

REPORT

ON

PISCICULTURE IN SOUTH CANARA.

7th August 1870.

No. 1430
1870

From

H. S. THOMAS, ESQ.,
Collector of South Canara.

To

THE SECRETARY
to the Board of Revenue, Madras.

Sir,

In the marginally quoted Order the Government
dated 27th November 1868, was pleased to sanction the grant of
No. 2252. rupees 3,000 for one year's experimental
pisciculture in the rivers of South Canara, and the year
having elapsed, I presume it is incumbent on me to report
results.

2. It may save trouble in perusal, if it is stated on the
threshold that the frequent marginal notes are not necessary
to the understanding of the subject matter. They have been

introduced, partly to lighten the body of the report, but mainly to facilitate reference when passing orders, for which latter purpose also a table of contents is prefixed.

3. Directly I returned to the district, I selected an **Mr. Samuel Ball**, officer to have the immediate superintendence of observations and to collect information, and giving him instructions, at once commenced operations.

4. Here, as in England, opposition has been experienced from the very men who could render the best assistance, and are to reap the greatest advantages from the present inquiry. The fishermen conceived that the sole object was to enrich the State at their expense.

5. Their reticence, their sometimes wilfully false information, and their ridiculous beliefs, have necessitated no small amount of careful scrutiny, and nothing has been set down in the following paragraphs that has not been subjected to all the personal testing that time, opportunity, and our own ignorance allowed to my superintendent and myself.

Rivers.

6. It will be convenient to treat first of the rivers and then of the sea, and in elucidation of remarks that will follow, it may be well to seek attention to the general features of the rivers of South Canara. The district lies between the sea and the high plateau of Mysore and Coorg; most of its rivers consequently take their rise in those provinces, and, as long as their course lies therein, they are beyond the jurisdiction of the collector of South Canara. Though rapid and rocky at their sources, they are tortuous at their mouths, and subject to much tidal influence. These two main features may perhaps be more clearly conceived by **Appendix A.** reference to the accompanying map. They would

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Poisoning of Rivers.

7. It may be interesting to commence this subject with a notice of the substances used for poisoning the rivers. They are :

Croton tiglium,
Anamirta cocculus,
Copsicum frutescens,
and Káre kái (Tulu), a Posoqueria, probably nutans or longispina.

8. Though very considerable progress has been made within the last two years in stopping the annual wholesale poisoning of the rivers much still remains to be done. As long as fish can be easily captured in large quantities by this means, so long will this species of poaching be popular. In the wilder

Pro. Govt., dated 27 Nov.
1868, No. 2,302, para. 3.

forest-locked parts of the interior it is not easy to observe and check it, and when the sympathies of the village authorities and police are with the people, it is doubly difficult.

9. The difficulty is further enhanced by the bad example of neighbours. The inhabitants of Mysore and Coorg habitually poison with impunity such portions of the rivers as lie within their limits; they also make annual excursions in large parties to hunt and fish after this manner within the confines of Canara, and the inhabitants of this district are encouraged to co-operation and induced to silence by the impunity of their neighbours and a share in the take.

10. An effectual check can scarcely be put to the poisoning of the rivers till the same measures are pursued throughout their whole length, whether they run in Mysore, Coorg, or Canara, and till the means are provided for the better observation of the parts more remote from villages. This latter might be done by the aid of a small staff of water bailiffs; and rewards for informers might obtain them some aid from the police and the public. The proposed staff and the estimated expenditure for rewards is given with other expenses in appendix C. The outlay could be met from the fines and rents hereafter suggested.

11. The destructiveness of poisoning is more extensive than at first sight appears. Though there may be many pools in a river, there are a few at intervals of four or five miles that are specially affected by the larger sorts of fish. These are generally the deepest and longest; they are sometimes as much as twenty feet deep and a quarter of a mile long. They are generally cooler from being overshadowed with trees and more or less overhung with rocks. Their very depth also would keep them cooler than the

wide shallows extending for miles together, and in the height of the hot season, of a few inches only in depth, under a tropical sun. Their depths afford also concealment and probably greater facilities for escape from otters. To bottom feeders, which the large fish mainly are, they must also yield more food than the shallows. They are natural resting places for the spawners, as shown below.

12. These pools are well known to the villagers, are all distinguished by local names, and are selected as the ones for poisoning; consequently the poisoning of one of these pools is pretty nearly equivalent, as far as the bigger sorts of fish are concerned, to the poisoning of four or five miles of river.

13. Thus whatever may be the cause of larger sorts of fish congregating in the deepest pools, the fact remains that they do so, and that it is taken advantage of for their poisoning. It may also be taken advantage of for their protection.

14. But the chief sources of most of the Canara rivers are on the western ghâts of Mysore and Coorg, and to these it is that the best fish migrate for spawning purposes. Efforts to stop poisoning and to protect the fry must therefore be incomplete till the same measures are adopted in Mysore and Coorg. It is obvious that to be treated successfully the rivers must be treated as a whole, no matter what territory they run through. It may seem unreasonable to object to the Coorgs and Mysoreans destroying the fish within their own countries; but it should be borne in mind that they cannot stop the effects of their poison abruptly at their boundaries, the tainted river will roll on. They also will benefit as well as Canara, for if they spare the fry that are to descend and stock its rivers, those same fry, when grown, will not fail to revisit them annually, crowding

up in increased numbers to spawn. In short, Mysore, Coorg, and Canara possess more or less in common one water farm which to be cultivated to advantage must be worked in unison. At present, however, these people poison the fish and waylay the descending fry in innumerable cruives.

15. It is true that Canara is not entirely dependent on the Coorgs and Mysoreans for their co-operation in this matter, as its rivers have other sources besides those in their territories. Many of the tributaries, which are themselves rivers, run their whole course in South Canara, and these can be controlled from end to end. Still the culture of Canara rivers would be more complete if it could be extended to those portions also that traverse Coorg or Mysore.

16. Coorg has also coffee pulpers. When numerous, they apparently affect a river as injuriously and offensively as do the flax pits of Ireland. On the Mercara Ghât there are many coffee estates. During the crop season their pulpers are constantly at work, and the refuse from them all runs into the head of the Puiswani river. Pulped as coffee now is, a great quantity of water is defiled, and the river for miles down is rendered literally as dark as porter, and as fetid as flax water. Even after it commences to clear, the stones are all coated with slime. Without hastily coming to the conclusion that because the river was foul and offensive to human beings it must necessarily be so to fish also, every practicable effort was made to ascertain accurately whether the fermenting sacarine matter brought down by the pulpers, was attractive and nutritious to fish, or was repulsive enough to cause them to migrate, or so far deleterious as to sicken or kill the smaller ones, or so poisonous as to destroy all fish in the river for many miles. The river being within Coorg limits, the co-operation of the

superintendent was sought and readily given. The result, however, was not quite as conclusive as could have been wished; for, in a subject altogether new to them, native observers failed to appreciate sufficiently the necessity for pains-taking accuracy, and the conclusions at which different amildars have arrived, are consequently somewhat contradictory. It is to be regretted also that European owners of coffee estates bordering on the river abstained from communicating their experience. The only means of testing the matter which remained to one kept by other duties more than 50 miles away at the time the river was befouled, were not neglected. A few handfuls of pulp were obtained, crushed, and soaked till fermented, and healthy lively fish were then put into the water. The invariable result was their speedy death. Even without this experiment it would have been a fair conclusion that water so befouled as to coat the stones of the river with a glutinous slime would similarly coat the gills of the fish, thereby stop their respiration, and kill them by suffocation. Considering the coffee and the piscicultural interests involved, it may be well to place this matter beyond a doubt by more local observation than has been practicable in the present season, though there really seems no sufficient cause for hesitation in accepting the conclusion that pulp water is eminently destructive to fish for many miles down the river, and that too in their very spawning grounds.

17. But this befouling of the river is not an unavoidable necessity of coffee growing. Mr. J. Russel, himself a planter on this ghât, assures me that coffee could be quite as well pulped with less water, and with the advantage to the coffee planter, as well as to the river, that all the refuse could be retained on the estate as a valuable vegetable manure. It would seem that the water required for the pulper itself is much less than is ordinarily used; that the use of a crusher before putting the coffee through the

pulper would make it feasible to use still less water, and that if the pulp hole were built large enough (say 20 feet square by 4 feet deep), and made watertight, and all clean water taken by a different course direct to the river, the whole of the matter which now flows to the river might be retained in the pulp hole as valuable manure for the estate, and the advantage of its retention would it seems quite overbalance the slight extra expenditure resulting from employing labour to carry, instead of water to float, the berry and the pulp. A paper which he has kindly supplied on the subject is enclosed. (Appendix D.)

