

10.—REPORT ON THE PROPOSED INTRODUCTION OF THE JAMAICA MOUNTAIN MULLET INTO THE UNITED STATES.

BY TARLETON H. BEAN.

LETTER OF TRANSMITTAL.

SIR: I inclose herewith such material as I could find bearing upon the experiment of the introduction of the Jamaica mountain mullet. These data have been gathered from various sources and, while they are not in all respects so satisfactory as they might be, they appear to me to justify the proposed acclimatization of the species, and to indicate that the transfer can be successfully and profitably made. After giving a brief differential diagnosis of the genus *Agonostoma*, contrasting it with our marine mullets, I have collated such notes on the habits and characteristics of the Jamaica species as I could find in the publications upon that island.

A general sketch of the Jamaica mountain ranges follows, and after this occur notes upon the character of the rivers, their elevation, and the temperature of the air at various heights, whenever such data were accessible.

The same kind of information has been collected from State reports, atlases, and newspapers concerning the States of North Carolina, South Carolina, and Georgia, in the alpine regions of which States, in my opinion, the experiment will be most likely to succeed. I believe that streams suitable for the undertaking may be found in all of these States, and, perhaps, in some others which contain elements of the Appalachian chain.

In North Carolina favorable results may be expected in the Yadkin, Catawba, Big Pigeon, and French Broad. In this State the Appalachian chain reaches its greatest elevation, and the mountain streams have the general character of Jamaica rivers in which the mountain mullet abounds. Brook trout are indigenous to, and abundant in, streams in the vicinity of Mount Pisgah, in Haywood County, the Big Pigeon and its tributary creeks in particular. Landlocked salmon and rainbow trout have been successfully reared in this Commonwealth. I assume that trout streams will prove suitable for the species of *Agonostoma*.

In South Carolina the Keowee and some of the mountain tributaries of the Congaree would seem to promise the best localities. In 1882 the South Carolina Fish Commission planted 166,000 salmon and some salmon trout in the waters of the State.

In the alpine region of Georgia there are streams tributary to the Tennessee, the Coosa, and the Chattahoochee which appear to be adapted to the experiment. Some of the small tributaries of the Savannah may also offer a suitable home for the species. Particular attention might be given to streams originating in the Rabun Bald and the Brasstown Bald, on the summits of which peaks arctic insects are found.

From a comparison of the data respecting the temperature, elevations, and the nature of the water-courses, it appears to me feasible to introduce the Jamaica mountain mullet into alpine streams of the Southern States above mentioned and, perhaps, into some others. It remains an open question whether or not a supply of a species of *Agonostoma* could be obtained from Mexico instead of Jamaica. If the Mexican species is accessible and sufficiently abundant, there would be the advantage of rapid transportation by rail.

Very respectfully yours,

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U. S. Commissioner of Fish and Fisheries.

THE GENUS AGONOSTOMA.

(Mountain Mullet.)

The genus *Agonostoma* belongs to the mullet family and is very closely related to the marine mullets, *Mugil* spp., but its species are characterized by the presence of teeth in the jaws, by a less muscular stomach than that possessed by *Mugil*, and by their fresh-water habitat.

The number of known species is not large, but their range is extensive. They occur in the West Indies, Central America, Mexico, Mauritius, Celebes, Australia, Comoro Isles, and in New Zealand.

Agonostoma nasutum is found in the rivers of Guatemala. *A. monticola* is said to occur in Mexico as well as in numerous rivers of Jamaica. Investigation might show that it would be more convenient to obtain a supply from Mexico than from Jamaica.

Agonostoma, like *Mugil*, feeds upon soft organic materials and very small animals. The intestinal tract is very long and makes many convolutions.

AGONOSTOMA MONTICOLA.

(Mountain Mullet.)

