C.A. Beck and R.K. Bonde

From October 1974 to February 1979, 48 East Indian Manatees (*Trichechus manatus latirostris*) were examined for parasites. Most of these animals represented single strandings and originated from both coasts of Florida, primarily during the winter months. The purpose of this study was to qualitatively and quantitatively characterize the parasite fauna of manatees and to assess the impact of parasitism on manatee populations. The fauna was comprised of four types of parasites: Nasal flukes (*Opisthotrema cochleotrema*) occurred in 50% of the animals with numbers per animal ranging from 2 to 250. Paramphistome flukes (*Chiorchis fabaceous*) were found in the intestines and cecae of 76% of the manatees with total numbers as high as 24,000 per animal. A third type of fluke (representing several species in the family Microphallidae) was found in the intestines of a number of animals with up to 132,000 being found per manatee. A fourth parasite, the ascaroid nematode

Plicatolabia hagenbecki, was present in the stomachs in numbers ranging from 1 to over 1,600 per animal. The potential impact of these parasites on manatees will be discussed.

A STUDY OF SELECTED PARAMETERS IN A RECIRCULATING FISH CULTURE SYSTEM

Jeannine P. Gilbert and J.B. Gratzek

The objective of this research is to determine the effectiveness of a closed system in fish culture. The system consists of 36 20-gallon tanks whose water is filtered centrally by means of passing rotating biological contactors through a diatomacous earth filter and finally past a UV sterilizing light before being returned to the tanks. Fish used for the study were channel catfish fingerlings. Selected water quality parameters were measured twice weekly. The expected nitrification cycle was demonstrated. To determine the effectiveness of the central filtration unit and UV light, Ichthyophthirius was added to selected tanks within the system. The parasite spread to all other tanks. This experiment remains to be repeated along with further experiments using virus and bacteria. An infestation of Costia was treated using malachite green and formalin with no ill effects on the biological filter. Further work on all phases of this closed system needs to be done before any conclusions can be drawn.

FATAL HEPATOENCEPHALOPATHY IN A GROUP OF CALIFORNIA SEA LIONS

W.G. Gilmartin, J.C. Simpson, Mary F. Platter-Rieger, Maeve E. Kimball and P.R. Helms

During a period of six days during July 1978, a group of over 40 adult California sea lions came ashore on beaches in Ventura County, California. All of the animals were located from the surf wash zone to the high tide line. They displayed identical symptoms including paralysis, excessive lacrimation and salivation, absence of a corneal reflex, and occasional severe tonic convulsions. The animals died from a few hours to three days after they beached. Necropsy of seven seals revealed them to be in good flesh and without gross lesions indicating cause for the observed syndrome. Similar histopathology was observed in all cases, believed to be lesions in varying stages of the same disease. The common changes of most significance were in: a) heart-myocarditis and edema, b) liver-periportal inflammation and congestion,

c) brain changes including satellitosis and neuronophagia and d) lung and kidney congestion. Selected viral and bacterial cultures were negative. Tissues were not exceptionally high in metals, organochlorine or organophosphate residues. Pathology and symptoms are consistent with a viral hepatoencephalopathy.

PRELIMINARY DESCRIPTION OF A SKIN DISEASE IN THE NORTHERN ELEPHANT SEAL

Donald E. Griffin

Northern elephant seal strandlings of a particular age group appear to have a high incidence of a debilitating skin disease. This disease has been seen in strandlings received at the California Marine Mammal Center at Fort Cronkhite, California, over the past 3 years. It is characterized by a progression of visible lesions beginning with multiple, elevated, epidermal blebs -- hair loss and hyperkeritization over the bleb area -- cracking and breaking of epidermal integrity over area of lesion -- subcutaneous abscess formation -- sloughing of epidermal and upper dermal tissues. Bacteriology on biopsies obtained in the earlier sequences of the syndrome consistently yields a beta-hemolytic Gp. G streptococcus. In the later sequences, many opportunistic organisms are present, also. These include Candida sp., Pseudomonas sp., and coliforms. Slide documentation will be presented and therapy regimens will be discussed.

