ESTUARINE AREAS AND JELLYFISH CONTROL

HEARING

BEFORE THE

MERCHANT MARINE AND FISHERIES SUBCOMMITTEE

OF THE

COMMITTEE ON COMMERCE

UNITED STATES SENATE

EIGHTY-NINTH CONGRESS

SECOND SESSION

ON

S. 3528

A BILL TO AUTHORIZE THE SECRETARY OF THE INTERIOR IN COOPERATION WITH THE STATES TO PRESERVE, PROTECT, DEVELOP, RESTORE, AND MAKE ACCESSIBLE ESTUARINE AREAS OF THE NATION WHICH ARE VALUABLE FOR SPORT AND COMMERCIAL FISHING, WILDLIFE CONSERVATION, RECREATION, AND SCENIC BEAUTY, AND FOR OTHER PURPOSES

S. 3744

A BILL TO PROVIDE FOR THE CONTROL OR ELIMINATION OF JELLYFISH AND OTHER SUCH PESTS IN THE COASTAL WATERS OF THE UNITED STATES

SEPTEMBER 28, 1966

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WITNESSES

ESTUARINE AREAS AND JELLYFISH CONTROL

WEDNESDAY, SEPTEMBER 28, 1966

U.S. SENATE,
COMMITTEE ON COMMERCE,
SUBCOMMITTEE ON MERCHANT MARINE AND FISHERIES,
Washington, D.C.

The subcommittee met at 10:07 a.m., in room 5110, New Senate Office Building, Hon. E. L. Bartlett (chairman of the subcommittee) presiding.

Senator BARTLETT. The subcommittee will be in order.

This morning the Subcommittee on Merchant Marine and Fisheries will hold hearings on two bills which deal with important problems confronting our Nation's coastal waters. These are S. 3528, introduced by Senator Edward Kennedy, and S. 3744, introduced by Senator Brewster.

S. 3528 would establish a national system of estuarine areas to be composed of both federally acquired and State or locally acquired estuarine areas.

Our Nation's estuaries serve as important habitats for important finfish and shellfish. In addition these estuarine areas provide recreation in the form of swimming, boating, and many other pursuits. However, many of these vital areas are being destroyed through pollution, or residential or industrial development.

Under S. 3528 a thorough nationwide study would be conducted to identify the estuarine areas of our Nation which need protection. This study would be the basis for recommending, under S. 3528, certain areas to be included in a nationwide system of estuarine areas.

S. 3744 is a bill designed to discover methods of controlling or eliminating jellyfish—sometimes known as sea nettles.

Under this legislation, the Secretary of the Interior would be authorized to cooperate with the States in giving financial and technical aid for the study and control of sea pests which adversely affect recreation as well as our fish and shellfish. Cost of the legislation would be shared by the States on a 50–50 basis.

(The bills follow:)

[S. 3528, 89th Cong., 2d sess.]

A BILL To authorize the Secretary of the Interior in cooperation with the States to preserve, protect, develop, restore, and make accessible estuarine areas of the Nation which are valuable for sport and commercial fishing, wildlife conservation, recreation, and scenic beauty, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) the Congress finds and declares that the estuarine areas of the United States are rich in a variety of natural, commercial, recreational, and esthetic resources of immediate and potential value to

NOTE.—Staff counsel assigned to this hearing: Donald C. Cole.

the present and future development of our Nation; that many of these areas have been damaged or destroyed by commercial and urban developments; and that it is the policy of Congress to preserve, protect, develop, and, where possible, restore and make accessible for the benefit of all the people selected parts of the Nation's diminishing estuarine areas which are valuble for sport and commercial fishing, wildlife conservation, outdoor recreation, and scenic beauty. In furtherance of this policy, there is established a National System of Estuarine Areas (hereinafter referred to as the "System") composed of both federally acquired and administered estuarine areas authorized by statute and other estuarine areas acquired and administered by the States or their political subdivisions and designated with the approval of the Secretary of the Interior.

The Secretary shall establish an advisory committee whose function shall be to consider each estuarine area proposed to be included in the system and to make recommendations thereon to the Secretary. In addition to the other members of the committee selected by the Secretary, there shall be from time to time at least two persons who shall represent the State wherein a paricular proposed estuarine area may be located.

SEC. 2. The Secretary, in consultation with the States and other Federal agencies, shall conduct a nationwide study of estuarine areas for the purpose of identifying areas that are (1) relatively unspoiled or undisturbed by the technological advances of man, including, but not limited to, pollutants, or (2) areas that are partially spoiled or disturbed by such advances but should be protected from further adverse effects. The Secretary shall then study such identified areas to determine the estuarine areas that should be preserved or protected, considering, among other things, all the resource and scenic values of those areas, their economic and recreational potential, their ecology, navigation, flood and erosion control, the present and future urban and industrial effects on such areas, other uses of estuaries, and the most appropriate means or methods of preserving or protecting those areas. Particular attention shall be given to whether such areas should be acquired by the Secretary because of their national significance, or by the States or by local subdivisions thereof, and whether these areas may be protected adequately through local zoning laws or other methods without Federal land acquisition. Such studies shall be coordinated with the nationwide outdoor recreation plan formulated or in preparation pursuant to the Act of May 28, 1963 (77 Stat. 49), with any plan prepared and developed or in preparation pursuant to the Water Resources Planning Act (79 Stat. 244), and with statewide plans prepared or in preparation and found adequate pursuant to the Land and Water Conservation Fund Act of 1965. The Secretary shall from time to time submit the studies to the President, together with his recommendations for inclusion in the System of any estuarine area of national significance, and the President shall submit to the Congress such recommendations as he deems appropriate. Recommendations made by the Secretary shall be developed in consultation with the States and other interested Federal agencies. Each such recommendation shall be accompanied by (1) expressions of any views which the States and agencies may submit within ninety days after having been notified of the proposed recommendation, (2) a statement setting forth the probable effect of the recommended action on any comprehensive river basin plan that may have been adopted by Congress or that is serving as a guide for coordinating Federal programs in the basin wherein each estuarine area is located, and (3) in the absence of such a plan, a statement indicating the probable effect of the recommended action on alternative beneficial uses of the resources of such estuarine area.

SEC. 3. The Secretary of the Interior may acquire lands and waters or interests therein within any estuarine area authorized by Congress to be included within the System by purchase with appropriated or donated funds or by lease, donation, or exchange, except that he shall not acquire with appropriated funds any lands and waters or interests therein owned by a State or by any political subdivision thereof. In the exercise of his exchange authority, the Secretary may accept title to any non-Federal property and in exchange therefor the Secretary may convey to the grantor of such property any federally owned property under his jurisdiction which he classifies as suitable for exchange or other disposal. The values of the properties so exchanged either shall be approximately equal, or if they are not approximately equal, the values shall be equalized by the payment of cash to the grantor or to the Secretary as the circumstances require.

The Secretary may use donated funds and enter into agreements with public and private agencies, organizations, or individuals for research for the purpose of this Act.

Any lands, waters, or interests therein within a designated estuarine area which are acquired pursuant to this Act shall be administered, managed, and developed primarily for the purposes of sport and commercial fishing, wildlife conservation, outdoor recreation, and scenic beauty, and for such other purposes as the Secretary determines are compatible with these purposes.

Any Federal land located within a designated estuarine area may, with the consent of the head of the agency having jurisdiction thereof, be transferred to the Secretary of the Interior for administration as part of said area.

The States shall be encouraged to cooperate in the planning and in the management, pursuant to cooperative agreements, of estuarine areas included in the System.

SEC. 3. The Secretary is authorized to issue regulations governing the public use of estuarine areas administered by him.

SEC. 4. Any person who violates or fails to comply with any regulation issued pursuant to this Act shall be guilty of a misdemeanor and upon conviction thereof shall be fined not more than $500 or be imprisoned not more than six months, or both.

SEC. 5. In all planning for the use and development of water and related land resources, consideration shall be given by all Federal agencies involved to potential estuarine areas, and all project plan reports submitted to the Congress shall discuss any such potential and make recommendation thereof. The Secretary of the Interior shall make specific studies and investigations to determine which estuarine areas within the United States shall be evaluated in planning reports by all Federal agencies on potential alternative uses of the water and related land resources involved.

SEC. 6. The Secretary in cooperation with other Federal agencies shall encourage States and local subdivisions thereof to consider, in their comprehensive planning and proposals for financial assistance under the Federal Aid in Wildlife Restoration Act (50 Stat. 917), as amended (16 U.S.C. 669 et seq.), the Federal Aid in Fish Restoration Act (64 Stat. 430), as amended (16 U.S.C. 777 et seq.), the Land and Water Conservation Fund Act of 1965 (78 Stat 897), the Commercial Fisheries Research and Development Act of 1964 (78 Stat. 197), and under title VII of the Housing Act of 1961, as amended, the needs and opportunities for establishing estuarine areas on lands and waters owned or acquired and administered by them. Such areas may be designated as parts of the Nationwide System of Estuarine Areas by the States with the approval of the Secretary of the Interior. When approving such areas to be included in the System, the Secretary shall establish such terms and conditions as he deems desirable to insure the permanent protection of such designated areas. The lands or interests therein of any estuarine area included in the System by a State shall not be disposed of by sale, lease, donation, or exchange without the prior approval of the Secretary.

SEC. 7. (a) Nothing in this Act shall restrict or extend such jurisdiction as the States now have with respect to State water laws, nor be construed as an express or implied claim or denial on the part of the United States as to exemption from State water laws.

(b) Nothing in the Act shall affect the jurisdiction or responsibilities of the States under other provisions of law with respect to fish and wildlife.

SEC. 8. For the purposes of this Act:

(a) The term "estuarine areas" means an environmental system consisting of an estuary and those transitional areas which are constantly influenced or affected by water from an estuary such as, but not limited to, salt marshes, coastal and intertidal areas, embayments, lagoons, inshore waters, and channels.

(b) The term "estuary" means all or part of the mouth of a navigable or interstate river or stream or other body of water having unimpaired natural connection with the open sea and within which the sea water is measurably diluted with fresh water derived from land drainage.

(c) The term "person" as used in this Act means any individual, partnership, corporation, or association.

SEC. 9. There are authorized to be appropriated such sums as may be necessary to carry out the purposes of this Act.

[S. 3744, 89th Cong., 2d sess.]

A BILL To provide for the control or elimination of jellyfish and other such pests in the coastal waters of the United States

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, for the purposes of conserving and protecting the fish and shellfish resources in the coastal waters of the United States and promoting and safeguarding water-based recreation for present and future generations in these waters, the Secretary of the Interior is authorized to cooperate with, and provide assistance to, the States in controlling and eliminating jellyfish, commonly deferred to as "sea nettles", and other such pests.

SEC. 2. In carrying out the purposes of this Act, the Secretary, in cooperation with the States, is authorized (1) to conduct, directly or by contract, such studies, research, and investigations, as he deems desirable, to determine the abundance and distribution of jellyfish and other such pests and their effects on fish and shellfish and water-based recreation, (2) to conduct studies of control measures of such pests, (3) to carry out, based on studies made pursuant to this Act, a program of controlling or eliminating such pests, and (4) to take such other actions as the Secretary deems desirable: *Provided*, That the costs of such actions shall be borne equally by the Federal Government and by the States, acting jointly or severally.

SEC. 3. There is authorized to be appropriated not to exceed $10,000,000 for the Federal share of the program authorized by this Act.

SEC. 4. The Congress consents to any compact or agreement between any two or more States for the purpose of carrying out a program of research, study, investigation, and control of jellyfish and other such pests in the coastal waters of the United States. The right to alter, amend, or repeal this section or the consent granted herein is expressly reserved.

SEC. 5. Nothing in this Act shall be construed to alter, amend, repeal, modify, or diminish the present general authority of the Secretary of the Interior to conduct studies, research, and investigations related to the mission of the Department of the Interior.

(The agency reports follow:)

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., July 7, 1966.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate, Washington, D.C.

DEAR SENATOR MAGNUSON: Your Committee has requested the comments of this Department on S. 3528, a bill "To authorize the Secretary of the Interior in cooperation with the States to preserve, protect, develop, restore, and make accessible estuarine areas of the Nation which are valuable for sport and commercial fishing, wildlife conservation, recreation, and scenic beauty, and for other purposes."

S. 3528 establishes a National System of Estuarine Areas to be composed of both federally acquired and State or locally acquired estuarine areas.

We recommend enactment of S. 3528.

Estuaries serve as habitat, spawning, and nursery areas for many species of commercially important finfish and shellfish. Estuarine areas attract recreationists for swimming, boating, bird watching, hiking, or just an opportunity to enjoy the beauty of natural resources along coastal areas.

Estuaries are places where salt water meets fresh water. A meandering river flows to the sea and terminates in an estuary. At this point, the river waters, the ocean tides, the coastal currents, and the contours of our shores interact resulting in the depositing of river sediments and sediments washed up by the sea in the estuary. It is a holding place for nutrients and, in some cases, for pollutants. This sediment slowly settles as the river flow slows when it enters the estuary and forms sand or mud flats which are covered with algae and other plants that can survive in salt and brackish water. These plants also collect more sediment and build up the area upon which more plants grow. Thus, the coastal marsh is formed with its myriad channels and creeks and small potholes with their gently sloping sides. This marginal sea and land area is the environment for many natural resources. It is these areas that we believe should be protected and preserved. When they are destroyed through residential or industrial development or badly polluted, they cannot be replaced. When this happens, the Nation as a whole is the loser.

The destruction of estuarine areas has progressed more rapidly in recent years because of population pressures for housing space, industrial developments, and works of improvement for hurricane protection and control of beach erosion and salt water intrusion. In addition, many estuarine areas are being altered ecologically to the detriment of desirable organisms by pollution and water flow control. Nearly every past action by man along the coastline has damaged, to some degree, the physical existence or biological quality of the estuarine areas. For these reasons, this Department strongly supports the concept of a system of estaurine areas in the United States which will be preserved and managed for the benefit of future generations.

S. 3528 provides that before we embark on a broad estuarine land and water acquisition program a thorough nationwide study should be conducted to identify the estuarine areas of the country that need protection, and detailed studies should be undertaken on a regional basis to determine the most appropriate means and measures of preserving particular areas. We believe that this approach is sound. The detailed studies should consider whether such areas should be acquired by the Federal Government or by the States, or local government, and whether such areas can be appropriately preserved through other protective measures such as the control of dredging and filling in navigable waters, or the development of adequate zoning laws without any or with only limited Federal acquisition.

These studies would be the basis for recommending the course of action that should be taken to protect estuarine areas. These studies will help to formulate reasonable criteria for determining which areas should be included in a Nationwide System of Estuarine Areas either as federally acquired estuarine areas because of their national significance, or as State or local government acquired acquired areas. When an estuarine area meets the criteria for areas of national significance, it will be recommended to the Congress to be included within the System and to be managed by the Secretary of the Interior. The Secretary will encourage the States and political subdivisions thereof to retain, or, where necessary, to acquire and to administer other estuarine areas which meet the criteria for areas to be included in the System. Funds made available under the Land and Water Conservation Fund Act of 1965, the open-space program under title VII of the Housing Act of 1961, the Dingell-Johnson Act, the Pittman-Robertson Act, and the Commercial Fisheries Research and Development Act of 1964 could be used by the States for such areas, assuming, of course, that they meet the other requirements of those Acts.

In summary, S. 3528 provides (1) land acquisition, management, and administrative authority for federally acquired estuarine areas, but that this authority not be utilized until the Congress provides by statute, after study, for the designation of individual estuarine areas, and (2) for the designation with the approval of the Secretary of the Interior of non-Federal public estuarine areas to be included in the nationwide System.

The federally acquired areas will be those of national significance. Before the Secretary can begin to acquire, however, Congress will have to consider and approve each one on its own merit. This approach is similar to the one followed in the case of our national recreation areas, national seashores, wild rivers, national trials, and wilderness areas. The areas designated by the States may include areas owned by local subdivisions of the States. The Secretary will have to approve each area to be designated.

The bill authorizes the Secretary to acquire lands and waters within an estuarine area only when such area has been authorized by Act of Congress. Where the lands and waters are already publicly owned, purchase with Federal funds is prohibited.

The bill directs the Secretary to encourage States and their local subdivisions to establish estuarine areas within their borders. Some of these areas might be acquired and developed with grants made under programs mentioned in the bill. The areas could then be designated by the States to be included in the System. The Secretary of the Interior would have to approve each area based on studies and the criteria established by those studies. The designated areas would continue to be administered by the States and their local subdivisions.

The objective of such designation is to insure that these estuarine areas are permanently protected. Thus, the bill prohibits the disposal of these areas without the prior approval of the Secretary.

The Bureau of the Budget has advised that there is no objection to the presentation of this report from the standpoint of the Administration's program. The Budget Bureau believes, however, that this bill should be limited to a study by the Secretary of the Interior, in cooperation with the States and other affected

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Federal agencies of the feasibility and desirability of establishing a Nationwide System of Estuarine Areas. The result of such a study would then be available prior to consideration by the executive branch and the Congress of legislation to establish such a System.

Sincerely yours,

STANLEY A. CAIN,
Assistant Secretary of the Interior.

OFFICE OF THE DEPUTY ATTORNEY GENERAL,
Washington, D.C., September 19, 1966.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate, Washington, D.C.

DEAR SENATOR MAGNUSON: This is in response to your request for the views of the Department of Justice on the bill (S. 3528) "To authorize the Secretary of the Interior in cooperation with the States to preserve, protect, develop, restore, and make accessible estuarine areas of the Nation which are valuable for sport and commercial fishing, wildlife conservation, recreation, and scenic beauty, and for other purposes."

The bill would authorize the Secretary of the Interior to study throughout the Nation estuarine areas which meet the standards set forth in the bill for protection or preservation for fishing, wildlife conservation, outdoor recreation, and scenic beauty, and to recommend to the Congress the inclusion of specific areas in the National System of Estuarine Areas which would be established by the bill. Details as to the acquisition of lands within such areas as may be authorized by Congress to be established, their management, and the inclusion within the System of State-created estuarine areas, are set forth.

The subject of the bill appears to concern primarily the operations of other agencies of the Government. We perceive no legal objections to the bill, and defer to the views of the agencies more directly concerned as to whether or not it should be enacted.

The Bureau of the Budget has advised that there is no objection to the submission of this report from the standpoint of the Administration's program.

Sincerely,

RAMSEY CLARK,
Deputy Attorney General.

COMPTROLLER GENERAL OF THE UNITED STATES,
Washington, D.C., August 29, 1966.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate.

DEAR MR. CHAIRMAN: By letter dated August 19, 1966, you requested our comments on S. 3744, 89th Congress. The stated purpose of this measure is: "To provide for the control or elimination of jellyfish and other such pests in the coastal waters of the United States."

We have no special information that would assist the committee in its consideration of S. 3744 and therefore offer no comments with regard to the action to be taken on this measure.

Sincerely yours,

FRANK H. WEITZEL,
Assistant Comptroller General of the United States.

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., August 25, 1966.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate, Washington, D.C.

DEAR SENATOR MAGNUSON: Your committee has requested this Department's views and recommendations on S. 3744, a bill "To provide for the control or elimination of jellyfish and other such pests in the coastal waters of the United States."

We recommend the enactment of S. 3744.

S. 3744 authorizes the Secretary of the Interior to cooperate with the States and give financial and technical aid to them in the study and control of jellyfish and similar pests which adversely affect fish and shellfish and water-based recreation. The Secretary is also authorized to conduct, either directly or by contract, or both, research into the sea nettle problem, including their life history, to conduct studies on developing control measures, and to control, based on such studies, or eliminate jellyfish and similar pests in the coastal waters of the United States.

Section 2 directs that the cost of this program will be shared (50–50) by the States and the Federal Government. The bill authorizes a total appropriation of $10 million to carry out the Federal share of this program.

While the bill is sufficiently broad to cover any pest adversely affecting fish, shellfish, and recreation in our coastal waters, it is primarily aimed at the "sea nettle" problem in Chesapeake Bay. This problem has received a great deal of public attention. It is not new, of course, for periodic explosions of adquatic life to occur—one species or another.

We believe that the Federal Government has an important interest in this problem from the standpoint of water-based recreation. It is of great concern to the many people who annually use this and similar areas along our coasts for recreational purposes. Also, it is of concern to those who derive economic benefits from these recreational users.

The Federal Government also has an interest from the standpoint of the methods used to control these pests. We do not now consider the "sea nettle" as a serious threat to marine game or commercial fish and shellfish resources. We lack, however, adequate knowledge about its life history to assure us that it has no indirect effect on these resources, as a competitor for food, or carriers of disease.

It should be pointed out that this Department is now authorized by the Fish and Wildlife Act of 1956, as amended, and the recently enacted Organic Act of the Bureau of Outdoor Recreation to conduct studies and research into the problems created for fish and shellfish and water-based recreation by these sea nettles. Also, the Act of September 22, 1959 (73 Stat. 642), authorizes a continuing study of migratory marine game fish. The Department, however, has not to date utilized any of these authorities or sought funds to study the "sea nettle" problem.

In addition to the Federal Government's interest in this problem, the States have similiar interests and, from an economic standpoint, very vital interests. Thus, we strongly believe that any effort undertaken by way of research and control of this problem must be done jointly by the States and the Federal Government. Both should share the costs equally. S. 3744, unlike our other authorities, provides for such cost sharing. It recognizes the joint Federal-State interest in this problem.

Rational and effective control must be based on knowledge. It seems that biologists generally have neglected the ecology of this group and have little, if any, knowledge of possible and acceptable environmental controls in this case.

Preliminary estimates indicate that a research effort adequate to gain the necessary knowledge of the distribution, life history, and biology of the "sea nettle" and similar pests and to evaluate the control would be very costly. Possibly, the answer to the problem will not be direct control of the "sea nettle," but control of other factors, such as pollution. Exhaustive tests will be needed to ensure that any method of control developed will have no harmful effect on humans or other animals or valuable aquatic resources. We must know where, in the case of chemicals, they go in the ecosystem as well as their effect on the target species. We estimate that the Federal share of this program may be as high as $1 million annually.

Despite the costs and our present inadequate knowledge, we very definitely believe that such a joint Federal-State program should be authorized. We should not take a pessimistic view on its success. It could and should render a distinct service to many millions of people.

We recommend that section 4 of the bill be amended by adding two new sentences at the end thereof to read as follows:

"Such compact shall not be in conflict with any law of the United States. Nothing in such compact shall be construed to affect, impair, or diminish any right, power, or jurisdiction of the United States over or in regard to any navigable waters or any commerce between the States."

The Bureau of the Budget has advised that while there is no objection to the presentation of this report, the Bureau recommends that action on S. 3744 be deferred at this time. The Budget Bureau believes that further preliminary investigation of the jellyfish problem, such as the study now being conducted by the University of Maryland under a matching grant made available from the Department of the Interior under the Water Resources Research Act should precede both the authorization of a large-scale program of research, control, or eradication and determination as to where the responsibility lies for bearing the substantial cost of such a program.

Sincerely yours,

CLARENCE F. PAUTZKE,
Deputy Assistant Secretary of the Interior.

Senator BARTLETT. Senator Kennedy, the sponsor of the estuaries areas bill, had planned to present testimony in favor of his bill this morning, but, unfortunately, because of a death in the family, will not be able to be present. I would like, however, to place Senator Kennedy's prepared statement in the record at this point.

(The statement follows:)

STATEMENT OF HON. EDWARD M. KENNEDY, U.S. SENATOR FROM THE STATE OF MASSACHUSETTS

Mr. Chairman, I appreciate this opportunity to appear before your Subcommittee to testify in support of my bill, S. 3258, to establish a National System of Estuarine Areas.

More and more in recent years, we have become aware of—and concerned about—our Nation's estuaries. Most of us see them near our homes or in our travels, and everyone who has ever examined a large map of the United States has seen them represented—those innumerable and indeed fascinating indentations along our coasts, from Maine to Florida and Texas and from California to Alaska.

Perhaps many who have seen estuaries or seen them depicted on a map have not associated them with that name. It may be helpful, at the outset, to describe them in fairly precise terms. An "estuary" means all or part of the mouth of a navigable or interstate river or stream or other body of water having unimpaired natural connection with the open sea and within which the sea water is measurably diluted with fresh water derived from land drainage.

There is a companion term which is also important: "estuarine area." This phrase refers to an environmental system consisting of an estuary and those transitional areas which are constantly influenced by water from an estuary such as salt marshes, coastal and intertidal areas, embayments, lagoons, inshore waters, and channels. Both of these terms are defined in S. 3528 and will be heard many times before this hearing is concluded.

