

THE TARPON IN THE PANAMA CANAL¹

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THE tarpon (*Tarpon atlanticus*) long has held a place of high esteem among anglers and is considered by many to be the world's gamest fish. Whether caught on a hook or surrounded by a net it wages a terrific fight for freedom. The sportsman, when properly equipped, generally delights in hooking the tarpon. The net fisherman, on the other hand, almost hates to find them in his net, for the large, powerful fish (the largest one reported to date being 8 feet, 2 inches long) too often "run" through the net, leaving large gaping holes. Furthermore, the fishermen sometimes are endangered by the large fish, for if they do not succeed in breaking through the net the fish generally leap high into the air, occasionally striking a fisherman in their efforts to free themselves. Commercially the tarpon has little or no value, as in most localities the fish is not marketable. In Panama the natives and particularly the West Indian immigrants, however, are very fond of tarpon, which is known to them as "sabilo real," *i.e.*, king shad. Some fishing is done on a commercial basis and tarpons frequently are seen in the Colon market.

Although the tarpon has been sought far and wide by anglers, and to some extent by naturalists, throughout its range, which extends from Cape Cod to Brazil and through the West Indies, much of its life history remains a mystery. It is not known to the present day where its spawning grounds are. Nor have the manner of spawning, the spawned eggs and the early larvae been discovered.²

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It had long been supposed that the tarpon, like some of its near relatives, passed through a leptocephalus stage similar to the eel. In this larval stage the fish is very strongly compressed, ribbon-shaped and almost transparent; certainly bearing no resemblance to the parents. A full grown leptocephalus, of those species that have been studied, is considerably longer, though not greater in bulk than the newly transformed young. For example, the leptocephalus of *Elops saurus*, known as the bonyfish in Panama, a relative of the tarpon, reaches a length of fully 60 mm, but during transformation it is reduced in length to about 20 mm. That the tarpon does pass through a leptocephalus stage was proven a few years ago, when the author of the present article described in *Copeia* (April, 1934) a young tarpon 20 mm long, which was in the transition stage.

This postlarval tarpon was taken in an estuary at Beaufort, N. C. It does not necessarily follow, however, that tarpons spawn in that vicinity. We need only to remember that both the American and European fresh-water eels spawn in the ocean between Bermuda and the West Indies, and that the European eel travels across the Atlantic in the leptocephalus stage and then transforms and enters fresh water, and the American eel similarly migrates to our shores before it transforms. Therefore, the postlarval tarpon taken at Beaufort may have been hatched far from the place of capture.

Young tarpons, of about 2 inches and

² For the most complete account of the tarpon published the reader is referred to a book entitled "The Tarpon," by Louis L. Babcock, 4th ed., 1936, privately published.

upward in length, have been found by investigators in shallow stagnant brackish water pools at various places, as on Sanibel Island (Fla.), Andros Island (Bahamas), Puerto Rico and Haiti. However, these young were all fully past the leptocephalus stage.

It has been known a long time that adult tarpons inhabit Lake Nicaragua, a body of fresh water a hundred feet above sea level. Recently I. W. Miller (*Field and Stream*, May, 1936) reported more or less regular fishing for tarpon in the Rio Frio, which empties into Lake Nicaragua. The Rio San Juan, which is the outlet of this lake, has falls, the height of which is unknown to the writer. The late Dr. Seth E. Meek (Publication Field Mus., Zool. Ser., VII, 1907), who investigated the fishes of the lake, stated "It is hardly probable that they (tarpon and some other marine forms) have come up over the falls at the head of the Rio San Juan in late years." Dr. Meek, therefore, assumed that the tarpons were landlocked. However, no young tarpons seem to have been found in the lake.

Concerning breeding it can be stated only that tarpons with large roe have been taken from time to time. Such fish have been captured by sportsmen and investigators in June at Boca Grande, Fla.; and in March, April and May at Sanibel Island, Fla. Though there has been some conjecture that these fish spawn in the general vicinity where taken, the fact is that no one knows definitely where the reproductive activities take place. Presumably in the latitude of southern Florida spawning takes place during the spring and possibly summer.