"It is * * * known * * * as the Mountain Mullet on account, it is said, of its being entirely confined to the high water-courses; but this is not true. It is to be seen and is commonly taken by the angler even at the mouths of all our mountain streams as they mingle their waters with the ocean. * * * They are also called the Stream Mullet, on account of one of their habits, viz, swimming in the center or hugging the sides of running sweet waters. It is a very delicate fish; the flesh is remarkably sweet and white, and the roe is a most *recherché* morsel. In general it is found nearly as large as the fish itself. The Mountain Mullet seldom exceeds 10 inches

in length, and weighs half a pound, and in some instances above a pound. * • • In the Yallah's, the Buff Bay, the Wag Water, and particularly the Swift and Spanish Rivers they are to be seen in this perfection of their growth. The Stream or Mountain Mullet rises readily at the fly; a black or a red tackle is generally most successful. For bait fishing the scoured earth-worm kept in damp moss, small silver prawns, and half-ripe avocado pears are the best. There are two modes of dressing them for the table. First wrap them up in a plantain leaf and put them in hot ashes and there let them remain for an hour; but the writer prefers them fried. The fine, large, delicious roes should not be treated in any other way for the *gourmet*. It is the best mode of preparing them for the table.

“The Mountain Mullet is entirely confined to the fresh water-courses, even to their final termination in the great and wide sea. As both mandibles of the Stream Mullet are full of very small teeth, some precaution is necessary in angling for them. The material (gut, as it is termed) by which the hook is attached to the line is much abraded and worn after taking a dozen or two of these fishes, and ought to be renewed.”

AGONOSTOMA MICROPS?

(Hog-nose Mullet.)

A large species of *Agonostoma*, known as the Hog-nose Mullet, occurs in the Rio Grande. This is described as one of the most palatable of the species. “The length of the Hog-nose Mullet taken out of the Swift River, below the Fish Done, will often measure 23 inches and usually weighs from 2 to 4 pounds. It is designated by this name on account of the elongation or projection of the cartilage of the upper mandible considerably over the lower, ending in a blunt point, with which contrivance it turns up mud, or the fallen leaves frequently found in conglomerated heaps, etc., in search of its ordinary food.

“This fish does not rise to the fly. It is by bait alone that the skillful fisherman can hope to secure so rich, so desirable a prize. The baits most used with success are fresh red earth-worms, small silver shrimps taken out of springs and streamlets in the vicinity of rivers, half-ripe avocado pears, etc. The silver shrimps are preferable; they are the best of all baits. The hook must be attached to fine silver gimp, about 8 or 10 inches long; gut and Indian weed in common use will not answer to secure the fish, by reason of its teeth, which so fret these materials after a few struggles that they break asunder and the captive escapes. * * * This Mullet is easily scared, very sly and retired in its habits, and is rarely seen swimming to and fro like its congener.”

JAMAICA MOUNTAIN RANGES.

The surface of the island is extremely mountainous and attains considerable altitudes, particularly in the eastern part, where the central range is known as the Blue Mountains. A great diversity of climate is therefore obtainable; from a tropical temperature of 80° to 86° at the sea-coast the thermometer falls to 45° and 50° on the tops of the highest mountains, and with a dryness of atmosphere that renders the climate of the mountains of Jamaica particularly delightful and suitable to the most delicate constitutions.

The midland parts of the island are of course the highest. Through the county of Surrey, and partly through Middlesex, there runs the great central chain, which trends generally in an east and west direction, the highest part of which is the Blue Mountain Peak, attaining an elevation of 7,360 feet.

From this range subordinate ridges or spurs run northerly to the north side of the island, and southerly to the south side; these ridges in their turn are the parents of other smaller ridges, which branch off in every direction with considerable regularity and method; and they again throw off other ridges, until the whole surface of the country is cut up into a series of ridges with intervening springs or gullies.

RIVERS OF JAMAICA.

While most of the rivers have generally northerly and southerly directions, it must not be forgotten that the subordinate ridges, which are nearly at right angles to these lines, will produce subordinate streams, meeting the rivers on their eastern and western banks.

In consequence of the great elevations from which most of the rivers flow they are very rapid in their descent, and in times of flood become formidable torrents, sweeping everything before them and operating as dangerous obstructions to the traveler.