SERUM VITAMIN E LEVELS IN BOTTLENOSED DOLPHINS: HEALTH RELATIONSHIPS AND FUNCTIONS OF THE VITAMIN

R.D. Gunnels and G.W. Harvey

After encountering low serum vitamin E levels in some captive bottlenosed dolphins in Hawaii, a large number of animals were screened to evaluate these levels. Prior to oral supplementation of 900 IU of dl alpha tocopheryal acetate, a group of nine male and female dolphins had mean serum levels of 9.67 ug/ml and 9.20 ug/ml, respectively. After approximately 6 months of supplementation the mean serum level of the males was 15.1 ug/ml and the females, 15.3 ug/ml. The average human serum level is 11 ug/ml with deficiency syndromes evident at 5 ug/ml. Simultaneously, total serum lipids were determined to evaluate their relationship to the serum vitamin E, but these levels were not significantly changed in either sex by supplementation. Analysis for serum iron was conducted to determine its relation to serum vitamin E. Prior

to supplementation the mean serum iron concentrations were 250 ug/dl in males and 303 ug/dl in females. The post supplementation serum concentrations rose slightly to 269 ug/dl in the male group and 322 ug/dl in the female group.

PARASITIC BRAIN LESIONS IN NON-STRANDED CETACEANS FROM THE WEST INDIES

Nicholas R. Hall and Robert D. Schimpff

A relatively high incidence of neuropathology has been found during the course of a five-year study of brain disease in stranded cetaceans. Cerebrovascular, parasitic and non-parasitic infectious processes have been found in a variety of species. The role that such disease plays in causing strandings is difficult to ascertain without knowing the incidence of these disorders in the normal, non-stranded population. Furthermore, whether or not certain types of lesions even result in serious impairment is not resolved. To gain a better understanding of the incidence of parasitic infections involving the brain and auditory system of non-stranded cetaceans, the survey has been expanded to include animals that are caught as a result of the small scale whaling industry continued in St. Vincent by tradition and necessity.

Supported in part by grants from the National Georgraphic Society and from St. Georges University College of Medicine, Grenada, West Indies.

MYCOTIC PNEUMONIA IN GREEN SEA TURTLES IN AQUACULTURE

Elliott R. Jacobson, Jack M. Gaskin,
Robert P. Shields and Franklin H. White

Juvenile 4-5 month old green sea turtles (Chelonia mydas) were presented with a respiratory disease manifested by buoyancy abnormalities as seen by swimming at an angle to the horizontal. Most animals were thin with consistent plastronal lesions. Necropsy revealed an emphysematous left lung and a consolidated nodular right lung. Histologic examination of the right lung showed multifocal granulomas with a central core of caseated material. GMS staining demonstrated branching septate hyphae within the central core of the granulomas. Sporotrichium sp., Cladosporium sp., and Paecilomyces sp. were cultured from lung tissue of several turtles.

BACTERIAL INFECTIONS IN FORMULA-REARING OF MANATEES

P.T. Cardeilhac, C.M. Walker, R.L. Jenkins, J.M. Popp, D.J. Forrester, F.J. White and R.T. Smith

Attempts were made to formula-rear two abandoned male Florida manatees. Formula consisted of dairy cream supplemented with protein, fat and carbohydrates by adding vegetables, egg yolk and cereal (commercial baby foods), cod liver oil, Sustagen (Mead Johnson) and Casamino-acid (Difco) to provide a calculated composition of 3.5% carbohydrate, 15% fat and 5% protein. Composition of the formula was based on analysis of manatee milk. One infant survived 80 days in captivity and had a mean daily weight gain of 0.86% of body weight over a 5 week period of gain with a mean daily consumption of 900 ml of formula. During this period the infant appeared to be in good condition and clinical values were similar to those found in other apparently normal adult animals; therefore, the formula was considered to be nutritionally adequate. Seventy-five days after capture the infant had a sudden sharp drop in food consumption and died 5 days later. Salmonella heidelberg was isolated from chronic inflammatory lesions of the small intestine. The second infant died 24 days after capture. The animal had numerous ulcers of the skin and acute pneumonia. Both infants were free of parasites. Multiple inflammatory lesions suggested bacterial infections. Dermatoses and other bacterial infection are frequently observed in captive manatee, particularly following stress. Antibiotics in the formula may be important to successful rearing.