It is evident from the foregoing remarks that the life history of the tarpon was still largely unknown. Therefore, the writer was eager to add something to the known facts of its life history while making an investigation of the fishes of the Panama Canal during the early part of 1935. He was stimulated, further, in

devoting special attention to the tarpon by the claim of local residents that both adult and young tarpons were common in Gatun Lake, a strictly fresh body of water. The study was expected to shed some light, also, on the moot question of the use of the locks as a passageway by the tarpons and possibly other fishes. The time for the last mentioned study was particularly auspicious, as the Gatun Locks were dewatered for overhauling during the writer's visit.

THE INVESTIGATION

The investigation was conducted principally along the following lines: (a) Local anglers were interviewed concerning the occurrence of the tarpon in the waters of the Canal Zone, particularly in regard to their occurrence in Gatun and Miraflores Lakes. (b) A search, principally for larvae and small tarpons, was made in Gatun and Miraflores Lakes and their arms and inlets. (c) Specimens of tarpon were secured and examined for the state of development of the gonads while the Gatun Locks were being dewatered.

It was definitely asserted by several anglers that adult tarpons are year-round residents in the strictly fresh water of Gatun Lake. A few native fishermen, operating principally on the upper part of the lake, in the vicinity of the entrance of the Chagres River, where the fish appear to be most numerous, angle for the tarpon more or less on a commercial basis. Heavy tackle, like that employed for catching sharks, is used.

One fisherman who catches tarpons to sell has built a board walk to deep water at the upper end of Gatun Lake on one of the banks of what formerly was the Chagres River. At the end of the little pier he has rigged a large pole about 25 feet or so in length, which tapers from about 4 to 5 inches at the base to about 2 inches at the small end. The pole is set at an angle of about 40 degrees to the



Courtesy William Ackerman

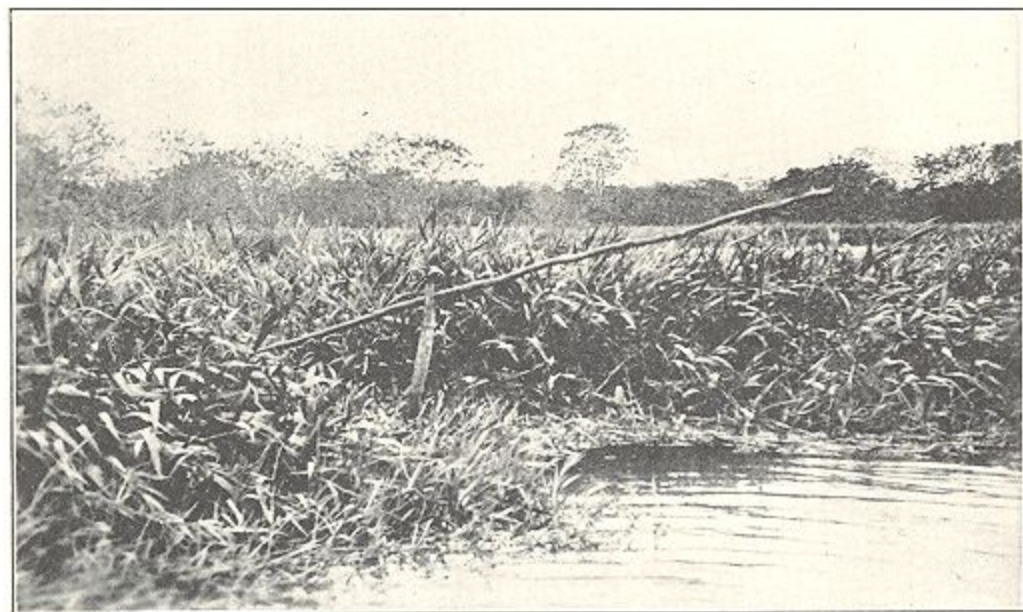
THE TARPON, *TARPON ATLANTICUS*

water and is supported near midlength by a post. The line with the baited hook is attached to the pole. When a large fish (tarpon) takes the hook the movement of the pole can be seen from a distance. By the use of this device the fisherman may stay in a cool shady place, conversing with friends, or possibly engage in other work, until the pole begins to sway.