18. The proposed change in the manner of pulping will not entail any serious outlay. It will be no hardship therefore to make river poisoning by the present method of pulping penal after sufficient notice to allow of the change being conveniently introduced.

19. Munzerabad, in Mysore, also has coffee pulpers discharging their waste water into an affluent of the Netravati river. But the pulpers are few and the stream seems sufficiently large to carry off the pollution without injury to the fish.

Fry in Rivers.

20. But whether the poisoning of the waters or the capture of the fry be the more fertile source of ruin to the rivers it is hard to decide. Dr. Day and I have already urged that too much importance can scarcely be attached to the suppression of the practice of destroying fry wholesale. It has not been possible to obtain an exactly accurate account of the number of small meshed cruives used in the district of South Canara, but there are sufficient data for concluding that there were at least 1,050 on the one river, the Netravati, with its affluents. If it be calculated that every one of these cruives captures on an average 3,000 fish in a day, then there are as many

as 91,500,000 tiny fry destroyed for no adequate purpose in a single month in one river alone. To say what may be the total number thus destroyed in the course of a year in all the rivers of Canara would be beyond my arithmetic. These closely-wooven bamboo cruives then have been forbidden and vigorously hunted out of the rivers. It is not to be concluded that they have been entirely got rid of, far from it; there are clearly many remote places where they are freely used, and the water bailiffs sought are wanted as much for this purpose as for stopping poisoning. Still a considerable impression has already been made.

21. The consequence has been that the most ignorant and therefore the most obstinate opponents have been convinced by the testimony of their own senses and have exclaimed, to use their own words, "truly, the river is everywhere *bubbling* with fry," and, what is still more to the point, their practice has not belied their words, for they have taken to fishing on grounds that were before considered profitless.

22. Though this is nothing more than in my former paper I anticipated would be the natural result of the simultaneous stopping of poisoning and prohibition of the use of closely-woven cruives, still the actual sight of the result has surprised even my sanguinely expectant self. Two years' discouragement of poisoning and one year's discouragement of fine cruives, has worked such a change that it has been demonstrated beyond the cavil even of the ignorant and of the interestedly opposing, that marked advantages can be reaped from the adoption of these two simple measures alone.

23. It should not be concluded that the fry above alluded to are all the young of valuable kinds of fish. This they could not be, for the breeding of any particular fish by an artificial process has not been sanctioned. Such as nature has given have been protected. The fry are therefore the

young of all sorts of fish, from the minnow and the loach to fish running up to 10 and 20 pounds weight.

24. This may possibly be considered unsatisfactory by those who breed nothing meaner than a salmon. But there are and can be no salmon in these tropical waters.

Neither does it appear that there are any sea migrating fish like the hilsa (chupca), but purely fresh water fishes migrating only to different parts of the river at different seasons of the year.

These nature, who knows best how to maintain her own balance, has probably distributed in the wisest proportions, and without a thorough knowledge that it can be done to undoubted advantage, it is common prudence not to disturb them. The smaller fish which are comparatively valueless to man, are invaluable as food to the larger fish; and the fry of the smaller sorts of fish are excellent food for the fry of the larger sorts.

25. There would also seem to be no fear of the smaller fish disproportionately increasing on and starving out the larger sorts of fish, for the fish calculated to prey on and keep them in check are not few in number. A carp (mahseer barbus mosal) is placed prominently amongst the fish eaters, but not without the clearest evidence from the contents of many stomachs personally examined. But the precise details of the food of different fish will find its place elsewhere.

26. Again it would be arbitrary for these in easy circumstances to declare that any particular fish are valueless. The poorer classes in this country, to whom animal food in any shape is a rarity, may and do relish as a luxury what wealthier Europeans might consider not worth the cooking. Many of the smaller fish are also considered sweeter than the larger ones. In this district no sheep or oxen are bred for slaughter, and a few fowls form the only animal food

on rare occasions; pulses and millets, which are the main food of the labouring classes in other parts of India, have in Canara only an existence as a luxury, and rice, the least nutritious perhaps of all grains, is almost the sole diet of the poor. Under these circumstances, it is not surprising that there should be a craving for any description of fish, and the occasional consumption of some such nitrogenous food would seem to be a necessary of health. It may also be mentioned in passing, that a good authority in such matters has stated that all fish, and especially sea fish, are better calculated than any other nutriment to restore expended brain tissue.

27. An outspoken critic gave it at his very decided opinion that pisciculture in west coast rivers, that are at one time in high flood, and at another a mere dribble, was "all gammon." He is probably not singular in his opinion. His objection, therefore, ought to be answered. This very variableness in the rivers, instead of being an insurmountable difficulty, would seem to be the most convenient arrangement that could possibly be desired. When the south-west monsoon commences, the rivers are at once in flood, and continue so for four months, subsequently diminishing by slow degrees. This enables the grown fish to ascend to new feeding grounds in the forests that are quite inaccessible to them at other times, and ten-pound

fish are to be found half-way up the Mercara Ghat. In the high waters the big fish linger till the gradually subsiding streams warn them to drop gently downwards. The early spawners linger the longest to secure shallow waters for spawning; this done, they keep dropping gently downwards with the continually decreasing waters, and before the spawn they have deposited is hatched, they are probably completely cut off from their fry, so that till the commencement of the same monsoon in the following year, they cannot return to devour them. The fry thus not only have

This cannot be stated with certainty till it is ascertained how long the spawn takes to hatch.

the heads of the rivers securely to themselves, but they have them also beautifully accommodated to their puny strength, the impassable torrent having become a mere dribble of an inch or so in depth.

28. Though the variation in the size of the Canara rivers is much greater than the changes in English rivers, it is at the same time much more regular. Though Canara has in a year 130 inches of rain-fall to swell its rivers, and a tropical land, and irrigation to waste them, yet they come in their regular season. Almost the whole of the 130 inches falls during the prevalence of the south-west monsoon which commences with June and lasts about four months. This monsoon ended, there are only such moderate rains as cannot affect the rivers. This monsoon ends then with September, and from that time the rivers continue to subside steadily till the following June. The fish spawn in the interim, and the spawn is safely hatched and the fry are somewhat grown before the recurrence of the annual floods in June. There are thus no unseasonable floods coming down, as in England, after the spawning time, and carrying away the spawn; and when they do come in June they seasonably sweep away the obstacles in the shape of temporary irrigation dams that would otherwise prevent the spawning fish from ascending.

29. In respect therefore both of the extremes of change, and the regularity of the change, the Canara rivers have an advantage over the rivers of England.

30. But while providence has thus beautifully arranged to shield the fry from their voracious parents, they are by that very arrangement placed entirely at the mercy of short-sighted man, and the necessity for prohibiting all closely-woven cruives can scarcely be too strongly insisted on.

31. The spawning fish alluded to in these paragraphs (27, 28, and 29) are named by Doctor Francis Day, the

Mahseer *barbus mosal*. They are the best fish in the Canara rivers, for they are the largest, and excepting only the salmon their flavor is as good in my opinion as any English fresh water fish. They are great fish-eaters, though of the carp species. Other Indian carps also seem to be habitual fish eaters.

32. That their habit of spawning is that described, would seem to be deducible from the data collected. Personally examining as I have every fish that I could capture or get captured, and keeping a regular note book of results with the dates and places of examination, it appeared that while the rivers were in flood the mahseer abounded most at the heads of the rivers, that the higher up they were the more advanced their roe and milt generally was, and that lower down there was scarcely a mahseer to be found at the same time, though they were well known to abound there later in the year.

Fry in Rice Fields.

33. But the beautiful arrangement spoken of in paragraphs 27, 28, and 29 lays the tiny fry at the mercy of improvident men in yet another way. While the south-west monsoon prevails, the ample rainfall on this coast supplies abundant water for irrigational purposes, and the rivers are the while too turbulent to be diverted. But as the dry season commences, and water is wanted for the irrigation of the second crop of rice, the rivers have settled down to more manageable proportions, and near their sources it becomes an easy matter for the farmer to collect the boulders in the stream, lay them in a line across it, and after filling in the interstices with shingle from the bed, to stop the whole with clay and bushes from the banks. A temporary and inexpensive, yet effective, dam is thus run up annually by every farmer that has ground conveniently situated for irrigation. Though it is completely swept away by the first flood in the next south-west monsoon, it lasts throughout the hot weather,

throughout the lifetime of the fry, and the river or rivulet being thus completely cut off, is diverted entirely into an irrigation channel. As it is the instinct of the grown fish to ascend the rivers to spawn, so is it the instinct of the fry, as they grow, to allow themselves to drop downwards with the stream to deeper wider waters. Down

they glide therefore, day by day a little way, feeding as they go, and unconscious that they are already in an irrigation channel which can end only in a rice field, and thus it is that the channel-fed rice fields swarm with fry of apparently all descriptions.