THYMUS GLAND IN THE HARBOR SEAL (Phoca vitulina): RELATIONSHIP TO AGE AND DISEASE

Murray L. Johnson, Steven J. Jeffries, Larry Cargol and M.J. Wicks

The thymus glands of over 70 wild-collected harbor seals were examined to determine what correlation existed between age, sex, season, presence of disease, and other conditions. Collection was by fire-arm. Complete evaluations including gross and histopathology examinations, blood counts and chemistries were done. Aging was done by tooth section. The presence of disease was determined by the presence of gross or microscopic evidence of parasites and other abnormalities, and this correlated with the weight of the thymus glands. Thymus glands were found to be large in comparison with usual mammalian norms. A high degree of parasitism, especially heart worms, was found. Lipogranulomatosis of the liver was very common. Despite some positive correlations, the reasons for persistently enlarged thymus were not satisfactorily explained.

THE USE OF A BIOLOGICAL FILTER AND KETOCONAZOLE TO CONTROL AND TREAT CANDIDIASIS IN A GROUP OF Tursiops truncatus.

G.W. Jones

The use of a biological filter to help control water quality and an antifungal drug Ketoconazole has been successful in controlling and treating Candidiasis in a group of Tursiops truncatus. The biological filter reduced the amount of chlorine needed to maintain acceptable water quality. It was felt that chlorine in the system encouraged Candidiasis by altering the normal bacterial flora of the animal's skin and caused additional stress on the animals. A discussion of how the biological filter was adapted to the system and how well it functioned will be presented. Ketoconazole proved to be effective in treating active cases of cutaneous Candidiasis. The case reports of two animals that received Ketoconazole will be discussed.

EXOTIC FISH PROBLEMS IN THE U.S.

James A. McCann

In August 1977 the Secretary of Interior authorized the U.S. Fish and Wildlife Service to establish a Research Laboratory in Gainesville, Florida to develop a national research program on exotic fishes which have been or are likely to become established in U.S. waters. A preliminary survey in 1977 found that 43 species of exotic fish have established viable self-sustaining populations in the U.S. Twenty-six of them are presently established in Florida with 5 species showing a major expansion in distribution during the last 6 years. Some of these species have created or are likely to create adverse impacts on the native fishes or their habitats. The laboratory will support the Service's efforts to stop further introductions of injurious species, determine the behavior and life histories of all established species, evaluate their actual or potential impact on the nation's aquatic ecosystems and develop a series of protocols to fully evaluate the beneficial or harmful characteristics of any new exotic fish being considered for introduction into this country. Research contracts are presently being funded to inventory the native and non-native fishes in North America and to determine the status, distribution and impacts of the non-native fishes presently found in the open waters of Florida.

KETOCONAZOLE TREATMENT FOR CANDIDIASIS

S. Nakeeb, B. Babus and D. Velle

Candidiasis is a common problem in captive bottlenosed dolphins and often fatal. Available treatment methods are not successful. A new medicine, "Ketoconazole," (PM-3-41,400) was used in treating a progressive case of cutaneous candidiasis in a three year old female bottlenosed dolphin. A daily oral dosage of 20 mg per kg body weight given in four divided doses for five days showed remarkable recovery. No clinical manifestation of toxic effect was noticed in the eighteen day course of treatment. Pre and post treatment hematology and blood chemistry did not reveal significant changes. Ketoconazole is a very promising drug for the control of candidiasis in dolphins.