We have been using estuaries and their environs for a long time, as time is reckoned in our country: 300 years and more. Numerous and very conveniently situated along our coastline, they have been ideal areas on and around which to build our civilization. Unfortunately, the process of use has also been accompaned by two unwelcome brothers, abuse and destruction. In our rapidly accelerating push to use estuarine areas for commerce, industry and urban complexes, we have, regretfully, been consigning too much and too many of these rich repositories of natural resource wealth to oblivion. That is why we are here today—to try to do something to halt this destructive trend.

There are no environments in the continental landscape and waterscape richer in natural resources than estuaries and estuarine areas. Not all these resources have been destroyed or impaired, or impaired beyond recovery.

It is the natural fertility of estuarine areas which sustains the rich variety and quantity of these important and renewable natural resources. The reasons for this high productivity are complicated, and only partly known at present. The waters have circulation patterns providing efficient nutrient exchange. The inhabiting organisms basic to productivity are favored with a nutrient supply continually being replenished from the sea and by runoff from the land. And equally important, the productive capacity of this environment occurs year-round, not just seasonally as is the case in most upland environments.

Many of the important things in our lives and in our world have values which cannot be measured by the yardstick of the market place. And so it is with a large share of the resources produced in the estuary and its environs. Nevertheless, these elements which are valuable and unmeasurable in this environment are responsible, in ways not yet fully understood, for producing the estuarine resources which we can and do measure.

Take, for example, the measurable domestic commercial seafood catch from our coastal waters. In 1963, the weight of the catch and the amount paid to fishermen (ex-vessel value) from all three coastal areas—Atlantic, Gulf, and Pacific—were 4.7 billion pounds and $362 million, respectively. An estimated 65 to 75 percent of this catch was estuarine dependent. We need this protein harvest from our coastal waters as much as we do the products of our agricultural lands, and we shall need it more for a projected population level of 245 million by 1980 and 331 million by the year 2000.

Another example is the waterfowl resource. From recent surveys, some significant estimates on the activities of waterfowl hunters have been obtained. In 1965 the total number of waterfowl hunters in the United States was over 1.6 million. About half of the above total, some 784,000, use our Nation's estuaries in pursuit of their sport. These estuarine waterfowl hunters spent over $41 million during slightly less than 6.5 million man-days afield an traveled more than 300 million automobile passenger-miles on their hunting trips.

A third example concerns sport fishing. Over 4 million people fished in estuaries in 1965. These fishermen are estimated to have spent more than $600 million on more than 72 million recreation days and to have traveled over 3 billion automobile passenger-miles while enjoying their sport in 1965.

And let us not forget the recreational opportunities provided by the estuarine environment, in addition to these already mentioned. By the millions, we boat, swim, camp, look at the scenery, and expose millions of feet of camera film in the process. Added to all this are the scientific and educational values of estuaries and estuarine areas. These values are less appreciated now than they should be, but time and research will change this for the better.

Unfortunately, this appealing picture of great natural wealth and productivity is beclouded, as I intimated earlier. The estuarine environment is deteriorating as a result of population pressures, the accompanying urban development, and the exploitation of natural resources in the expansion of our economy.

Major types of practices undertaken by man which affect estuarines areas are few in number, but their effect is usually adverse—and too often devastating.

There are dredging and filling projects for the construction, improvement and maintenance of navigation channels in estuaries. Millions of cubic yards of material called spoil is removed from these channels and dumped where it is easiest and cheapest to dump it—on the peripheral wetlands. Once filled, the spoil areas frequently become urban developments which, over the years, tend to crowd in and continually constrict the estuarine waters. Creation of new land for urban and industrial development is also a primary as well as a secondary purpose of dredging and filling shallow coastal waters.

There is pollution of estuarine areas. I need not go into detail about the fantastic amount of human sewage, and the industrial and chemical wastes, including pesticides residues, which pour into our waterways, estuaries and rivers. This is a national problem—inland and coastal, and a national shame.

I do not, for a moment, suggest that we bring all the wheels of civilization to a screeching halt to reverse the impairment and destruction of the estuarine environment. Certain of the processes, where they have occurred, are irreversible, in any case. I do suggest that we put into motion other wheels which will slow down and, in some areas, prevent the destruction of valuable estuarine areas of our country. This is the least we can do in the public interest.

In my own State of Massachusetts, the legislature in November 1965 enacted legislation giving the Department of Natural Resources the right to restrict or prohibit dredging, filling, removing or otherwise altering, or polluting, coastal wetlands, for the purpose of promoting the public safety, health and welfare, and protecting public and private property, wildlife and marine fisheries. The law also gives any owner who feels that such restriction constitutes a land-taking the right to petition the courts for compensation and the State may acquire the wetland under eminent domain procedures. We hope to spare from destruction nearly 45,000 acres of salt marshes in Massachusetts under this legislation.

In 1965, the Rhode Island legislature passed a law establishing a system for coastal wetland zoning. This law gives the Department of Agriculture and Conservation authority to designate, following public hearing and notification thereof to all owners of record, such wetlands as deemed necessary to protect the purity and integrity of those coastal areas. These wetlands include values related to public health, marine fisheries, wildlife, and coastal protection from natural disasters. There is provision also for recovery of damages by wetland owners disadvantaged by this zoning.

But we must do more—much more—and do it on a national scale, or see most of our valuable estuarine resources eventually disappear from the American scene. S. 3528 is a step toward preservation and wise use of these resources and away from the discouraging and self-defeating trend toward their obliteration. It provides for a nationwide study by the Secretary of the Interior to identify the estuarine areas which should be protected from further deterioration. Such a study would pinpoint those areas that warrant Federal acquisition and administration because of their national significance.

If an estuarine area met the criteria for areas of national significance, it would be recommended to the Congress for inclusion within the National System. When such an area was authorized by an Act of Congress, it would be managed by the Secretary of the Interior.

Of equal importance is the role that the states must play in estuarine preservation. Under this bill, states and their political subdivisions are encouraged to acquire and administer estuarine areas where the study reveals such acquisition and administration to be desirable. The end result would be a nationwide system of estuarine areas composed of federally acquired areas and those designated by the states. This approach represents a recognition that both the Federal Government and the individual states must share the responsibility in this most important area. The approach is also similar to the one followed in the case of our natonal recreation areas, national seashores, wild rivers, national trails and wilderness areas.

At the time I introduced S. 3528 the Senate had not acted on S. 2947 (of which I was one of 48 sponsors). This bill amends the Federal Water Pollution Control Act to improve and make more effective certain programs pursuant to such Act. S. 2947, as recently passed by the Senate, authorizes general surveys of the Nation's estuaries. However, they do not authorize the Federal acquisition of lands and waters within estuarine areas authorized by Congress to be included within a National System of Estuarine Areas, as does my bill S. 3528.

Mr. Dingell introduced H.R. 13447, in the House on March 9, 1966 to accomplish the same objectives as S. 3528.

H.R. 11236, a bill introduced by Congressman Tenzer, would establish a Long Island National Wetlands Area in order to assure the preservation and protection of the natural coastal wetlands in that area. Senator Kennedy of New York has introduced similar legislation, S. 3271 in the Senate. Congressman Wydler introduced H.R. 16008, a bill calling for a commission to study the best methods to conserve the Long Island Wetlands Conservation Area.

Mr. Chairman, both Congressman Dingell's bill and the one introduced by Congressman Tenzer and Senator Kennedy are concerned with a conservation problem that is vital to our country. All departmental reports on the bills were favorable and, with one exception, all the testimony received at the hearings was favorable. H.R. 13447, Mr. Dingell's bill has been rewritten in order to incorporate the desirable features of Congressman Tenzer's bill and Congressman Wydler's bill as well as the suggested departmental amendments. It has been ordered reported to the House.

Mr. Chairman, in its present form H.R. 13447 is a remarkable piece of legislation. Its provisions are designed to meet the urgent need to prevent the further deterioration of coastal areas of great commercial, recreational and aesthetic value. The amendments that have been added as the result of departmental suggestions and the specific concerns of other House bills are extremely constructive.

The bill provides for the study that is so urgently needed to identify the areas of greatest need. Its provisions ensure the coordination of all water resources projects relating to estuarine areas and it incorporates the principle of joint responsibility on the part of the Federal Government, the States and political subdivisions. Protection is provided for property owners who own improved property within a designated area and nothing in the bill is intended to restrict

or expand the jurisdiction that the states now have with respect to state water laws and laws concerning fish and wildlife.

Mr. Chairman, we have only a limited number of days remaining in this session. In view of the importance of this legislation, it is my hope that your Committee will consider the constructive amendments of the House so that when the bill is reported, and hopefully, when it is passed, there will be no substantial variance to cause a conference delay.

Senator BARTLETT. We will be pleased to hear from Congressman Herbert Tenzer.

We will be pleased to hear from you, Congressman, either by way of prepared statement or extemporaneously, or both.

STATEMENT OF HON. HERBERT TENZER, U.S. CONGRESSMAN FROM THE FIFTH DISTRICT OF NEW YORK

Mr. TENZER. I do not have a prepared statement, Senator. I will take only a few minutes, in view of the fact, as you are well aware, that the House has had extensive hearings on similar legislation.

I am not a member of the subcommittee of which the Honorable John Dingell is chairman, but I had the privilege of presenting early last year legislation to bring about this same result, aimed primarily at the preservation of our wetlands areas in Long Island, the southern part of New York State. I later saw the wisdom of stretching this benefit to the estuarine areas and wetlands throughout the United States.

When one comes from a district new to the political arena, one thinks in terms parochially of the problems in one's own district, but when you come and find the situation is very much the same elsewhere in the United States, one addresses himself to the benefit of the 179 million people in the United States, and this is what this legislation is addressed to.

I am certain that the distinguished chairman of this committee is aware of the hearings that were held on June 16, June 22 and June 23, 1966, on various legislation dealing with the preservation of the wetlands and estuarine areas throughout the United States. The bill was later amended and is now H.R. 13447, which is the committee bill amended to include all of the estuarine areas around the United States.

I am particularly pleased that the essential features of my own bill, H.R. 15770, which was designed to provide for the protection and development of the particular estuarine area which is of great significance—Long Island wetlands—was included as part of this bill as reported by the House, now H.R. 13447.

I am a resident of the south shore of Long Island, and when I came there in 1936 we had an area of some thirty-odd thousand acres of wetlands which the United States in a joint survey with the State of New York found back in 1959 to be the most important wetlands area for migrant waterfowl on the east coast of the United States. Unfortunately, since 1936, to date, there are only 16,000 acres left. Fourteen thousand of those acres have been protected in perpetuity under concrete and are no longer available for its great natural purposes for the development of the marine life, the ecology of the entire south shore area.

No longer is it possible to swim in those waters which have become polluted as a result of the indiscriminate dredging, and for the purpose of taking out fill to fill in and build housing and industrial areas along the shore.

I remember boating in that area. It was a very easy thing for my son to dive off the boat and swim, but those waters today are polluted and that is not possible any more. At the same time, a great many people used to derive their surplus food from those waters, clamming and oyster fishing was a popular sport there.

Many of these oyster beds have been destroyed. Where there were 4 and 5 feet depths maintained throughout this area, they have been dredged to 30 feet, destroying the possibility for this type of shellfish to survive in that type of atmosphere.

What this committee is now considering, what the House has done, and what it has hopefully and respectfully expected that the Senate will do, is to protect and preserve these wetlands and in perpetuity. This is essential to the maintenance of our natural resources.

Preservation of natural resources is a constant problem of the Congress of the United States, and it is respected for its natural resources and scenic beauty, but primarily for the ecology and preservation of the marine life and the source of food for the future which is extremely important.

This bill does all of those things, as it has been amended and I hope that this committee, in its wisdom, will approve the bills before it and amend them to include the essential provisions which appear in the Dingell bill as amended by the House subcommittee, and by the full Committee on Merchant Marine and Fisheries. The bill has been reported out unanimously by the subcommittee and unanimously from the full committee, and hopefully the Senate will go along with us.

Senator BARTLETT. Do you have any notion, Congressman, when the bill might be taken up by the House?

Mr. TENZER. Well, I understand a request has been made that it appear on the calendar on Monday.

Senator BARTLETT. The suspension calendar?

Mr. TENZER. Yes.

Senator BARTLETT. I want to congratulate you for having been an early mover in this area, which becomes more important, as you noted, each year. You said in another day there were 35,000 acres of wetlands?

Mr. TENZER. Yes; in 1936 there were 30,000 acres within my district on the south shore, and there are only 16,000 left.

Senator BARTLETT. Now, would it be a purpose of the bill to enlarge that tract?

Mr. TENZER. No; that is no longer possible. That would require the moving of housing, and an essential feature of the bill as it now appears was that it should not be necessary for the Federal Government to acquire by condemnation estuarine areas and wetlands areas which have no other purpose than preservation and protection of benefit of all people. It should not be necessary to appropriate funds to acquire that.

This bill calls for management of those lands between the Federal Government, State, and any municipalities that may own lands, and any lands that are in public ownership, we shouldn't have to pay for them.

Senator BARTLETT. You find any opposition to this in your district?

Mr. TENZER. Well, originally there was, but it was strictly on political lines. Today all groups seem to agree, and there were recent editorials pointing out that everyone now agrees that this is a good thing. They used to talk in terms of "Federal control," but there is no Federal control involved in this bill. There is no compulsion. This is permissive legislation.

Senator BARTLETT. There wasn't any opposition, then, based upon the desire of developers. Perhaps I should put that in and out of quotes to acquire the remaining 16,000 acres?

Mr. TENZER. No; it seemed to me that everyone that testified testified on the necessity of preserving the wetlands. They differed only as to who should preserve them—whether the Federal, State, or locality should do it. But then it developed that when you acquire many specialists with a great many disciplines to properly maintain a wetland area, the local community do not have available to them scientists possessing these disciplines, and it is only the Federal Government which can come in with an agreement with the locality to supply the know-how in maintenance of these areas.

Senator BARTLETT. If a measure such as this were enacted into law, do you see a possibility of the restoration of the clam and oyster beds, for example?

Mr. TENZER. Yes; with the knowledge that the Department of the Interior has, they probably can restore the remaining wetlands wherever the management might require. I am not an expert on this, but it seems to me that when I used to boat, and there was an area that had an area of 5 feet, or 4 feet, let us say, and at the time of a storm they would wash in a great deal of sand and deposit the sand, and 2 days later you couldn't pass over that water. It came to a depth of 2 feet. Perhaps the proper management would restore those waters to the natural depth, and this is the management that local communities and States do not do, and do not have the capacity and know-how to do, but combined with the Federal Government now, an agreement between the State and Federal Government and locality, this could be done.

Senator BARTLETT. Thank you very, very much.

Mr. TENZER. Thank you, Senator.

Senator BARTLETT. I had the pleasure of testifying, the other day, before Congressman Dingell, and now we are reversing the roles. John?

STATEMENT OF HON. JOHN D. DINGELL, CONGRESSMAN FROM THE 16TH DISTRICT OF MICHIGAN

Mr. DINGELL. Mr. Chairman, members of the committee——

Senator BARTLETT. Glad to have you here.

Mr. DINGELL. It certainly is a pleasure to be with you this morning. It is always a pleasure to see my good friend of long standing, with whom I served in the House some years ago, who is now presiding as the chairman of this subcommittee. I wish to say that I am pleased to see him well and fit this morning, and hope that I will have the pleasure of seeing him well and fit for many years to come.

Senator BARTLETT. Thank you very much.

Mr. DINGELL. Mr. Chairman, I want to commend this subcommittee and its distinguished chairman for the hearings being held today. They are on matters of some importance to the Nation.

I might mention I have with me this morning my good friend and counsel for my subcommittee, Mr. Ned Everett.

I would like to treat both of the bills that are on this program this morning, in very brief fashion, Mr. Chairman.

The first, S. 3528, is an excellent piece of legislation. It is aimed at the preservation of important resources.

The lateness of the hour and the great speed with which this committee has acted have prevented me from studying that legislation as carefully as I would have liked. We did, however, go over the whole subject matter very carefully in the House and have come out with H.R. 13447. This measure will be on the calendar next Monday and is substantially similar to S. 3528, but is couched in terms of a nationwide program.

H.R. 13447 came unanimously from the subcommittee, was reported unanimously from the full Committee on Merchant Marine and Fisheries, and we expect it will pass the House without any difficulties.

I would point out there were difficulties involving viewpoints of different Members. The originator of the whole concept on the House side of the Capitol is a distinguished member of our body, who just appeared before you, Mr. Herbert Tenzer, of New York. I had the privilege of working with him in trying to resolve the whole series of difficulties that faced us in securing enactment of this particular legislation.

H.R. 13447 embodies the suggestions and thoughts of Members of both sides of the aisle, and reflects a real attempt by the subcommittee and the committee to eliminate objections that were felt by Members on both sides of the aisle. I commend that legislation.

I would, at this time, Mr. Chairman, like to comment on some of the bases for this legislation and point out that extensive hearings were held by my subcommittee, at which time rather complete testimony was taken from persons who live in our shoreline areas, and, also, from witnesses of the Department of the Interior and other Government agencies, all of whom expressed great concern about the manner in which the wetlands are being dredged and destroyed for all time.

These are the major spawning and nursery areas for almost all of the fisheries of the Atlantic, the Pacific, and the gulf coast. When these are gone, we may well find that the fishing resources of these areas have been irreparably damaged.

It is also true that these areas are of pressing importance to fish and wildlife uses, and are major spawning areas for oysters. They are a great source of recreational value. They have habitats for birds, and offer a real challenge to preserve one of our great remaining recreational and natural beauty resources.

There are very few estuarine areas left. They are going very fast, and I believe the time is very short in which we may act; that is one of the reasons I am particularly pleased at the vigor with which this committee has acted under the needs of these circumstances.

I would like to comment briefly on S. 3744——

Senator BARTLETT. Before you come to that, are you rushed for time?

Mr. DINGELL. No, Mr. Chairman.

Senator BARTLETT. I was wondering if it would not be well for the record, for either Mr. Everett, or counsel for the Senate subcommittee, to give us the essential differences between the House and Senate bills, for I am in the same situation as you are. I don't know the main differences.

I have just been informed that the Assistant Secretary, Mr. Cain, is going to tell us the difference between the two bills so it will not be necessary to go into it now.

Mr. DINGELL. I notice Mr. Finnegan is here and he is quite familiar with the differences in these bills.

The only comment I wish to make is with regard to the other bill pending before the committee. I have with me another member of the committee staff, who has the statement of our distinguished chairman, the Honorable Edward A. Garmatz, who is the sponsor of that particular legislation. With the permission of the Chair, I would like to submit the statement of our chairman, and express, on behalf of the membership of the committee, the sincere hope that this committee will act expeditiously on that particular statement.

Senator BARTLETT. Let the statement be incorporated in the record, following yours.

Mr. DINGELL. If you please, Mr. Chairman, that legislation was for the control of sea nettles on the east coast. We have very little knowledge of what they do besides make a nuisance of themselves, and it is my hope that this committee will act sympathetically at a later time on that legislation. It is of considerable importance to the chairman of the committee on which I serve, and on which I believe you also served, Mr. Chairman.

Senator BARTLETT. Happily so, yes.

Mr. DINGELL. And with those comments, Mr. Chairman, I would be happy to answer any questions the Chair might direct.

Senator BARTLETT. I have no questions to put to you, Mr. Dingell.

I would say, having been around Chesapeake Bay once in a while, I believe this will be comparable to conquering space.

Mr. DINGELL. I believe you are right, Mr. Chairman. I believe the thoughts of the House committee, in terms of the reduction in the amount of money in the sea nettle bill might be a useful guideline to you and to this distinguished committee, in framing the kind of legislation that would be useful, and in securing passage of the bill in the Senate in this late hour.

Senator BARTLETT. Thank you very, very much.

Mr. DINGELL. Thank you very much, Mr. Chairman.

(The statement of Chairman Garmatz follows:)

STATEMENT OF HON. EDWARD A. GARMATZ, CHAIRMAN, HOUSE COMMITTEE ON MERCHANT MARINE AND FISHERIES

Thank you, Mr. Chairman, for giving me this opportunity to present my views and my feelings on this legislation, which proposes to provide for the control or elimination of jellyfish—sometimes known as sea nettles—from America's coastal waters.

For the information of your distinguished Committee, I would like to note that my bill, H.R. 11475, has been unanimously ordered reported to the House by the Committee on Merchant Marine and Fisheries. It is identical to Senator Brewster's bill, S. 3744, with the exception of Section 3, which deals with the authorization of Federal funds.

I have requested that my bill be considered on the Floor of the House under Suspension of the Rules. The next Suspension of the Rules is scheduled for Monday, October 3, and I am most hopeful that my bill will be considered by the House at that time.

On August 9, 1966, I made a statement before the Subcommittee on Fisheries and Wildlife Conservation, when it initiated hearings on my bill. Since that statement so aptly expressed my sentiments, and so thoroughly touched on the important aspects of the jellyfish problem, I would like to again emphasize some portions of it.

I introduced my bill, H.R. 11475, on October 7, 1965 because I feel very strongly that something must be done to at least control these pests. I am optimistic that a satisfactory solution can be discovered if sufficient funds are made available for a comprehensive research program into this problem.

Such a solution, I am convinced, would result in untold millions of additional revenue for the Chesapeake Bay area alone. The vast recreational potential of this water playground has been severely inhibited in its growth and development because of the yearly invasion of the sea nettle; other fine recreational areas along America's coast and in its many estuaries have also been handicapped by this sea creature, whose role in the scheme of nature is not yet understood by man.

But aside from the obvious benefits of making areas like the Chesapeake Bay more pleasant to live, work and play in, there is a more important goal to be realized from the research program my bill would provide funds for.

Such a program could ultimately shed much light on the new and exciting science of underwater exploration, especially in relation to marine life. Such a program would almost certainly provide information which would prove beneficial to all sea life—not only in the vast expanses of the Chesapeake Bay and the far reaches of Maryland's Eastern shore, but in all of America's coastal waters.

I certainly am not a scientist, but I firmly believe that scientific research—with the help of Federal and State funds—can successfully explore and penetrate the mysterious world of the jellyfish.

Although little is known at this time about the jellyfish, it has been suspected that its life cycle in some way does have an impact upon other forms of marine life—especially the oyster.

If it is found that jellyfish are eating oysters, or in other ways are detrimental to oysters or other fish and shellfish, then we will have received a bonus for our efforts. The possibility of such a discovery should provide even further incentive for this worthwhile program.

I am, of course, aware that the role of the sea nettle in the delicate balance of nature must be understood before we try to disrupt that balance by eliminating, or even controlling, this sea animal.

My confidence in the ultimate success of this research program is based partially on the success of recent control of the vicious Sea Lamprey in Great Lakes waters. This eel-like creature practically wiped out the lake trout fishing industry until a chemical control was discovered as the result of a joint Federal-State venture.

While I realize the jellyfish problem is far more complex, I feel that the control of the Sea Lamprey tends to illustrate the effectiveness of a program implemented through a cooperative effort on part of State and Federal agencies. This is the type of program which my bill would initiate.

It has often been said, in a joking way, that "Garmatz is out to get the Jellyfish." I can appreciate the humor in this statement, but I don't think it's any laughing matter to a person who has been stung by a sea nettle.

And it certainly is no laughing matter to the poor vacationer and his family, who find their summer plans and recreational opportunties frustrated by these water pests.

Neither is it a laughing matter to the thousands of small Maryland businessmen, such as beach resort owners, gas station operators, etc., who are deprived of untold revenues because fine recreational areas are depopulated by this annual marine invasion—which is becoming worse each year.

I am confident the enactment of this legislation will enhance our knowledge of all marine life and help extend—to the benefit of the entire Nation—man's frontiers of knowledge in the fascinating and challenging world of the sea.

Senator BARTLETT. The next witness will be the Assistant Secretary for Fish and Wildlife and Parks, Department of the Interior, Dr. Cain.

Dr. CAIN. Mr. Chairman, I have with me Mr. Gottschalk, the Director of Bureau of Sport Fisheries and Wildlife, and Mr. Finnegan, of the Legislative Office.

Senator BARTLETT. Good.

Dr. CAIN. I believe you have before you a copy of this testimony, which runs about eight and a half pages. A good part of it describes the estuaries, and the importance of estuaries to sport fisheries, to recreational beauty.

If you wish, for the sake of time, I could read the part of this testimony that relates directly to the analysis of the legislation before us.

Senator BARTLETT. That will be fine.

Dr. CAIN. Thank you very much. I assume——

Senator BARTLETT. The entire statement will be placed in the record, of course.

Dr. CAIN. And if you wish some statistical data about the importance of this, we can provide it subsequently.

Senator BARTLETT. Right.

Dr. CAIN. So I would like to start, then, on page 4, in the middle of the page.