The description of the native's method of fishing given in the foregoing paragraph is offered, aside from the interest in its uniqueness, to show that the tarpon

is sufficiently numerous in the upper part of Gatun Lake to induce a fisherman to go to some expense and trouble to equip himself for the fishery. Others presumably fish just as much as the man who has the boompole, but in a less pretentious way. Americans, of course, fish for sport only. So far as could be learned, tarpons are about equally numerous throughout the year and the sport or fishery is not limited to any particular season.

The writer did not angle for tarpons in Gatun Lake; nor did he see any taken



Courtesy Dr. Herbert C. Clark

BOOMPOLE USED BY NATIVE TARPON FISHERMAN
ON UPPER PART OF GATUN LAKE. A LINE WITH BAITED HOOK IS ATTACHED TO THE POLE.

by others during his visits. However, he did see several large fish "break water" and partly show themselves above the surface, which unmistakably were tarpons.

The more or less regular occurrence of the tarpon in Miraflores Lake (the small fresh to brackish body of water situated on the Pacific slope of the Canal Zone between the Pedro Miguel and Miraflores Locks) was reported by such reliable informants as Mr. R. A. Canthers, chief of the maintenance office at Pedro Miguel, and by Dr. Herbert C. Clark, director of the Gorgas Memorial Laboratory, who maintains a veterinarian station on the lake. The writer did not see this fish caught in the lake, though he saw a very large fish break water which quite certainly was a tarpon.

It was stated earlier in this article that the writer was informed by several natives of the presence of young tarpons in Gatun Lake. On one of the collecting trips one of the men who claimed that many young tarpons were present in the

lake was with the collecting party. We had not been working long when this man called excitedly that we had captured a young "sabilo real." However, this "sabilo real" proved to be an adult silverside, *Menidia chagresi*, about 3½ inches long. Later many more silversides were secured and preserved. These fish were shown to two other natives, who had stated that young tarpons were common in Gatun Lake, both immediately exclaimed "sabilo real." It was evident that the men had mistaken silversides for young tarpons. The search for young fish, however, was continued. Collections were made in many different sections of both Gatun and Miraflores Lakes and adjacent streams, but no young tarpons were found.

The investigator was present to examine the stranded fish during the dewatering of the east side of Gatun Locks, from February 20 to 24, 1935 (the other side having been drained in January, before his arrival in Panama). Several large tarpons (exact number un-

known) were stranded in the upper chamber, which of course was drained first. Only one specimen was secured for examination, the rest having been taken away by the Negro laborers before the writer could get to them. After this experience the superintendent of the locks forbade the men to remove a single fish until the investigator gave permission.

The middle chamber contained eight large tarpons, ranging in length from 3 feet, 3 inches, to 6 feet, 8 inches. The lowest chamber contained none.

It seems of interest to state here that the west side of the locks, dewatered in January, according to Mr. H. M. Thomas, assistant superintendent of the Gatun Locks, contained very few fish and no tarpons, in contrast with a comparatively large variety of species and great quantities of the "bonyfish" (*Elops saurus*) and the "jack" (*Caranx hippos*) found in the east side. Mr. Thomas stated that a similar ratio has existed each time the locks have been drained for overhauling, which is done at intervals of about three years. The writer knows no reason for the difference in the abundance of the fish in the opposite sides of the locks. The information is given here merely as a matter of interest.

Only the two smallest tarpons taken in the locks, respectively 3 feet 3 inches and 3 feet 7 inches long, were males, both being nearly ripe. Of the seven females one contained large roe, one small roe and the others were undeveloped.

Tarpons generally are numerous at the foot of the spillway, a high concrete structure built in the great Gatun dam. The dam itself is so large and broad that a golf course is maintained on it. The dam and spillway together hold the large body of water known as Gatun Lake, which forms a considerable portion of the canal. The water necessary for operating the locks is obtained from this lake. When there is a surplus it is used in gen-

erating electricity for operating the machinery connected with the locks, and when there is still a further surplus of water it spills over the spillway from the level of the full lake to the old bed of the Chagres River near sea level. The water from the turbines, too, enters the old bed of the Chagres River below the spillway. It is in this usually greatly disturbed water that tarpons collect. Here the water was fairly astir with tarpons and other brackish and marine fishes when the writer made observations in January and again in March, 1924. I did not find the opportunity to revisit this particular spot in 1935, but was informed that the situation remained unchanged. At the time of my visits the anglers present (Americans) stated they did not care to catch tarpons there, as the fish were so numerous and so easily caught it was not considered sport. The fish seen and taken were rather small, all under three feet. It is understood, however, that large ones do frequent this place.