NASAL PASSAGE OF STOMACH TUBES IN WEST INDIAN MANATEES

F.C. Neal and A.B. Irvine

Five sonic thermistors (14x57 mm, weighing 9.1 gms) were inserted into the gastrointestinal tract of 3 captive manatees (Trichechus manatus) to monitor core body temperature during metabolic studies. Preliminary attempts at oral passage using an equine balling gun were met with vigorous resistance by the manatees and damage to one thermistor. Subsequent nasal passage of a stomach tube (19 mm OD x 12 mm ID) was accepted without a struggle by the manatee. A thermistor, held in the tip of the tube, was passed through a nostril into the esophagus (total distance 40 cm). The thermistor was gently forced from the tube by passing a probe through the lumen of the tube. Thermistors were swallowed and passed through the gastrointestinal tract in 6 to 20 days. Manatees appeared to have normal respiration while the tube was in place.

Stomach tube passage through a nostril is preferred to the oral route for introducing materials (thermistors, drugs, etc.) into the gastrointestinal tract of manatees.

CLINICAL DATA FROM FREE-RANGING AND CAPTIVE WEST INDIAN MANATEES (*Trichechus manatus*)

F.C. Neal, A.B. Irvine, K.C. Bachman and R.L. Jenkins

Brief discussions on the following subjects will be presented:

1. Blood and urine values in free-ranging and captive manatees.
2. Body temperature responses to cold environments.
3. Composition of manatee milk during late lactation.
4. Skin lesions in captive manatees.
5. Freeze branding of manatees for identification in field studies.

ANTIBIOTICS AND AQUATIC BACTERIA

K.E. Nusbaum, E.B. Shotts, Jr. and Deborah Talkington

The minimum inhibitory and minimum bacteriocidal concentrations (MIC, MBC) of four common aquatic bacteria (*F. columnaris*, *A. hydrophila*, *A. salmonicida*, and *P. fluorescens*) were determined for four commonly used antibiotics (tetracycline (TC), chlorampenicol sodium succinate (CH), erythromycin (ER), and Furanace (FU). While the authors concluded TC and FU to be the most effective, they also found that the pharmacological preparation and environmental influences are crucial in the selection of an appropriate antibiotic. The need for identification and sensitivity testing previous to antibiotic administration is illustrated by resistant agents and plasmid testing.

USE OF SYNTHROID^{R} TO REDUCE AND PREVENT GOITER IN SHARKS

John B. Sciarra

A brief observational study was made to determine if Synthroid^{R}, synthetic hormone, could reduce and prevent goiter in two species of elasmobranchs. Four sharks showing swelling in the pharyngeal region and one not were injected intramuscularly with dosages of Synthroid^{R} from .2 - .45 mg arbitrarily according to estimated weights. Each of the sharks showing swelling were reduced or eliminated within weeks following treatment. The shark not showing swelling in the same system has not shown signs of developing goiter.

A STUDY OF BACTERIAL FLORA ASSOCIATED WITH THE SPIRACLE OF CAPTIVE DOLPHINS

Emmett B. Shotts, Jr., Wayne Jones and F. Deborah Talkington

A study was made of the microflora associated with the spiracles of a group of twenty captive dolphins. The results of this investigation indicate that a number of both Gram-positive and negative organisms may be found at this anatomical site. Coagulase positive Staphylococci (60%) was the most common organism isolated. Other organisms included alpha streptococci (2.5%), Pseudomonas aeruginosa (5%), Pseudomonas putrifaciens (5%), Corynebacteria (2.5%) and Candida spp (47%). These flora will be discussed as they relate to comparable flora from similar sites in domestic animals.