STATEMENT OF DR. STANLEY A. CAIN, ASSISTANT SECRETARY OF THE INTERIOR FOR FISH AND WILDLIFE AND PARKS; ACCOMPANIED BY JOHN S. GOTTSCHALK, DIRECTOR, BUREAU OF SPORT FISHERIES AND WILDLIFE; AND DAVID FINNEGAN, ATTORNEY-ADVISER, OFFICE OF THE LEGISLATIVE COUNSEL, DEPARTMENT OF THE INTERIOR

Dr. CAIN. In recent years we have made great strides in setting aside, preserving, and developing many areas of the country as wildlife refuges, parks, seashores, and recreation areas. Much still needs to be done in these areas if we are going to provide a meaningful natural heritage to future generations of Americans.

In trying to attain our refuge, park, and recreation area goals, we have tended to ignore some of our most valuable natural areas. These are the many, but fast dwindling, estuarine and wetland areas that are found particularly along the coastlines of the United States. S. 3528 will enable us to concentrate more of our efforts on these very valuable natural areas.

Estuaries are places where fresh and salt water meet. A river, such as the Potomac, the Hudson, or the Sacramento, meandering toward the sea, terminates in an estuary. Here, where the coastal currents, ocean tides, riverflows, and contours of our shores interact, river sediments settle out and form sand and mud flats which are covered with algae and other plants that can survive in salt and brackish water. These plants, in turn, collect sediments, which build up deposits in the areas. In this way, fertile coastal marshes are formed, with their myriad channels and creeks. These areas are tremendously rich in many natural resources. I would like, at this point, to quote briefly

from the recent report of the Environmental Pollution Panel of the President's Science Advisory Committee. The Committee's statement sets forth in graphic terms the many values of the estuarine-wetland areas:

Large populations of birds, including such game species as ducks, geese, swans, rails, and snipe, concentrate in the waterlogged lowlands—"wetlands"—associated with estuaries, bays, sounds and keys. Waterfowl come there chiefly during the winter to feed on the lush vegetation or on the brackish water invertebrate animals that abound in the zone.

Many of our most valued commercial and game species such as prawns, menhaden, bluefish, weakfish, croaker, mullet, and channel bass, spend their juvenile stages in the protected inside waters of the estuarine zone. Oysters, soft clams, blue crabs, and diamond back terrapins are all residents of estuaries. Fishes that divide their lives between fresh water and salt such as salmon, striped bass, shad, river herring, and eels, pause for a sojourn between coastal waters and their upstream or oceanic spawning grounds.

Several qualities combine to give peculiar biological value to the estuarine zone. To begin with, the salt marshes are extraordinarily fertile. The Sapelo marshes of Georgia, which are cited as an example only because they have been studied more than any others, produce nearly seven times as much organic matter per unit area as the water of the continental shelf, 20 times as much as that of the deep sea, six times as much as average wheat-producing land. It is no wonder that the creeks meandering through the marshes are superlatively rich feeding grounds for fish and wildlife. For this reason alone the estuarine waters are excellent nursery grounds for coastal fishes. Another reason is that the estuarine systems are capacious; for the meandering marsh creeks add enormously to the area of the shallow water nurseries.

Over 90% of the total harvest of sea foods from waters off the United States are taken on the continental shelf. Nearly two-thirds of that fraction are composed of species whose existence depends on the estuarine zone; or which must pass through the zone enroute to spawning grounds. These include resources which have singular values. To cite a few examples: the menhaden is the most abundant of all our commercial fishes, the cheapest source of animal protein, and the object of the largest fishery in North America. Southern shrimps, oysters, blue crabs and Pacific salmons are among our most valuable fishery resources. Striped bass, sea trout, bluefish, tarpon, and bonefish rank among the most celebrated of marine food and game fishes.

In 1960, estuarine dependent sea food resources supported about 90,000 commercial fishermen to whom they yielded 2.8 billion pounds. This quantity was worth 59 million dollars on the wholesale market. The resources yielded an additional 900,000 pounds to about 1,600,000 anglers. It is hard to evaluate recreational fishing, but if the amount spent specifically for fishing expeditions over and above normal living costs be accepted as an index, the value of the sportsmen's catch of estuarine dependent fishes was about 163 million dollars.

North America is endowed with a remarkable variety and abundance of waterbirds, that is to say, birds which must obtain food largely in or about water. These included all the waterfowl (ducks, geese, brant and swan); and all those that live in marshes such as herons, egrets, ibises, rails, gallinules, and cranes; and shore birds, such as sandpipers, plovers and numerous other species that run along the beaches in search of food; and it includes a miscellaneous variety of fish-eaters such as cormorants, pelicans, grebes, loons. For most of these bird species, no economic value can be assigned. They are simply items in our nation's treasury of natural beauty, essential parts of what makes "country"; but even so unevaluable. Waterfowl, on the other hand, do have measurable dollars-and-cents value; for they are among our leading recreational assets. In 1960, nearly two million people hunted waterfowl and spent over 89 million dollars for this form of recreation.

We estimate that nearly a million of these hunters enjoyed their recreation in estuarine zones. The report goes on to say:

Although the life habits of waterfowl vary from species to species, most of them nest during the summer in inland areas of the United States and Canada, some of them far north of the Arctic Circle. Their wintering grounds are characteristically in the marshes of the Atlantic, Gulf, and Pacific coasts; and for several species, extend south into Central America.

The fish and wildlife resources of the shore zone have value as food, as a basis of recreation and as objects of esthetic enjoyment.

We firmly believe, from preliminary studies conducted in recent years and observations extending over the past decades, that many of these areas must be preserved and protected through the most effective means available. This must be a joint effort by all public agencies and responsible citizens.

It should not be just a Federal or a Federal-State effort. When these areas are destroyed through man's technical advances, they cannot be replaced and the entire Nation is the loser.

S. 3528 will provide adequate authority to preserve and protect these areas.

S. 3528 provides that before we embark on a broad estuarine land and water acquisition program a thorough nationwide study should be conducted to identify the estuarine areas of the country that need protection, and detailed studies should be undertaken on a regional basis to determine the most appropriate means and measures of preserving particular areas.

We believe that this approach is sound. The detailed studies should consider whether such areas should be acquired by the Federal Government or by the States, or local government, and whether such areas can be appropriately preserved through other protective measures such as the control of dredging and filling in navigable waters, or the development of adequate zoning laws without any or with only limited Federal acquisition.

These studies would be the basis for recommending the course of action that should be taken to protect estuarine areas. These studies will help to formulate reasonable criteria for determining which areas should be included in a nationwide system of estuarine areas either as federally acquired estuarine areas because of their national significance, or as State or local government acquired areas.

When an estuarine area meets the criteria for areas of national significance, it will be recommended to the Congress to be included within the system and to be managed by the Secretary of the Interior. The Secretary will encourage the States and political subdivisions thereof to retain or, where necessary, to acquire and to administer other estuarine areas which meet the criteria for areas to be included in the system.

Funds made available under the Land and Water Conservation Fund Act of 1965, the open space program under title VII of the Housing Act of 1961, the Dingell-Johnson Act, the Pittman-Robertson Act, and the Commercial Fisheries Research and Development Act of 1964 could be used by the States for such areas, assuming, of course, that they meet the other requirements of those acts.

In summary, S. 3528 provides (1) land acquisition, management, and administrative authority for federally acquired estuarine areas, but that this authority not be utilized until the Congress provides by statute, after study, for the designation of individual estuarine areas, and (2) for the designation with the approval of the Secretary of the Interior of non-Federal public estuarine areas to be included in the nationwide system.

The federally acquired areas will be those of national significance. Before the Secretary can begin to acquire, however, Congress will

have to consider and approve each one on its own merit. This approach is similar to the one followed in the case of our national recreation areas, national seashores, wild rivers, national trails, and wilderness areas. The areas designated by the States may include areas owned by local subdivisions of the States. The Secretary will have to approved each area to be designated.

The bill authorizes the Secretary to acquire lands and waters within an estuarine area only when such area has been authorized by act of Congress. Where the lands and waters are already publicly owned, purchase with Federal funds is prohibited.

The bill directs the Secretary to encourage States and their local subdivisions to establish estuarine areas within their borders. Some of these areas might be acquired and developed with grants made under programs mentioned in the bill. The areas could then be designated by the States to be included in the system. The Secretary of the Interior would have to approve each area based on studies and the criteria established by those studies. The designated areas would continue to be administered by the States and their local subdivisions.

The objective of such designation is to insure that these estuarine areas are permanently protected. Thus, the bill prohibits the disposal of these areas without the prior approval of the Secretary.

Within the last few days, the House Committee on Merchant Marine and Fisheries ordered reported H.R. 13447 which is similar to S. 3528. H.R. 13447 incorporates some of the provisions in a bill (H.R. 15770) which is designed to provide for the protection and development of a particular estuarine area of national significance; namely, the Long Island wetlands in New York. We believe that this "blending" of the House bills has greatly improved the legislation. The principal differences between the House-reported bill, H.R. 13447, and S. 3528 are:

1. The House bill requires approval by the President of areas of national significance to be included in the system rather than by act of Congress. The House committee believed that this procedure was far more desirable and less cumbersome.

2. The House bill authorizes a maximum annual appropriation of not more than $5 million for land acquisition. In addition, that bill limits the total appropriation to $15 million.

3. The House bill authorizes the Secretary to enter into agreements with State and local agencies whereby the Secretary will administer and develop estuarine areas already in public ownership, such as the Long Island wetlands in New York. The development costs for outdoor recreational purposes must be shared equally with the Federal Government.

4. The House bill authorizes the Secretary to work with local communities in developing adequate zoning laws designed to protect the estuarine zones and still allow individuals to retain their property. Similar provisions are found in the statutes establishing Cape Cod National Seashore and Fire Island National Seashore.

5. The House bill requires the Secretaries of the Army and Interior to develop adequate plans to prevent destruction of any estuarine zone by filling or dredging.

We have no objection to any of these provisions. In fact, we believe that they serve to improve this very desirable legislation. We urge enactment of legislation this year.

Another bill, S. 2947—the clean rivers bill, which passed the Senate—contains a provision which authorizes the Secretary to carry out a 3-year study on the effects of pollution in the Nation's estuaries on fish and wildlife, recreation, and on water supply and water power. In our report to the House Committee on Public Works on the Senate-passed bill, we indicated that we strongly preferred the enactment of either H.R. 13447 or S. 3528 because both bills authorize a broader study and provide a means for carrying out adequate protection of our estuaries through Federal and State action.

Thank you very much, Mr. Chairman.

Senator BARTLETT. Thank you, Mr. Secretary.

Senator Kennedy's bill was open ended in respect to appropriations in that it authorized such appropriations that might be needed.

It is my understanding that the statement that Senator Kennedy will submit for the record, on account of his necessary absence from the city today, will give his blessing to the changes proposed by the House, so there won't be any difficulties insofar as Senator Kennedy is concerned in that area.

Congressman Tenzer told us that in the last 30 years the wetlands acreage in his district has decreased by about 50 percent.

Can you inform the committee if this pattern is general throughout the country?

Dr. CAIN. Speaking in general terms, the answer is "Yes."

I am sure that from one locality to another the percentage of loss in a given time would vary, but it is the experience of our bureaus who are working with estuarian problems all around the Nation's coast that this is an extremely serious process, the dredging, the filling, and the other forms of destruction of estuaries, which is going on with great rapidity. We have some statistics, if you would like them read in the record.

Senator BARTLETT. Yes.

Dr. CAIN. As an example of the effect of these forces along our North Atlantic Coast from Maine to Delaware, about 45,000 acres of tidal wetlands were destroyed in 10 years, 1954 to 1963. Now, this amounts to less than 10 percent of what was available in 1954. You see, at that rate, it is a rapidly diminishing resource.

During the last 5 of these years, the losses due to deposition of spoil was 34 percent; housing, 27 percent; recreational development, 15 percent; construction of bridges, roads, parking areas and airports, 10 percent; industrial sites, waste disposal, 6 percent, and miscellaneous causes, 1 percent, so the actual physical loss of acreage is largely, you see, filling or filling subsequent to dredging operations. On Long Island alone 12,635 acres of marshes were obliterated from 1954 to 1963.

We could, if you would like, supply for the record statistics on, say, estuaries in Florida, where studies have been made, in Tampa Bay.

I would like to make the point now that in dredging for filling behind bulkheads in the State of Florida, where, say, in one bay something like 16 or 17 percent would be filled in, to get the fill an equal amount of natural bottom is dredged up and destroyed, so the actual figure of destruction is about double that of the filled acreage, and in one case where this has been studied by the Bureau of Commercial Fisheries, the dredged bottom, after 10 years has shown no recovery from this disturbance.

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Now, I suppose eventually it will recover, but it is a very slow process, and this is the nursery, as it were, for perhaps as many as two dozen species, of fish, shellfish, crustaceans that are of commercial and sport interest.

Senator BARTLETT. Are these additional figures readily available?

Dr. CAIN. We can supply for the record a sampling of the other coasts, if you wish.

Senator BARTLETT. Just a sampling, I think, would be useful to have in the record, and since we don't have too much time, if it isn't too much work, the sooner we can get it, the better.

Dr. CAIN. We can get it for you in a couple of days.

Senator BARTLETT. Fine. The subcommittee is to understand, then, that this problem has never been tackled aggressively on a nationwide basis?

Dr. CAIN. That is correct.

Senator BARTLETT. By the Federal Government?

Dr. CAIN. That is correct.

Senator BARTLETT. Or on any basis by local, State, or Federal Government?

Dr. CAIN. No, there are cases, I am sure, of local concern for the protection of estuaries.

Senator BARTLETT. I mean but not any real concerted effort on a statewide basis, for example?

Dr. CAIN. Mr. Gottschalk has just pointed out that in Senator Kennedy's statement he calls attention to the fact that the State of Massachusetts in 1965 passed legislation with the objective of protecting estuaries, and that the State of Rhode Island, also in 1965, has established a law of coastline zoning, so the answer is that there are beginning to be laws by States that result in coastal protection.

Senator BARTLETT. Have you in the Interior Department received any objections to this proposed legislation?

Dr. CAIN. None has come to my attention, sir. Everybody said "No."

Senator BARTLETT. Well, thank you very much, gentlemen.

Dr. CAIN. You are very welcome, gentlemen.

(Subsequent statement on losses of estuarine habitat submitted by Dr. Cain for the record:)

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., October 7, 1966.

Hon. E. L. BARTLETT,
Chairman, Subcommittee on Merchant Marine and Fisheries, Committee on Commerce, U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: During my testimony on S. 3528 before your Subcommittee on September 28, I indicated we would provide examples of estuarine habitat losses along the Nation's coasts in addition to the material I presented at that time. The data presented in my testimony were applicable to the destructive forces associated with a variety of activities—urban and industrial development, waste disposal, dredging and filling, stream channelization, et al.—along the North Atlantic Coast from Maine to Delaware.

The enclosed information summarizes some of the more important examples of estuarine area deterioration and elimination by these activities and others, along the Pacific, Gulf, and the South Atlantic Coasts. For the most part, this material is necessarily less precise as to the extent of losses than was the material I presented at the hearing. No detailed surveys have been made or precise data compiled on the estuarine losses along the coastlines mentioned above, but we know these areas are being exposed to the same destructive activities as

those of the North Atlantic Coast. This dearth of information is an excellent illustration of one important reason for enacting legislation which will not only help preserve estuarine areas but provide us with the tools to study the serious impact of human activity on them.

We are pleased to supply this additional information for the hearing record on S. 3528.

Sincerely yours,

STANLEY A. CAIN,
Assistant Secretary of the Interior.

STATEMENT OF THE U.S. FISH AND WILDLIFE SERVICE ON EXAMPLES OF ESTUARINE HABITAT DETERIORATION AND LOSS IN THE UNITED STATES [1]

PACIFIC COAST

Periodic maintenance work by the Corps of Engineers on navigation channels requires spoil disposal areas in many bay areas. Large acreages of tidelands have been designated for such use and are gradually being destroyed to the detriment of fish and wildlife and scenic and other recreational values.

Tabulated below are the estimated acreages of designated disposal areas and total tidal areas in three major Oregon estuaries:

	Total tidal area (acres)	Disposal area (acres)
Area:		
Coos Bay	4,570	400
Umpqua River	1,550	450
Siuslaw River	600	175

Other important locations in the Pacific Northwest in which similar activity is destroying estuarine areas and their resource values are Tillamook Bay in Oregon, and Willapa Bay, Grays Harbor, and Puget Sound in Washington. Acreage data are not immediately available for these areas.

Many applications by private interests for permits to dredge and fill in estuarine areas are received by the Corps of Engineers each year, but acreage data are seldom provided in such applications. However, acrage data for the following four typical projects recently completed in the State of Washington are available: Padilla Bay—20 acres, Nisqually River—70 acres, Seattle Waterway—10 acres, and Snohomish Delta—66 acres. Individually, these examples appear insignificant, but multiplied many-fold such projects cause much of the serious and widespread estuarine habitat losses being suffered along all coasts of the United States.

In California, the following selected examples further illustrate estuarine habitat destruction and detrimental disturbance. These do not include many private dredge and fill projects completed each year under permits issued by the Corps of Engineers.

Mission Bay. At one time this bay contained marsh and tidelands of particular value for fish and wildlife. It has been completely developed although some open water area has been allowed to remain.

Morro Bay. At the present time, this bay is one of the last remaining natural areas for fish and wildlife along the California coast. Eel grass beds on the tidal flats are very important for the black brant. A highway including fill on the tidelands is now under construction across part of the bay. A plan for ultimate bay development has been prepared by a private consultant firm as part of a master plan for the County of San Luis Obispo. Involved in the plan are land fills, airports, and housing and commercial developments which would completely eliminate the valuable marshes and tidelands of this bay.

If such a plan is completed, Morro Bay would become similar in fish and wildlife value to the present condition of Mission Bay.

[1] Includes data covering the Pacific, Gulf and South Atlantic Coasts and supplements similar data on North Atlantic Coastal Areas, Maine to Delaware, presented by Assistant Secretary of the Interior Stanley A. Cain in testimony on S. 3528, before the Subcommittee on Merchant Marine and Fisheries of the Senate Committee on Commerce, September 28, 1966.

State Senator Fred Farr has prepared a resolution (No. 176) for adoption by the California State Senate providing for the setting aside of lands in Morro Bay to be kept in a natural state.

San Francisco Bay. This is the largest estuary on the Pacific Coast. It consists of about 435 square miles of surface area at mean high water. In 1850 it was even larger than it is today. More than 300 square miles of marsh lands along its shore gave it the appearance of vastness, particularly during winter tidal periods when tides and flood runoff combined to flood much of the marsh lands. Since 1850 more than 240 square miles of these marshes have been reclaimed. About 17 square miles of submerged baylands have been filled-in along the water fronts of San Francisco, Oakland, and Richmond and along the shores of Richardson Bay, San Raphael Bay, and the portion of the south bay in San Mateo County.

San Francisco Bay presents few physical obstacles to those who wish to diminish it further. Four-fifths of its waters are less than 30 feet deep, and 70 percent are less than 18 feet deep at low tide. Maps prepared by the Corps of Engineers indicate that almost 248 square miles of tidal and submerged lands are "susceptible of reclamation." If this area were filled and used for urban expansion, only 187 square miles of the bay would be left. The remaining bay would be reduced to major channels with broad expanses of deep water in a few areas, and its value would be restricted largely to its use for shipping and pleasure boating.

The report to the California Legislature prepared by the San Francisco Conservation Study Commission in January 1965 shows that 26 square miles of marsh and tidelands are now being filled or are planned to be filled soon. This is only a part of the total picture. Since that time, plans have been made to fill other marsh areas of the bay.

Moss Landing. Located in Monterey Bay some 80 miles south of San Francisco, this area consists of an extensive system of tidelands and salt marshes extending inland for several miles along Elkhorn Slough. Present development includes a small boat harbor and a commercial salt extraction operation. Recent proposals for development include a major oil refinery.

At present this area offers an outstanding opportunity to preserve an extensive natural habitat important for shore birds, water birds, and migrating waterfowl.

Other Areas. Following are three additional and noteworthy examples of potential destruction of estuarine habitat. One is a Soil Conservation Service project which could result in the draining of El Estero Slough, an important salt marsh near Carpinteria, California. The others are Corps of Engineers projects, one of which involves channelization of the lagoon area of Pescadero Creek Basin south of San Francisco, and the other, flood control and channel works, including possible dredging of Garriota Slough near Santa Barbara.

To summarize, virtually all the remaining marsh and tidelands along the California Coast have been planned for some type of development which would cause their destruction or serious impairment.

GULF OF MEXICO AND SOUTH ATLANTIC COASTS

In Texas, Galveston Bay provides a prime example of the severity of estuarine habitat losses. To date, and estimated 90,000 acres (approximately 21 percent of the total bay area) have been totally destroyed (68,000 acres) or heavily damaged (22,000 acres).

Sabine Lake, which empties into the Gulf of Mexico on the Texas-Louisiana border, has suffered a 4,000-acre loss in estuarine habitat.

There is no cause for optimism for the future of estuarine habitat in Texas, if the present trend continues. The loss rate is accelerating rapidly under pressure of the familiar agents of destruction and deterioration: drainage, dredging and filling, new land-forming, dewatering, et al. It is estimated that the loss of coastal wetlands and open water habitat of Texas during the 10-year period 1965–1975 will be 1,250,000 acres, and for the 25-year period 1975–2000, over 1,360,000 acres. These figures include significant percentages of the present estuarine areas of the State, but they are not limited to these areas.

Eastward from Texas along the Gulf Coast, the trend of attrition offers no solace either.

The Mississippi River in southern Louisiana has provided this Nation with one of the larger deltaic-estuarine complexes in the World, and, characteristically, one rich in renewable natural resources. Historically, two-thirds of the coastal shoreline of the State of Louisiana was an active delta, resulting from the flooding and the associated alluviation by the river and its coastal distributaries.

The construction of the lower Mississippi River levee system now confines river flows. Alluviation is no longer a formative factor. Lands surrounding and underlying the estuarine complex are subsiding. Subsidence within this 4,500 to 5,000 square mile area results in increased intrusion of Gulf waters, increased shoreline erosion rates, and, of course, increased salinities.

An example of the above effects is depicted by Sister Lake, located south of Houma, Louisiana. Prior to 1953, the Lake had a productive oyster area of about 7,000 acres. Increased salinities (above 15 parts per thousand) have encouraged the invasion of the oyster drill. Sister Lake now has a productive oyster area of less than 600 acres.

Coastline erosion is occurring at a rate approaching 65 feet per year in some locations. The Rockefeller State Wildlife Management Area in the southwest part of Louisiana is an example of such a location.

The Mississippi River-Gulf Outlet project, now under construction, will be a sea-level channel 36 feet deep and 500 feet wide which will extend from New Orleans, Louisiana, southeast 60 miles to the Gulf of Mexico. It will traverse one of the most important estuarine areas of the Gulf Coast in terms of fish and wildlife resources. Directly and indirectly it will disturb or destroy the estuarine regime on either side of the channel by alteration of water circulation patterns through the total area dissected by the channel, and by deposition of spoil material during construtcion and later through channel maintenance. Construction of the channel itself and deposition of removed spoil alone will directly destroy over 36 square miles of estuarine habitat.

Other estuarine areas in Louisiana are under siege by developments as well, including Calcasieu Bay on the southwestern coast of the State, by channelization and harbor improvement.

Channelization and harbor development is also having serious adverse effects on estuarine areas in Alabama (Mobile Bay, where some 33,000 acres of habitat have been totally destroyed); in Florida (Pensacola Bay); in Georgia (Savannah River, bordering South Carolina); in South Carolina (Charleston Bay); in North Carolina (Pamlico and Albemarle Sounds); and in Virginia and Maryland (Chesapeake Bay).

Along the coastlines of those States, dredge and fill projects to create new lands are increasing in number and in their total effect on estuarine areas. Creating new land by dredging and filling is another of these practices resulting from man's desire to locate his industry and his home adjacent to coastal waters. New land is created by filling-in shallow water areas landward of a bulkhead dike constructed of material dredged from the bottom immediately to seaward. Fill material is obtained by bottom dredging of nearby waters. This practice is particularly popular in Florida, where an estimated 20 percent of the total estuarine area of the State has been destroyed and seriously impaired by this and other means.

Senator BARTLETT. Now, Mr. Callison, Assistant to the—is Mr. Callison here?

The answer is negative.

Now we turn to S. 3744, a bill to provide for the control or elimination of jellyfish.

The first witness is Mr. McKernan, Director of the Bureau of Commercial Fisheries, Department of the Interior.

STATEMENT OF DONALD L. McKERNAN, DIRECTOR, BUREAU OF COMMERCIAL FISHERIES, DEPARTMENT OF THE INTERIOR

Mr. MCKERNAN. Thank you, Mr. Chairman.