34. This would be no misfortune if even here the fry were left to themselves. The rice grows in fields that have been carefully levelled by man, and partitioned with narrow and shallow embankments, so as to economise the water, and spread it over the largest possible area. From a piscicultural point of view the whole stretch of rice fields has the appearance

of a vast and admirably constructed nursery. A whole river or rivulet has been turned on, a river too that has been stocked with ova, the water has been economized to the utmost, the depth regulated exactly to suit the fry, large predatory fish thoroughly excluded, the whole manured, ploughed, and planted so as to provide the maximum of insect life, with the desired modicum of varying shade under the growing rice, and the area of the nursery is measured, not by the inch or foot, but by the acre or square mile. In this extensive nursery, therefore, which costs the pisciculturist nothing, the fry thrive admirably, and still following their instinct go feeding dawdling downwards with the stream. This takes them leisurely from rice field to rice field, and in the direction of the waste water, which of itself not unfrequently runs into the

The fry of the following sorts have been identified. How many more there may be that enter the rice fields cannot be as yet said. Numbers 7, 8, 9, 10, 11, 12, 13, 15, 16, 26, 27, 30, 32, 34, in the list of fishes in Appendix G.

See also p. 10, 11, 12, 13, 15, 16, 26, 27, 30, 32, 34, in the list of fishes in Appendix G.

Frogs, however, find their ways in the great number of small are destructive. See para. 31.

river again, or might almost always be contrived so to run. But at each drop from rice field to rice field, the cultivator places a basket made of finely split bamboos, having a wide mouth, a narrow neck, and a wide bottom. It lets the water pass but stops every single fry, and what was an admirable nursery becomes one vast trap from destroying the majority of the fry in the river. So highly are these juicy morsels appreciated that no peasant fails to place a basket at every outlet.

35. The accompanying map of the district shows the Appendix A. number and position of the temporary river dams. Omitting dams on minor hill streams there are more than 2,000. One alone of them diverts for six months a stream 12 feet broad and 3 feet deep at the commencement, and irrigates an area of 1,700 acres. Many others are but slightly inferior to it, and the area irrigated under all the river dams in the district is estimated at 39,962, or in round numbers 40,000 acres, or more than 60 square miles of nursery. Calculating from a very low average of the number of fry contained in 50 acres, this area must contain in all probability considerably more, and certainly not less than 283,500,000 of diminutive fry, which are annually destroyed for a comparatively insignificant number of juicy curries.

36. This is the destruction of fry under the river dams alone, without taking any account of the numbers that that enter the rice fields from hill streams, from the annual overflowings of the river in certain localities, and that enter marshes from the rise of the tide in the estuaries. The numbers of these two latter there are no means of computing, but they may safely be put down at about the same as in the dam fed rice fields. These also are destroyed most of them in the same way as the fry of the rivers, and some in other ways to be described in connexion with sea fish.

37. The almost innumerable hosts of fry that enter the

rice fields from the hill streams have been excluded from the above calculations, because they are the fry of small fish, for though every rill of a foot in breadth teems in the season with minute fishes, they are apparently only the fry of minnow, loach, and such like small fish, the destruction of which is perhaps not of much consequence, as there are probably enough of them intermixed with the larger sorts of fry from the rivers. Still it is worthy of note that the smaller sorts of fishes seek the smallest rills to spawn in, and struggle up them to astonishing heights at the commencement of the monsoon, and it may remain a question whether the larger predatory fish would not be benefited by any protection extended to their natural food.

38. Omitting these, however, the annual destruction of fry in the rice fields and marshes may be fairly put down at not less than 567,000,000. This is not unavoidable or accidental destruction, but it is willful, reckless, and preventable. Some of these fry it will be remembered are capable of becoming fish of 10 and 20 pounds in weight. Many more will run to two and three pounds, and very few comparatively to less than two or four ounces. It seems fair to assume for the purpose of calculation, that on an average the fry weigh at an early age not less than a grain each, and are calculated to grow to one pound weight. Is it worth while to turn these grains of meat into pounds, or in other words to allow them to multiply themselves by 7,000, for that is the number of grains in a pound. Is it worth while to turn 567,000,000 grains or 81,000 pounds of meat into 567,000,000 pounds, or 253,125 tons of good food? Though the average weight attained and consequently the multiple employed in this calculation be reduced by a half or three-fourths to meet the destruction by fish preying on

Though every care has been taken to make the numbers in this paragraph, and in paragraphs 26 and 27 as correct as possible under the circumstances, and to err on the side of moderation rather than of possible exaggeration, still large multiples of comparatively small multiplicands are generally more or less fruitful of error, and these figures should consequently be relied on only for the purpose for which they have been introduced, that of presenting an approximate idea of the amount of food destroyed.

each other, the figures that will remain will still be sufficiently indicative of the largeness of the results obtainable from the protection of fry. And against this reduction may be advanced the argument that by maturing so many more fish the number that are to produce ova in succeeding years will also be greatly increased.

39. This, be it remembered, is the destruction of fry computed to be still continuing. It was much greater before the discouragement of the finely-twined cruives in Para. 20. the rivers which alone must have destroyed vast numbers. If the calculation made in the preceding paragraph were applied also to the fry spoken of in paragraph 20, there might be conveyed a more adequate idea of the extent of the destruction foolishly wrought.

40. If then the machinery for destruction is so great, and it is possible not only to stay its destructiveness but even to use it as a machinery for propagation should not the opportunity be availed of?

41. In the matter of pisciculture something has already been gathered from the Chinese. This intelligent, though uncommunicative, people have long practised it, and as they also have rice fields, it is probable that they have thoroughly studied how to overcome irrigational obstructions. On this, the main Indian difficulty, much valuable information might probably be obtained from them. It is not likely to be found in books, for they are not the class of difficulties to attract the attention of a European or American. Personal inquiry on the spot, by one interested in the subject, is what would seem to be required. Such an one can probably be found among the regiments or residents there stationed.

Legislation for Fry.

42. But private interests are concerned in the rice fields, and the question arises, how they will be affected? The

agriculturalists will doubtless be much discontented if they are prevented from enjoying the juicy morsels which they have been accustomed to obtain with such ease, and they will certainly think it very hard that they should not be allowed to eat even the little bits of fish in their own fields. But will they be right in thinking themselves aggrieved? It would seem that they will have very little, if any, more right to complain than has the English miller. They are like each other in diverting the rivers for their own benefit, and of each of them the request made would be the same, namely, that they should do it without injury to the fisheries. The Indian farmer may, like the English miller, claim that he has a prescriptive right to the water, and that it is no part of his business to protect the fry. It has nevertheless been decided against the English millers, equally with the companies or persons in charge of artificial channels for navigation, or for supplying towns with water, that they shall put gratings so as to prevent the passage of salmon fry to their destruction, and that, failing to do so, "they shall incur a penalty not exceeding 5*l.* for every day" of delay, and "a penalty not exceeding 1*l.* for every day" during which they may fail to maintain them when erected. Would it be unjust in the public interests to make the same demand of the Indian agriculturalist?

43. But the Indian farmer cuts off the whole stream, Para 11. and leaves no downward passage at all, except through his own fields. The option therefore might be given him, "either you must leave a fair passage in the river for the fry and put a grating before your own artificial channel, or if you needs must have every drop of water in the river and make the only passage run through your own fields, then you must leave that passage unobstructed to the fry." Whichever alternative is accepted the result is the same, fry are not to be

entrapped in the rice fields. As with salmon in England, therefore it should be made illegal "to place any device for obstructing their passage."