ECOLOGICAL INVESTIGATIONS OF PETROLEUM PRODUCTION PLATFORMS IN THE CENTRAL GULF OF MEXICO: HISTOPATHOLOGY OF MARINE FISH

R.F. Sis, N.H. McArthur, G.G. Stott, R.J. Tarpley, V.L. Jacobs and W.E. Haensly

Six tissues (muscle, liver, stomach, gonad, kidney, gill) from each of 2 species of benthic or platform associated fish were examined microscopically for histopathologic conditions. A total of 1440 specimens (6 tissues x 5 fish x 2 species x 24 stations) were collected from 20 oil producing platforms and 4 control stations in the north-central Gulf of Mexico. The objectives were to describe pathologic conditions and to ascertain any correlation with their proximity to production platforms. This work was part of a broad project which also included studies of hydrography, hydrocarbons, sediments and biota, trace metals, microbiology and invertebrate histopathology. The following conditions were observed in all six tissues: protozoa, helminths and acidiphilic granular cells. Less frequent observations were: hyperplasia of the gill filaments, vasocongestion (gill), edema (gill), leukocytosis (liver, gill), fatty infiltration (liver) and chromatophores (liver, kidney, stomach). These are preliminary observations; the final data synthesis has not been reported.

PROBLEMS IN FARMING ORNAMENTAL FISH IN FLORIDA

Ross B. Socolof

Mr. Ross Socolof is one of the leading ornamental fish culturists in the world. He has been asked by the IAAAM program committee to review selected major problems in the production of ornamental fish in Florida. Mr. Socolof is active in the day to day operation of Four Star Fish Farm in Bradenton, Florida.

ORGAN DISTRIBUTION OF THE ANAEROBIC BACTERIUM *Eubacterium tarantellus* IN FISH FROM BISCAYNE BAY, FLORIDA AND SURROUNDING WATERS

L.R. Udey

Eubacterium tarantellus was previously shown to be associated with fish kills in Biscayne Bay and the Texas Gulf Coast. The organism was primarily isolated from the brains of dead and moribund fish. We postulated that the anaerobe was harbored in a carrier state in the brains of fish and that clinical manifestations were stress associated.

Twenty-four fish species from Biscayne Bay and the surrounding ocean waters were sampled to determine the incidence of *E. tarantellus* in the brain, liver, kidney, spleen and intestines of clinically healthy specimens. In addition, the number of *E. tarantellus* per gram of brain tissue was determined for one species.

Thirteen of the species harbored the anaerobe in the brains. Although some specimens had the anaerobe in other organs, the incidence was low; no fish had the organism in other organs if its brain was not infected. Juvenile *Eucinostomus gulu* brains contained only 20 to 250 bacteria per gram of tissue.

FUNCTION OF THE SKIN AND FATTY ACIDS OF THE NORTHERN FUR SEAL (*Callorhinus ursinus*) AS A NATURAL BARRIER TO FUNGAL PENETRATION

N.A. Vedros, Alayn Waldorf and A.W. Smith

Fungi are ubiquitous in the Pribilof Rookeries but Frank Dermatophyte infections are rare. A detailed examination of the skin by Histology, depot fat by GLC, and in vitro inhibition of selected dermatophytes by certain fatty acids was made. The deep stratum corneum, interlamellar lipids, and tight collar of keratinized cells in the follicle shaft appear to aid in preventing fungal penetration. The fat contains greater proportions of C:15 and short chain fatty acids than other seal species. The short chain fatty acids were capable of inhibiting Autochthonous Dermatophytes in vitro. The role of various factors which might interfere with this balanced parasitism are discussed.

IMMUNOLOGIC INVESTIGATION IN DOLPHINS WITH CUTANEOUS CANDIDIASIS

Linda Werner, R. Halliwell and D. Buesse

Recently, an immune potentiating drug, levamisole phosphate, has proven efficacious in achieving regression of skin lesions in dolphins with Candida Albicans (CA) infection suggesting that immune deficiency might contribute to the pathoetiology of this disease. Immunocompetence was evaluated in 5 groups of dolphins using lymphocyte transformation (LT), and skin test challenge with CA extract. The test groups included normal dolphins in captivity, normal dolphins medicated with levamisole, dolphins with CA lesions, dolphins in remission from previous CA infection and dolphins procured from natural habitat. Intradermal challenge with CA extract resulted in positive delayed hypersensitivity reaction in all dolphins except those procured from natural habitat. LT experiments showed normal responses in all groups tested when fetal calf serum (FCS) was used in the nutrient media. Serum from dolphins with disseminated CA suppressed LT completely, while serum from a dolphin whose disseminated CA was eliminated with systemic antifungal therapy was no longer suppressive to LT. These results indicate that immune deficiency may be acquired with chronic CA infection, and not necessarily a primary or predisposing factor. Immune suppression constitutes a rationale for the use of levamisole in conjunction with specific antifungal therapy. Environmental factors must not be ignored. Skin test results and the increased incidence of CA infection in artificial environments indicate that there is greater exposure, and perhaps increased susceptibility compared to the natural environment. The above conclusions are convincing evidence that the etiology of CA infection in dolphins is multifactorial, that altered environment may introduce predisposing factors and that acquired immune deficiency may account for disseminated infections refractory to conventional modalities of therapy.