I have asked Mr. Finnegan of the Solicitor's Office to be at the witness table with me, with your permission.

Senator BARTLETT. It is granted.

You have a prepared statement?

Mr. MCKERNAN. Yes, Mr. Chairman, I have a prepared statement, and it is not too long.

With your permission, perhaps I can explain the purposes of this bill by quickly going through——

Senator BARTLETT. Why don't you read it?

Mr. MCKERNAN. Thank you, Mr. Chairman.

The sea nettle or common jellyfish of Chesapeake Bay has become a major economic problem and a growing source of physical and psychological irritation to residents and visitors alike. This pest is not new to the area; in fact, it has probably been present for many centuries.

Scientists know very little about the sea nettle. We do know in general its life history which consists of two distinct phases:

(1) A small, nearly microscopic "plantlike" stage in which the animal spends the winter attached to the bottom; and

(2) The familiar umbrella-shaped swimming stage which begins to appear in May and continues into early autumn.

It is during its swimming stage that the sea nettle causes us problems. The tentacles which dangle from the pulsating umbrella-like body contain stinging cells, called nematocysts. Whenever anything brushes against these cells, a triggering device releases a poison barb. This is a very effective technique for immobilizing small animals which the jellyfish can then proceed to eat. However, if these barbs pierce the skin of a human, they may cause a brief period of pain and unsightly red welts which may last several days. Unless the tentacles contact sensitive areas, such as the eyes, the sting is more annoying than dangerous.

Complaints about sea nettles in Chesapeake Bay have increased in recent years. Scientists are not sure if this is because there are more people coming to this area, or if, in fact, the sea nettle population has increased. If sea nettles are more abundant we do not know whether this is due to a "normal" population increase—and cyclic fluctuations are characteristic of most animal populations—or to a change in the environment in Chesapeake Bay.

The major impact of sea nettles is on the recreation industry. With expanding populations in the metropolitan areas of Washington and Baltimore, more people are spending their leisure in water-related activities of the bay area. An important industry has developed providing goods and services to these people. An article on sea nettles appearing in the January-February issue of the Maryland Conservationist reports that the resort business drops about 30 percent if sea nettles appear in midsummer and more than 50 percent where nets are not used to protect the beaches.

The report also noted that one resort operator estimates he has about $30,000 invested in pilings and nets to keep his beach only 60 percent free of sea nettles. He spends another $10,000 a year to install and repair the nets and to keep the area dipped free of jellyfish.

Sea nettles affect other activities and industries associated with the bay, although this is relatively minor and difficult to document. The fishermen complain that during periods of high abundance the nettles catch on lines and other fishing gear. Working equipment under these conditions can be annoying and reduces efficiency. Although there is little or no scientific research to support the contention, some fishermen believe that sea nettles prey upon certain important commercial fish or their foods.

Finding an effective control for the sea nettle will require considerable time and study and may be costly. Little fundamental bio-

logical research has been conducted on this animal and knowledge of its life history and ecology will be important to the development of a control. Although the swimming stage is the troublemaker, the attached stage may be the period when control measures could be most effectively applied.

Knowledge of when and where these stages occur, their abundance, the effect of environment on each stage and the foods of each will be important to solving the control problems. Much of this knowledge is not now available, although research is underway at the Natural Resources Institute of the University of Maryland, financed in part by the State of Maryland and in part by a grant made this year by the Department under the Water Resources Research Act.

Scientists foresee two broad areas for development of controls:

(1) Biological; and

(2) Chemical.

Mechanical controls have been fairly well explored with little or no success. However, mechanical controls should not be overlooked in any study program.

Biological control which can range from finding a disease of sea nettles to introduction of a predator would be the most satisfying and acceptable to the marine scientists, but would probably be the most difficult to find and develop. Biological controls have many advantages. They are usually specific, very effective and once begun are frequently self-perpetuating, therefore, most economical in the long run. They can be dangerous, if not backed up with sufficient research, and therefore, are usually expensive to develop.

Chemicals to control all varieties of pests have received much attention in the last 20 years, as attested by the over 70,000 different formulations of registered pesticides. These compounds have definite limitations in the marine environment, because of interactions with the dissolved minerals in sea water or their extreme danger to other marine species in very minute quantities. However, they are possible controls and, therefore, should be investigated. Ideally, a chemical control should be specific, easily handled and applied, nonpersistent, and cheap.

We estimate that the Federal share of an adequate research program to study the life history and develop control methods would cost about $1 million per year and require several years to complete. The final program studies will depend somewhat on the results of early research, and it will be necessary to shift emphasis as knowledge accumulates. We visualize that this program should consist of the following studies as minimum.

(1) Determine the distribution of both the attached and swimming stages by a series of sampling surveys covering Chesapeake Bay and its tributaries.

(2) Correlate present knowledge of the hydrography of the Bay with natural distribution to find any possible relationships.

(3) Develop methods for breeding and growing sea nettles under controlled conditions in the laboratory. Such methods will be needed to develop control techniques.

(4) Determine effects of various environmental factors on life history by laboratory studies.

(5) Determine foods of sea nettles and their predators in laboratory and field experiments.

(6) Determine parasites and diseases of sea nettles for possible biological controls.

(7) Screen chemicals for effect on various life stages in laboratory studies.

(8) Test any suitable control methods for their effect on other marine species and man.

(9) Test any suitable control methods under small scale field conditions.

(10) Develop efficient and inexpensive methods for applying control measures.

(11) Register any chemical control with the U.S. Department of Agriculture.

A number of laboratories are competent to handle part or all of these studies. The Department of the Interior operates a marine biological laboratory at Oxford, Md., where marine experts are available. We would undoubtedly contract part of the study to specialists at State, university, or private organizations.

The above cost and time estimates are for the research phase only. If controls are found, additional funds would be required to purchase and apply these controls.

The chemical developed by the Bureau of Commercial Fisheries for oyster drill control costs about $100 per acre for ingredients. The chemical to control sea lampreys in the Great Lakes costs about $350,000 to treat 50 streams. Rotenone used for fish control in farm ponds costs about $5 acre-foot. These are some comparative figures for costs of chemicals used in pest control in the aquatic environment. They do not include costs of labor, ship operation, and other expenses necessary for application.

Chesapeake Bay and its principal tributaries has a surface area of over 2¾ million acres. Probably not all of this area would have to be treated, but if only one-tenth or one one-hundredth of this acreage had to be treated, chemical costs alone could range from, at least, $150,000 to $1,500,000 for each treatment. It is difficult, at this time, to make a good estimate of the frequency of treatment, but we could expect at least one treatment per year for several years.

We believe that, because of the hazards that may be involved in using either biological or chemical controls, any controls applied for reduction of sea nettles should be administered by responsible experts from State governments. Use by private citizens should be prohibited.

That finished my statement, Mr. Chairman.

I would be glad to answer any questions.

Senator BARTLETT. Well, Mr. McKernan, it is noted that the Interior Department has reported on this bill introduced by Senator Brewster, who has now entered the chamber, over the signature of Clarence Pautzke. The Bureau of the Budget appears to have advised the Department that there is no objection to presentation of the report, but the Bureau recommends that action on the bill be deferred at this time. The report goes on to say that there ought to be further preliminary investigation of the jellyfish problem, such as the study now being conducted by the University of Maryland, under a matching

grant made available for the Department of Interior, under the Water Resources Research Act.

What was the size of that grant, if you know?

Mr. McKernan. $30,000, Mr. Chairman.

Senator Bartlett. When was that made?

Mr. McKernan. About last February, I believe.

Senator Bartlett. And that is a cooperative effort between the State of Maryland and the Federal Government?

Mr. McKernan. Dr. Cronin, of the Chesapeake Laboratory of the University of Maryland, is carrying out the program under this grant, and, incidentally, I think that the results so far are promising and, it seems to me, that it is being handled very competently.

Senator Bartlett. I would assume that, if the State of Maryland is making financial contribution, in terms of direct appropriation of dollars or facilities, that it wouldn't be more than a 50–50 basis?

Mr. McKernan. That is right.

Senator Bartlett. And what I would like to ask you: Do you believe that the expenditure of $60,000 is going to be very meaningful with respect to such a massive problem?

Mr. McKernan. No, Mr. Chairman. I don't believe that the adequate surveys can be carried out with the current funds.

Senator Bartlett. I think it is coming to the attention of all Members of Congress, and others, that the Bureau of the Budget wants to differ about everything right now.

Mr. McKernan. I would point out, Mr. Chairman, that the Department has recommended the enactment of the bill.

Senator Bartlett. We will cease that line of questioning then. On page 2 of your statement, Mr. McKernan, you spoke about the foul means which these jellyfish employ in seeking out and attacking their prey, and you mentioned that the poison barb, which is part of the jellyfish, is used to immobilize small animals.

What animals would be involved here?

Mr. McKernan. Oh, plankton, mactoplankton, and small fish are eaten.

The jellyfish, according to my understanding, is not too selective. Animals that become available to it are pretty well on a wholesale basis, immobilized and eaten by the animal. Of course, it is not very mobile itself. It tends to have power of motion, but somewhat erratic motion at best.

Senator Bartlett. Would you care to strike in your statement the first paragraph on page 2, the word "brief," where you said, "However, these barbs pierce the skin of the human they may cause a brief period of pain," because sometimes it isn't brief?

Mr. McKernan. I would not object to that. I have been stung by them myself, and the definition of "brief," of course, varies considerably. I would have no objection to striking "brief," Mr. Chairman.

Senator Bartlett. As an habitual visitor to Piney Point, Md., I claim great experience with jellyfish. I have been stung numerous times, and there has never been a brief period of pain.

Mr. McKernan. Well, Mr. Chairman, I would certainly back away in evidence of your superior experience in this field.

Senator Bartlett. Oh, constant experience. [Laughter.]

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The words you used on page 3, in the paragraph starting this way, "Finding an effective control for sea nettle will require considerable time and study and may be costly," implies to me that actually very little has been done to date by anyone to seek out a means whereby these marauders may be brought under control.

Mr. McKernan. That is correct. There have been some very good starts in and some some small efforts at studies of life history, and recently the University of Maryland, Dr. Cronin's group, have quite successfully located some of the sedentary stages, but on the whole, and in comparison with many other economically important animals in the sea, this animal has been studied very little.

The study itself will involve really the entire ecology of Chesapeake Bay, the relationship of these animals to other animals. The relationship of the changing environment in Chesapeake Bay to these animals must, most certainly, be understood before an effective control can be devised.

Right at the present time I can't really imagine a practical control, but I do not question but that an effective control can be worked out if enough scientific and technical effort is applied to this problem. We have certainly solved as difficult problems before.

Senator Bartlett. Your statement in geographical reference applied only to Chesapeake Bay, but jellyfish are to be found on most of our coasts if not all of them.

Mr. McKernan. Yes; this particular jellyfish is found in Chesapeake Bay and on some of the other important bays—Delaware, Long Island Sound, I believe, too, and in considerable abundance sometimes, and then of course there are jellyfish in possibly all of the estuarine and offshore areas of the ocean surrounding our coasts.

Of course, the Portugese man-of-war that sometimes comes in on our ocean beaches is bothersome at certain times of the year. I am not certain that any type of practical control of the jellyfish problems of estuaries would apply to these ocean species, but it seems possible.

The bill, I know, Mr. Chairman, is broad enough to cover all aspects of this program in all waters affecting the coastline of the United States, wherever the problem might be.

Senator Bartlett. However, I would assume that it might be a part of wisdom to concentrate in one area first, and if a method of control would be discovered it subsequently could be launched elsewhere.

Mr. McKernan. Yes.

Senator Bartlett. You mentioned the possibility of biological contol, and this might be attained by the introduction of a predator. So far as knowing now, is there any predator?

Mr. McKernan. I believe that certain species of fish in Chesapeake Bay feed to some extent on jellyfish, but there are no important predators of jellyfish that I know of which could be used for this purpose.

Now, undoubtedly there are diseases of jellyfish. I don't think there are any animals known to man that are not preyed upon or do not carry some kind of disease. I would envision scientists examining jellyfish not only locally but exotic species of jellyfish. They should be searching for diseases and parasites of these other species, and in the laboratories testing the effect of these introduced diseases on jellyfish. This is one way that one finds biological control, and it has been successful in a number of areas in this country, and for a number of species of insects and other animals where control has been sought.

Senator BARTLETT. Can we defer for a minute?

You brought sea lampreys into your testimony. How is that program coming along?

Mr. MCKERNAN. Very successfully. I am not an unbiased observer, Mr. Chairman, since I am a member of the international commission that has followed this very carefully over a number of years, and I believe the sea lampreys are now controlled in Lake Superior.

The lampreys have diminished to about 5 percent of their former abundance, and the lake trout which survived—very small populations survived in some of the offshore reefs—have come back in great abundance.

The planted trout that are now being planted from State and Federal hatcheries are surviving in great abundance, and in some parts of Lake Superior the abundance of lake trout is higher than it has been in 30 or 40 years.

Very small and limited recreational and commercial fisheries are now beginning, the growth rate of trout has increased, and lamprey are becoming scarce. They are something that one talks about now when he sees them in Lake Superior.

The control is now being pushed on Lake Huron, and other lakes, and the trout are increasing—that is planted trout. The trout were eradicated from Lake Michigan. So the prognosis is good in the Great Lakes.

Senator BARTLETT. The trout disappeared from Lake Michigan principally or even exclusively because of the lamprey; is that right?

Mr. MCKERNAN. Yes; the scientists believe that the eradication of the trout was due to sea lamprey. There were other factors that perhaps contributed to its decline, but its final eradication was almost definitely due to sea lamprey, and several other species were decimated by this predator.

Senator BREWSTER. Will the Chairman yield for a minute?

What is a sea lamprey?

Mr. MCKERNAN. It is a large eel-like animal with a sucking mouth and teeth. It is a genus of animals called Retromyzon, and it is a predator during its adult life. It is anadromous in that when it matures it migrates upstream to spawn, and the young larvae bury themselves in the mud and detritus of the stream where they stay from anywhere from 3 to perhaps 8 years and mature.

Then they transform into adults and drift out of the streams into the lakes and into the sea.

Now, this animal in the Great Lakes entered the Great Lakes from the ocean and took up a fresh water habitat. It has changed the fish composition tremendously in the Great Lakes by feeding heavily during its adult parasitic stage on various species of fish. Fortunately, in some marine areas, much of the food of sea lamprey is not the food of man. In other cases their food is perhaps less important food to man, where they are attacking fish in areas that are not so fished by man. In the Great Lakes, however, lampreys attack fresh water chubs, as well as the Great Lakes trout. These species have been reduced, in fact almost eliminated in Lake Michigan and Lake Huron, with declines in Lake Erie, Lake Ontario, and Lake Superior.

Senator BARTLETT. This control program in the Great Lakes was launched only a few years ago, Mr. KcKernan?

Mr. McKernan. Yes. The Congress, in fact, supported the first direct appropriations for sea lamprey control, and scientists of the Department were successful first in recognizing that the phase of sea lamprey life history involving an upstream migration was a weak link in the life history.

I might relate that to the present program, and point out that the scientists will look for a weak link in the life of the sea nettles. We found that in the phase of the life history where the sea lamprey migrated upstream, first control methods involved trapping the adults as they moved out of the lakes into the streams to spawn. From there we went to electric barriers which killed the adults, and then from there to specific chemicals, which attacked the breathing mechanism of the larval ammoccetes, and that is the way they are treated at the present time. Using these specific chemicals, which for the most part, if administered properly, no harm occurs to other important recreational species that are found in the same habitat.

Senator Bartlett. The chemical method is the most successful?

Mr. McKernan. Yes.

Senator Bartlett. Well, this, of course, is a thrilling story, which has not been publicized enough. It indicates to me that vast as the problem is relating to jellyfish, it is no more complicated than control of the sea lamprey. Although a layman may say at first blush, how are you ever going to do this job, a demonstration has been made in the Great Lakes that a similar undertaking was started and proved successful.

Mr. McKernan. Yes, Mr. Chairman, and not only laymen may think that. Perhaps half the scientists in universities and Government departments around the Great Lakes felt that it would be impossible to control the sea lamprey, so that while I am not optimistic, nor do I see a method for control of the jellyfish in Chesapeake Bay or other waters of the mid-North Atlantic, I would agree with you that this doesn't mean it can't be done and can't be done in a practical means. I think it is too early to be pessimistic about this.

Senator Bartlett. Are you familiar with the differences between the bill before the Senate committee and the bill before the House committee?

Mr. McKernan. I am informed by Mr. Finnegan, that there is just the money difference. The amount authorized was $10 million in the Senate version, and it is $2.5 million in the House version.

Senator Bartlett. Now, Senator Brewster, you are the author of the bill.

Senator Brewster. Mr. Chairman, I might add one thing. There was a change in the length of time, too. The House version authorizes this expenditure over a 3-year period, the Senate version is 5 years.

Senator Bartlett. Right.

I am sure the author of the bill, Senator Brewster, will have some questions to put to you.

Senator Brewster. Mr. Chairman, I would like to hear from Dr. Cronin and withhold my questions until afterward, if that is agreeable with you.

Senator Bartlett. It certainly is.

I want the record to show that this will be one of the last times, and perhaps the very last, in which Mr. McKernan will appear before us in his capacity as Director of the Bureau of Commercial Fisheries, where he has served so ably and effectively, because he is, on November 1, to become the Assistant to the Secretary of State for Fish and Wildlife. From that time on, Senator Brewster, he will be Ambassador McKernan. I want to congratulate the State Department and the fishing industry for acquiring his services in his new capacity. I also want to praise him publicly and now for the really splendid job he has done for commercial fisheries throughout the United States, not only as Director but in the years before then when he served in other capacities.

We will miss you in the one assignment, and we welcome you to another, Mr. McKernan.

Mr. McKernan. Thank you, Mr. Chairman.

Senator Bartlett. Dr. Cronin, please?

We welcome you, Dr. Cronin. We are glad to have you here.

STATEMENT OF DR. EUGENE CRONIN, DIRECTOR, CHESAPEAKE BIOLOGICAL LABORATORIES, UNIVERSITY OF MARYLAND; ACCOMPANIED BY DAVID G. CARGO, RESEARCH ASSOCIATE

Dr. Cronin. Thank you, Senator Bartlett.

Senator Bartlett, Senator Brewster, gentlemen, we have a prepared statement. I would like to read it, because it is specific and pertinent to the bill.

Thank you for the opportunity to present testimony on S. 3744, which is related to one of the most serious recreational problems of many States and territories.

We are both engaged in research on the ecology and resources of the estuaries and coastal waters. I have worked for 25 years in the Chesapeake and Delaware Bay areas and now direct the Chesapeake Biological Laboratory and Natural Resources Institute of the university. Mr. Cargo has studied the invertebrate species of the Chesapeake Bay for about 15 years and is now engaged intensively in research on the sea nettle. Attached reprints describe his program and some of its valuable results. He is thoroughly familiar with present published and unpublished knowledge of this nettle, and we will be glad to answer any questions you may have.

Our testimony will be limited to the scientific and technical aspects of the bill and its effects. We are deeply concerned about the widespread economic impact of jellyfish on the vast recreational potential of coastal waters and on the great commercial fisheries of these areas, but others can present more pertinent testimony on those economic problems. We propose to provide information on the distribution of jellyfish and the problems they cause, outline the life history of the most important Chesapeake Bay species, summarize present knowledge of jellyfish and their control, indicate the research which should be undertaken, and comment on the specific provisions of S. 3744.

Mr. Chairman, we have brought along a picture of the jellyfish. It is much prettier this way than it is at Piney Point. But perhaps some of the other members of the committee haven't seen it.

Senator BARTLETT. Let us hope that the day will arrive when we can see only pictures of them.

Dr. CRONIN. The jellyfish problem is an important one of worldwide scope. Many species of these animals exert a serious and even deadly influence in areas where recreational use of the water is extensive. They produce some of the strongest toxic materials of all animals. After the stings of some species, death can result within seconds. Many other species are less injurious but still dangerous to swimmers, to military and civilian divers, and indeed to all those who enter the water.

All waters surrounding the United States support venomous jellyfish and other related organisms. The west coast and Gulf Coast States are affected at times by invasions of jellyfish which can lead to a severe restriction of water-based activities. We are not personally familiar with the extent of the problem in all of these areas but we have the impression that jellyfish are most damaging on the east coast. The notorious Portuguese man-of-war is virulent and sometimes so abundant that it forces the closure of major beaches and gravely damages the image and actual quality of Florida's greatest asset. The coastal areas of the New England States and New York are subject to intermittent swarms of jellyfish, brought to the inshore areas by vagaries of the coastal currents and winds. Here, again, they cause a severe reduction in recreational use of the waters.

The most common and serious jellyfish in the Chesapeake Bay is the summer sea nettle, *Chrysaora quinquecirrha*. This species is worldwide in distribution, and is reported to have caused deaths in the Philippines. However, the species is not known to be lethal in the Chesapeake, but it is so irritating that it destroys the pleasure of swimming and other water uses. It occurs along many coasts of the world but, unfortunately, seems to occur in greatest numbers in partially protected areas like the Chesapeake Bay. In this great estuary, it produces very heavy crops in some years and sharply restricts swimming almost every year in late summer. We have, in an unusually bad season, counted as many as 50 nettles per cubic yard. The sea nettle also presents problems to industrial boating and commercial fishing interests by clogging pump intakes and nets, by causing nets to rot, and by skin irritations to those handling these materials.

The most annoying sea nettle of the central Atlantic coast is *Chrysaora quinquecirrha*. From research at the Chesapeake Biological Laboratory, the general complex pattern of life history has been learned, and the same pattern probably occurs in other coastal waters. The entire life cycle is completed within the Chesapeake.

The familiar large stinging stage or medusa is the sexual stage which occurs from May through October. Eggs and sperm are produced and microscopic planula larvae are released in midsummer. They set on the undersides of a variety of hard substrates. We have seen them on oystershells, clamshells, glass, beer cans, wood, and on other animals. After setting, the larva changes into the plantlike polyp stage. The tiny polyp, about one-eighth inch tall, is the overwintering form. It is very hardy and capable of asexually reproducing itself through the formation of cysts. It can also encyst itself when conditions are unfavorable. The following spring each polyp produces 4 to 10 ephyrae which grow rapidly into the adult medusae. After producing ephyrae, the polyp resumes its normal form and, apparently, barring accident or predation, can repeat this cycle in-

definitely. The medusae, after spawning, die or disintegrate within a few weeks. We know of at least two fish which feed on the medusae, but they feed too late and too little.

Mr. Chairman, I might interject that Piney Point is much better this week than the last time you were there, but the water temperature is not as pleasant.

You asked about predators. This is a tiny snaillike animal, looking like a naked snail with wings and about three-eighths inch long, that slides along on the surface of an oystershell or clamshell. Wherever it finds a polyp it eats it very aggressively. We have not yet had enough experience to know how widespread or how abundant this small snaillike animal is, but it is out there working for us, and we intend to understand it as fully as possible.

This general life cycle pattern was discovered at our laboratory at Solomons Island about 30 years ago. Since that time we have made a number of minor studies, including study of the nematocysts, or stinging cells, the distribution of medusae and ephyrae, food items of the medusae, and an examination of the efficacy of air bubble screens as a barrier for swimming beaches. We have kept a daily record of jellyfish abundance since 1960. As far as we know, this is the only such record, and it has been of unusual value.

PRESENT MARYLAND RESEARCH PROGRAM

In 1965 the Maryland General Assembly allocated $30,000 for jellyfish research. The Natural Resources Institute of the University of Maryland then began a full-time investigation of this pest and other related organisms. There was little basic understanding of the role the sea nettle plays in the overall Chesapeake Bay ecology and any forthcoming control activities must be tempered with a consideration of their effects on other organisms. Therefore, we began a broad-based program of investigation and observation. We have been most fortunate in having the interest and excellent assistance of Dr. Leonard P. Schultz, of the Smithsonian Institution, as coinvestigator.

The discovery of the natural habitat of the polyp stage and the limits of its distribution were very quickly accomplished. With this knowledge, our subsequent efforts have been aimed at increasing our understanding of the tolerances and capabilities of the sessile stages and the interrelationships of sea nettles with other local organisms. The accompanying paper reports much of this early work. And there is appended a recent paper summarizing much of this early research.

We have found polyps on oystershells at all areas in Maryland where oysters occur and wish to learn more about relationships between nettles and oysters. Other organisms, including commercially valuable species, may aso be affected and possibly damaged. On the other hand, we have reason to suspect that sea nettles may do some good to human interests by feeding on another jellyfish which sometimes eats oyster larvae and fish eggs. The problems involved in controlling any animal in the bay are clearly complex and must be approached with care and thoroughness.