The late Dr. Seth E. Meek and the writer, while collecting cold-blooded vertebrates in Panama in connection with the Smithsonian biological survey of the Canal Zone in 1911 and 1912, found small tarpons, ranging in length from 12 to about 24 inches, rather common in the brackish water in the vicinity of Mindi and New Gatun, that is, along the sea level end of the canal. Also, one large one, 5 feet or so in length, delivered itself into the collectors' skiff in that vicinity by leaping high in the air, "landing" first on Dr. Meek's back (hurting him somewhat and frightening him badly) and then falling into the boat. Its head slipped under a thwart, giving the writer a chance to administer a stunning blow with an oar. No tarpons were seen in strictly fresh water at that time, that is, before Gatun Lake had been formed. The area now included in the basin of the lake was thoroughly sampled in 1911 and 1912, and it is believed that if tar-

pons had been present they would have been found.

DISCUSSIONS

It is very evident from the foregoing remarks that tarpons are fairly common in Gatun Lake and that they also occur in Miraflores Lake. It does not follow, however, that tarpons spend their entire lives in these fresh-water lakes, for if the complete life cycle were carried out there the larvae (*leptocephali*) and small tarpons should be present. It has been shown in the preceding pages that during a fairly thorough search no larvae and no small tarpons were seen in the lakes.

Tarpons could reach Miraflores Lake only by passing through Culebra Cut and Pedro Miguel Locks, for the Pacific Ocean is not the home of the tarpon, as already stated. Since tarpons have reached Miraflores Lake by passing through the Pedro Miguel Locks, the writer knows of no reason why they can not go on to Panama Bay and the Pacific Ocean through the Miraflores Locks. However, to date the tarpon has not been reported from the Pacific.

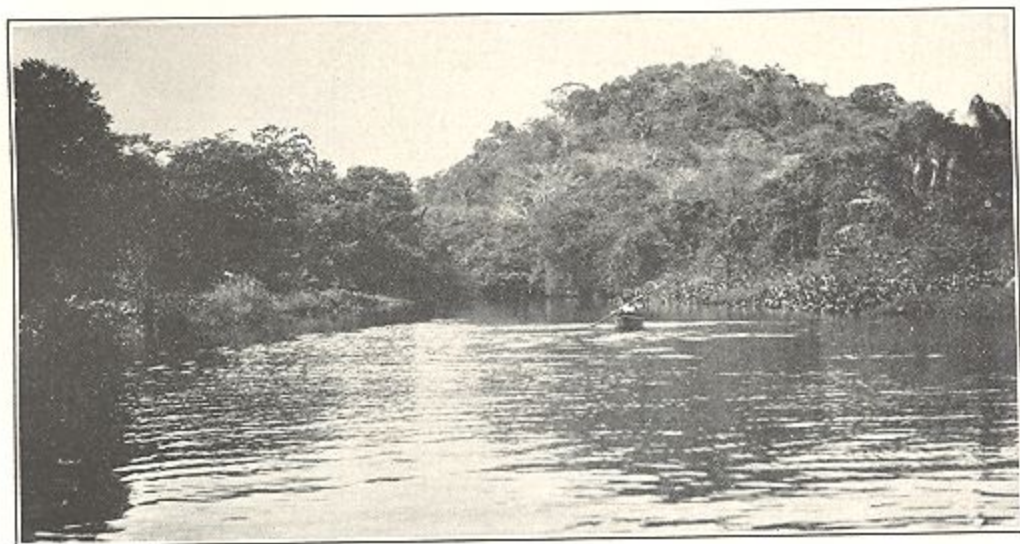
Since it is definitely known that tarpons have passed through the Pedro Miguel Locks, it may be assumed with certainty that they also pass through the Gatun Locks. If the fish did not reach Gatun Lake by that route it would have to be assumed that they were present when Gatun Dam was closed in 1913, and that the fish now in the lake either were there in 1913 or have reproduced in the lake.