USE OF ELECTRON MICROSCOPY TO STUDY SPERMATOGENESIS IN AN ESTUARINE FISH (*Lagodon rhomboides*)

J. Winstead

The fine structure of germ cells from the pinfish, *L. rhomboides*, is described. Mature pinfish testis were fixed in phosphate buffered glutaraldehyde and osmium tetroxide and examined with electron microscopy. Spermatogenesis in *L. rhomboides* is similar to other teleosts and resembles spermatogenesis in mammals. Germ cells proliferate from the walls of seminiferous-like tubules in the normal mitotic and meiotic sequence common to all vertebrates. Spermatogenesis in *Lagodon* occurs within cysts created by cyst epithelial or Sertoli cell homologues. Germ cells progress through the maturation cycle with all cells in the same stage of development. Cyst epithelial cells maintain the germinal environment

and phagocytize cast out debris from maturing germ cells. Attention is being given to the morphological processes involved in cellular organization, growth and differentiation in normal and abnormal development. Ultra-structural studies of fish reproductive systems could give researchers and aquaculturists better understanding of the mechanisms responsible for important fishery related phenoma such as hybrid vigor, sterility, early stage survival and population stability.

APPENDIX B:

ASSOCIATIONS AND SOCIETIES CONCERNED WITH AQUATIC ANIMAL MEDICINE

(Eds. Note: The following are those non-governmental organizations having a national or international scope in aquatic animal medicine and do not include local or state organizations, or federal agencies that may have similar interests.)

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American Veterinary Medical Association
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Fish Culture Section
American Fisheries Society
c/o Dr. Shyrl E. Hood, President
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Fish Health Section
American Fisheries Society
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University Station Box 3312
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European Association for Aquatic Mammals
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European Association of Fish Pathologists
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APPENDIX D: CONFERENCE SCHEDULE

IAAAM -- TENTH ANNUAL CONFERENCE AND WORKSHOP

AND

AQUATIC ANIMAL MEDICINE: A STATE OF THE ART

Presented by IAAAM and Florida Sea Grant

MONDAY, APRIL 23

8:00 A.M.	Registration
9:00 A.M.	Welcome -- J. B. Gratzek -- President IAAAM

Session I

Chairperson -- R. K. Stroud

9:10 A.M.	Introduction to Fish Medicine -- M. P. Dulin* -- USDA-APHIS National Veterinary Services Lab
9:45 A.M.	Exotic Fish Problems in the U.S. -- J. A. McCann* USFWS National Fishery Research Lab
10:05 A.M.	Problems in Farming Ornamental Fish in Florida -- R. B. Socolof* -- Four Star Fish Farms, Inc.

Session II

Chairperson -- T. A. Gornall

10:40 A.M.	Parasitic Brain Lesions in Non-Stranded Cetaceans From the West Indies -- N. R. Hall* and R. D. Schimpff -- Kingston College of Marine Science.
11:00 A.M.	Parasites of Manatees (Trichechus manatus) in Florida -- D. J. Forrester*, D. J. Black, D. K. Odell, J. E. Reynolds, C. A. Beck, and R. K. Bonde
11:20 A.M.	Results and Progress of a Salvage Program Directed Toward Trichechus manatus -- D. J. Black*, D. J. Forrester, C. P. Spencer -- College of Vet. Med., University of Florida
11:40 A.M.	Bacterial Infections in Formula-Rearing of Manatees -- P. T. Cardeilhac, C. M. Walker, R. L. Jenkins*, J. M. Popp, D. J. Forrester, F. H. White and R. T. Smith