In the course of these investigations, at least three other jellyfish have come under scrutiny and two of these are numerous enough at times to be considered objectionable although one is a winter form.

Two of these also have polyp and cyst stages which have been observed in local waters or in the laboratory.

At present, we are operating under a matching fund program supported by the Office of Water Resources Research of the Department of the Interior, and the State of Maryland.

Within the limits of our present funds, Mr. Cargo, Dr. Schultz and their associates are intensively conducting a wide variety of field and laboratory observations and experiments. Briefly, we are attempting to:

1. Complete knowledge of the life history of *Chrysaora quinquecirrha*, including the reproductive stages, feeding habits, and the distribution of each stage at all seasons.
2. Learn the relations of this and related species to salinity, temperature, silt, and other environmental factors which may control their abundance.
3. Determine the effects of this and related species on other bay animals, so that losses and benefits from control efforts can be fairly assessed.
4. Develop, test, and evaluate chemical and biological methods to control sea nettles or reduce their damage to human welfare and interests.

NEEDED RESEARCH AND DEVELOPMENT

Our present studies of basic biology have only begun the long-range program required for an effective attack on this problem in the Chesapeake area. Still ahead are investigations of the interrelationships of the sea nettle with other bay species, and of possible biological, chemical, physical, and electrical methods of control.

In addition to our present specific plans, we now know that the following problems should also be answered:

1. What poison or poisons are produced by each type of jellyfish? Can creams or lotions be invented to neutralize them?

I would like to interject that we are in discussion with a dermatologist at the university school of medicine, school of pharmacology. He is very much interested in how you can protect the skin before stinging. This is one line we feel worthy of further pursuit.

2. Is it possible to treat sea nettles in the water so that they cannot discharge their stinging cells?
3. How can swimming beaches be protected from sea nettles? which engineering methods are best and most practical?

Again, we have opened discussion with other people about better sea nettle nets by electric or bubble or improved wire screens of some sort. So while we are looking at the biology on the one hand, we are seeing if there are practical, immediate ways to improve public beaches at the same time.

4. What are the life cycle and feeding habits of the nonstinging ctenophores or comb jellies, which feed sea nettles and consume oyster larvae and fish food?
5. Can commercial uses be made of noxious species?

Since we are most concerned with the Chesapeake Bay species, these suggestions apply especially to those species. However, many of the same questions must be asked for the Portuguese man-of-war and many other species in other areas.

Our present program is producing rapid strides with modest support only because the investigators are entering a field where little has been done before. Further progress along the lines just outlined will require a well-supported long-term program of research. For Maryland alone, we believe that funds would be required for:

1. An experimental laboratory where the many factors involved can be controlled and studied adequately.
2. Biological and chemical research at an adequate level for a period of at least 10 years.
3. Thorough engineering studies of new and unproved methods of beach protection.
4. Field testing and evaluation of control measures or engineering techniques which show promise.
5. Actual application of controls, if they are proven to be both feasible and desirable in the broad public interest.

COMMENTS ON S. 3744

Section 1 and section 2. The Secretary of the Department of the Interior is, in our opinion, the appropriate agent for administration of the program. That Department is aware of both the importance of the problem and of the complexities of controlling wild species without destroying other resources.

We agree that the States should carry the burden of participation in this program by providing matching funds. Maryland has made a modest but highly fruitful beginning, and other States will wish to participate. Federal funding is also appropriate, however, because of the widespread nature of the problem, because Americans are increasingly mobile, and because results produced in one State can also be applied in many other areas.

We wish to recommend a broad definition of "jellyfish and other such pests." In our opinion, "jellyfish" should include all of the stinging jellyfish which fall in the zoological phylum coelenterata, and also the nonstinging jellyfish or ctenophora whenever there is reasonable indication that one or more of these may be destructive to the uses of marine waters for food or recreation. "Other such pests" might well include poisonous fish, sea urchins, sea worms, toxic mollusks, and other noxious forms.

Section 3. The authorization of $10 million in Federal funds for this purpose appears to be an appropriate level since:

(a) Many coastal States are involved, about 23.
(b) Additional research facilities are needed in some areas.
(c) Long-term continuation of some of the studies will be essential.
(d) Any feasible methods of reducing jellyfish damage are likely to be costly.

Section 4. Joint programs should, in our opinion, be undertaken by appropriate States. The marine laboratories of Maryland and Virginia cooperate effectively on many fronts in attacking problems of common interest in the Chesapeake Bay and adjacent oceanic waters. We believe that the interests of the States might best be served if these investigations were implemented at a local level where extreme interest and familiarity with the problem would place the States in the strongest position for effective utilization of the supporting funds.

RECOMMENDATION

In conclusion, we urge early passage and implementation of S. 3744. Furthermore, we strongly urge that the following interpretations be applied in effectuating the program:

1. That "jellyfish and other such pests" be defined broadly.

2. That the studies and research deemed desirable by the Secretary of the Interior include thorough study of the ecology of each species and its relations to other species.

3. That control measures be permitted only when they are clearly shown to be in the broad public interest.

Thank you.

(The attachments follow:)

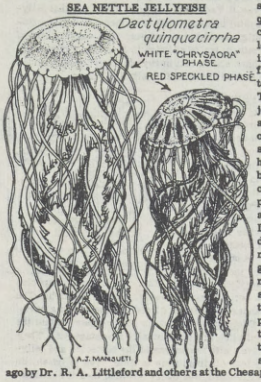
NATURAL RESOURCES INSTITUTE, UNIVERSITY OF MARYLAND, Chesapeake Biological Laboratory, Solomons, Md.
L. Eugene Cronin, Director
Extract from the Maryland Tidewater News. R. Mansueti, Editor. Vol. 12, No. 3. Supplement No. 7. August 1955.
Revised Edition September 1962

The Sea Nettle, Chesapeake Bay's Troublesome Summer Jellyfish

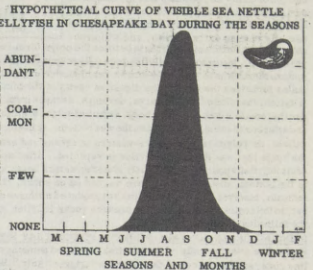
By R. MANSUETI

JELLYFISH REACH PEAK ABUNDANCE IN MID-SUMMER: Each year "sea nettles," the jellyfish of Chesapeake Bay, arrive with the same regularity and certainty as death and taxes. In fact, Chesapeake Bay residents pride themselves in being able to predict the time and invasion of this species, known scientifically as Dactylometra quinquecirrha, into their special coves, shores, and Bay locations. The pests appear in late June, reach a peak the first week in August and ostensibly disappear in October. Two other species of large jellyfish, Cyanea and Aurelia are found in Chesapeake Bay only during winter and early spring months. Sea nettles have fluctuated greatly in abundance each year; when they occur in large numbers, people find that swimming virtually ceases for the summer. In spite of their great abundance and detrimental economic importance, the biology and control of jellyfish are not well known. A thumbnail sketch of what is known about the life history may help people understand the reasons for the lack of knowledge about this species. The principal study was made some years ago by Dr. R. A. Littleford and others at the Chesapeake Biological Laboratory.

SEA NETTLE JELLYFISH



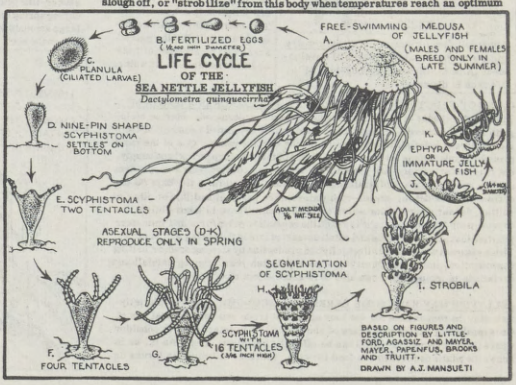
HYPOTHETICAL CURVE OF VISIBLE SEA NETTLE JELLYFISH IN CHESAPEAKE BAY DURING THE SEASONS



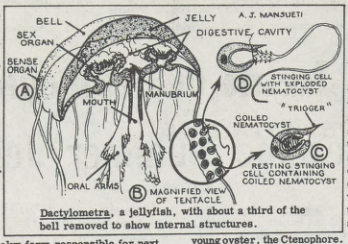
RADIALLY SYMMETRICAL JELLYFISH IS LARGELY WATER: If one watches a jellyfish languidly pumping near the water's surface, he cannot help but marvel at the complex-looking creature. And yet it is a relatively simple animal, being related to the hydras, sea anemones, and other coelenterates, which are simple two-layered animals whose body cavity and digestive cavity are the same. Composed of 95 percent water, and the balance largely salts and protein, the jellyfish is a beautiful radially-symmetrical medusa with an umbrella or bell that reaches nearly 8 inches in diameter. The margin of the bell of a fully mature jellyfish is notched, and there are 8 marginal sense organs, in addition to the tentacles. It has a mouth, stomach, sex and sense organs, and apparatus for offense. A jellyfish is essentially primitive when compared to a higher animal. It has no brain but does have a nerve net that serves to coordinate the pumping contraction of the bell and feeding activities. Except for the feeble rhythmic contractions of the bell, jellyfish are largely at the mercy of currents and waves. The tentacles or trailing threads are usually whitish, but may be yellow, and they may stream down for a distance of 30 to 50 inches in the water, partially veiling the 4 mouth arms or lappets. There are many small wart-like clusters of nematocysts, or stinging cells, scattered over the bell and the tentacles, being especially numerous on the oral arms. Virtually all jellyfish observed in Chesapeake Bay are a dull milky-white color, called the "Chrysaora" phase, an imperfectly developed or stunted variety of the more widely distributed "red" or "speckled" jellyfish. The white Bay jellyfish, however, is sexually mature in this stage. The beautifully-colored red form, observed with 16 short bars composed of reddish specks on the upper or convex side of the umbrella, we know is the same as the white jellyfish of Chesapeake Bay. The white jellyfish has only 24 tentacles and 32 marginal lappets, but the red variety has 40 and 48, respectively.

SEA NETTLES PREFER BAYS AND ESTUARIES: The sea nettle is the only large jellyfish found in Chesapeake Bay during summer months. It ranges from Long Island and Vineyard Sounds to the tropics. It occurs in Chincoteague Bay and in the Atlantic Ocean off Ocean City, Maryland, but it is never observed in the same densities as experienced in Chesapeake Bay. Perhaps this lack of a jellyfish problem is related to the ocean surf and higher salinity; in direct contrast, the Bay waters are relatively quiet and have lower salinities. These conditions apparently are beneficial to jellyfish populations. The sea nettle seems to prefer the relatively sheltered waters of bay and estuaries throughout much of its range. Each brackish tributary apparently has its own jellyfish stock, and as far as is known, there is no single point of origin in the Bay as it is sometimes suggested. In Chesapeake Bay and its tributaries, it ranges far up the tributaries to slightly brackish conditions. In July, 1954, for example, the Dactylometra was observed in the Patapsco River, Baltimore Harbor, in waters about 1/10 the salinity of the ocean (about 3 parts per thousand). The distribution of jellyfish in any one area depends on a number of factors; the most obvious being the effects of winds, tides, and currents. In some places they are common one day, scarce or absent the next. They are less common in higher salinities in the lower Bay.

REPRODUCTION IN SPRING IS ASEXUAL BY VEGETATIVE MEANS: Jellyfish show an interesting "alternation of generations," in which a medusa or jellyfish generation gives rise to a hydroid (a budding polyp) generation and the hydroids produce jellyfish again. In Chesapeake Bay it reproduces asexually during late May and early June from a vegetative plant-like animal known as a polyp, which looks like a tiny trumpet. This stage is a result of sexual reproduction in late summer, as will be described below. This form is found on the bottoms of estuaries and creeks in the lower portions of rivers. The polyp stage, known as a scyphistoma, is an attached creature, and is about 1/8 of an inch high, which can "bud" to produce more polyps. From each of these 4 or 5 plate-like disks slough off, or "strobilize" from this body when temperatures reach an optimum



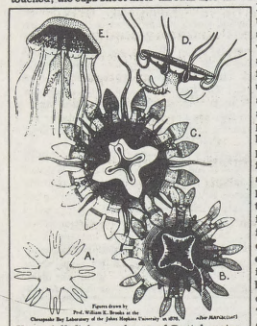
in spring. It is this stage that is most vulnerable to the elements. The tiny young jellyfish look much like saucers, and are known as ephyrae. They are free-swimming, and shortly invert in umbrella-shaped bodies and move freely. They grow rapidly into adults, resplendent with tentacles containing thousands of stinging cells.



Dactylometra, a jellyfish, with about a third of the bell removed to show internal structures.

SEXUAL REPRODUCTION IN LATE SUMMER PRODUCES LARVAE: Marine biologists believe there is no relation between a poor or bumper crop of one year and the size of a subsequent year's production of jellyfish in Chesapeake Bay. Next year's crop is dependent on sexual reproduction of males and females and the effects of environmental conditions at the bottom. Jellyfish that are available in late summer will spawn sexually (during early August), and will probably produce sufficient offspring to become the polyp form responsible for next year's crop. Mature male jellyfish generally possess bright pink gonads, while mature females have yellowish-brown reproductive organs. The sperm from males fertilizes the eggs in the digestive cavity of the female. An immature jellyfish, the ciliated planula larva, develops, escapes from the oral pouch under the female's umbrella-like body, swims about for a while, and then settles and attaches to some hard object on the sea bottom. It becomes the flower-like animal, the polyp stage, and over-winters in creeks and estuaries. In spring the cycle that was described earlier is repeated. After spawning in August, adult jellyfish apparently die shortly after the waters begin to cool. They sink to the bottom, disintegrate, or are washed up on shore. Laboratory studies indicate, however, that the polyp that has produced medusae do not die in spring but, to the contrary, may live and produce young jellyfish in plate-like forms the following spring.

STINGING CELLS CONTAIN PROTEIN POISON THAT IRRITATES HUMAN SKIN: The stinging cells of the jellyfish are called nematocysts. They are like tiny cups, each with a coiled thread and a "trigger" hair. When the latter are touched, the cups shoot their threads into the victim. These are used to paralyze their small prey of invertebrates and, occasionally, small fishes. In summer, when vacationers splash too close, and make contact with the jellyfish the stinging cells are stimulated to shoot microscopic stingers into the arms, legs and any part of the body. The poison discharged from the cell body is a little-known complex protein substance, and is not formic acid, as is sometimes stated. The prey is seized and paralyzed by stinging cells on the oral lobes, and then carried into the mouth and finally taken into the digestive cavity at the center of the bell. If it is necessary to handle a jellyfish, it is best grasped by the top of the bell with the fingers. The sting of a jellyfish is seldom serious. The most recommended antidotes are to bathe the painful areas with bicarbonate of soda or ammonia diluted with water.



Young jellyfish or ephyrae of Dactylometra quinquecirrha in various stages of development (A to E). Size range-roughly 1/64 to 3/4 inch in diameter.

CAUSE OF FLUCTUATIONS IN APPARENT ABUNDANCE IS A MAJOR MYSTERY: The causes of jellyfish fluctuations are not understood. Marine biologists at the Chesapeake Biological Laboratory have developed a number of theories about why jellyfish become scarce during certain years. One of the most plausible explanations for the scarcity is that of temperature and oxygen supply, but it is, unfortunately, not proven. Heavy rains, coupled with a very warm spring, may cause marked stratification of estuarine waters in the Bay: (a) one of fresher, less dense, oxygen-rich water on the surface; and (b) the other of saltier, denser oxygen-poor water on the bottom. There is a possibility that oxygen-poor bottom waters may reach the vegetative polyp form and immature jellyfish that occur in creeks and small estuaries late in the spring and summer. These stagnant waters may affect jellyfish production by slowing down or halting reproduction, and the result may be a poor jellyfish year. Spring rainfall and variations in temperature can also have some effect on abundance.

JELLYFISH MAY HAVE SOME BENEFICIAL ECONOMIC VALUE: The jellyfish may be responsible for the loss of tourist trade and recreational use of Chesapeake Bay during peak years of abundance. It is interesting to consider where these detrimental effects can be offset by beneficial ones. As far as is known the adults do not serve as food for other species, although the larvae or small stages are consumed by plankton feeders, and thus may be important in the food chain of Bay fauna. Dr. Thurlow Nelson, of Rutgers University, has formulated an interesting theory that during years of jellyfish scarcity, there is a concurrent abundance of ctenophores, or sea walnuts (small, non-stinging jellylike creatures that are similar to jellyfish). When ctenophores are abundant, they are believed to feed extensively on oyster larvae. Some people have speculated that this predation could result in a low set of oysters. During years of jellyfish abundance, the high density somehow depresses ctenophore numbers, so that oyster larvae survival is greater. According to one jellyfish authority, Dr. E. J. Papenfus, "The sea nettle is a friend to the oyster for it eats an enemy of the young oyster, the Ctenophore. Thus it is evident that nettles are of some economic importance although they are a nuisance to bathers. Our young nettles furthermore do not eat crab larvae." From this, one can speculate that jellyfish abundance may benefit the oyster industry. All such theories will eventually be tested by scientific investigation and experiments. The exact nature of jellyfish food has not been determined, but in addition to food items mentioned earlier, experimental studies have shown that heavy plankton concentrations and pieces of oyster meat are suitable as food for jellyfish larvae.

FISH OCCASIONALLY FOUND FEEDING UNDER JELLYFISH BELL: One of the most interesting phenomena observed in Chesapeake Bay is the close association and crowding of certain fish under the bell among the tentacles of the common jellyfish. On August 22, 1954, in the Patuxent River in front of the Chesapeake Biological Laboratory, for example, a juvenile harvestfish, Peprilus paru, was observed swimming in and out of a jellyfish. The fish, about 1-1/2 inches long, refused to leave the jellyfish even though it was being dipped out of the water. A number of other people have reported one or more small harvestfish consorting with Dactylometra in the Bay. Several other species of fish have been observed to accompany the medusa of this jellyfish. The famed marine biologists, Alexander Agassiz and Alfred G. Mayer, in a beautifully illustrated study of the Dactylometra made in 1898, observed that the relations between the fish and jellyfish are not mutually advantageous. They noted that the fish gorge themselves with fragments of the tentacles and jellyfish mouth fringes, which they tear off from time to time. The jellyfish, on the other hand, is not wholly unavenged, for every now and then it succeeds in stinging to death and devouring one of its persecutors.

Top view of a mature sea nettle, Dactylometra quinquecirrha.

CONTROL AND MANAGEMENT OF JELLYFISH IS A COMPLEX PROBLEM: There is no known method of controlling jellyfish abundance. Their habitat is so large, and their life history is so affected by a combination of such general limiting factors as temperature, oxygen tension, and salinity, that man can hardly expect to alter these conditions as he can for pond fishes. Jellyfish nets that are used in certain waterfront communities to restrict bathing areas from the influx of jellyfish are not as effective as desired because the small saucer-like young jellyfish can easily squeeze or are swept through the mesh during spring and early summer after the nets are set up. At the same time, large amounts of sea grass, debris, and even incrusting organisms, accumulate on the nets, and prevent water exchange from taking place, thereby sometimes creating stagnant conditions. During late summer the nets are useful but not perfect method of keeping large jellyfish out of swimming areas, but tides, winds and currents pile up the bodies on the nets to the point where portions of tentacles and medusa bodies sweep into the restricted area to sting the swimmers. Regrettably, jellyfish may be here to stay. There are certain chemicals which are known to kill jellyfish, but none is known to destroy it without killing other important organisms. The solution would lie in the discovery of an extremely cheap chemical specific for sea nettles. Continued research can at least provide some prediction of each year's crop and perhaps clues to control.

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Notes on the Biology of the Sea Nettle, *Chrysaora quinquecirrha*, in Chesapeake Bay[1]

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ABSTRACT: Despite the continuous nuisance value of the sea nettle in Chesapeake Bay, the only major report on the biology of this species was that of the laboratory studies by Littleford in 1939. Therefore, we began a study of the biology of *Chrysaora quinquecirrha* aimed at increasing the understanding of its life history which had not been investigated. The occurrence of sessile stages on the under-sides of a variety of substrates, especially oyster shells, is reported for the first time. The geographic range of the polyp stage in Chesapeake Bay is partially delineated with respect to depth (<11 m) and salinity (5‰–19‰). Sampling for ephyrae near Solomons, Maryland suggested that strobilation began in April and extended into August. The growth of medusae was rapid, and their feeding appeared opportunistic and frequent.

The response of polyps to unfavorable conditions was to encyst. We also noted the production of pedal cysts during late summer in the absence of any apparent inducement, suggesting an important asexual mode of reproduction. A brief discussion of observed ecological associations of the polyps and medusae with other organisms is included.

This paper summarizes some of our field observations in the Chesapeake Bay area and the results of laboratory studies made during 1965 on the biology of the sea nettle, *Chrysaora quinquecirrha* DeSor (Kramp, 1961). Our efforts included: searching for the natural occurrence of the sessile (polyp and pedal cyst) stages of the sea nettle; sampling for the natural occurrence of the earliest pelagic stages; observations on reproduction; and on the association of *Chrysaora* with other organisms. The above studies were undertaken to gain a better understanding of the life cycle of this common summer sea nettle as a basis for further investigations.

The major contribution to the biology of *Chrysaora* in Chesapeake Bay was by Littleford (thesis[2] and 1939), which dealt with the experimental culture of larvae and polyps produced from mature medusae and with the strobilating polyps and resulting ephyrae. Mansueti (1955) summarized current knowledge and the possible biological role of the sea nettle in the ecology of Chesapeake Bay. Although both Littleford and Mansueti mention that sessile stages exist on the bottoms of estuaries and creeks and in the lower portions of rivers, we did not note in the literature any record of the exact location and types of hard substrata on which *Chrysaora* polyps had been found.

[1] Contribution No. 301, Natural Resources Institute, University of Maryland.

[2] Littleford, Robert Anthony. Ph.D. Thesis, Univ. of Maryland, 1938. A study of the life history of *Dactylometra quinquecirrha* L. Agassiz, and the taxonomic validity of this species. 47 pp., 19 pls.

Since the polyps of *Chrysaora* had not been seen previously by us, a search was made for them in aquarium tanks in which Bay water had been constantly circulating for more than one year at the Chesapeake Biological Laboratory (CBL). On April 27, 1965, scrapings from the tank walls bore polyps and later we found them on the under-side of glass bowls and on oyster shells in the tanks.

Although we presumed they were polyps of *Chrysaora,* two other common scyphozoans, *Cyanea* and *Aurelia,* occur in the Bay and could have produced polyps. Culture of the polyps was attempted on April 28 and by raising the temperature from 13.3°C to 24°C, strobilation began on May 5, producing free ephyrae on May 10. The ephyrae were identical to those figured by Littleford (1939) for *Chrysaora* and unlike the ephyrae of *Cyanea* and *Aurelia* illustrated by L. Agassiz (1862), Mayer (1910), and Spangenberg (1965).

Since oyster shells were assumed to be the most common substrate on which polyps might occur naturally, on May 7 we took oysters with a common oyster dredge off the mouth of Hellen Creek in the Patuxent River. We scanned dozens of oyster shells with a binocular dissecting microscope and found a colony of seven polyps on the inside of an oyster box. These were the remaining shells of a dead oyster. Dredging was continued from May through mid-December and polyps were found frequently on oyster shells and occasionally on the under-side of certain other objects in the Bay, from the Bay Bridge to the mouth of the Potomac River, in the Choptank River, and in several other places, to a depth of 11 meters (see Table 1). Observations of the kind of organisms associated with the polyps soon made it possible to predict the likely occurrence of polyps on oyster shells from the general appearance of the shells.

TABLE 1. Record of capture of *Chrysaora* polyps during 1965.

Date of capture	Locality	Depth in meters
May 7	Off mouth Hellen Creek, Patuxent River	5
12	Off CBL Pier, Patuxent River	3
21	Green Holly Bar, Patuxent River	10
26	Fishing Point Bar, off mouth of Patuxent River	11
26	Chinese Mud Bar, off mouth of Patuxent River	10
June 1	Off Tolchester Beach, Chesapeake Bay	7
1	Mouth of Chester River	4
2	Herring Bay, Chesapeak Bay	6
2	Broad Creek, Choptank River	5
17	St. Mary's River, off Horseshoe Point	3
21	Off Buzzard Island, Patuxent River	4
21	Off Prison Point, Patuxent River	3
July 20	St. John Creek, Patuxent River	4
20	Sandy Point Bar, Patuxent River	10
Sept. 21	Cobb Island, Potomac River	5
21	Swan Point, Potomac River	6
Oct. 14	Little Choptank River	4
Dec. 9	Deal Island, Tangier Sound	5

At the beginning of our search we noticed that the polyps occurred mostly on the under-side of certain hard substrata, also observed by Fraser (1962) for *Aurelia.* The natural occurrence of polyps on the underside of objects is thought to be significant for their survival because the settling of sediments, along with dense marine fouling occurring on the exposed upper surfaces, may cover the polyps to the extent that survival is impossible. Under natural conditions the upper surfaces are illuminated, and thus, light may serve as an orienting factor in directing the planulae to set on the darker, underside surface, which is relatively free of fouling. This suggests that the planulae may be negatively phototrophic. However, in aquaria where sedimentary deposits were regularly removed, polyps were found on both the exposed upper and lower surfaces.

