

tains little that is characteristic, and the typical example seems to be lost. We have, however, no doubt that it was based on a young individual of the large skate called by us, on page 252 and elsewhere in these Proceedings (Vol. III), *Raia cooperi*. The presence of the single spine on the median line of the back anteriorly, as described by Girard, is one of the most constant diagnostic characters of the young of this species, and we have never found less than three or four such species in the corresponding position in the species called by us hitherto *Raia binoculata*.

The *Raia cooperi* of Girard is based on a drawing by Dr. Cooper, and the great size is the only diagnostic character assigned to it. As three of the species reach a length of but 30 inches and the other a length of 6 feet, we have no difficulty in making an identification with the species described by us as *Raia cooperi* on page 252. *Raia binoculata* of Girard is thus probably the young of *Raia cooperi* of Girard. The large skate should therefore be called *Raia binoculata*, while the species described by us on page 134 of the Proceedings as *Raia binoculata* may receive the new name of *Raia inornata*.

Specimens of this species obtained at Santa Barbara represent a marked variety, distinguished by the small number and feebleness of the spines and prickles, and in the presence (in the females) of a band of small prickles on the posterior part of the pectorals, parallel with the edge. Suprocular spines almost obsolete. Two or three minute prickles often present on the median line at the shoulders. A series of minute stellate prickles beginning near the middle of the back, becoming hooked spines on the tail. Lateral caudal spines scarcely developed, even in the female. A band of small prickles on the posterior part of the back. Males almost smooth. Size and color as in *R. inornata*. This form may be known as var. *incermis*.

UNITED STATES NATIONAL MUSEUM, January 13, 1881.

ON THE FISH-MORTALITY IN THE GULF OF MEXICO.

By ERNEST INGERSOLL.

SIR: Pursuant to your verbal suggestion, I made it an object, during my recent cruise down the western coast of Florida in the service of the Superintendent of the Census, to inquire into the so called "poisoned water" which was supposed to have caused the remarkable mortality among the sea-fishes that occurred in the autumn of 1880. I am sorry to be able to give so meagre an account of the matter as follows; but must beg excuses on the plea that I was too late to see any actual destruction, since the cause had wholly disappeared previous to my arrival there, and also from the fact that I was unable to carry out my intention of going to Key West, where most of the fishermen live who suffered injury, and who could perhaps have furnished additional information.

It appears that this misfortune is not a new experience in the eastern part of the Gulf of Mexico. One of the oldest residents on the Floridan coast, Mr. Benjamin Curry, of Manatee, told me, what others confirmed, that as far back as 1844 a wide-spread destruction of all sorts of salt-water animal life occurred, apparently due to causes precisely similar to those which produced the lately noticed desolation. Again, in 1854 the fishes suffered all along the southern shore, and have done so at intervals since to a less degree, until in 1878 an excessive fatality spread among them, which was wider in the extent of its damaging effects and probably more destructive in point of number of victims than the later visitation of 1880. Even the cooler half of 1879 was not exempt from some appearance of the plague.

In regard to some of the manifestations of this deadly influence in the sea during 1878, Mr. John Brady, jr., an intelligent captain, told me that the time of year was January, and that the "poisoned water", to which universal belief credits the death of the fishes, could easily be distinguished from the clear blue of the pure surrounding element. This discolored water appeared in long patches or "streaks", sometimes 100 yards wide, drifting lengthways with the flow of the tide. The earliest indication of it was the floating up of vast quantities of dead sponges—chiefly "loggerheads". All those seen by Mr. Brady were less than 40 miles north of Key West, in what is known as "The Bay", nor has anything of the sort been seen at any time outside (*i. e.*, southward or eastward) of the Florida Reefs; but it was soon discovered that all the hitherto profitable sponging grounds lying off the coast as far north nearly as Cedar Keys, and particularly off the Anelotes, had been ruined. These grounds are only now beginning to show signs of reproductiveness in sponges. At the same time, many portions of this area—for example, Sarasota Bay—seem not to have been affected, sufficiently at least to cause the death of swimming fishes to any great extent. In the case of the sponges, only a few of other species than the loggerhead would be seen floating; but when they were hooked into, all were found dead, though still clinging to the bottom. When a sponge dies naturally it gradually becomes white at its base, through the loss of its sarcodal matter, but all these were observed to have turned black. The abandonment of these sponging grounds from the Reefs to Cedar Keys, during the three or four years following this attack, entails a loss which it is hard to estimate, because partially compensated in the increased price of the article in the market due to its consequent scarcity, and because at all times the product there is an uncertain quantity; but I hazard the opinion that \$100,000 would not repair the damage to this business interest alone. Had it not been for the fortunate discovery just at that time of the sponge-tracts off Rock Island, northward of the Suwanee River, almost a famine in this article would have ensued.