Session III

Chairperson -- M. A. Dailey

1:45 P.M.	Serum Vitamin E Levels in Bottlenosed Dolphins: Health Relationships and Functions of the Vitamin --

* Denotes speaker

R. D. Gunnels* and G. W. Harvey -- Naval Ocean Systems Center

2:05 P.M. Elevated Ceruloplasmin in a Pilot Whale with Gastritis -- J. E. Beal, Jr.* and P. T. Cardeilhac -- College of Veterinary Medicine, University of Florida

2:25 P.M. Do We Need Vitamin/Mineral Supplementation? -- W. H. Dudok van Heel -- Dolfinarium, Netherlands

2:45 P.M. Thymus Gland in the Harbor Seal -- M. L. Johnson*, S. J. Jeffries, L. Cargol and M. J. Wicks -- University of Puget Sound

Session IV

Chairperson -- J. B. Gratzek

3:20 P.M. A Study of Selected Parameters in a Recirculating Fish Culture System -- J. P. Gilbert*, J. B. Gratzek and E. B. Shotts, Jr. -- College of Veterinary Medicine, University of Georgia

3:40 P.M. Mechanisms of Copper Toxicity to Marine Fish -- P. T. Cardeilhac -- College of Veterinary Medicine, University of Florida

4:00 P.M. Antibiotics and Aquatic Bacteria -- K. E. Nusbaum*, E. B. Shotts, Jr. and D. Talkington -- College of Veterinary Medicine, University of Georgia

4:40 P.M. Anaphylactic-like Reactions in Fish -- B. Goven and D. L. Dawe*, College of Veterinary Medicine, University of Georgia

5:00 P.M. Use of Synthroid® to Reduce and Prevent Goiter in Sharks -- J. B. Sciarra* -- Mystic Marinelife Aquarium

TUESDAY, APRIL 24

Session V

Chairperson -- R. D. Gunnels

9:00 A.M. "Friday" the Hawaiian Monk Seal -- A Case History -- J. F. Allen*, D. B. Mackay, L. R. Taylor, T. R. Sawa, W. G. Gilmartin and G. C. Wittow -- Waikiki Aquarium

9:20 A.M. Preliminary Description of a Skin Disease in the Northern Elephant Seal -- D. E. Griffin* -- California Marine Mammal Center

9:40 A.M. Fatal Hepatoencephalopathy in a Group of California Sea Lions -- W. G. Gilmartin*, J. C. Simpson, M. F. Platter-Rieger, M. E. Kimball and P. R. Helms -- Naval Ocean Systems Center

10:00 A.M. Function of the Skin and Fatty Acids of the Northern Fur Seal (Callorhinus ursinus) as a Natural Barrier to Fungal Penetration -- N. A. Vedros*, A. Waldorf, A. W. Smith -- Naval Biosciences Lab., University of California at Berkeley

Session VI

Chairperson -- E. B. Shotts, Jr.

10:40 A.M. Ecological Investigations of Petroleum Production Platforms in the Central Gulf of Mexico: Histopathology of Marine Fish -- R. F. Sis*, N. H. McArthur, G. G. Stott, R. J Trapley, V. L. Jacobs and W. E. Haensly -- College of Veterinary Medicine, Texas A & M University

11:00 A.M. Use of Electron Microscopy to Study Spermatogenesis in an Estuarine Fish (Lagodon rhomboides) -- J. Winstead* -- University of Southern Mississippi

11:20 A.M. Organ Distribution of Anaerobic Bacterium, Eubacterium tarantellus in Fish from Biscayne Bay, Florida and Surrounding Waters -- L. R. Udey* -- University of Miami

11:40 A.M. Mycotic Pneumonia in Green Sea Turtles in Aquaculture -- E. R. Jacobson*, J. M. Gaskin, R. P. Shields and F. H. White -- College of Veterinary Medicine, University of Florida