Observations on the pelagic stages of *Chrysaora* were made in the laboratory and in the field. On April 27 we isolated polyps and placed them in finger bowls of Bay water at 22°C, in order to induce strobilation and the production of ephyrae. Each polyp produced from 3 to 9 ephyrae. The most common number was 5. They were measured with ocular micrometers and were found to be approximately 2.4 mm in diam-

eter, whereas Littleford's (1939) were morphologically identical but smaller, measuring .84 mm. An attempt was made to feed the ephyrae newly-hatched *Artemia* and other small organisms but they did not survive longer than 7 days.

Field studies on the early pelagic stages began on May 28. We found ephyrae, post ephyrae, and early medusae of *Chrysaora* up to 52 mm in diameter in the head waters of St. John Creek near Solomons, Maryland, where they were reported by Littleford and Truitt (1937) and where Dr. Rosemary Hein and her CBL assistants again found them in 1956. We continued to make weekly samplings with small plankton nets until September 20, and took ephyrae through August 27 except in the samples of July 9, July 13, and July 20. More ephyrae were caught regularly in the net hauls near the bottom than at the surface.

The presence of small medusae in the upper reaches of the deeper creeks at least 3 weeks prior to their appearance in the Bay suggests that conditions suitable for strobilation are reached earlier in the creeks than in the Bay. The chief difference noted so far was that the temperature of the surface water of upper St. John Creek was 2°C to 5°C higher than in the Bay at the same time.

An interesting adjunct to our observations resulted from the biweekly fish larvae sampling program at CBL. One meter plankton nets, towed in the Magothy River, failed to take any ephyrae until September (W. L. Dovel, personal communication). An earlier dredge-sample at that locality in June did not contain any substrata bearing polyps. We are unable to explain these irregularities in the occurrence of ephyrae.

Sampling in the head waters of St. John Creek yielded ephyrae in large numbers compared with only an occasional one with the same effort at the mouth of Mill Creek and nearby in the mouth of the Patuxent River. No ephyrae were collected in the Bay during the same period. We have obtained ephyrae in other deep tidal creeks, especially in the upper Bay area (Fig. 1). We believe the ephyrae are generated in supposedly optimal conditions in the head-

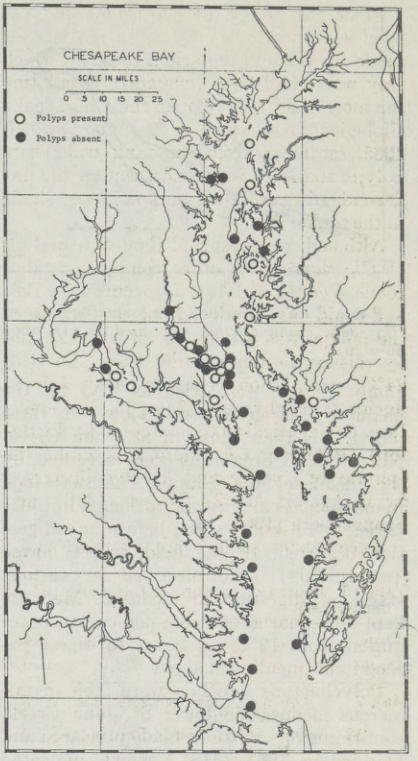

Fig. 1. Dredge sampling locations for the sessile stages of *Chrysaora quinquecirrha* in Chesapeake Bay during 1965.

waters of these sluggish deep tidal creeks; if they are not, then they must be carried there by currents, suggesting that deep tidal creeks are important nursery grounds for ephyrae and young medusae.

In order to estimate the rate of growth, experimental feeding of ephyrae, post ephyrae, and medusae was attempted in a non-circulating but aerated aquarium. Aeration was found to be essential for the well-being of these pelagic stages. Medusae and polyps were fed brine shrimp frequently and given plankton once a week. The polyps prospered, but no growth was observed for the medusae. Cut-up fish, tiny live fish, and commercial bloodworms, *Glycera dibran-*

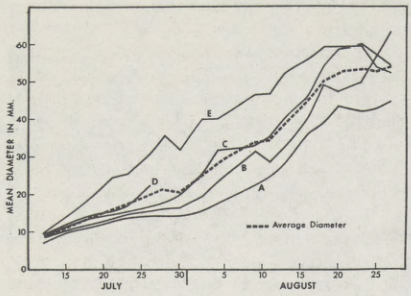

Fig. 2. Rate of growth of five young medusae of *Chrysaora quinquecirrha*. One medusa (D) died July 26.

chiata Ehlers, were tried as food for the medusae; but growth was slower in these individuals than those in St. John Creek. Not all food organisms were accepted by the medusae; for example, unusual food items such as earthworms, although initially taken, were soon ejected before any digestion occurred. In the field, insect larvae (caterpillars) were observed in various stages of digestion in medusae. Medusae kept in aquaria at room temperature required from 12 to 18 hours to digest the food items mentioned above.

Polychaetous annelids were seen in numerous medusae in lower St. John Creek, confirming observations made by Cargo and Dormer in 1963 (MS),[3] which indicated that these worms were an important item in the natural diet of the local sea nettle. Therefore, in mid-June we began feeding *Nereis succinea* (Frey and Leuckart) and *Nereis virens* Gars to the medusae twice a week, and the medusae increased in diameter as much as 12 mm per week. From mid-June to the first of September, three medusae grew from 12 mm to 75 mm in diameter. They had dusky gonads in September and may have spawned in our tank. In a concurrent experiment an assistant fed these annelid worms exclusively to 5 medusae held in aerated river water, which grew from an average diameter of from 8.8 mm to 53.7 mm from July 12 to August 27 (Fig. 2).

The significance of salinity for the survival of polyps appears to be important since no polyps were found in such creeks as Parker and Fishing Creeks (Calvert County, Maryland) which are subject to flushing with fresh water from heavy rainstorms. Also, we have not found polyps in the upper Potomac and the Magothy Rivers, which normally have low salinities during the spring. Another factor is the great amount of sediment deposited in small creeks, resulting from heavy rains, whereas in large rivers, such as the Potomac, strong tidal currents might clean the substrata.

Our survey of the geographical distribution of the polyp stage suggested these forms were most common in areas where the salinity is greater then 5‰ and less than 20‰. Therefore, with the assistance of a summer student, salinity tolerance experiments were conducted. We found that most of the polyps died and others encysted at salinities of 5‰ and lower and at 25‰ and higher. The best survival was at 10, 15, and 20‰. Artificial sea salts ("Rila Marine Mix") were used for the experiments.

The salinity tolerance studies with polyps resulted in some unexpected responses. The polyps previously held at about 15‰, upon a change in salinity of 5‰ downward and 5 to 10‰ upward began strobilation within 4 days. This occurred despite a reduction in temperature from 25°C to 20°C. The apparent onset of strobilation in the field in the spring of 1965 coincided with a sharp rise in temperature along with a drop in salinity. These observations suggest further investigations are needed to determine the role that salinity and temperature play in the initiation of strobilation. The effect of artificial salts is also a factor which must be examined before conclusions can be drawn concerning the influence of salinity on strobilation.

High salinity appears to be a factor limiting the distribution of the polyps. For example, in Chesapeake Bay between the mouth of the Potomac River and the Chesapeake Bay Bridge-Tunnel and in lower Tangier Sound, where the salinity varied

[3] Some observations on the macro-organisms taken by *Chrysaora quinquecirrha* in the vicinity of Solomons, Maryland in 1963. Unpublished manuscript.

from 19‰ to 25‰, the 17 dredge-samples collected were without *Chrysaora* polyps, whereas among 40 samples taken from the upper Bay Bridge to the mouth of the Potomac, where salinities were lower and varied from 7‰ to 18‰, polyps occurred in 18 collections (Fig. 1).

The occurrence of sexual reproduction in local waters in 1965 was verified by placing two trays of cleaned oyster shells at the end of CBL pier on July 19 and 23. These shells were prepared from live oysters which were cleaned by natural processes in the woods for 5 weeks. They were then reassembled into oyster boxes by propping open the two shells with a small pebble and holding them together with rubber bands. We had previously observed that under natural conditions oyster boxes were particularly favorable habitats for polyps. One tray was inspected on October 8 and many polyps and cysts were found. On November 18 a tray with 137 shells were examined and colonies of polyps and pedal cysts were found on 126 shells, each colony consisted of from 1 to more than 100 cysts and polyps.

We concluded that planulae, resulting from natural sexual reproduction of medusae during July, August, and September, became attached to our cleaned oyster shells (described above) where they developed into polyps that produced a large number of cysts before the water temperature had lowered significantly. In one of our experimental aquaria, a polyp kept between 21°C and 23°C formed 52 cysts and 6 polyps by October 12. Polyps held in other aquaria since the previous spring produced numerous cysts during the summer and early autumn.

Early in the spring, many cysts were observed in close association with polyps. We had assumed that these cysts formed from polyps as a result of the increasing coldness of the water as winter approached. However, there appear to be several other causes of cyst formation when conditions are unfavorable for the survival of the polyps. For example, we have induced 100% cyst formation in aquaria in the following ways: (a) by causing an oxygen-depleted situation associated with some hydrogen sulphide, in which the polyps formed cysts within a few weeks; (b) by rapidly reducing the water temperature to below 4°C, the polyps encysted within 72 hours; (c) by raising the temperature slowly, the polyps encysted within 48 hours when the temperature reached 34°C to 36°C; (d) when the salinity was raised to over 30‰ and lowered to 5‰. Cysts also were formed when heavy bacterial fouling occurred in aerated aquaria. When the polyps were encysting under these conditions, we observed a differentiation of the cell layers, and found that only the cell-protoplasm migrated into the cyst, leaving a thin, transparent remnant of endodermal and ectodermal layers with nematocysts intact. This differentiation of cell layers enabled us to predict and observe encystment. If pedal cysts are returned to favorable conditions, some develop into polyps within a few weeks, and later produce more polyps and cysts.

Polyps naturally form pedal cysts in the following ways: (a) The foot or base of the polyp spreads or divides into two or more parts, sometimes spreading to distances of 2 or 3 mm. The protoplasm of the polyp at each of the points of contact with the substratum then forms a reddish-brown opaque structure. These are about 0.5 mm thick and about 2 mm in diameter. The top is flat, with concentric rings and often of a lighter color in the center. The wall has a leathery texture. (b) Pedal cysts are formed from a stolon, which grows laterally from the stalk of the polyp and then curves downward to contact the substratum. This stolon may form either a pedal cyst or a new polyp.

The importance of pedal cysts in the life cycle of *Chrysaora* became apparent as our knowledge about them increased. They not only serve as a means of survival during unfavorable environmental conditions but their formation is especially important in asexual reproduction as suggested by Truitt (1939). Cyst formation is not necessarily induced by a gradual lowering of the water temperature; instead their abundance in late summer and autumn indicates a natural phase of the life cycle, which makes possible in early spring the sudden development of polyps from these cysts followed by an

extremely abundant bloom of medusae as observed in the headwaters of the deep creeks tributary to the Bay.

Although *Chrysaora* polyps are associated with numerous invertebrate organisms, we have not yet seen any such organism feeding upon the polyps. On the other hand, the polyps may ingest almost any available small marine organisms that they can catch. They readily take recently-hatched brine shrimp and a number of naturally occurring organisms, for example, amphipods, protozoa such as *Stentor, Folliculina, Parafolliculina,* diatomaceous accumulations, organic detritus, and unidentified worms (probably nemerteans).

The polyps share living space within oyster boxes with at least four species of fishes. The most abundant of these is the clingfish (*Gobiesox strumosus* Cope), which cleans a part or the entire inside area of an oyster box, then lays its eggs on the inside surfaces of both shells. In some of the trays containing oysters at the end of the CBL pier, over 25% of the boxes contained clingfish eggs under parental care. However, we have found polyps on the uncleaned part of the shell not used by the clingfish, thus both exist together. The other less numerous kinds of fishes using oyster boxes for nests are: the striped blenny, *Chasmodes bosquianus* (Lacépède); feather blenny, *Hypsoblennius hentzi* (LeSueur); and the naked goby, *Gobiosoma bosci* (Lacépède).

The medusae are preyed upon during late summer and autumn by at least two kinds of fishes in Chesapeake Bay. The most common and best known (Mansueti, 1963) is the harvest fish, *Peprilus alepidotus* (Linnaeus), the small young of which frequently accompany a medusa and feed heavily upon the tentacles and oral lappets, whereas schools of those longer than 50 mm may destroy scyphozoan medusae in minutes. Another predator unreported to our knowledge, is the orange filefish, *Alutera schoepfi* (Walbaum), juveniles of which were observed (DGC) on two occasions feeding actively on medusae of *Chrysaora.*

A number of individuals have assisted us in many ways. We appreciate the help of Miss Sara K. Wedeles, Cambridge University, Cambridge, England, in the growth and salinity tolerance experiments. We are also indebted to W. L. Dovel, E. A. Dunnington, Jr., and especially to H. T. Pfitzenmeyer of the Chesapeake Biological Laboratory, for securing occasional field samples and to other CBL staff members for their assistance.

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A NEW ATTACK ON SEA NETTLES

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Contribution No. 297, Natural Resources
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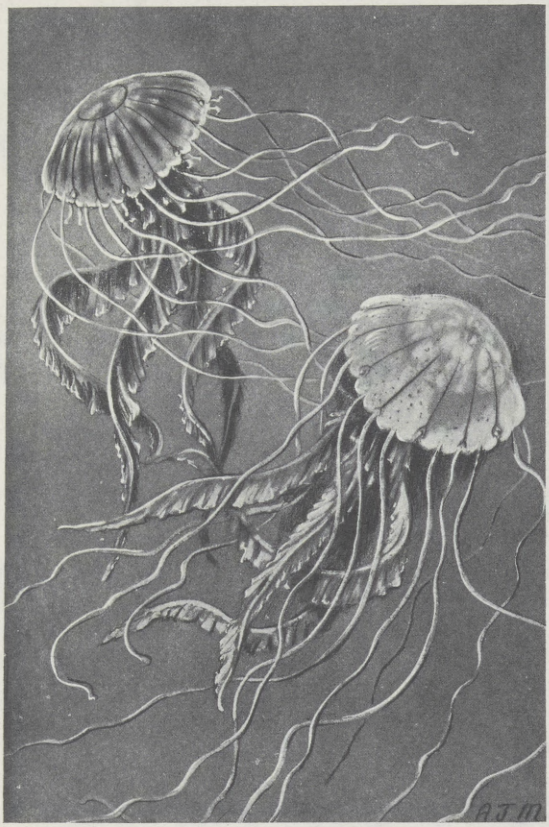
A NEW ATTACK



AN ACCOUNT OF RESEARCH ON THE SWIMMER'S NEMESIS

by Edison T. Blair

Mr. Blair is the Editor for the Natural Resources Institute.

The two varieties of the sea nettle, Chrysaora quinquecirrha, on the left, the red-specked phase, on the right, the white, or "stunted" phase. This drawing, and the one on page 18 were done by Mrs. Alice J. Mansueti, of the Chesapeake Biological Laboratory.

ON SEA NETTLES

SEA NETTLES, present in varying numbers for centuries, have become a major economic problem in Chesapeake Bay because a constantly growing number of people are turning to the Bay for recreation and leisure living only to be repulsed by sea nettles.

Until this burgeoning population, with more money and leisure time in which to spend it, made its economic presence felt, Bay area residents accepted sea nettles as part of the natural scheme of living on the Bay. Residents reacted to jellyfish much as the mountaineer reacted to a swarm of gnats on a summer evening or the city dweller to rush hour traffic; they got out of the way. Some years the sea nettles are very thick, but most years they are a moderate nuisance, and many years the Bay is nearly free of them.

Nobody likes sea nettles. Fishermen and crabbers curse the slimy animals that gum up lines and fill crab pots. Swimmers and water skiers who have felt the nettles' stinging tentacles hate them more. Although the nettles' sting is not severe and the pain is soon gone, the unsightly red welts will last for several hours, even days. Divers who carelessly let the tentacles brush their eyes might even find jellyfish dangerous. So, soon after the nettles make their appearance in the Bay, the resort beaches and recreation areas are practically deserted and the economic pinch begins.

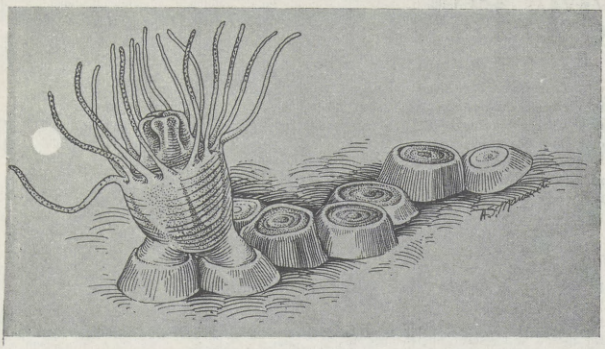
"The resort business on the Bay rises and falls with the sea nettle population," one beach operator says. "Business drops off about thirty per cent if the jellyfish show up in mid-summer and we would lose more than fifty per cent if we didn't have nets. We carefully dip all the nettles out of the water every morning but you can never get all the bits and pieces. Just let one or two children get a bad sting and come crying up the beach and everybody begins to pack up and go home.

Our profit depends on having a crowd that will stay around spending money all day. When they leave early, we lose. Not just us, but the people back down the road, the gas stations, the motels and restaurants, the people who rent cottages, the grocers, the whole community. People today aren't looking for just a few hours recreation. They have time and money enough to go elsewhere if the facilities aren't good enough, and they do."

Another resort operator estimates conservatively that he has about $30,000 invested in piling and nets to keep his beach only sixty per cent free of sea nettles. He spends another $10,000 a year to install and repair the nets and to keep the area dipped free of the jellyfish. The wind and tides still break the jellyfish up into small pieces which easily wash through the nets. Since the sea nettles' sting is purely involuntary, the bits are just as obnoxious as the whole animal, because anything that brushes against the triggering device will discharge the nematocyst, or stinging cell, which shoots out a microscopic, hair-like, barbed stinger loaded with protein poison.

Apparently then, all of the economic effects of the jellyfish population are

David G. Cargo, Chesapeake Biological Lab left, and Dr. Leonard P. Schultz, Smithsonian Institution, gathering specimens for their study of the sea nettles that infest Chesapeake Bay every summer.



This drawing shows the plant-like polyp forming a cyst stage of the sea nettle, Chrysaora quinquecirrha.

negative. Persons with waterfront property to sell are confronted with the question, "are you troubled with sea nettles?" Cottage rentals fall off; people decide not to swim or ski; not to buy property; not to build homes or businesses; all in direct ratio to the number of sea nettles in adjacent waters.

What can be done to eliminate or control the sea nettle population?

What should be done?

What is being done?

Nobody knows the answers to the first two questions. Yet. The answer to the last question is research, already started, which may answer the others. One of the great lessons learned in our present age of scientific discovery is that the Creator didn't make many mistakes, except with man, perhaps. Mother Nature functions far better than even the finest of clocks, remaining in perfect balance so long as every tick has a tock to eat it.

"It is absolutely essential that we know what role the sea nettle plays in the ecology of the Bay before attempting wholesale eradication of the animal," says Dr. L. Eugene Cronin, director of the Natural Resources Institute of the University of Maryland.

"We must know not only what the sea nettle eats, but also what eats it before we upset the balance of nature," Dr. Cronin said. "The destruction of one link in the intricate food chain of the commercially important finfish and shellfish in the Bay might ultimately destroy them."

The current jellyfish research aimed at gaining such knowledge is being conducted by the Institute's Chesapeake Biological Laboratory at Solomons, which Dr. Cronin also heads. A senior scientist of the Smithsonian Institution, Dr. Leonard P. Schultz, who had been searching for sea nettles in their wintering-over stage asked the Laboratory for cooperation last spring. That same week David G. Cargo, a research associate, discovered what he believed was the plant-like polyp stage of the sea nettle clinging to the bottom of a bowl in an aquarium he was cleaning. Several days later the polyp produced a tiny sea nettle.

The two men launched a search for the animals in their natural habitat, found several polyps, and began a study of their reproductive processes. Enough progress was made during the summer that a broader, more intensive, and comprehensive study of the sea nettle was started with the $22,000 appropriated by the last General Assembly through the Board of Public Works. The Board of Public Works, composed of Governor J. Millard Tawes, Louis L. Goldstein, and John A. Leutkemeyer, has since increased this figure to a total of $30,000. Matching federal funds from the Department of the Interior, Office of Water Resources Research have now been assured since nearby coastal areas where jellyfish of one or another species is a problem will benefit from any new knowledge of the troublesome animals. The Smithsonian Institution has authorized Dr. Schultz to continue using a portion of his time helping with the current program.

When Dr. Schultz and Mr. Cargo began their study last summer they found that very little was known about this particular animal. A summer visitor's description of the sea nettle was "Ugh!" Scientific literature didn't add a great deal more. An internationally recognized Danish authority on jellyfish and its close relatives, Dr. P. L. Kramp, describing the common sea nettle, *Chrysaora quinquecirrha,* said that "all specific characters are vague and variable." These variable characteristics have resulted in a number of name changes of the species in the past 80 years.

Some helpful data about the sea nettles' reproductive cycles had been reported by Dr. E. J. Pappenfuss and Robert Littleford who had studied the biology of the animal with some crude equipment at C.B.L. during the 1930's. There are male and female sea nettles. An egg, spawned and fertilized in late summer, becomes a tiny microscopic ciliated larva, a metamorphic animal called a planula that swims by waving hair-like arms. The planula attaches itself to some object in the bottom of the bay in nobody-can-even-guess-how-many locations or in what numbers. The larva then changes its shape, first to that of an inverted bowling pin, and eventually that of a trumpet no wider than a pin head. This is a polyp, or what scientists call the scyphistoma phase of the sea nettles' life, when it looks more like a plant than an animal.

The polyp grows 16 tentacles that wave about in search of food. By early spring and warm weather the polyp strobilates, a scientific term for a particular type of division in a living plant or animal. Ring-like segments form at the trumpet-bell top and progress downward until four or five disks are evident. Finally something, time, temperature, light, sends the top segment, now about three-thirty-secondths of an inch in diameter, into undulating spasms that free this "bud" from the parent stalk. The free-swimming bud, now called an ephyra, is barely visible with the naked eye under the right conditions. It soon develops into the familiar bell-shaped body of the mature sea nettle considered so objectionable in its medusa phase of life.

A few clues were provided by short studies done by other members of the Laboratory staff on techniques of holding adult nettles for study, feeding habits, wintering stages, and the effectiveness of bubble screens to protect beaches. Except for a few anatomical details and some educated guesses, that was about all that was known about sea nettles when the current research started. It has been generally believed that sea nettles prey on ctenophores, another jelly-like animal more commonly called a sea walnut, which are known to consume oyster larvæ. If sea nettles do eat ctenophores then we may be reaping a sort of second-hand benefit from these detested jellyfish in the form of greater oyster larvæ survival.

But Dave Cargo says that so far in his still preliminary investigations he has been unable to confirm the sea nettle-ctenophore relationship by observation or from the scientific literature. The belief apparently stems from the fact that sea nettles increase in the Bay at the same time the ctenophore population decreases. However, no one has yet reported that they watched one devour the other in any stage of their life cycle. This can be proved only by deliberate and repeated observation under both controlled and contrived natural conditions.

On the other hand, Cargo points out, sea nettle polyps seem to occur most frequently near some of the Bay's most valuable mollusks. The polyps also appear to become most active in their budding or asexual reproductive process at about the same time that oysters and soft shell clams reach their peak spawning periods. Is this because the sea nettles themselves thrive on oyster and clam eggs and larvæ? Or is it because they find the feeding ctenophores fatter at this time of the year? Again, only further, more explicit research can provide the answer.

"All these relationships must be fully investigated and all the likely economic effects studied before we jump to conclusions and start killing off all the sea nettles," Mr. Cargo maintains.

The first three years of the research program envisioned by Mr. Cargo and Dr. Schultz aims at several major accomplishments. First they want to obtain a complete knowledge of the sea nettles' life history. That means the time, place, and manners of reproduction. They may have already uncovered some new facts in this area.