Concerning the attack of 1880 I am able to say more. It began suddenly, and immediately followed the terrible hurricane which is known

as the "August gale", the fish and all other ocean life suddenly dying in hordes all along the southern (eastern) shore of Tampa Bay, on Egmont Key, at its mouth, which was the most northern point, and thence southward as far as Shark River, in Whitewater Bay, on the coast. Thence fatal localities were to be found in the currents that set southward through Bahia Honda Passage, through the Northwest Passage beyond Key West, and even out in the neighborhood of the far-isolated Tortugas.

Everywhere throughout this whole extent of coast, except in the mouths of the rivers and in the shallow bayous, all the forms of sea-life died as though stricken with a plague fatal alike to all, and were drifted upon the beaches in long windrows so dense that near human habitations men were obliged to unite in burying them to prevent a pestilential stench, or to haul them away by wagon-loads to be prepared for manure, as was done in some cases. Not only were swimming fishes destroyed, but sponges, crabs (I saw upon the beaches thousands of horseshoe-crabs laden with their chains of undischarged eggs), and great numbers of mollusks. The oysters at the mouth of Manatee River and in Tampa were spoiled (in imagination if not in fact!), and the excellent clams of Sarasota Bay became weak, tasteless, and of a repulsive green hue at their edges. A graphic account has been given me in a letter received from Mr. Charles Moore, jr., keeper of the light-house on Egmont Key, at the entrance of Tampa Bay, the original of which I transmit herewith. This point witnessed the height of the calamity, and as Mr. Moore was present during the whole season, his account of facts is valuable. Mr. Moore writes:

EGMONT KEY, FLA., *February 20, 1881.*

SIR: As I promised to give you all the information about the fish dying at this station, I will do so to the best of my ability. The first dead fish we saw was on Sunday, October 17, as the tide came in. There were thousands of small fish floating on the water, most of them quite dead. I saw only one kind the first day; they were small fish, four or five inches long; the Key West smackmen called them "brim". They were a new fish to me. The next day other kinds were dying all along the shore; the pompano was about the next to give in, and by the 25th October nearly all kinds of fish that inhabit these waters were dying, except the ray family. I don't remember of ever seeing any stinger or whipper ray, or the devil-fish, as we call the largest ones of the ray family. From the 25th of October to the 10th of November was the worst time; during that time the stench was so bad that it was impossible to go on the beach. I sent my family to Manatee, and the assistant keeper and myself shut ourselves up in our rooms and kept burning tar, coffee, sulphur, rags, etc., night and day in order to stand it. It was warm, damp, and calm weather. They continued to die for about six weeks; they kept getting less every day. I counted seventy sharks

within 80 yards, all small; I never saw a shark over four feet long dead. The cow-fish and eels were about the last to die. In regard to the cause of their dying, I have made up my mind it was caused by the fresh water, as there was immense quantities of fresh water coming down the bay, and the water here was nearly fresh on the surface, while the water underneath was perfectly salt. Now, if the fresh water could have passed off into the Gulf without being disturbed by winds, and it would have naturally spread out thinner and thinner as it would have rolled on towards the Gulf Stream, and once it got there, then there would have been no trouble. But on the 7th of October we had a heavy gale from the southwest, and it continued to blow from the south and west until the 11th of October, and a very heavy sea running at the mouth of the bay, and it *churned* the fresh and salt water all up together, and the strong southerly winds set this mixed water back and kept it here for several days. I noticed, a few days before the fish commenced to die, a peculiar smell on the water, something like the smell of bilgewater, and the color of the water was a dirty green, mixed with small sediment. I noticed the fish while they were dying, when they first come in shoal water; they would act crazy, dart around in every direction, but in a short time would give up and float ashore. On examining them I found their gills all glued together with a slimy substance and of a whitish color,* and in a short time the gills would turn green and the fish bloat very large. I cannot make any correct statement as to the number that died, but thousands of barrels floated up on this island. There are no fish dying now; all we catch are fat and nice. I should have written to you before, but I have been very busy. I've had a new duty to perform, taking the tide every half hour. Any information I can give you at any time I will be happy to do so.