Rio Grande River, in the parish of Portland, is one of the finest rivers in the island; it flows from the northern slopes of the Blue Mountains. The Back and Stony Rivers, two of its great affluents, furnish not only some of the loftiest and most picturesque water-falls, but the wildest and most romantic country in the island.

The elevation of the western peak of the Blue Mountains is 7,360 feet.

The mean annual temperature of the air at 7,500 feet is 57.4°.

The upper districts of this region are too cold for coffee, but suitable for cinchona. Lower portions are adapted to coffee and cocoa.

Swift River, in the parish of Portland. It has the same character as the *Rio Grande*.

Spanish River, in the parish of Portland. It has the same character as the *Rio Grande*.

Buff Bay River, in the parish of Portland. It has the same character as the *Rio Grande*.

Agua Alta (Wag Water) River, in the parish of St. Andrew. It rises in the mountains back of Stony Hill; runs through the parishes of St. Andrew and St. Mary, debouching at Annott Bay.

The elevation of Stony Hill, where main road crosses it, is 1,360 feet.

The air temperature of Stony Hill, at an elevation of 1,425 feet, is 75°.

Yallah's River, in the parish of St. Thomas. In consequence of the great elevation from which it flows it is very rapid in its descent, and in times of flood becomes a formidable torrent.

Yallah's Hill is 2,348 feet high.

The mean annual temperature at this elevation is about 72.6°.

The *Hope River* rises in the hills around New Castle, and joins the sea at the sixth mile-stone from Kingston, on the windward road. From this river the city of Kingston is supplied with water.

Willard Nye, jr., informs me that the water at the dam, 6 miles from Kingston, is not too cold for comfortable wading.

New Castle Hospital is at an elevation of 3,800 feet. The mean annual temperature of the air at this height is 68°.

NORTH CAROLINA.

MOUNTAINS.

For 40 miles behind the flat region there extends as far as the lower falls of the rivers a belt of land of a surface moderately uneven, with a sandy soil, of which pitch-pine is the natural growth. Above the falls the surface is undulated, and still farther, beyond the Yadkin and the Catawba, is an elevated region, forming part of the great central plateau or table-land. On the border, between this State and Tennessee, is found the highest land east of the Mississippi River. The two ranges known as the Black and Smoky Mountains are the termination of the Appalachian range; and the highest peak of the first, called Black Dome, rises to a height of 6,707 feet, while the highest peak of the second attains an elevation of 6,306 feet, and is known as Roan Mountain.

RIVERS.

Among the rivers which would seem to be best adapted for the experiment with the mountain mullet are the Catawba, the Big Pigeon, and the French Broad. The latter two may have some advantage over the first, as they fall into an elevated basin in the mountains of eastern Tennessee, and mingle finally with the waters of the Gulf of Mexico. The Yadkin may also be a suitable stream for the purpose. There are many streams in western North Carolina in which the brook trout abounds, and it is highly probable that trout streams would be entirely suitable for the mountain mullet. In the American Field, beginning March 10, 1888, and continuing to the present time (April 14), is a series of articles on trout fishing in western North Carolina. The writer of these articles fished the Pigeon River, in Haywood County; also Crawford's Creek, a tributary of the Big Pigeon; Shining (or Shinning) Creek; and Hungry Creek. In Crawford's Creek and Shining Creek he found trout abundant. These streams are in the vicinity of Mount Pisgah.

Pigeon River, in this locality, is a very rocky and rapid stream. "There are long riffles, deep pools, and big overhanging rocks almost without number, and it is the very ideal of a trout stream. It would be a splendid stream for salmon, I should think, but I do not know if they could get up there from the ocean. Salmon have been planted in the lower waters of the Pigeon, but I do not think they can make the journey to the sea. Perhaps the land-locked salmon might thrive in that river, but I think the fish would die in attempting a journey up and down the Mississippi."

SOUTH CAROLINA.

"The alpine region of South Carolina occupies the extreme northwestern border of the State; commencing at King's Mountain, in York County, it extends westward throughout Spartanburgh, Greenville, Pickens, and Oconee Counties, widening in the three last named until it embraces a tier of the most northern townships, two or three deep. This wedge-shaped area has a length of 114 miles, and a width varying from 8 to 21 miles.