They plan to use time-lapse motion picture cameras fitted with special magnifying lenses to study jellyfish eggs from fertilization through the larval stage until they become polyps. This particular phase of the research cannot be done very efficiently by an individual peering through a microscope for hours on end awaiting an event that might or might not happen on that particular day. But a film would provide a permanent record that could be studied again and again with attention focused on each separate minute detail.

If the goal of his research is a method to control sea nettles, Mr. Cargo points out that he must first find the most vulnerable stage in their life cycle to apply these controls. Scientists finally found a chemical larvicide especially lethal to the lamprey larvæ infesting the Great Lakes, but it took 14 years of biological studies following the failure of mechanical and physical barriers to control them.

Complete knowledge of the feeding habits of sea nettles at every stage of their life cycle will be vitally important to the study. The sea nettle diet may include other organisms that are potentially even more harmful than ctenophores to commercially valuable species. The nettles are basically carnivorous animals, a fact foreshadowed by their stinging abilities. While the nematocysts, or stinging cells, function quite well as defensive weapons, they do an even better job of stunning or paralyzing small fish and other live organisms that stray within range. Many sea nettles in the medusa, or adult stage, have been observed through the transparent bell digesting small fishes.

Biologists spend hours trying to maintain near natural living conditions for both the young and the adult netties in the lab.

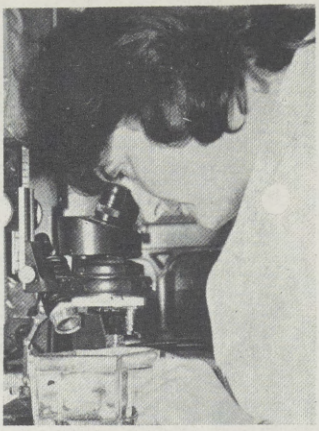
But there is also evidence that some small fishes, particularly the harvest fish often found consorting with these jellyfish, take occasional bites of their hosts. Giant ocean sunfish that weigh up to two tons are known to eat some species of ocean-living jellyfish. Although they require many pounds of solid food per day to reach this size, these sunfish follow currents gulping drifting jellyfish which are about 98 per cent water. It could be that our common sea nettles provide a food source for similar fish in the Bay. This too, is a possibility yet to be examined.

Sea nettle polyps are certainly voracious feeders, Mr. Cargo learned last summer. In addition to plankton, they appeared to thrive on the brine shrimp, a common commercial food for tropical fish, he placed in the aquaria regularly. Of course, under these early and unplanned laboratory conditions he was unable to make a careful study of the amount of free-floating phytoplankton, or vegetative matter that they ingested.

Nothing is known to feed on sea nettle polyps but this is not surprising. It would be very, very difficult to observe them in their natural habitat long enough to see if fish or other animals prey on them. They would also be easily overlooked in any stomach analysis of other captured animals since the polyps are largely water.

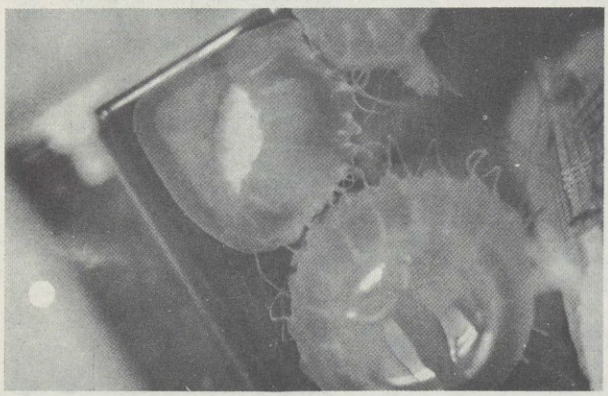
A knowledge of the distribution of jellyfish in their various stages, egg, larvæ, polyp, and medusa, will be essential in developing control methods. Some distribution data has already been accumulated as a fallout from other research projects. William Dovel, another CBL scientist studying the spawning habits of finfish and the distribution of their larvæ, inevitably gathers jellyfish in his plankton nets. He reports the places and number of sea nettles in any form found each season of the year.

Mr. Cargo and Dr. Schultz are spot-checking many areas of the Bay using an oyster dredge rig operated from the deck of the ORION, the laboratory's largest and newest research boat. They also analyze and record the physical qualities and depth of the water and the type of bottom in the area. They have found plenty of polyps, but they did not always find them where they were expected to be, Mr. Cargo said. From this part of the study the researchers have learned to associate the presence of polyps with certain objects and the presence of certain fouling organisms.



Jellyfish polyps apparently dislike silt and muddy bottom conditions. For a home the polyps seem to prefer the undersides of such objects as oyster and clam shells, beer cans, rocks, and old boots submerged in up to 30 feet of water. One oyster shell taken from 18 feet of water had 142 polyps clinging to it. But Mr. Cargo cautions that the sampling program is still far too young to offer any meaningful correlation between these animals and objects. Greater areas must be carefully examined before any definite conclusions can be drawn.

From water quality data the scientists expect to determine the relationship between the sea nettles' life cycles and the physical factors in their environment such as salinity, water temperature, and the presence of silt and turbidity. A great deal of water quality information is already available at



A small fish is clearly visible in the digestive cavity of the sea nettle at left center.

Solomons where temperature and salinity records have been kept for 30 years. Still other water data is available from a number of other research projects conducted by members of the CBL staff. Mr. Cargo says he will call on scientists working in every discipline for any information that might prove useful in the jellyfish research.

He has already borrowed some small controlled-environment aquaria specially designed and built for a finfish study underway at the Laboratory's Hallowing Point Station near Benedict. An electronic sensing, regulating, monitoring, and recording system continuously controls temperature and measures oxygen content of water in the tanks. An experiment just completed Christmas Eve appears to indicate that polyps are quite sensitive to temperature changes.

But the experiment is far from conclusive, Cargo says, and they hope to run it at least one more time in the borrowed equipment before it is needed for its original purpose. They must haul salt water from the Bay at Solonons 25 miles upriver so the tanks can be changed daily. The water is tempered for at least 24 hours in plastic pickle jars (obtained free from a well-know restaurant) to avoid temperature fluctuations.

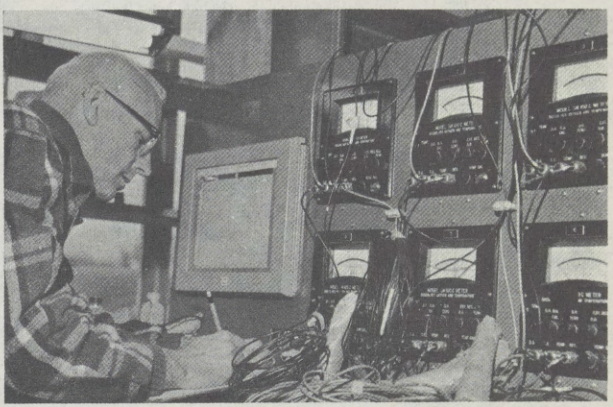
"The arrangement is inconvenient and wastes time in travel," Cargo says, "but we have to take advantage of this equipment while it is available. It may take us months to get similar environmental equipment of the type we will need for our egg, larval, and polyp studies, so this puts us ahead of the game."

The sea nettle polyp's reactions to temperature were noticed last spring after Cargo found the first polyps in the aquarium. When removed to a shallow glass bowl on a sun-warmed bench in his upstairs laboratory, they began to strobilate. He noticed as the water warmed from 55 degree F. temperature of the large tank to around 68 degrees, the watery gray color of the polyps changed to the pinkish tint of the ephyra which budded off between 70 and 75 degrees F. This reaction was repeated each time he tried more polyps from different locations as the study progressed. Not all the polyps they find are sea nettle polyps, but they can't be identified without further study. All likely-looking samples are brought to the Laboratory for closer observation. Polyp-bearing objects are kept in small tanks and examined frequently until there are signs of budding. Then they are isolated in small bowls until they produce ephyræ which help the biologists identify the species. A time-lapse camera could simplify and reinforce this phase of the research. Film could be held indefinitely while they compared size, shape, color and other identifying characteristics of polyps of different species.

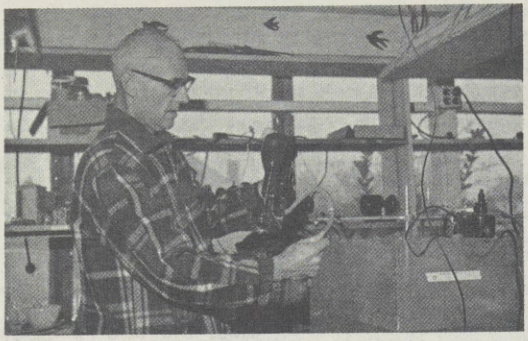
There is almost irrefutable evidence that sea nettles over-winter in the Bay as polyps. But the research has introduced other intriguing questions. What is the life span of a polyp? How many years does it remain a polyp? How many times can it bud off the young medusa? Is the polyp easier to kill than adult nettles? Only time and study will tell. Right now, Mr. Cargo believes sea nettles sometimes have another phase in their life cycle, a sort of regressive, but more rugged form better adapted to survive under severe changes in its environment. He is trying to collect proof.

"It is beginning to look as if being called a jellyfish could be a compliment," Cargo said a few days ago. "They are tough, resourceful little animals and they cover their bets on survival even when not seriously threatened."

After they acquire enough knowledge about sea nettles to work with, the scientists will begin to develop, test and evaluate chemical and biological methods of controlling the animals as the research progresses. They will give special attention to any natural controlling factors they might find. The very fact that nearly all the polyps found to date have been attached to the undersides of objects may be significant. Are they hiding in places inaccessible to natural enemies? Hope-



"An electronic sensing, regulating monitoring, and recording system continuously controls temperature and measures oxygen content of water in the tanks."



"Controlled - environment facilities which will incorporate the most modern aquaria and equipment for controlling the physical environment in each tank are badly needed to carry out this kind of research."

fully, the research program will disclose potentially vulnerable points in the life cycle of sea nettles where tested control methods can be applied.

Mr. Cargo estimates that the program they have laid out will cost in the neighborhood of $200,000 over the initial three-year study period. Much of the first year's budget will go for equipment and apparatus, such as time-lapse cameras, aquaria with devices to control the environment, and other specialized gear. Later more money will go for salaries, travel, and the actual cost of the research itself. Once the field sampling is done they hope that the egg, larval, and polyp stages through the budding and asexual reproduction process can be studied under precise laboratory conditions.

Although it has never been done before, perhaps a means can be found to hold and study the adult or medusa forms of sea nettles while they complete the sexual reproduction process of spawning and fertilization. But adult sea nettles that measure up to eight inches in diameter are hard to keep in a tank filled with circulating salt water which is necessary to approximate natural conditions. They sooner or later tend to go down the drain!

Cargo, who designed and installed the sea water circulation system in the aquarium room at Solomons, thinks he can thwart this tendency by simply changing water at regular intervals and adding the necessary oxygen with an over-size air pump. Dr. Cronin has suggested the use of a special aquarium arrangement which is used in Europe in fish culture tanks. The most critical problems Cargo will face in this sort of experiment will be environmental control devices.

From the meager evidence available sea nettles spawn in response to time and temperature, although they may also be influenced by such factors as food and salinity or some other water quality. That is, after a more or less specific period in which the nettles mature, the sun-warmed water of the Bay reaches a certain temperature and contains the nutrients the larvæ need for survival, and they spawn. If these conditions are indeed necessary for spawning, then the laboratory tanks where they are confined must have facilities to control heat and light, and be supplied proper foods in order to induce sea nettles to spawn for science, and their possible destruction by man.

There are very good reasons for using the water from beneath the pier at Solomons for these studies. This is the only place on the Eastern seaboard where sea nettles have regularly been counted for five years. Daily counts have varied from almost zero to fifty nettles per square yard. Local waters are circulated through the tanks in the laboratory's aquarium room, so records of its temperature, salinity, acidity, and oxygen content have been kept for years. But the laboratory and aquaria facilities are terribly limited, and the jellyfish research team must share them with scientists working on a dozen other research projects.

The laboratory staff hopes this situation will be improved shortly. Dr. Cronin has proposed a new controlled-environment facility which will incorporate the most modern aquaria and equipment for controlling the physical environment in each tank. This new laboratory will greatly simplify and speed up the sea nettle research as well as other projects on crabs, oyster, clams and finfish. Since the amount of new knowledge gained in each ecological and biological experiment depends upon the precision with which the variable factors are measured, Dr. Cronin believes such facilities are essential.

"New knowledge being gained by Mr. Cargo and Dr. Schultz hopefully will solve the economic problems created by the presence of sea nettles," Dr. Cronin says. "But they, and a great many Marylanders who earn their livelihood from Chesapeake Bay realize that the subtle balances of nature cannot be tampered with until we also know what the consequences will be. That can be learned only by patient and thorough research which involves the total balance of life in the Bay. That is the knowledge we seek here at the Laboratory and the knowledge that responsible persons must have before any definitive measures can be taken to serve the best interests of all Maryland." • • •

Senator BARTLETT. Thank you, Dr. Cronin, for a complete statement.

Senator Brewster?

Senator BREWSTER. Dr. Cronin, I would like to congratulate you and your associates on the work you have already done and propound just a question or two.

Does the present rate of pollution in the Chesapeake Bay have anything to do with the existence of the tremendous number of jellyfish that are there?

Dr. CRONIN. Senator Brewster, we think industrial pollution is not affecting jellyfish at the present time.

It may be possible that the increased enrichment of the bay from released treated sewage, in other words, fertilization of the bay may be affecting the crop. The crop last year, apparently was very high, as it was the year before. This summer was not as bad, although they were objectionable.

In our record there is such great change from year to year that there is no simple long-term pattern of increase, but we are deeply concerned that this increased fertilization of the bay, from cities, towns, cottages and boats, may increase objectionable animals.

Senator BREWSTER. This is just a conclusion that I have reached from personal experience, but there seems to be many more jellyfish in the bay today than when I was a child, and as I remember, we used to swim in the bay at all times in the summer.

Is there any truth in that observation?

Dr. CRONIN. Our accurate records go back only to 1960, and I concur with you, the background of the bay country, I remember some very bad years many years ago, but we have no good record which makes it extremely difficult. We have had very dry summers in sequence. It is a widespread impression that dry summers are coincident with large numbers of jellyfish, and this seems to hold, but we can't test it critically yet. So our impression is that if the water ever gets back to average, and rainfall gets back to normal, this may bring some reduction.

Senator BREWSTER. You have no clinical proof or actual records that would substantiate that possibility?

Dr. CRONIN. That is correct; not yet. It takes time.

Senator BREWSTER. Does this point up the need for the study and the establishment of the history of a great many years in efforts to control this pest?

Dr. CRONIN. I think it indicates it very strikingly, Senator Brewster, and one thing I would like to stress is that in the sea lamprey, and cancer research, and every difficult problem, long-term continuity is an absolutely essential element. I am pleased that the House has acted and moved the bill that lies before them that was presented to them, but we are a bit concerned with the concept of shortening the period to a 3-year period. It is recognized as initiation period, after which there will be review and further action, this might be effective, but we would not wish to imply that we can answer jellyfish problems in 3 years. They appear to be too complex.

Senator BREWSTER. Do you have any estimate on the number of dollars that are lost per year in both commerce and recreation because of this pest?

Dr. CRONIN. Senator Brewster, we have made some preliminary estimates, but they are very difficult to accumulate. So much of the damage of jellyfish is a negative kind of damage, where people decide not to go to a particular beach, or they decide not to buy a cottage on a particular river, or the restaurant owner decides not to build his restaurant in that particular point. These are, of course, invisible and hard to measure. We have talked to resort owners who now spend $25,000 a year fighting sea nettles.

We have talked to resort owners who say their business would increase a third or a half, if they could say "there will be no sea nettles on my beach this summer." We know many a large number of these beaches in bad years are badly affected. We know that real estate values drop, that the pleasure the public gets from the water is grievously injured, but we haven't been able to measure it.

Senator BREWSTER. As one who uses the Chesapeake Bay with my family every summer, I can personally testify that we go out on a boat, the children just don't swim because of the sea nettles. Swimming is just out of the question in certain periods of the summer.

Also, a month or more ago I visited Smith Island for a day and talked to several commercial fishermen that made their living out of crab pots, and when they would pull these crab pots, wire cages, as you well know, at the end of a long line, the jellyfish would collect on the line and in the pots to such an extent that the poison would get in their eyes, and over the face and nets, and they just had to stop, and couldn't put in a day's work, so there is very great commercial harm.

Dr. CRONIN. They can also accumulate on pound nets and break the nets. When they put the nets away every winter, with jellyfish on them, when they break these nets out in the summer, the juice that comes out can be dangerous to the eyes. And we are extremely interested in the jellyfish and the oyster and other commercial fish in the bay.

The food changes are not yet known, are not yet clear, but we know enough to realize that they are related and we must understand that relationship.

Senator BREWSTER. Well, as a nationally recognized scientist and expert in this field, can you hold out some hope that if the U.S. Government spends this money that there may be some way we can control this pest?

Dr. CRONIN. Senator Brewster, I would hold out considerable hope that we can reduce the damage they do to people by a combined attack for exploration for control, improved beach protection, and any other avenue. Some of this, I feel quite certain, will pay off in improved protection to people. Control is a difficult thing to predict, and I don't think we know enough to say it is possible yet or not.

I can promise you that from our point of view there will be tremendous gains of information on other problems, and I think this will have very high value to the people of the country.

Senator BREWSTER. So far as Chesapeake Bay is concerned and your organization, do you have the mechanical facilities and skilled personnel to practically utilize such Federal funds that would be put up to match State funds?

Dr. CRONIN. Senator Brewster, I think we have demonstrated by the best method, by achievement, that we can contribute substantially to the problem with our present facilities and staff. We have land where we could place the additional experimental facilities that we would propose, and we have a strong group throughout the university and in other educational institutions, and private industries we feel could be is harnessed into an effective team. Certainly we would wish to explore all possible avenues in such work.

Senator BREWSTER. There is a very distinct possibility that a model of the Chesapeake Bay will be constructed, with which you are well aware. Would this be associated in any way with your current jellyfish control program? Would it be helpful to you?

Dr. CRONIN. It would contribute to it tremendously, Senator Brewster, in general terms. It would speed up and make more precise our prediction of the distribution of saline in the bay, that would result from the changes in rainfall in the Susquehanna, which you know controls the bay, primarily.

I would say that it would be one of an array of important tools. It would not answer the problem, obviously, but it would be of very high value in knowing where and when to apply control methods that are developed to the best effect.

Senator BREWSTER. Thank you very much, Dr. Cronin. It is indeed a rewarding experience to have somebody appear who really knows what he is talking about. Thank you.

Senator BARTLETT. Thank you, Senator.

Senator Brewster explored every subject, Dr. Cronin, which I had in mind. I would like to ask you only one question.

You said that jellyfish in Chesapeake Bay are not lethal, and earlier you had informed the committee that, and I quote, "After the stings of some species death can result in seconds." What kind of jellyfish are these and where are they found?

Dr. CRONIN. Senator Bartlett, I would ask Mr. Cargo to comment on that. I know the general literature, but he knows it specifically, and I am sure he can tell you some interesting things.

Mr. CARGO. Most of these species are in a different type of animal called the Cubo Medusa, and they are found in the southwest Pacific, particularly around Australia. The one that is currently being touted as the most venomous is about 7 or 8 inches tall. The bell is taller than it is wide. It stretches up in this direction more, with leather-like tentacles that stretch down, and it is almost invisible in water, and these have been known to kill persons, even an adult human being, in a matter of less than a minute.

Senator BARTLETT. And these are found in swimming areas?

Mr. CARGO. Yes. Apparently they don't frequent or breed in swimming areas on the coast of Australia, but under certain meteorological conditions, currents, winds, storms, and so forth, they seem to invade areas, and this is when the contact with human beings develops, and this particular species was identified and described about 1957. And there are two or three of these closely related species which cause these mortalities, and most of the jellyfish mortalities in the world have resulted from the stings of these three species of jellyfish.

Senator BARTLETT. Well, comparing Piney Point with Australia, with that kind of jellyfish and sharks, I think I will take Piney Point, even if they have jellyfish there.

You have been very helpful, Dr. Cronin.

Thank you, Mr. Cargo, for an excellent presentation.

Now, that completes the list of witnesses on S. 3744.

Senator BREWSTER. Mr. Chairman, one of the most knowledgeable men on sea nettles, on their effect on waterways, is Mr. Joseph Manning, director of the department of Chesapeake Bay affairs, for the State of Maryland. Mr. Manning appeared to testify on behalf of this legislation at the hearing in the House of Representatives. Unfortunately, he is unable to be here this morning, but at his request, and on behalf of the administration of the State of Maryland, I would ask your consent that Mr. Manning's testimony before the House committee be reprinted in this record, as he would have testified in the same manner if he had appeared here today.

Senator BARTLETT. It will be incorporated in the record.

Senator BREWSTER. Thank you, Mr. Chairman.

(The statement follows:)

STATEMENT OF JOSEPH H. MANNING, DIRECTOR, DEPARTMENT OF CHESAPEAKE BAY AFFAIRS, STATE OF MARYLAND

Mr. MANNING. Mr. Chairman, gentlemen, I have a statement which I will read, if I may.

H.R. 11475 is a bill of critical importance to the State of Maryland, and I have been directed by the Governor to convey his strongest wishes for its enactment and his assurance of support for the appropriation of matching State funds.

The stinging sea nettle, *Chrysaora quinquecirrha*, has long been a major impediment to recreational use of Chesapeake Bay. Ranging from Long Island Sound to the Tropics, this species finds apparently optimal conditions for reproduction and growth in the brackish, relatively quiet waters of the upper and middle bay, for nowhere else is it so abundant.

Numbers fluctuate from year to year, and there is no evidence or reason to believe that we have more or fewer nettles now than were present a century or 10 centuries ago, but even in the years when they are least abundant, they are a deterrent to water-oriented recreational pursuits, and their presence occasions a severe economic loss to the State.

To the best of my knowledge, Maryland is the only State that has appropriated funds for studies directed toward the control or elimination of sea nettles. In 1965 the Maryland General Assembly and the board of public works made available to the University of Maryland $30,000 for research on the biology of *Chrysaora quinquecirrha*, and a like sum was appropriated for the same purpose in 1966.

The natural resources institute of the university has conducted competent research designed to augment knowledge of the complex life history and distribution of the species, and has published a preliminary report of its findings in the June issue of Chesapeake Science.

The report indirectly lends emphasis to the already-recognized difficulties of developing effective control measures. To do so will almost

certainly require a major expenditure of funds and recruitment of the most competent research scientists and technologists to the cause.

If successful, the effort will contribute immeasurably to the recreational development of one of the world's most beautiful and accessible waterways.

We respectfully urge favorable consideration of H.R. 11475 by the Committee on Merchant Marine and Fisheries.

Senator BARTLETT. Now we are going to turn to S. 3528 because Mr. Callison wasn't here when we called his name and he was a bit late in arriving.

Mr. Callison?

STATEMENT OF CHARLES H. CALLISON AND ROLAND C. CLEMENT, NATIONAL AUDUBON SOCIETY

Mr. CALLISON. Thank you, Senator Bartlett, and I am sorry I am late. I caught the second section of the shuttle, and if I had caught the first one I would have been here on time. But thank you very much for this opportunity. I have some copies of my statement.

My name is Charles H. Callison and I am assistant to the president of the National Audubon Society. I am joined in the authorship of our statement today by Mr. Roland C. Clement, staff biologist of the Audubon Society who is not here. It is my privilege to speak for him as well as myself in behalf of the society.

The estuaries and related coastal wetlands of the United States constitute an ecological zone of such immeasurable importance that importance is hardly the word for it. The word is essential. It is a zone of lifegiving productivity that is absolutely essential to all aspects of human welfare, to the economy which our civilization has built as well as to man's physical and spiritual well-being—to the whole man.

It is now recognized that man must turn increasingly to the seas for sources of proteins in order to maintain the numbers of his own kind with which he has populated the earth. But we have been destroying the life-producing estuarine zone at a disastrous rate and unless the destructive processes are stopped, the capacity of the seas to yield proteins will be vastly diminished.

The processes of destruction are well known. They are dredging and filling for residential, commercial, and industrial developments on "made land;" drainage and filling of marshes for the same short-sighted purposes; fills for highways that could go around the wetlands instead of through them; dredging to create navigation channels and boat marinas and by no means least in damaging results, pollution. There are always local "economic" reasons for each piecemeal elimination of a marsh or estuary. Some even take place in the name of our latest national shibboleth, recreation, as when a marsh is filled to make a golf course or a park high and dry enough to support picnic tables and parking lots or when a highly productive arm of a bay is dredged and polluted to barrenness to create a marina.