There is no evidence that tarpons were present in the vicinity, which now is the lake basin, before the dam was closed, as already stated. Furthermore, fish present as early as 1913 would be very old now, much older than the age usually attained by fish. Then, too, the fish would be expected, unless there was reproduction, to become scarcer from year to year. According to information ob-

tained the fish, however, are increasing rather than decreasing in abundance. It seems highly improbable that reproduction is taking place within the lake, since the evidence obtained during the recent investigation, as already shown, is entirely negative.

It has been stated in the preceding pages that several tarpons were present in the Gatun Locks when they were dewatered in February, 1935. According to Mr. H. M. Thomas, assistant superintendent of the Gatun Locks (who has supervised the periodical draining of the locks from the beginning) some tarpons were stranded each time the locks have been dewatered. It is the opinion of the writer that the tarpons that are stranded, when the locks are drained, are not necessarily actually in transit either to or from the lake. It is believed, rather, that the locks are used by the tarpons (and several other fishes) as feeding grounds, for small fish and crustaceans were quite numerous during the recent inspection, and it seems probable that a new supply of food is brought down from the lake or enters from the sea level end of the canal when the locks are operated. The locks apparently are used, therefore, as feeding grounds, somewhat like the base of the spillway where large numbers of tarpons (and other species) collect, as already stated. However, the fish appear to stray away from the feeding grounds within the locks from time to time, some no doubt returning to the sea, whereas others pass on into Gatun Lake, and a few of these eventually go on across that lake, through Culebra Cut, the Pedro Miguel Locks and on into Miraflores Lake.

If the fish can pass through the locks to Gatun Lake they surely can return by the same route. The fish, indeed, had to pass "down" and through the Pedro Miguel Locks in order to reach Miraflores Lake. Therefore, they certainly can, and no doubt do, go "down" the Gatun Locks



THE MOUTH OF THE RIO COCOLI, MIRAFLORES LAKE
WHERE TARPONS ARE OCCASIONALLY SEEN.

and out to sea at will, or as the necessities of life or reproduction require it.

The foregoing remarks seem to require an explanation, for the benefit of the reader who may not be familiar with the construction and operation of the locks of the Panama Canal, of how the fish manage to pass through the apparent obstruction.

A brief description of the passage of a vessel through Gatun Locks will illustrate also how a fish—a tarpon, for example—may find its way through the locks of the Panama Canal. In the first place Gatun Lake when full is about 85 feet above mean sea level. Therefore, a vessel passing from the Atlantic Ocean to Gatun Lake must be lifted from sea level to the level of the lake. This is done with a series of three equal lifts in close succession. The boat enters the lowest chamber of the locks at sea level. Heavy iron gates are closed behind it. Water is let in from Gatun Lake until the water level of this chamber reaches that of the second or middle one. Then the gates in advance of the vessel swing open and the boat enters the middle chamber. Now

the seaward gates of this chamber are closed behind the vessel, and as before water is let in from Gatun Lake until the water level of the middle chamber equals that of the upper one. When that level is reached the gates at the bow of the vessel are opened and the boat passes on to the third or upper chamber of the locks. After the gates between the second and third chambers have been closed the water in the upper one is raised to the level of Gatun Lake. The vessel is now ready to sail out into Gatun Lake. To lower a vessel from Gatun Lake to the sea the process, of course, simply is reversed.

The locks on the Pacific side are operated in the same way. There is only the difference that the three flights are not all together. One flight is located at Pedro Miguel and two are at Miraflores on the other side of Miraflores Lake about four miles away.

A fish certainly could follow a vessel through the locks in either direction, providing of course that it could endure the rather sudden change from salt to fresh water or *vice versa*. However, the fish