44. It may be argued that the analogy of the Indian farmer and the English miller is faulty in one respect, the former having the use of the water itself, while the latter has a right only to its passing power. But the principle at the root of both cases is the same. The real question is whether or not private interests are to yield to public advantages; whether it is necessary that they should yield, and what amount of hardship the yielding will entail. As regards the hardship involved, the expense to which the Indian agriculturalist will be put will be as nothing to that of the English miller; the loss of much appreciated morsels will be a vexation, and the fact of their being replaced by fish becoming more plentiful is not likely to be taken into account. On the other hand, the necessity for the measure may be judged of by the destruction now Para. 25 to 40. carried on in the rice fields. Though in the case of fresh water fish it might be possible to arrange, by gratings at the commencement of the channels, to keep them in the river till the monsoon came and carried away the temporary dams, still they would be in many respects very unfavourably placed; and in the case of sea-going fish like the *clupea palasah*, there seems no other way of protecting their fry from total extermination, for reach the sea they must, and they have no other way but through the rice fields. Therefore it would seem unavoidable to prohibit the entrapping of fry in the rice fields.

45. It will further be desirable to make provision for a way being kept open for the fry eventually to rejoin the river by means of the waste water. This will frequently be found to have arranged itself, though in some places it will be susceptible of improvement by a very little labour, while

in others it may be a little expensive to open a satisfactory communication. Most of these places again are liable to get a little out of order from being trodden by cattle, and from other causes, and may at the commencement of the monsoon require the most trivial repair to keep them in order. In those cases in which the labour entailed is really nil, or next to nil, the responsibility of maintaining them in order might be thrown on the cultivator. In other cases a contract could be made with the cultivator to make and maintain any desired communication. Which cases should be thrown on the cultivator, and which should not, might be decided under the orders of the Collector of the district, as such subordinate matters are by conservators and commissioners in England. The Collector's decision might also be subject to appeal to the Board of Revenue, as are the decisions of commissioners to the Home Office, or in their place to an Inspector General of Pisciculture for the Presidency.

46. It may at first sight seem arbitrary to cast this labour on the farmer, but it is not requiring more of him than is exacted of the millowner in England. The latter is called on to make repairs to prevent leakage, when such wastage of water from the main stream is considered to interfere with the safe passage of the salmon. The chief ground of the demand would seem to be that the necessity for it arose out of the action of the person on whom the call is made. In the case under consideration it is the diversion of the water by the farmer that has caused the necessity for providing other passage for the fry.

47. In maintaining the channel, practically no one can have less difficulty than the person always on the spot, to whom also there will not be wanting enough of opportunities for throwing seemingly accidental obstacles in the way. For instance, what is easier than to remove a plank and

lay the blame on the force of the stream; what is easier than to scrape the shingle together in a mound across the waste water so that the little stream shall percolate through it, and none of it be able to run over. By this means the fry would be effectually prevented from getting down to the river. The farmer deprived of the fry to which he had been accustomed would be not at all unlikely to retaliate in some such manner. And who is to fix it upon him? It would be generally impossible. It is therefore necessary to make him responsible for the maintenance of the passage for the fry.

48. It will be similarly desirable to fix the same responsibility on the man who contracts to do the same for a consideration, for if a suit is to be filed in the civil courts for every breach of such contract, the fry will not survive "the laws delay."

49. These, and other things necessary for the protection and improvement of the fisheries, cannot be done without law; a rough sketch of a draft Act is therefore enclosed in Appendix F. It need hardly be mentioned that it would be impossible for such a draft to be made complete and legally accurate by one who has not at command for reference the already existing Indian enactments on matters which must be provided for, matters such as jurisdiction, commutation of fines, collection of taxes and rents, together with provision against abuses therein. All that has been

The Laws relating to Salmon Fisheries in Great Britain, &c. by Thomas Baker, Esq., B.L., &c. London: Horace Cox, "Law Times" Office, 10, Wellington Street, Strand.

aimed at, therefore, has been to aid those whose proper duty it may become to draw up a law on the subject by a sketch indicative of such requirements as strike the writer and might not strike the reader. The little work marginally noted, may also be found useful as showing what has been done in the matter in England, Scotland, and Ireland.

50. Apart from the question of legal accuracy and completeness, it will be remembered that the subject of this report is the fisheries of the South Canara district alone, and that consequently it is beyond my province as well as my opportunities to make proposals about any other; though the proposals contained in this report will probably be found to have applicability to other west coast rivers also, and other seas and estuaries. It is obvious that in the Madras Presidency alone, further provision will be required for differing circumstances on the east coast and in the interior. In reference to these, the opinions of the several collectors, and of Dr. Day who has visited their fisheries, are doubtless before the board. In connexion with the innumerable reservoirs therein, it may be allowable, however, to throw out, in passing, the suggestion, that instead of constructing them as our engineers do with the sluice so placed as annually to drain out the very last drop of water, it might be wiser in all fresh constructions and when possible in repairs, to follow the example of Hyder, who so placed the sluice that after all the water available for irrigational purposes had been drawn off, there was still left in the reservoir some six or ten feet of water at the embankment, and this water served in the dry season, and more especially in times of drought, the treble purpose of feeding wells and thus supplying drinking water to the inhabitants, of watering the cattle of the agriculturalists, and of keeping alive a nucleus of fish wherewith to re-stock the reservoir by natural breeding on its refilling at the commencement of the rains. The manner of constructing and repairing reservoirs, and the restrictions necessary to prevent netting when they are so low that it is next to impossible for the fish to escape extermination, are among the matters to be considered in any legislation calculated to meet the requirements of the east coast and interior equally with those of the west coast.

Fry in Pools.

51. Before quitting the subject of fry it will be well to guard against misconception on one point. It has been Para. 33. said that the whole river is frequently diverted into the rice fields, and that none of the fry in the rice fields Para. 34. escape destruction. It would be a not unnatural conclusion that it is meant to be conveyed that all the fry in the river are thus destroyed, and so it would be if the Para. 27, 28, 29. spawning places alluded to were the only ones, and if the fry had not sometimes intermediate water deep enough to satisfy their descending instinct. But fortunately the fish do not all spawn by one rule, so as to make their fry all dependent on the accident of the successful or disastrous issue of a single arrangement. The mahseer apparently go on spawning at different localities for three months. Many will thus be below the dams when spawning, and many again will be below the upper dams, and have miles of deep water in which to live between them and the lower dams. This is the case at *Siradi*. There are four miles above and 12 miles below it, altogether 16 miles, without a dam across the river. Within this space there are many deep pools, which tempt the big fish to stay, and which shelve gradually up to very shallow water running over sand, gravel, or shingle. The shallow water at the tail of these pools is not after the spawning time liable to any great fluctuation in depth; for, however low the water in the river, the water in the pool must necessarily rise to the same level before it can flow over at all. Consequently the tails of pools form favourable spawning beds, and being not unfrequently followed by a long scour, the fry have a very fair chance of escaping their devouring parents, who, after spawning, have returned to deep water nearer the head of the pool, a

furlong or a quarter of a mile, more or less, away from their fry. These are the fry that, having kept out of the rice fields, used to be caught in the numerous basket work cruives set in the river. These are the fry which have peopled the river since those cruives have been removed, and since the poisoning of these pools has been checked.

Para. 20, supra. Also para. 11 of my former report in Pro. Madras Government, Rev. Dept., 27th Nov. 1903. Nos. 504-506.

Para. 21, 22.

52. Seeing then that the larger pools are not only the hot-weather resorts of the larger fish, but frequently the birth-place of the fry also, the mischief done by poisoning them and tainting the scours below, is greater than at first sight appears; for fry, as well as big fish, are poisoned.

Stock Pools.

53. But though poisoning be reduced to a minimum, the fact of the larger fish being driven out of the rest of the river by the lowness of the water in the dry season, and compelled to mass themselves in the pools, will still be taken advantage of for netting them. At that time parties of Moplals make expeditions as far as Sirady, 50 odd miles from Mangalore, prepared with boats and sets of large nets to fish all the pools; and so great are their takes that traders come down from Manzerabad and the neighbourhood to purchase, slightly salt, and carry into the interior, the fish that are in excess of the local demand. Weavers, and others who are not fishermen by trade, turn out in force, unite all their nets in one, and sweep these pools. There is the danger, therefore, of the river being over-netted, and an insufficient stock left to supply spawn the next year. It would be well, therefore, to select a few of these pools, and in them to prohibit netting altogether.

54. That there might be no needless anxiety as to which were prohibited pools, and no idle excuses of having netted them by mistake, they might be distinctly marked, at a trifling cost, with the Queen's broad arrow, cut on the rock. An arrow on each side pointing up stream from the tail of a pool, and an arrow on each side pointing down stream from the head of the pool, would indicate that all between them was reserved from nets.

The cost of this precaution is estimated at Rs. 100, and entered in Appendix C.