Destruction of the estuarine zone has now reached a point of national crisis. We use the word "national" advisedly. This a national resource, and it is time to take national action through our Federal Government to conserve it. When the wetlands of Long Island are

turned into housing developments and the estuary of the Hudson River becomes the world's biggest sewer, it isn't just New York City, or the States of New York, Connecticut, and New Jersey that are affected adversely. The bulkheading and filling that is going on all about Florida is damaging to more than Florida. The pollution and shell dredging that sicken the lagunas and bays along the coast of Texas sicken more than the welfare of Texas. The filling of San Francisco Bay affects more than the bay cities. The elimination of the shell fisheries of Chesapeake Bay deprives more than the oyster eaters of Washington and Baltimore. All the people of the United States, and all our future generations, are deprived by these processes of destruction, wherever they occur.

The National Audubon Society welcomes the opportunity to testify at this hearing and to urge favorable action on Senator Edward Kennedy's S. 3528. We hope that in passage the bill can be strengthened, not weakened. We have no objection to studies of the estuarine areas—they are needed. But what is more urgently needed is a halt to the dredging and filling and drainage while the studies are going on. The extent and location of the estuarine zone is no mystery. There is ample basis for Federal protection. Practically all of the waters involved are navigable and/or interstate in character. The estuaries are vital to migratory birds, which the Federal Government has treaty obligations to protect. Many of the fishery resources that are spawned or reared in the estuaries move across State lines and into international waters. When harvested they move in interstate commerce.

We believe the Congress can understand that the estuarine zone—from Calais, Maine, to Brownsville, Tex.; and from northern Alaska to southern California—is a biological continuum, a unit that cannot be segmented without diminishing its productivity and impoverishing the Nation. To the extent that it has already been segmented by filling and dredging and pollution, the Nation has been impoverished.

If connecting lines were drawn to show the importance of each "separate" section of estuarine zone for all the important commercial and sport species of finfish and shellfish, there is not a mile of this coastline that would not be tied into the web.

This means that urban and industrial-site needs must be—and they can be—satisfied inland, away from the estuary. Oil tank farms, for example, are better set inland where accidental spills will be absorbed in sand or soil rather than pollute the waterway. They can be connected to shipping lanes by pipelines. This will cost a little more, but it is the most economic way for the Nation whose citizens will pay the cost in any event, whether through slightly higher fuel costs or in lost biological resources and lost recreational opportunity.

There is a misconception apparent in the Department of the Interior report which proposes an amendment and a policy that would categorize and treat only segments of the estuarine zone as of "national significance" and therefore worthy of being "federally acquired." It is all of national significance and the objective need not be land acquisition. The basic need is protection through the imposition of land-use restrictions on all estuarine areas such as Massachusetts has recently imposed on its salt marshes. This is needed to prevent the further sale of bay bottoms by the States or local units of government to private enterprise, the true source of the conservation problem in most areas.

In summary then, we recommend enactment of S. 3528, but we hope this distinguished committee will strengthen it by adding regulatory and zoning authority, and by restricting the authority of the Army Engineers to issue dredging and filling permits without the approval of the Secretary of the Interior.

Mr. Chairman, specifically on that last point, we recommend consideration by this committee, and the inclusion in this bill, of section 7 that was written into the similar House bill, H.R. 13447, by the Merchant Marine and Fisheries Committee.

Senator BARTLETT. And that says what?

Mr. CALLISON. That says:

The authority of the Chief of Engineers, Department of the Army, to undertake or contribute to, or issue permits for, shore erosion control, dredging, filling, or beach protection measures on lands or waters within any estuarine area established or designated pursuant to this Act shall be exercised in accordance with a plan that is mutually acceptable to the Secretary of the Interior and the Secretary of the Army and that is consistent with the purpose of section 2 of this Act.

Senator BARLETT. I have no questions, Mr. Callison. Do you have anything further?

Mr. CALLISON. No, that is all.

Senator BARTLETT. Senator Brewster?

Senator BREWSTER. I really have no questions. I would like to thank Mr. Callison for coming down here and testifying today. It has been very helpful.

Mr. CALLISON. Thank you very much for allowing us to present our views. Thank you very much.

Senator BARTLETT. There will be placed in the record two letters, one from Congressman Wolff of New York, endorsing S. 3447, companion bill to the one Mr. Callison discussed, and another letter from Congressman Halpern of New York, likewise urging favorable consideration of S. 3528 with amendments contained in the House bill.

Senator BREWSTER. Off the record.

Senator BARTLETT. Well, the committee will stand in recess.

(Whereupon at 12 noon the subcommittee was adjourned.)

(Statements and letters received for the record:)

STATEMENT OF HON. ROBERT F. KENNEDY, U.S. SENATOR FROM THE STATE OF NEW YORK

Mr. Chairman, I welcome the opportunity to testify on S. 3528, a bill to authorize the Secretary of the Interior to preserve, protect, develop, restore and make accessible estuarine areas of the Nation which are valuable for sport and commercial fishing, wildlife conservation, recreation, scenic beauty and for other purposes.

Passage of this bill will insure that the Department of the Interior is actively involved in the planning, passage of legislation, and management necessary to protect our estuarine wetlands. This is vital if these unique and invaluable areas are to be protected. For they are under assault by man and his activities.

There are many coastal marshes and bays that are threatened today. Members of the President's Science Advisory Committee have pointed out that 60% of the seafood taken from water surrounding the United States is dependent on these coastal bays and marshes for their existence. If these wetlands are filled in, polluted, or otherwise destroyed, this seafood will no longer be available.

Waterfowl also live on food growing in or near these areas. For our incredibly rich coastal marshlands produce as much as six times the amount of organic material as is grown on the average wheatfield. These wetlands play a vital part in the lives of fish and wildlife.

Unfortunately, these estuaries, coastal marshes and wetlands are threatened by the growing number of people on our coasts. Almost 60 percent of our population lives in a 250-mile-wide band along our Atlantic, Pacific and Gulf Coasts.

These people turn to the seacoast for recreation, for employment, and for new homesites. As a result, undeveloped land on our seacoasts is becoming increasingly rare. And the projections show that these pressures for land along the sea will increase.

New homes and industry along the coasts usually pollute and destroy our estuaries and wetlands. Byproducts of the pulpmill, the oil refinery, or the steel mill destroys marine life more effectively than overfishing or natural predators can. Municipal sewage and chemical wastes are poisonous to all but the lowest forms of life.

The coastal wetlands lying in Hempstead and Oyster Bays on Long Island's south shore are a good example of the problem to which I refer.

A State-Federal Planning Committee for Preservation of Long Island Wetlands was formed in 1957. Their survey of the wetlands, completed in 1959, showed that 12½ percent had been destroyed since 1954. They estimated that 30 percent was threatened in the next 5 years and an additional 39 percent was threatened in the foreseeable future. In all, the survey estimated that more than 80 percent of the wetlands will be destroyed.

This committee with representatives from the New York State Department of Conservation and the Fish and Wildlife Service of the Department of Interior, recommended that approximately 16,000 acres of wetlands be protected as a fish and wildlife area.

Pointing to the need for protection, the committee recommended that this area be dedicated to these purposes by Hempstead Township and in 1959, the New York State Legislature passed a law authorizing the town of Hempstead to enter into an agreement with the New York State Conservation Department to preserve this wetland area.

In a limited recognition of this need in 1962 the town of Hempstead dedicated 2,500 acres to the wetlands for conservation purposes.

But, unfortunately, the pressures on these towns for landfill and new housing projects were so great that the planning committee's recommendations had not been accepted by the fall of 1965. And during this period the wetlands suffered.

Between 1954 and 1964 a total of 4,635 acres of wetlands in Nassau County were destroyed. A total of 2,219 acres was destroyed prior to 1960. And since 1960, an estimated 2,416 additional acres of wetlands have been filled in and large sections of the shallow bay bottom have been dredged up.

In 1962, the Town Board of Hempstead approved the dredging of 4 million cubic yards of fill from East Bay to fill in the shore line in South Bellmore. A stretch of bay bottom, 3,000 feet by 3,000 feet was dug out leaving a 20- to 30-foot-deep pothole in the bay. Housing was constructed on this land fill. In this case, both the Federal and New York State Governments objected to the dredging.

Again in 1964, the Town Board of Hempstead approved the dredging of 800,000 cubic yards of land fill from Garrett Lead and portions of Middle Bay to fill in the shoreline at Oceanside for housing. Today, there are 300 private houses being constructed on this sand dredged from the bay bottom. Again, both the Federal and New York State Governments objected to this destruction of the bay bottom.

There have been other permits for dredging and land fill issued by the town of Hempstead. Having received an estimated $500,000 per year since 1961 from the sale of this fill, it is no wonder that there is some reluctance on the part of Hempstead to dedicate this wetlands to conservation use.

In view of the continuing destruction of these wetlands, Congressman Herbert Tenzer introduced a bill to create a Long Island National Wetlands Recreation Area in October 1965. This bill, H.R. 11236, would authorize the Secretary of Interior to acquire 16,000 acres of wetlands to establish the Long Island National Wetlands Recreation Area.

At a meeting January 14, 1966, between Secretary Udall, Congressman Tenzer, Senators Javits' and Kennedy's representatives, the New York State Conservation Department and the town of Hempstead announced that they had dedicated an additional 7,500 acres of these wetlands to wildlife and conservation on December 28, 1965.

However, this dedication does not provide the necessary protection for the wetlands. As Secretary Udall stated in a letter to Congressman Tenzer:

"This document is wholly inadequate, and I am quite frankly disappointed at such a timid effort. In my opinion, the agreement will not afford genuine protection to the wetlands."

I ask that the full text of Secretary Udall's letter be printed in the hearings.

"Hon. HERBERT TENZER,
"*House of Representatives,*
"*Washington, D.C.*

"DEAR MR. TENZER: Since meeting with you and representatives of Senators Javits and Kennedy and Congressman Grover and local and State officials of New York and others interested in conservation, I have had an opportunity to review the 'Cooperative Conservation Agreement' recently executed by the New York State Conservation Department and the town of Hempstead which you sent to us.

"This document is wholly inadequate and I am quite frankly disappointed in such a timid effort. In my opinion, the agreement will not afford genuine protection to the wetlands.

"As I understand it, the agreement subjects about 10,000 acres of wetlands previously dedicated by the town to conservation purposes to a vaguely defined cooperative development and management program. I understand that the 10,000 acres are included within the boundaries of the area described in your bill, H.R. 11236. It also reserves to the town of Hempstead certain rights, including the right to continue to lease any of these lands now under lease and to lease other lands within the area with the State's approval. The agreement does not in any way restrict the uses to which the leased lands can be put by the lessees. Obviously, many uses, such as the removal of fill material, might not be compatible with the preservation of these natural wetlands. In addition, the agreement can be terminated by mutual agreement of the parties, unlike your bill.

"As I indicated at the beginning of our meeting, the idea expressed in your bill of preserving these natural and irreplaceable wetlands for their extremely valuable fish, shellfish, and wildlife, as well as outdoor recreation, is consistent with this Department's general policy of preserving such natural areas for present and future generations of Americans. We are now concentrating our efforts in developing appropriate suggestions in the form of amendments to your bill which we believe will accomplish our mutual purposes.

"Let me again commend you for your far-sightedness in introducing this legislation.

"Sincerely yours,

"STEWART UDALL,
"*Secretary of the Interior.*"

Mr. Chairman, I share Secretary Udall's view of this local agreement. It does not do the job. It does not limit the ways in which this wetland can be used and the agreement can be easily terminated. If we settle for this agreement, there will be further inroads on this area. And one morning there will be no more wetlands.

Although I have used the wetlands on Long Island's south shore as an example, I could have used Mt. Sinai Harbor on Long Island's north shore, New Jershey's marshes, the tidewaters of the Carolinas, the bayous along the Gulf of Mexico, or the waters of Puget Sound. For all of our estuarine areas are threatened.

The President's Science Advisory Committee recognized this danger in its report "Restoring the Quality of Our Environment" and recommended that efforts be made to protect, either directly or through the States, important marshes, lagoons, and estuaries which could then serve as national and state parks, monuments, wildlife refuges, and public recreation areas.

Senator Edward Kennedy's bill, S. 3528, will enable the Department of the Interior to begin this task.

In considering this bill, I hope that the Committee will also consider the provisions of H.R. 13447 as reported by the House Committee on Merchant Marine and Fisheries. This bill, introduced by Congressman Dingell, incorporates many of the features of Congressman Tenzer's Long Island Wetlands bill. Inclusion of some of the specific features of H.R. 13447 would strengthen S. 3528 and provide the tools for cooperative State-Federal management of our valuable estuarine wetlands.

At this point, I would like to compliment Congressman Tenzer for his action in highlighting the need to protect our wetlands. His original legislation, introduced in the fall of 1965, pointed out the direction we must take.

I urge the Committee to consider S. 3528 favorably, and to report it to the Senate for action.

STATEMENT OF HON. JOSEPH D. TYDINGS, U.S. SENATOR FROM THE STATE OF MARYLAND

It is a pleasure to express my support for H.R. 11475, introduced by a fellow member of the Maryland delegation and my friend, Congressman Edward A. Garmatz, the distinguished Chairman of the House Committee on Merchant Marine and Fisheries.

H.R. 11475 would authorize the appropriation of $10 million to finance a joint federal-state research program to develop ways for controlling or eliminating that marine animal called the jellyfish or sea nettle.

This problem is a truly national one. All waters surrounding the United States support some form of jellyfish. I believe this is sufficient justification for a federal program to deal with the problem.

I have a keen interest in seeing action on this problem, and I urge the Federal Government to develop programs for bringing the sea nettle under control.

The Chesapeake Bay, most of which lies within the borders of the State of Maryland, has a burgeoning sea nettle population. The negative economic effects of this growth in the number of sea nettles have become worse in recent years, and public concern is mounting. H.R. 11475 will place the Federal Government squarely behind much needed research to determine appropriate methods for controlling the sea nettle without disturbing the natural ecological balance of our coastal waters.

The Chesapeake Bay is one of Maryland's major natural resources. Exports and imports shipped through the Port of Baltimore rank third in tonnage in the nation. The Bay supports a seafood industry which does a business of approximately $13 million a year.

It is possible that the jellyfish may perform a useful service by preying on the sea walnut, known to consume commercially valuable oyster larvae. Therefore, as Mr. David Cargo of the Chesapeake Biological Laboratory pointed out:

All these biological relationships must be fully studied and all the likely economic effects studied before we jump to conclusions and start killing off all the sea nettles.

Nonetheless, one of the most important uses of the Chesapeake Bay to the people of my State, and to visitors from neighboring States, is for recreation. Thousands of Americans visit the Bay to swim, to sail, and to fish. The beaches lining the Bay are the closest available to most of the people of Maryland. These people are annoyed and discouraged, to put it mildly, by having to run the risk of being stung by jellyfish every time they enter the water.

The entire impact on the recreation business in my State is graphically described by a Chesapeake Bay beach operator in an article in the January-February, 1966, issue of the *Maryland Conservationist:*

"The resources business on the Bay rises and falls with the sea nettle population, business drops off about 30 percent if the jellyfish show up in midsummer and we would lose more than 50 percent if we didn't have nets. We carefully dip all the nettles out of the water every morning, but you can never get all the bits and pieces. Just let one or two children get a bad sting and come crying up the beach and everybody begins to pack up and go home.

"Our profit depends on having a crowd that will stay around spending money all day. When they leave early, we lose. Not just us, but the people back down the road, the gas stations, the motels and restaurants, the people who rent cottages, the grocers, the whole community. People today aren't looking for just a few hours' recreation. They have time and money enough to go elsewhere if the facilities aren't good enough, and they do."

The sea nettles hinder the fishing industry, too. Mr. Joseph Manning of the Maryland State Department of Chesapeake Bay Affairs has said that because the sea nettles clog the fishermen's nets and fill them up, "the use of nets and seines for catching fish is generally impracticable during the summer months." He also said that it is entirely possible that the sea nettle has an adverse effect on oyster production in the Bay.

Beach owners and others have tried all types of mechanical and physical restraints to protect certain areas of the water from the sea nettle, but none of them has proven adequate. Again to quote from the January-February issue of the *Maryland Conservationist,* one resort operator estimated that:

"He has about $30,000 invested in piling and nets to keep his beach only sixty percent free of sea nettles. He spends another $10,000 a year to install and repair the nets to keep the area dipped free of jellyfish."

Furthermore, sea lettuce tends to encrust the nets, making the enclosed water stagnant.

Thus, it is obvious that we urgently need to discover alternative ways of coping with the sea nettle. This knowledge can only be derived from a full-fledged program of research. Although significant research is now in progress, we need to learn much more before action can be taken.

Areas which demand further study are:

—the relationship of the jellyfish to its environment, and its reproductive and feeding habits. It is possible that the sea nettle feeds on other organisms which may be even more harmful to commercially valuable species.

—the environment in which the sea nettle lives, in order to discover factors which might be manipulated to discourage their growth.

—the life cycle of the sea nettle, for during certain phases of this cycle it may be easier to control.

We need to develop a poison which could kill the sea nettle if this proves necessary, yet would not harm other aquatic life and humans.

Existing funds will not permit research on a scale large enough to provide us with answers to these questions. Thus, I strongly support passage of H.R. 11475.

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
September 27, 1966.

Hon. E. L. BARTLETT,
Senate Office Building,
Washington, D.C.

DEAR SENATOR BARTLETT: I regret that because of my commitments on the Senate Appropriations Committee I will be unable to attend the hearing of the Merchant Marine and Fisheries Subcommittee of the Senate Commerce Committee on S. 3744, the bill introduced by Senator Daniel B. Brewster to provide for the control or elimination of jellyfish and other such pests in the coastal waters of the United States.

As a Senator from a coastal state I support this proposed legislation which would authorize the Secretary of the Interior to conduct studies and research to determine effective means of eliminating jellyfish and other such pests along our coast. However, in Rhode Island we are also bothered perennially by the presence of seaweed which detracts from the beauty of our beaches and affects our tourist trade.

I would hope that the provisions of S. 3744 could be broadened to authorize the Secretary to study an effective means of eliminating the seaweed nuisance as well.

With best wishes, I am,
Sincerely yours,

JOHN O. PASTORE,
U.S. Senator.

SPORT FISHING INSTITUTE,
Washington, D.C., September 27, 1966.

Re S. 3528.

Hon. WARREN G. MAGNUSON,
Chairman,
Committee on Commerce,
Senate Office Building,
Washington, D.C.

DEAR SENATOR MAGNUSON: Congressman John Dingell, Chairman of the House Subcommittee on Fisheries and Wildlife Consrvation has authored a long-needed, meritorious bill, H. R. 13447 "to authorize the Secretary of the Interior in cooperation with the states to preserve, protect, develop, restore, and make accessible estuarine areas of the Nation which are valuable for sport and commercial fishing, wildlife conservation, recreation, and scenic beauty, and for other purposes." This course is now furthered by Senator Kennedy of Massachusetts, with his introduction of S. 3528.

The Sport Fishing Institute—the nation's only non-profit, non-government, professionally staffed fish conservation organization—would like to go on record in support of Senator Kennedy's bill. We fully recognize that estuaries are one

of our most vital natural resources, where much of our ocean aquatic life originates. It is here, where the sea touches land, that the nutrients and spawning habitats for much of our fishery resources is greatest. Estuaries provide ingress to the aquatic highways through which our anadromous fishes must pass to ascend freshwater rivers and streams in order to reach ancestral spawning grounds.

The gradual, often acute degradation of estuaries, as a result of man's alteration of the physical terrain and his continual utilization of our rivers and streams for his pollution dump, has already caused the loss of much of this aquatic habitat for maintenance of these valuable natural resources. His inventive genius has provided sanitary engineers with complex problems of waste treatment to rid effluents of highly toxic chemicals and heavy metals. In many cases much of this waste is still an environmental hazard by the time it reaches our coastal littoral zones.

MSX, a now identified bacterial disease of many of the Chesapeake Bay shellfish, is on the verge of completely destroying an immensely valuable shell fishery. Moreover, the ability of molluscs such as oysters to concentrate pesticides in their tissues up to levels of some 10,000 times that of their aquatic environment has made them potential killers of man. Much untreated sewage from habitations, from Naval and other large ships, and from unregulated pleasure craft and marinas is continually adding deoxidizing elements to our coastal waters. The process of decomposition robs them of their supplies of dissolved oxygen that sustains those animals living therein while aggravating the threat of chronic diseases due to bacterial contamination.

Unless we wake up fast to the idea that a system of estuarine areas long our American coasts must be preserved and managed in a life-supporting state, we cannot hope to maintain our contiguous oceans filled with marine organisms. The latter are required to provide needed outdoor recreation to U. S. citizens as well as to provide them with food and to furnish profit to the greater recreational fishing and industry alike.

In order to intelligently carry out a program to the benefit of our estuarine land and water conservation programs (including wise development), we must embark on a nationwide study to identify such areas requiring the support of the actions proposed in S. 3528. The state and federal conservation agencies should work cooperatively in designing a plan which would encompass such estuarine areas on a regional basis with recommendations for the preservation, protection, development, restoration, and accessibility of such valuable "sport and commercial fishing, wildlife conservation, recreation, and scenic beauty . . ." areas. Then and only then can a national course of action be formulated.

We would strongly support the Department of the Interior's recommended amendments so that there is established by this legislative action a nationwide system of estuarine areas that would be composed of federally acquired areas and areas designated by the states. This would follow similar former approaches such as those for our national recreational areas, national seashores, wild rivers national trails, and wilderness areas.

I invite your attention to the attached pamphlet published by the Sport Fishing Institute entitled "The Fishes—A Neglected Aspect of Estuarine Research." This was prepared by our Research Director, Mr. William H. Massmann, and adds further insight into the considerable importance of the coastal waters of our great country.

In sum, then, Sport Fishing Institute strongly supports Senator Kennedy's bill, S. 3528, and urges the inclusion of the strengthening amendments suggested by the Department of the Interior.

We would appreciate having this letter included in the written record of formal hearings on this measure by your Committee. Thank you.

Sincerely,

PHILIP A. DOUGLAS,
Executive Secretary.

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., September 28, 1966.

Hon. E. L. BARTLETT,
Chairman, Subcommittee on Merchant Marine and Fisheries,
Senate Commerce Committee,
Senate Office Building,
Washington, D.C.

MY DEAR SENATOR: I understand that the Subcommittee on Merchant Marine and Fisheries, of which you are Chairman, is this morning considering the bill, S. 3528.

I have long been concerned with effective legislation which would provide for the protection, conservation, and development of the coastal wetlands of Hempstead-South Oyster Bay on Long Island, New York. For this reason, I joined in sponsoring a bill for this purpose in the House. The original proposals have been revised since the hearings held in June of this year before the House Subcommittee on Fish and Wildlife Conservation.

As amended, H.R. 13447, now pending House floor action, represents a comprehensive approach to this whole field. Through the cooperation of all government authorities concerned, natural wetland areas can be effectively preserved.

I strongly urge that the Subcommittee not only approve S. 3528, but more important, adopt the perfecting amendments contained in H.R. 13447.

Sincerely yours,

SEYMOUR HALPERN,
Member of Congress.

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., September 27, 1966.

Hon. E. L. BARTLETT,
Chairman, Commerce Committee,
U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: As one of the original sponsors of legislation to preserve the Long Island Wetlands, I am very much concerned with the legislation now before your distinguished committee, S. 3528, introduced by Senator Edward Kennedy.

I strongly support the purpose and legislative intent of S. 3528 and a similar bill, H.R. 13447, of Mr. Dingell, which has been reported favorably by the House Merchant Marine and Fisheries Committee. However, I think it important to note that the House version, which I am informed is scheduled for Floor action very soon, was amended to include key provisions affecting Long Island wetlands. I would urge this Committee to consider and adopt these amendments.

Sincerely,

RICHARD L. OTTINGER,
Member of Congress.

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., September 27, 1966.

Hon. E. L. BARTLETT,
Chairman, Subcommittee on Merchant Marine and Fisheries,
Senate Commerce Committee, Washington, D.C.

DEAR SENATOR BARTLETT: May I respectfully urge that your subcommittee consider favorably H.R. 13447, which contains amendments proposed by a number of Members of Congress including myself.

In my opinion, Congressman Dingell's bill as reported out of the House Committee on Merchant Marine and Fisheries could make a substantial contribution to the preservation of the priceless natural heritage of our great Nation.

Thank you for your consideration.

Sincerely,

LESTER L. WOLFF,
Member of Congress.

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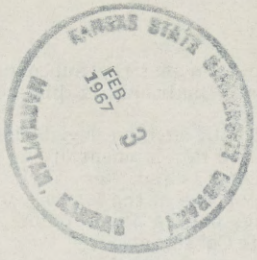
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