"The physical features of this region present a rolling table-land, broken or hilly on the margin of the streams, but scarcely anywhere inaccessible to the plow. It has a general elevation above the sea-level of 1,000 to 1,500 feet. The gently undulating surface extends to the mountains, whose rock-bound walls often rise suddenly to their greatest height.

"The boundary line of South Carolina reaches the most easterly chain of the Appalachian Mountains, known here as the Saluda Mountains, near the corner of Greenville and Spartanburgh Counties, and follows the summits of the ridge for 50 miles (30 miles in an air line), until it intersects the old Cherokee Indian boundary line. From this point the mountain chain, here called the Blue Ridge, curving a little to the north, passes out of the State, and the boundary line pursues a more southerly and a straight course to where the east branch of the Chatuga intersects the thirty-fifth degree of north latitude. The Chatuga flowing westward to its junction with the Tugaloo River, which in turn becomes the Savannah River, flowing to the southeast, are the northwestern and western boundaries of the State. The mountain chain divides the waters of the State flowing to the Atlantic Ocean from those flowing northward, which eventually find issuance to the southwest through the Tennessee and Mississippi Rivers into the Gulf of Mexico. Considering the water-shed of South Carolina alone, the culminating point whence the rivers of this section flow is to be found in the horseshoe curve of the mountain chain north of the straight boundary line referred to as uniting the Chatuga and the Blue Ridge. Hence the numerous sources of the Keowee, Whitewater, Toxaway, Jocassee, and other creeks take their rise and flow nearly due south. The main stream of the Saluda sweeps away to the east, and the Chatuga hurries westward.

"The elevation above the mean level of the sea of the following points in western South Carolina were determined by the U. S. Coast and Geodetic Survey:

"King's Mountain, 1,692 feet; Paris Mountain (near Greenville), 2,054 feet; Cæsar's Head, 3,118; Mount Pinnacle (near Pickens, the highest point in South Carolina), 3,436 feet.

"The bracing and healthy climate of this region, its beautiful scenery, the bold mountain outlines, the rich luxuriance of every growth, no stunted plant on mountain side or summit, every part, even the crevices of the rocks, covered with trees or shrubs of some kind, all full of life and vigor; the clear, soft streams that everywhere leap in a succession of cascades from crag and cliff and sparkle in their course along the narrow but fertile valleys, have made it for generations a health and pleasure resort during summer."

CLIMATE.

According to the physical charts of the Ninth United States Census, and the rain-charts of the Smithsonian Institution, second edition, 1877, this region has a mean annual temperature corresponding with that of Kansas or New Jersey. The more mountainous portions have, however, a mean annual temperature that corresponds with that of Montana, or the lower region of the Great Lakes. The mean of the hottest week in 1872, taken at 4.35, p. m., was 90° Fah. The mean of the coldest week of 1872-'73, taken at 7.35, a. m., was 25° Fah.

South Carolina springs.

Locality.	Time of observation.	Temperature.	
		Air.	Water.
Poinsett Spring, in Greenville, near North Carolina line.....	June 7, 7. 30 a. m..	72. 050	56. 86
Spring on Jones' Gap Road, near turnpike gate.....	June 16, 2 p. m. . . .	75. 74	57. 56
Cold Spring, or Caesar's Head.....	June 29, 9. 30 a. m.	80. 60	55. 40
House Spring, Caesar's Head.....	June 29, 10. 30 a. m.	78. 80	57. 58

In 1882 the South Carolina Fish Commission released 166,000 salmon in the waters of the State, besides some salmon trout.

It seems important in this connection to call attention to the numerous lakelets or springs in the pine barrens of South Carolina which have no outlets or are believed to communicate through fissures in the limestone rock with a subterranean stream or lake many miles in extent. The water in these lakelets is of crystalline clearness with a depth of 12 to 15 feet, and abounds in all the species of fresh-water fish common to the locality, including eels and alewives. Something similar to this is observed in Jamaica.

GEORGIA.

MOUNTAINS.