55. The pools would have to be selected not only with a view to their being convenient to the fish and fry, but also with some reference to their being convenient to protect. Pools in the neighbourhood of the land or house of the head of the village would be preferred; and for the extra duty of throwing his ægis over them a trifle might be added to his very meagre pay. Six rupees a year for each head of a village thus employed would probably come to somewhere about Rs. 300 a year out of the fishery rents. Without some payment it cannot be expected that the duty will be well done for a continuance.

56. Fortunately there are already two places on tributaries of the Puiswany and Netravatty where the fish have, in the priests of the temples at Thodikàn and Cicilly, friends as stout as were the monks of old. They have a legend that their god Ishwara performed a journey from Kailàsa to Thodikàn on the back of a mahseer. These fish, therefore, which are fortunately the best fish in the river, are considered sacred, and no man is allowed to harm them in any way, and the priests and pilgrims feed them. The consequence is that they are exceedingly tame and numerous. They crowd together till, for 20 yards round the temple steps, fish of all sizes, from eight pounds downwards, are packed as thickly in the river as sardines in a tin, scrambling over each others backs into the air, and up

the stone steps, and taking food out of the very hand. One was caught for identification in a saucepan, and immediately released again.

57. At Cicilly the fish are in the open river, and though nothing more can be done than to encourage the priests to go on feeding and preserving them as hitherto, it is at least an extensive stock pool guarded gratis.

58. At Bantwāl also the mahseer congregate in considerable numbers at the temple steps for the washings of the dishes, and are occasionally fed. But without catching them and expressing their ova no natural advantage can be taken of their presence in that locality.

59. At Thodikàn, however, the fish are most beautifully placed for piscicultural purposes. A bird's eye view sketch of the place, showing the present arrangements, and the advantage which it is proposed to take thereof is enclosed.

Appendix E. The place is a delta, and the mahseer crowd up both branches of the river to be fed. One of these branches of the stream is dammed in September or before the spawning season, and the fish are unable to get over the dam till it is washed away by the south-west monsoon, or in other words, till months after they have spawned and the fry are hatched. All the water from this stream is used for irrigation, and there are under it about 30 acres of rice fields. The waste water of these rice fields leads easily without any trouble into the river again. If the strict conservancy of these rice fields is taken up, millions of mahseer fry may be annually turned into the river.

Rate of Growth of Mahseer.

60. Here in the dammed up channel at Thodikàn there were mahseer of all ages down to less than the length of a

span; and it suggested itself that the numbers here, and the great ease with which they may be caught offered unusual facilities for ascertaining their rate of growth, whether slow as that of carp generally is, or bearing any sort of comparison to the rapid growth of a salmon. The concurrence of the temple authorities, with whom it is desirable to act in unison, was therefore obtained to any number of the sacred fish being marked by attaching a tiny plate to the dorsal fin. They sometimes adorn fish thus themselves, and were rather pleased at the idea, though well aware that the object was identification.

61. The mahseer being a carp has no adipose fin like the salmon that can be easily clipped. I could therefore think of no better device than having thin plates bearing minute consecutive numbers cut as small as possible, and fastened by a thin silver wire to the base of the second ray of the dorsal fin, and so loosely tied with a yielding knot as to allow of that ray growing to full size. The fish could be weighed before the plate is attached, and the number of the plate, together with the weight of the small fish being entered against the date in a book, the fish could be returned to the water; and any of these fish caught again in the next or following years could be again weighed, and the growth in a certain time thence calculated. By cutting

thus:
 stands for 985
of 1870.
 " " 985
of 1871.
and so forth.

out the plate with a die of a different shape each year, the year would be distinguished without multiplying figures or enlarging the plate so as to contain them. The dies have been very nicely made at a trifling cost by the courtesy of the superintendent of the public works workshops. They have not been here tried yet, because it was only lately that an opportunity occurred for visiting Thodikàn, and becoming aware of the facilities for there ascertaining the rate of growth of the mahseer.

62. A sufficient number of small fish might be marked by a couple of peons* in a week, while * Men paid at Rs. 7 or 14 shillings a month. superintending other arrangements at the same place, Thodikàn, and this may be among the things to be done in future piscicultural experiments.

Fixed Engines.

63. While for the protection of fry, closely-twined cruives have as far as possible been banished from the rivers, those in which the bamboos were far enough apart to allow a finger to pass have not been interfered with, and it now remains to be considered whether they should be permitted or not for the future.

This was promised in para. 24 of my former report, enclosed in Pro. Madras Govt. Rev. Dept. 27th Nov. 1908.

64. For the sake of perspicuity it was hoped that diagrams of the different fixed engines used in the Canara rivers might be enclosed, and models were brought to England for the purpose. But fresh models can if desired be procured from the Canara district. For want of precise English equivalents the native nomenclature is followed.

65. The common kuri is a basket made on the same principle as the mouse-trap with narrowing entrance and springy bamboo spikes projecting inwards so as to prevent return; on the same principle as the mouth of the purse in a trawl net. On this plan they are made of all sizes and of many shapes. The small ones used to catch the fry in the rice fields are about a foot long, and are made of finely-split and closely-twined bamboo, while those used in the rivers are sometimes the same, and sometimes as much as 10 or 12 feet in length, and more elaborately constructed. These are the traps called cruives in this Report. The closely-twined small ones have already been alluded to as banished as far as possible from the rivers for the protection of the fry. The larger ones are placed in the main runs, facing

either down stream or up stream according as the fish are known to be migrating upwards or downwards at the time. As the people knows the habits of the several fish, and adapt these fixed traps to the runs and the fish to be caught, and keep them down day and night, for months together, they are very successful traps.

66. The Voddu or Woddu is like a large hurdle the full breadth of the river, and is frequently thrown across a stream as large as the Thames at Richmond. A line of stakes being driven in right across the river, split bamboos are interlaced, and the whole is faced with bushes, so that, though the stream is not stopped, not a fish can pass. A few gaps are made, and in them are inserted the large cruives or kuris before explained, and each of some 10 or 12 feet in length. This structure is put up before the time when the fish usually descend the rivers, and is kept up till, from the diminution in the stream, all have endeavoured to do so and been caught. The kuris only are daily examined, and the fish removed. It will be easily conceived how destructive to migratory fish such a structure must be.

67. The Coorgs annually place Woddu at the heads of the Canara rivers to catch the fish returning from spawning.

68. The kàndàri is just a large kuri, with the addition of an upper lip extended forwards and upwards at the angle of 45°. It is put in a natural run in the river between boulders of rock, and made big enough to fill the whole passage, all minor ways being blocked with huge stones. The long protruding lip comes well out into the air, and prevents fishes from leaping over or being carried over the whole contrivance when coming down the rapids. It is obvious how destructive a fixed engine it must be, for every migratory fish coming down the rapids has no option but to run into it, and once in

exit is simply impossible. The trap is taken up and examined twice a day, the fish being removed by disconnecting the sack end from the mouth end at the neck. Where there are no convenient rapids they are artificially made, on a small scale, in the shallows, by placing long lines of large stones right across the river in the form of a V, a passage for the run of water, or a place to fit the kàndàri being left at the bottom of the V.

69. The yèvu and bàikuri trap is on the same principle, but better adapted to falls. The yèvu is a platform, made of bamboo, somewhat bellied so as to hold the stream, and propped up so as to lead ladderwise from the top to the bottom of the waterfall at an angle of 45°. The fall is thus broken and conducted with a rush into the bàikuri or wide-mouthed kuri, the construction of the bàikuri being very similar to that of an ordinary kuri, and the rush and concentration of the water being heavy, fish once down cannot reascend, but are quickly beaten to the bottom and smothered by other fish.

70. The yèpu is a less elaborate adaptation of this last contrivance to smaller falls.

71. The kunjol also is a rude sort of kuri.

72. All these fixed engines, particularly the Voddu which spans the whole river, interfere with the migratory habits of the fish, and are too thorough in their destructiveness to leave a sufficient number of spawning fish in the river. It is highly desirable that they should be generally prohibited, and only fair netting allowed. If permitted at all, they should only be allowed under special licenses in a few particularized runs out of many, so that other runs might still be open to the migratory fish.

Close Season.

73. The Board has desired to know whether a close time should be enforced. The circumstances of the South

Canara rivers differ so widely from those of English streams that it does not seem necessary to follow the home example in this respect. The monsoon floods render it practically impossible to net for four months in the twelve, and the body of water still in the river makes it scarcely worth while to net for three months more. Netting is generally delayed till the large fish are driven by the general lowness of the rivers to congregate in the pools.