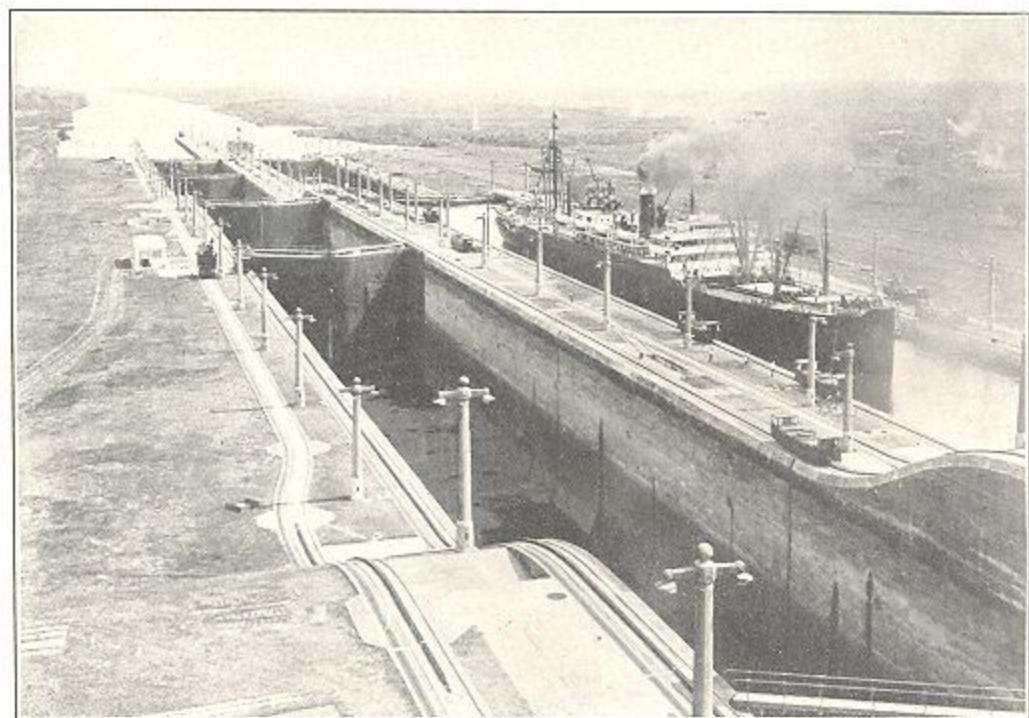
does not have to pass through the entire series with any one vessel, as each chamber contains ample water at all times for the welfare of the fish. Therefore, it may stop in any one chamber for an indefinite period of time, providing sufficient food is present. Should food become scarce, or the *wanderlust* get strong, or the urge to spawn come, the fish may follow a vessel to a higher or lower level. Or it even may go from one chamber to the next (one at a time) in the direction opposite to the course of the vessel, as there is nothing to prevent it from swimming from one chamber into the next one while the gates are open.

It is evident from the foregoing discussion that the chief barrier to fish formed by the locks is the change from salt to fresh water and *vice versa*. A fish that can endure such changes in

density should have no difficulty in passing through the locks. The tarpon evidently can accommodate itself to such differences in salinity, and the evidence at hand, as already indicated, shows quite conclusively that this fish does use the Gatun Locks (and the Miraflores Locks to some extent) as a passageway and probably as a feeding ground.³

It has been stated that three ripe or nearly ripe tarpons (two males and one

³ Since this manuscript was prepared the writer has examined the air bladders of several tarpons and found that they contain a comparatively large amount of lung tissue showing that the fish are not entirely dependent upon their gills for oxygen, which may be the reason why they can change from salt to fresh water and *vice versa*. A full account, with a figure of the structure of the air bladder of the tarpon, is included in Mr. Louis Babeock's book "The Tarpon" (Fourth Edition), 1936, pages 48 to 50.



Courtesy Panama Canal

GATUN LOCKS, SHOWING SEA-LEVEL END OF CANAL

IN BACKGROUND. ONE SIDE OF LOCKS IS EMPTY; A SHIP IS IN TRANSIT "UP" THE LOCKS (MIDDLE CHAMBER) IN THE OTHER SIDE.

female) were present among nine specimens examined in the dewatered locks at Gatun. No evidence whatsoever indicating that the tarpon spawns in the fresh waters of the Panama Canal was secured. It seems probable, therefore, that the ripe fish seen in the locks were enroute to their spawning grounds somewhere in the sea.

It was stated in the introductory remarks to this paper that the spawning grounds of the tarpon have not been found. Neither has the recent investigation helped greatly to discover the secret. It can only be stated here, as already shown, that the results of the investigation indicate that the tarpon does not spawn in the fresh waters of the Panama Canal.