My address is: Braidentown, Manatee County, Florida.

Very respectfully,

CHARLES MOORE, JR.,
Keeper of Egmont Light-House.

ERNEST INGERSOLL,
U. S. Fish Commission,
Washington, D. C.

Along this region of the Florida coast are several establishments or "factories" devoted to the catching and salting of fish, chiefly the mullet and its roe, and to the making of superphosphates. All of these were obliged to suspend operations, and their winter's work has been ruined, or at least all the profits are gone. One gentleman told me of a single definite loss he had thus suffered of \$800.

To this part of the coast, also, comes a large fleet of smacks and "smackees" every winter to catch fish for the Key West and Havana

*I failed to find any other instance in which this thickening or begumming of the gills had been observed. The dead fish were elsewhere reported as healthy in appearance, and in one case, at least, were eaten without harm, or even indigestion occurring.—E. I.

markets, principally the latter. These smacks found that, as before, the brownish, discolored water, "thick and glutinous" (as one described it), which seemed the cause of the mischief, lay in streaks drifting with the tide. The small fishes that swam into one of these patches (which had a vertical thickness apparently coextensive with the depth of the sea at that place) seemed unable to get out before they were stupefied, and died as though by suffocation. Even the large carnivorous swimmers, like the sharks and porpoises, often suffered the same fate, though frequently they would have strength to turn back and flounder out. In the pure element, between the deadly streaks, fish were as abundant as ever at the distance from the coast where the smacks operated, and their wells were often filled with promptness; but it was found that it was impossible, even by going straight out to the Tortugas, to run the gauntlet of the poisoned water floating between there and Cape Sable, since if once it was encountered, and entered the well, a very few minutes sufficed to bring about the death of every fin of the cargo. I have a few notes, culled from the Key West journals, which show that a loss of nearly \$10,000 resulted from only four or five such misfortunes. The consequence was that for some weeks the fishing throughout all that part of the Gulf had to be wholly abandoned, involving the idleness of a large number of vessels and their crews.

Seeking an explanation of the phenomenon, I everywhere asked what was the local theory to account for the matter, and was almost always told with confidence that it was due to an overflow of swamps and the pouring into the Gulf of bodies of fresh water poisoned by a decoction of noxious "acids", etc., leeches from the roots which had been soaking for years in the pent-up floods—a theory which I fail to find supported by such facts as I have been able to learn.

Those who *do* put faith in the sufficiency of this explanation, point out that the winter of 1877-'78 was unusually wet, and that this last fall saw more rain falling in South Florida than ever before in the recollection of the people there. This is probably true; and it may be, as asserted, that the years heretofore when fish have died have been those noted for their excessive rainfall, but I have not compared meteorological records. It is no doubt true also that if a sea-fish should be plunged into water saturated with the tannin derived from decomposing roots and stems of palmetto, oak, sumach, etc., which do abound in the Everglades, he would find it eminently unhealthy. But further than this the hypothesis will not hold. It requires us to believe that the overflow of a small surface of swamp-land shall so tincture the wide area of the Gulf as to destroy its healthfulness through several weeks, while the tides are ceaselessly swinging back and forth, and rapid currents continuously replace the water of every part with new and send the old elsewhere. This is preposterous. Moreover, provided it was true of the Manatee River (as is claimed), or of the Caloosahatchie farther south, why should it not equally be true of the Atlantic coast,

where there is the same or greater drainage, yet no such trouble known; or of the Withlacoochee, Suwanee, and a dozen other streams draining swamps like the Ofeekinofee, in whose tangled recesses grow plants as noxious as those farther south, yet whose discharging currents do no harm to the fishes? Moreover, in the Manatee River itself no fish were killed above the free range of the tides, though daily breasting the swamp overflow.