Para. 53. If a few stock pools are reserved and fixed engines

Para. 72. prohibited, a close time may as far as the fisheries are concerned, be safely dispensed with.

74. Whether by reason of any particular fish being at any particular season unwholesome for food, it be desirable, on sanitary grounds, that their return to the water should, as in the case of foul salmon, be insisted on, is a question to which a satisfactory answer is not readily returnable. To determine it further inquiry will be necessary. No ground has at least been met with for attaching any urgency to the early settlement of this portion of the question.

Size of Meshes.

75. The meshes of the nets now used in the rivers and in the sea are of all sizes, from three-quarters of an inch to twenty-four inches in circumference; the Government has ordered the prohibition of nets with meshes of less than 4 inches in circumference; but very many sorts of fish both in the rivers and in the sea never grow to a size to be entangled in such nets. To prohibit smaller meshes therefore is to prohibit netting for these fishes and to cut off from the people a large per-centage of the food in the waters. Properly to appreciate the effect of this order, it is only necessary to observe how large a fish can escape through a mesh 4 inches in circumference, and how many

Pro. Bd. Rev. No. 3823
dated 28th May 1869, Govern-
ment order thereon 25th June
1869, No. 1812.

sorts of fish there are that are seldom or never large enough to be caught in such meshes, and how numerous those sorts of fish are.

76. The ultimate effect on the fisheries would probably be still more unfortunate. The smaller sorts of fish having immunity from netting must disproportionately increase on the larger netted sorts. Nature has arranged that the larger predatory fish shall balance the smaller, and thus maintain due proportions, but if one sort is netted by man, and the other sort has immunity, the balance is disturbed, Para. 25. and the larger fish are no longer able to maintain their position. It is true that the predatory sorts of fish are not few in number, but their numbers must none the less have been calculated by nature with reference to the number and prolificacy of the smaller sorts of fish. But however well calculated they may be, to keep the latter within due bounds they must cease to be able to do so when their relative position is as altered as it must be by netting the larger fish and not netting the smaller. The balance is disturbed by the netting being thrown into one scale only. The mischief of the balance being disturbed lies in the fact of much of the insect life in the waters being the common sustenance of both large and small sorts of fish. If the latter disproportionately increase on the former they monopolize this food, and the larger fish, and especially their young, are starved. Minnows have starved out trout. It has been a question whether it would not improve the Thames fisheries to allow again a certain amount of netting of the smaller fishes. If this can be a question on a river that is crowded every day with hundreds and perhaps thousands of professional and amateur anglers, armed with the best of tackle, it must surely be beyond a doubt in a country where there are no amateur anglers, and the professionals are few indeed and very rudely equipped.

77. On both these grounds, therefore, it would seem that the size of the meshes to be prohibited should be reconsidered. The object should be not to interfere with the netting of fishes that are always small, and only to protect from premature capture the young of such as are calculated to grow to a large size. Two inches in circumference is found to be the size of mesh most convenient for the capture of several sorts of small fish that are the most abundant in the Canara rivers. These are fishes that when at the size to which they ordinarily attain, would escape through a mesh 4 inches in circumference. Their ordinary size is nevertheless such that but few fish are able to prey on them. There are no sorts, it would seem, but those given in the margin that would be large enough to prey on them when mature; and of these sorts even only one individual in a thousand would be grown enough to make of them a comfortable mouthful. Furthermore, even those fish that can eat a larger fish than their neighbours can, not unfrequently take smaller ones by preference. There would be few indeed then of the predatory fish that would habitually prey upon the fish that can be taken by the 2-inch mesh and escape the 4-inch mesh. As they are not only not required then by the larger fish, but would also be likely to injure them by out-numbering and starving them, and especially their young, if given immunity from the netting to which the larger sorts are subject, would it not be advisable to add them to the food of the people, and to that end to permit a mesh calculated to catch them. Such a mesh, it is repeated, is one 2 inches in circumference.

These are of the sorts numbered 3, 8, 9, 12, 19, 21, 22, 23, 27, 30, 31, 36, in the list given in Appendix G.

Nos. 17, 18, 24, 25, 26 in the same list.

78. While advocating the allowance of a mesh of this size in rivers, it would seem undesirable to allow any

smaller ones; for if there be no restriction placed on the size of meshes, it is probable that the fry of large fish will be captured along with the smaller kinds of fish; for below a certain size it is not always so easy to recognise the young of large fish, at least not so easy as to be able at once to pick them out and return them to the water alive, not easy enough to be able to detect them at a glance in the fisherman's or salesman's basket, not sufficiently easy to justify the magistrate in presuming *mala fides* against the destroyer thereof. If no meshes less than 2 inches in circumference be allowed, there will be no difficulty about recognition, and the fry of the larger sorts Para. 79. can be returned to the water. Again the restriction of smaller meshes will have the effect of leaving the smallest sorts of fishes as food for the bigger ones. These will scarcely be able to increase on and injure the larger ones by competition for food, for the fish that never grow large enough to be captured by meshes of 2 inches in circumference are more easily kept under by the predatory fish, because there are more fish that are large enough to prey upon them, and because more of them are required to satisfy the largest. It is not likely, moreover, that they will prove unequal in numbers to feed the larger fish, for they are very numerous and as prolific as they are small, and in addition to them there will always be the immature fish of the sorts proposed to be surrendered to the two-inch meshes. Moreover if both these fail to suffice, it is still easy to multiply *ad infinitum* the supply of these smallest End of Para. 37. fish by protecting the produce of hill streams.

79. If, then, meshes of all sizes from two inches in circumference upwards are allowed for the capture in the rivers of small sorts of fishes, provision will have to be made for the protection of the larger sorts of fish liable to be caught therein, and this might be done by making it obligatory to return to the water all the following fish :

In the rivers.

Those numbered in the list in Appendix G.

1,	}	When of 9 inches in length or under.
2,		
5,		
6,		
7,		
17,		
18,		
24,		
25,		
26,		
33,		
34,		

80. The objection may be raised that few fish once caught are likely to be returned to the water, and that consequently it will be more practical to prevent their being ever caught. But a sweeping prohibition of small Para. 76. meshes will, it has been urged, be more baneful than advantageous to the larger sorts of fishes, and the system here advocated is the one followed in England, and by the aid of punishments for offenders and rewards for informers might soon be set working in India.

Spawning Time.

81. The spawning times of all fish are probably subject to some variation in different years; the observations of a single year are therefore not to be implicitly relied on, though carefully made. There has also been considerable difficulty with some fish in capturing them at all times for examination. But of the fish shown in the following table Appendix G. sufficient numbers have been caught and examined from time to time to make the seasons set against them very fairly reliable.

82. Not only do some fish of a sort spawn early and some late, but the same individual seems to spawn two or three times, and perhaps oftener in a season. In October or November a mahseer generally contains three distinct sizes of roe, and the two larger sizes are mostly shed before January. Whether they have been laid in two batches or from time to time as they became mature, cannot be certainly stated, and it remains to be seen whether the minute

Roach carry two crops of roe at one time, and a laying fowl, it will be remembered, contains the yokes of the eggs of many days to come in different degrees of advancement.

these fish do not accomplish their spawning operations in as short a time as salmon, but lay a few eggs from time to time as they ripen, and that this lengthened spawning may be a provision to meet the variableness in the rivers. Several Indian fish have also been ascertained to spawn twice a year at distinct periods, with an interval of several months between, and more fish may do this than we are aware of. Here then is unusual fertility, as well as adaptability to changing rivers.

Particularized in
Appendix G.

83. It will be seen from column 11 of the accompanying Appendix G. table, that though there are in the rivers some fish or other spawning in every month of the year except August, the very great majority of the small fish spawn in May, June, and July, (a few of them repeating the performance in October, November, December, and January), and that the spawning time of the mass of the big fish extends over September, October, November, December, and January, but is chiefly confined to December and January.

84. The quantity of spawn contained in each fish has

been but slightly tested. As far as examination has been made, Indian fish seem to be as prolific as others.

A mahseer of 6½ lbs. contained 13,219 roe, which is 2,115 to the pound.

"	11½	"	10,587	"	941	"
"	6	"	9,444	"	1,574	"
"	5½	"	12,440	"	2,163	"
"	3½	"	4,350	"	1,243	"
"	5	"	6,034	"	1,206	"

Average - - 1,540

85. It may be interesting to know that here as elsewhere some fish build nests among the rushes at the margin of the

water, deposit their eggs therein and keep guard over them like a stickle-back. Others exhibit parental affection, swimming always close below their offspring and attacking everything that comes near them. This they do till the fry are about three inches long, when they turn on and eat them themselves if they do not disperse. Others again spawn in the sand, in the gravel, and even on rock. But all that has been ascertained will be found particularized against the different fish in column 11 of the list of fishes in Appendix G. An attempt to discover the period of incubation is also noticed below.