"The great Appalachian chain forms by far the leading topographical feature of the long line of the Atlantic States. In its relation to this great feature Georgia has its entire northern boundary among mountain ranges extending beyond her limits into Alabama on the west and South Carolina on the east. No peak in Georgia is a mile high, Mount Enotah, in Towns County, the highest, being 4,796 feet. The most noted mountains are the Rabun Bald, Blood, Tray, Yonah, Grassy, Walker's, Lookout, and the Stone Mountain, the largest mass of solid granite in the world."

RIDGES.

"The great ridge runs from the St. Lawrence River through the Atlantic States to Cape Sable, in Florida. This ridge, of which the culminating points are mountains, passes almost centrally through Georgia. It is for three-fourths of its length the long, irregular eastern edge of the great Mississippi basin.

"The second great ridge separates the Mississippi Valley from the Gulf slope. This, the southern edge of the Mississippi basin, also passes through northern Georgia. The two ridges meet near the corner of Rabun, Towns, and White Counties.

"At this critical point a man standing with an umbrella in a shower sheds the water so that one part reaches the Atlantic near Savannah, a second part the Gulf at Apalachicola, while a third enters the Gulf below New Orleans, having passed successively through the Hiwassee, the Tennessee, Ohio, and Mississippi Rivers."

RIVERS.

"In Georgia, which partakes of three great slopes, the rivers run in all directions, southeast, southwest, west, and north. They run as from the apex of a cone."

CLIMATE.

The annual mean temperature in summer is 79.7°, which is about the same as the lowlands of Jamaica. The winter mean is about 50°. In northern Georgia the summer mean is about 75.3°, the winter mean about 42.8°. In south Georgia the annual mean is 67.7°—summer, 81.3°; winter, 53.6°. In middle Georgia the annual mean is 63.5°—summer, 79.2°; winter, 47.2°.

The mean temperature of Atlanta corresponds with that of Washington City, Louisville, and St. Louis. The extremes are seldom as great as in the Northern States, and sun-strokes are less frequent. On the whole, the range of changes in climate is very wide, from the invigorating climate of the mountain to the rather debilitating climate of the South, modified, however, by the sea-breeze.

“The mountainous parts of the State lie in one degree of latitude, north of the thirty-fourth parallel.

“The Appalachian chain enters the State with several parallel lines of elevations; the highest of these, the Blue Ridge, has an altitude of over 3,000 to nearly 5,000 feet.

“The Cohutta range continuous with the Unaka of Tennessee, 3,000 feet in altitude, with an abrupt escarpment toward Oostanaula on the west, lies about 20 miles west of the Blue Ridge.

“Next in order on the northeast comes the Lookout and Sand Mountain, table-lands belonging to the Alleghany system. Between the principal ranges of mountains here enumerated are numerous minor elevations or ridges observing a general parallelism. These decrease in height towards the southwest, and ultimately die out, the most easterly ranges disappearing first, and the others in succession. The Blue Ridge, as an unbroken chain, extends only about one-third the distance across the State, terminating abruptly. The Cohutta range continues into Alabama in a low elevation, known as Dugdown Mountain, while the table-land mountains, with their associated ridges, extend with decreasing altitudes many miles into Alabama.”

DRAINAGE.

“The streams of the State flow either into the Atlantic Ocean or into the Gulf of Mexico. The divide between these water-sheds runs from the Okefinokee Swamp a northwesterly direction to Atlanta, whence it follows the Chattahoochee ridge a northeast direction to Habersham County, when it curves to the north, extending to Union County.

Of the Gulf drainage the larger part flows directly to the Gulf through the Chattahoochee and the Coosa Rivers and their tributaries, while some smaller streams near the northern line of the State belong to the Mississippi drainage system. The divide between these systems runs a zigzag course, often crossing the trend of mountains and valleys from near the northwest to the northeast corner of the State, dipping into the States of Tennessee and North Carolina at several points.

“On the summits of some of the mountain peaks, as the Rabun Bald and Brasstown Bald, arctic insects are found. Of this belt Georgia has but a bare patch, however, extending into North Carolina.”

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