Several investigators have taken young tarpons, all past the larval stage, in shallow salt and brackish water lagoons, as pointed out in the introductory remarks. It does not follow, however, that such places are spawning grounds. In fact, it is highly improbable that large fish, like the tarpon, would go to such places to spawn. Furthermore, the leptocephali undoubtedly would have been taken before now if they occurred in such places or in inshore waters. The writer ventures the opinion that tarpons very probably spawn quite a distance off shore and in deep water.

The young, as already stated, pass through a leptocephalus stage like the eels. It seems entirely possible that tarpon larvae, like fresh-water eel larvae, travel long distances. The larvae of the European eel are known to cross the Atlantic Ocean from deep water, lying between Bermuda and the West Indies, and those of the American eel migrate from the same general vicinity to the American shores. The young eels do not attain the adult form until they reach the mouths of the rivers they ascend, at the age of about one year for the American and about three years for the Euro-

pean eel. It does not seem unlikely therefore that tarpons, too, spawn considerable distances off shore and that the young make long migrations. The single specimen in transition from the leptocephalus to the adult stage, described by the present writer (see reference in the introduction), taken in an estuary at Beaufort, N. C., may have been enroute to a quiet, shallow lagoon or swamp, for such places appear to be frequented by small tarpons. In the light of the evidence offered the writer would search for the leptocephali of the tarpon in offshore waters.

It has been stated on a preceding page that it has been supposed tarpons spawn in the spring and summer on the west coast of Florida. Investigators arrived at this conclusion because fish with large roe have been taken there during that time. By the same criterion, it may be deducted that spawning probably takes place off the coast of Panama during the winter and spring, the entire period during which fish with large roe occur there having not been determined.

SUMMARY

Some important published information concerning the life history of the tarpon is reviewed. It is evident from this information that much of the life history of the tarpon remains unknown.

The occurrence of the tarpon in the waters of the Panama Canal is discussed, the discussion being based largely on investigations and observations made in 1911, 1912, 1924, and especially in 1935. It is shown that tarpons were present and apparently rather common, in the brackish to fresh water swamps and canals in the vicinity of Mindi and New Gatun in 1911 and 1912, before the canal was completed. It is stated, also, that no tarpons were found at that time in swamps and streams now included in the basin of Gatun Lake. In 1924 tarpons were numerous at the base of the spill-

way of Gatun Lake, a situation which apparently remained unchanged in 1935. Adult tarpons were common in some parts of Gatun Lake in 1935, and they also had reached Miraflores Lake, from whence they apparently may descend to Panama Bay, though no evidence has been secured that this has taken place. Young tarpons were mistakenly reported by native fishermen from Gatun Lake. No evidence was secured that they occur there.

Several large tarpons were stranded when the Gatun Locks were drained for overhauling in 1935. According to information offered by canal employes tarpons have been stranded there at each previous dewatering.

It seems probable that the Gatun Locks are used more or less regularly as a passageway, and probably to some extent as a feeding ground, by tarpons. Fish should not find it difficult to pass through the Panama Canal Locks in either direction, providing they can endure the change from salt to fresh water or *vice versa*. The tarpon evidently can endure the change. An explanation of how the fish may go through the locks is offered.

Three of the nine large tarpons examined when stranded during the drain-

age of Gatun Locks in February, 1935, contained large roe, indicating that at least some of the fish in the latitude of Panama spawn during that month.

The spawning grounds of the tarpon remain unknown. The author expresses the opinion, supported by some evidence, that they probably lie in deep water some distance off shore.

Tarpons pass through a leptocephalus stage, but the leptocephali have not been found. A specimen in transition from the leptocephalus to the adult stage, however, has been described.

ACKNOWLEDGMENTS

The writer wishes to express his sincere gratitude to Dr. Herbert C. Clark, director of the Gorgas Memorial Laboratory; to Major W. E. R. Covell, in charge of maintenance of the Panama Canal; to Mr. H. M. Thomas, assistant superintendent of the Gatun Locks; to W. H. W. Komp, of the U. S. Public Health Service; and to Mr. R. A. Cauthers, in charge of maintenance at Pedro Miguel, for assistance given in various ways. Without the cooperation of these gentlemen the investigation could not have been made. Special thanks are due Dr. E. W. Gudger for reading the manuscript and making valuable suggestions.