Nandus marmoratus.
Nandus malabaricus.

Ophiocephalus striatus.
" marulius.
" diplogramme.

Food of Fishes.

86. What has been ascertained of the food of different fishes is also shown in the accompanying table. This has been gathered, not from hearsay, but from the contents of the intestines. This is interesting as showing the sustenance necessary for their increase and their influence on each other. Some fish seem to be almost entirely herbivorous, and they find an ample supply of fresh water weeds* on all the rocks in the rivers. Others prey on their brethren, and others again are omnivorous, and none more so than the mahseer. For the

* Six different sorts of podostemaceæ have been gathered in flower and seed, but the names of only two of them have been ascertained. These are Moriopsis hookeriana and dalzellia pedunculosa.

purposes of this report the fish are classed in the accompanying table with reference to their food, and consequent influence on each other.

87. The teeth in the throat of the mahseer seem unusually powerful. They are required to be so to crush fresh water snails, and crabs the size of the palm. They would make very short work of breaking a finger bone. They are also somewhat more pointed or carnivorous than is usual with the carp species. This peculiar formation of their teeth accords with the observation that small fish also form a large portion of their food. Specimens of their teeth are submitted. The gall-bag too is unusually large. It is much prized by the country people as a remedy in cases of stomach-ache, cholera, and puerperal fever.

88. Except in the neighbourhood of the coast, the rivers are generally fringed with forests, the foliage of which yields no scant supply of insect life; the overhanging bamboo swarms with small moths and a bush that springs up in the bed of the river as it dwindles teams with various flies. The dhoop drops seeds as big as a bantam's egg, which with the different seeds at different seasons of many descriptions of trees and the bamboo rice, are greedily devoured by the expectant fish. The Cyanite rocks with which the rivers abound are covered with many sorts of water crickets, and the fresh-water weeds are alive with shrimps and beetles. The tender roots of trees and the leaves of the lillies in the shallows are freely found in the intestines of some fish, and others are filled to repletion with the simple green leaves of certain overhanging trees, well known to the natives, and used as ground bait before netting. Here in the tropics vegetation by the waterside is

Ampullaria elauca L.
Paludina bengalensis.
One of *Unio* species.
Lymnaea stagnalis.
Planorbis Indicus.
" *Coromandelina*.
Two of *Corbicula* species.

Vateria Indica or Vegetable
tallow tree.

Podostomacra.

Valisneria spiralis.

rank, and insect life is in profusion, so that the food supply of the Canara rivers can well bear comparison with the best waters of colder climes; and there seems no limit on this score to the number of fish that these rivers are capable of sustaining.

Enemies of Fish.

89. But the otter, the crocodile, the kingfisher, and the cormorant, share with man the produce of the waters.

90. The otter is doubtless much more destructive than the crocodile, both because it is more numerous, and because it kills and tastes a great many more fish than it eats. Fortunately there are men that entrap it for the purpose of eating it. A reward offered for its skin would stimulate their energies and enable them to spare more time to its pursuit. Similar inducement might with advantage be offered for the destruction of crocodiles. Want of sufficient funds has prevented their being offered in the year under report. The following rewards are proposed.

Payable by every Thasildar on production of the skin of the otter or head of the crocodile.	For every otter -	-	Rs. 3	0	0
	" " crocodile	-	3	0	0
	" " " egg	-	0	2	0

91. The kingfishers are numerous, and of four sorts, one as small as the common English kingfisher, another as big as a jay, and two others very little less. They live on the fry and small fish, but their bright plumage is their ruin, for it is saleable, and a class of men make their living by capturing them.

92. Frogs do some mischief among the fry, but they have themselves enough of enemies. In the water the murrel (*Ophiocephalus*) feeds almost entirely upon them, generally lying close under the banks for this purpose, and on

Hylorana malabarica; *hyla-*
rana florescens; *rana cyano-*
phlyctis (Schn) an unnamed
species of polypedates.

land, mongooses, snakes, kites, crows, and paddy birds assist in suppressing them, while watersnakes follow them in both elements. The frog is, however, mentioned here as a creature to be carefully excluded from artificial nurseries.

The most troublesome is the common brown one (*rana cyanophlyctis*.)

93. The ova also have their enemies here as elsewhere. The small insect forwarded in spirits was when taken very busily engaged tossing the ova up, and turning it round and round, and apparently tearing it open. At 5 o'clock in the afternoon the eggs had evidently been only just deposited, for the male was seen moving away, and the milt had not yet cleared off. Not one of these insects was then visible, but early the next morning the hollow was full of them. How keen then must be their sense for

discovering ova. In three days not an undestroyed egg was to be seen, the empty egg cases only were there. Tadpoles and small fry and a crab and the larvæ of other insects were also there on

the second and third days.

94. Some ova were speedily removed from the river, and carried in an earthen pot of water to a place where they could be kept under the intelligent observation of a gentleman, and there they were transferred to a finely-woven basket which was partially immersed in shallow water, so that there was a constant gentle stream through it from percolation, but no access for intruders. The same insects quickly gathered round the basket but could not find ingress. The mouth of the basket was also covered with muslin. Mr. J. Russel, who conducted this experiment, has sent word that these ova also failed. This opportunity for discovering the period of incubation of the ova of mahseer, has therefore been unfortunately lost.

This was seen by two natives set to watch all day in turns. They did not observe unobserved nor sufficiently intelligently, and so did not discover the intents of these visitants.

95. Men search in the rivers for hillocks where ~~in~~ spawn has been left, gather the ova and make it into cakes, which are considered a delicacy. The eggs of the kari and kalmuri are highly prized. (Nos. 1 and 3 in Appendix G.)

96. Here also lice like parasites are found adhering to the gills and scales of the Canara mahseer, specimens were preserved in spirits, but the bottle met with an accident.

I was informed by Dr. Day that they are a variety of fresh water Algae, hitherto not met by him, and as yet unnamed.

Indigenous Fish.

97. In pursuance of instructions, specimens of those kinds of fish of which the scientific names are unknown, are herewith forwarded in duplicate and triplicate, in spirits and stuffed. They are distinguished by varying numbers and descriptions of attached beads, as indicated in the accompanying table. Those that have been already named and figured, have been quoted as far as they could be recognised. For practical local use, the vernacular names have also been given in several languages.

Conveyed in para. 3 of the Pro. Bd. Rev., dated 23th July 1868, No. 8,405.

Column 2 of Appendix G.

Fish to be Introduced.

98. Hitherto, mention has been made only of the fish indigenous to Canara rivers. These should be first cared for, and they are not few or unworthy of attention. But hereafter it may be thought desirable to introduce a few *Clupea palasah*. others also. The hilsa or sable appears to be a particularly valuable fish, fattening itself in the sea like the salmon, and presenting itself in the rivers when full grown and ready to spawn.

99. The gourami would thrive in the large lake at Karkal, and in the numerous built reservoirs attached to temples and musjids, and used only for drinking and bathing purposes, probably also in the stiller parts of the rivers.

100. *Channa argus*. There is a very fine fish to be found only in one or two ponds at Cundapur, and, though it has now a distasteful muddy flavour, it has probably acquired it from the water in which it lives, for report says that Hyder introduced it, and dug the pond wherein to keep and rear it, as a luxury for his own table. Its flesh is very firm, and some 70 years ago it was selected for praise by Buchanan, and it runs up to 20 or 30 pounds in weight. If it be a fresh water fish, it is very worthy of introduction into the adjoining and other rivers. The water in which it now lives is very slightly brackish, and is tenanted in common by several predatory estuary fish, which would seem to have found their way in when the sluice connecting the pond with the backwater fell out of repair.

Mesopristis rubellus.
Caranx melanostethos.
Acanthopoma.
Chrysophrys caudatus.
 Also a Mugil either *cunneus*
 or apparently *subviridis*.

101. The character of the water in which it has learnt to live and thrive in confinement, would seem to be no indication of its natural habit, for there are ponds in the sand strip between the sea and river at Mangalore, in which the water is quite fresh enough to slake thirst, and yet they contain several distinct species of purely sea fish that have lived and spawned there for more than eight years.