Some, discarding any theory of the decoction of poison from plants as an explanation, will tell you that the excess of rainwater discharged by the rivers so freshened the surf as to cause the death of all shore-swimming fishes. This, as near as I can make it out, is Mr. Moore's explanation of the mortality at Egmont Key.

In a few confined spots, where fishes could not escape at will, this might now and then cause a death; but it is notorious that the fishes of the Gulf coast make little or no distinction between salt and fresh water. Alligators swim to the outermost keys, and the best sheeps-head caught are those far up the Caloosahatchie, where the stream is always sweet, while the porpoise and shark chase the mullet away in toward the head of the bayous, or until the river-channel gets too shallow for them to swim farther. A little fresh water, or a good deal, more or less, would receive no attention whatever from a Floridan fish. The Mississippi has been deluging the Gulf with a well-nigh Amazonian volume of water, fresh not only, but thick and nasty, yet no one supposes the fishes off the delta are obliged to stay in its murky flood unless they choose, or, if they do, that they suffer by it, except to the palate of the epicure.

But a more cogent argument, from facts perhaps overlooked heretofore, exists against any theory which seeks to explain the destruction of marine life inside the Florida reefs by any landward agency. This is that it was in all cases the dwellers on the bottom that perished first, while the surface-feeders were the last to be affected, and as a rule escaped altogether. (Until 1880, I was told, no mullets were ever known to be killed.) It was the death of sponges, conchs, sea-anemones, crawling horseshoe-crabs, of toad-fish, cow-fish, skates, and the like, which keep close down on the bottom, that first apprised the fishermen of the presence of their dreaded and mysterious enemy. Next came the bodies of red-fish, groupers, pompanos, and other deep swimmers, and last of all a few mullets and sharks. Fresh water, tinctured with tannin or untinctured, would not effect this. It would float on the surface, having a lesser density. If it exerted a noxious influence it would be the surface-life that would first succumb, the bottom-life longest escape. But quite the reverse has been the case, and this, with other appearances, leads to the conclusion that the "poison" springs from the bottom of the sea, or is formed in its waters.

The only way to account for this is by supposing that eruptions of volcanic gases may have taken place through the bottom of the sea

along a line stretching from Tampa Bay to the Tortugas, and through the western half of the Florida Keys. Inquiring as well as I could whether there had been any evidences of plutonic action in that region within a few years, I heard a tradition that about the holidays of 1877-'78 an earthquake shock had been felt on the west coast. I have had no opportunity, as yet, to verify this, but it is a well-known fact that just previous to the hurricane of last August, so well remembered by all the people of Florida West as a time of almost unparalleled destruction of shipping and height of tidal waves, a shock of earthquake was felt throughout the whole southwestern end of the peninsula. It did considerable damage in the city of Key West, and was so alarming at Tampa that several persons ran in a fright from their houses. Immediately after it, began the sudden destruction of fish I have described.

Whether the physical shock of such an occurrence, touching the fish and creepers on the bottom, would do them harm, or whether the subsequent patches of "poisoned water" owed their discoloration and undoubted deleterious properties to being saturated with sulphurous or carbonic-acid gases derived from subterranean vents, I cannot presume to decide. But if the last supposition had been proved true, or shall be at some future time, would it not be a rational and sufficient explanation of the death of the fishes, sponges, and their kin, whenever they came in contact with the discolored water alluded to?

Analysis of the suspected water would have done more to solve the question, probably, than anything else can do, and it is a matter of continued regret that I could not obtain specimens of it for that purpose. After the end of September, however, the evil diminished, and by Christmas all of the harmful water had disappeared from the Gulf.

Regretting that I could not have done more to get at the truth of the matter, in essaying which I was offered every aid by the citizens of Florida, but continually impeded by bad weather and other untoward circumstances, I beg to submit this little that I have learned; and I have the honor to be,

Very respectfully yours,

ERNEST INGERSOLL.

Professor SPENCER F. BAIRD,

United States Commissioner of Fish and Fisheries,

Washington, D. C.