Session VII

Chairperson -- J. C. Sweeney

2:30 P.M. Some Specializations of the Dolphin Eye -- W. W. Dawson* -- University of Florida

2:50 P.M. The Partially-consensual Pupillary Light Reflex of the Dolphin -- M. C. Barris*, W. W. Dawson, C. K. Adams and C. A. Litzkow -- University of Florida

3:10 P.M. A Study of Bacterial Flora Associated with the Spiracle of Captive Dolphins -- E. B. Shotts, Jr.*, G. W. Jones, and F. D. Talkington -- College of Veterinary Medicine, University of Georgia

3:30 P.M. Use of a Biological Filter and Ketoconazole to Control and Treat Candidiasis in a Group of Tursiops truncatus -- G. W. Jones* -- Quinlan Marine Attractions

Session VIII

Chairperson -- W. Medway

4:00 P.M.	Immunologic Investigation in Dolphins with Cutaneous Candidiasis -- L. Werner*, R. Halliwell and D. Buesse -- College of Veterinary Medicine, University of Florida
4:20 P.M.	Ketoconazole Treatment for Candidiasis -- S. Nakeeb*, B. Babus and D. Velle -- Sea Research Foundation Inc., State University of New York at Buffalo
4:40 P.M.	Nasal Passage of Stomach Tubes in West Indian Manatees -- F. C. Neal* and A. B. Irvine -- College of Veterinary Medicine, University of Florida
4:45 P.M.	Clinical Data from Free-ranging and Captive West Indian Manatees (Trichechus manatus) -- F. C. Neal*, A. B. Irvine, K. C. Bachman and R. L. Jenkins -- College of Veterinary Medicine, University of Florida
5:00 P.M.	Parasitic Diseases of the Hawaiian Monk Seal (Monachus schauinslandi) from the Northwest Hawaiian Islands -- M. D. Dailey* -- Southern California Ocean Studies Consortium

WEDNESDAY, APRIL 25

Aquatic Animal Medicine Conference: A State of the Art

Agenda

8:30 A.M.	Introduction and Welcome -- William Seaman, Florida Sea Grant
9:00 A.M.	The Business Management and Economics of Aquatic Animal Industries -- Louis Garibaldi, New England Aquarium
9:25 A.M.	Legal and Political Issues which Affect the Aquatic Animal Medicine Industry -- G. Steele, Executive Director, ZOOACT
9:35 A.M.	Your Regulatory World -- Changes In and Influencing It -- Robert Brumsted, U. S. Department of Commerce
9:50 A.M.	The Professionals in Aquatic Animal Medicine -- J. C. Sweeney, Marine Mammal Consultant and Veterinarian
10:30 A.M.	Researchers and Their Needs -- W. W. Dawson, J. Hillis Miller Health Center
10:55 A.M.	Aquaculture (Mariculture) and Aquatic Animal Medicine -- K. Johnson, Texas A & M University
11:20 A.M.	Aquatic Animal Medicine and the Needs of Aquatic Animal Industries -- J. B. Gratzek, College of Veterinary Medicine, University of Georgia
11:45 A.M.	Manufacturing and Supplying the Products Used in Aquatic Animal Medicine -- D. Amend, Tavolek Laboratories, Inc.
12:05 P.M.	Lunch
1:30 P.M.	Administering the Laws Affecting Aquatic Animal Medicine -- H. Hewitt, Department of Health, Education and Welfare

1:55 P.M.	Panel Discussion: A National and International Overview of Aquatic Animal Medicine -- D. D. Hammond (Ocean Park Limited); D. O. Beusse (Sea World of Florida); N. R. Hall (St. George's University Marine Mammal Research Center); Andrew Greenwood (Taylor and Greenwood) and W. H. Dudok van Heel (Dolfinarium Harderwijk); and A. Hoey (Sealand of the Pacific)
2:45 P.M.	Floor Discussions
3:30 P.M.	Keynote Speaker -- F. P. Meyer, National Fishery Research Laboratory