102. The number of the predatory fish in the one pond in which Hyder's fish have been specially protected is so great that that piece of water can scarcely be used, for multiplying the latter for the purpose of distribution. One perch-like fish in particular *Mesopristis rubellus* is unusually numerous, and the protection which, as far back as can be remembered or is recorded, has habitually been extended to this one pond, seems to have benefitted the wrong fish, the red perch rather than

Hyder's salmon-like fish. These perch evade the net by running into the muddy bottom, or among the many roots of wild pineapple with which the pond is surrounded, and the water may be thoroughly netted several times without a single one of them being taken. There is no hope of the pond being freed from these and the other predatory fish now abounding in it; and the only method of propagating the salmon-like fish would seem to be by digging a new pond in the immediate neighbourhood, giving it no connexion with the old pond except by percolation through a trustworthy division of sand, and then transferring a few parent fish to breed there. Being thus in a new pond by themselves all fry appearing might be relied on as belonging to that species, and might be transferred as fry to other waters. When grown they are said to transfer very badly, probably because they are so large and violent that they injure themselves in the small vessels generally used. After they have thoroughly established themselves and bred in the new tank, the old tank might with advantage be drained, pumped out, and thoroughly cleaned of all fish in the dry weather, with a view to its being subsequently re-stocked. But this operation would be rather expensive, costing probably about rupees 3,000 altogether.

103. This fish has obtained a wide celebrity from a mention made of it by Francis Buchanan, M.D., F.R.S., &c., in his work entitled "A journey from Madras through the countries of Mysore, Canara, and Malabar," and a pisciculturist in the Mauritius appears to have thereon meditated introducing it into that island. The manner of its capture is singular. Ordinary drag nets are connected till they are together long enough to stretch

Vol. III. Page 106.
 "Col. Williamson informed me that at no great distance there was a tank of fresh water in which was a kind of fish that the Sultan reserved for his own use, and which by the natives was named Hu-minu, or the flower fish. It is a large fish full of blood, and very fat, but it is only fit for use when salted. For this purpose it is abundant, a circumstance very rare with fresh-water fish; so that the propagating of this species in different parts of

the country would seem to be an object worthy of attention. My time would not admit of seeing any of them taken, as the fishery cannot be carried on without some days preparation."

N.B. Ha-minu, or flower fish, is a name given at random by the natives to several fish, simply because they are considered delicate eating.

On the thwarts in these canoes stand men extending a similar net in the air, at about the angle of 45° from the water, to the greatest height they can reach. Thus arranged the line proceeds, and the fish, frightened by the drag net in the water, endeavour to leap over it, and in so doing fall into the net spread in the air. It is a sight to see a silvery salmon-like fish of 20 pounds or thereabouts face the line with a spring that clears boats and standing men and upraised nets. Sometimes he leaps against the net close to a boatman, or even hits him and brings him down like a ninepin, a sort of tumbling that the fishermen seem to enjoy if the fish is secured and the eventual victory lies with them. Altogether it is a pretty and somewhat exciting scene to witness, especially if the spectator be himself under fire.

104. Want of funds, consequent on the curtailment necessitated by orders issued in connexion with the financial deficit, has prevented anything being done towards the introduction of new fish in the year under report. A few other shortcomings also are attributable to the same cause.

Molluscs.

105. But fishes are not the only food contained in the rivers. There are tons and tons of molluscs which are collected with great ease by the women and children. They are not to be despised in this country while similar articles of food are prized in

Unio.
Lamnae. ~~gibbosa~~.
Ampullaria ~~gibbosa~~ L.
~~gibbosa~~ ~~gibbosa~~.
Corostomella.
Paludina bengalensis.

Practical Waterfarming,
by Wm. Seard, M.D., LL.B.
Page 241, 239.

England and France. There is a growing demand in England for limpets and periwinkles, from 150 to 250 bushels of periwinkles being sold in a day in London alone. A farm for the artificial propagation and sale of edible mussels has been worked for seven centuries in France, and it must have been profitable or it would scarcely be in existence. But whether these shell fish can be artificially propagated, or in any way protected at certain periods, with advantage, is a matter yet to be ascertained. The velorita, which is the most numerous, and the most substantial eating, and is eaten also in Japan, has no byssus wherewith to attach itself, and the mark on one side shows that it lies on the mud with one edge upwards. The method followed for propagating oysters and mussels would therefore seem inapplicable.

The Preservation of Ova in Mud.

106. The possible utilization of sun-dried mud for suspending the progress of incubation in ova in tropical climes, was proposed in my last report. It is a subject the investigation of which would have been particularly interesting to me; but it has not been fairly within the scope of the experiments sanctioned by Government. The process could only be tested by collecting fecundated ova, and hatching them side by side with other exactly similar eggs that had been enclosed for varying periods and in various ways in mud; and as the propagation of fish by an artificial process was expressly excluded from the experiments sanctioned, the amount of time and attention that would have been required for the collection and treatment of ova could not be withdrawn from other subjects.

107. It is hoped, however, that it will be considered a proposal of sufficient importance to warrant its thorough investigation and application to practical purposes as the study of pisciculture advances in India, and in this hope the paragraph on this subject is extracted from my former report and placed in the appendix in order that it may be consulted if desired by any one inclined to make the experiment. Australia, Burmah, and the warmer parts of China and America also are probably in latitudes equally suitable to the trial, and in these places there is no lack of persevering and successful pisciculturists.

108. Meanwhile it is satisfactory to find Dr. Day and Major Puckle thoroughly confirming the premises on which the suggestion was based.

109. Before quitting the fresh waters it may be mentioned that there is at Puttur a pond containing pearl-bearing mussels, but they are generally taken before they are mature. The pond is the property of the temple authorities, and it only remains to advise them to care better for their own.

Sea Fisheries.

110. The observations hitherto made in this report have had reference only to the rivers. But the sea fisheries of this district are more fruitful, and more important. It has been computed that an acre of uncultivated sea bottom yields every week a larger supply of food than an equal extent of good land carefully tilled will produce in a year. The weight of fish and of beef annually consumed in London is in no great disproportion. In Canara, fish are almost the sole meat food of the people.

Report of Sea Fisheries
Commission.

Para. 26.

111. South Canara has a sea board of 120 miles, besides ~~Marginal~~ about 404 miles of estuaries. Apparently from the influence of the littoral upheavings above alluded to, and from the number of rivers carrying down silt into the sea in great quantities, during the violent monsoon, the estuaries are tortuous, and the sea coast is peculiar, shelving out very gradually to a considerable distance, where it suddenly becomes deep. This shallow sandy shore would seem to be favourable to the spawning and rearing of many sorts of fish. For such as require them, there are also not wanting rocky promontories and islands. The shores of the coral islands attached to this district are also fruitful in fish, and one of them in particular is consequently much visited by whales and porpoises.

112. The advantages of the coast fisheries are not confined to the coast inhabitants. Though there are no railways in South Canara for the rapid conveyance of fresh fish into the interior of the country, the many rivers with which the district is traversed afford peculiar facilities for economical carriage by boat, and great quantities of sea fish are sold at Uppinangadi and other places equally distant from the coast. It follows that all the intervening villages on and near the banks of the many rivers, are similarly supplied. There are also many places without river communication in which the fishermen have standing arrangements to deliver fish inland to Moplah merchants, in return for grain and condiments. These are places within 10 miles of the coast, and the fish are carried in baskets on the heads of the wives of the fishermen, and the equivalent in grain, &c. brought back by the same means.

113. The fish thus taken inland are sometimes fresh, but more frequently besmeared with the salt mud deposited on the margins of the backwaters at ebb tide, or slightly salted

with Government salt. But the salt is either so lost in mud or so expensive, that very little is used, and the fish are necessarily so partially cured that in most cases putrefaction has set in before they are consumed. Thus, a wholesome food is made an unwholesome one, and the consumers demand for it, is doubtless much reduced thereby.

114. Furthermore the distance to which sea fish can be carried without their becoming actually offensive at the time of sale, is necessarily very much curtailed by this partial curing. Were the fish properly salted, they might well be taken in cartloads to Munzerabad, Mercara, and other towns of Mysore and Coorg, besides being shipped to the railway termini on the coast, and thence distributed over a much larger portion of the interior.

115. But as long as the salt monopoly is maintained at its present repressive figure, so long will the sea fisheries of India labour under this disadvantage; while the price of this necessary of life is so high that the poor cannot afford to consume with their daily food enough even for the maintenance of health, it is not to be expected that they can indulge in fish cured with this expensive luxury. As long also as fish thoroughly salted in a country in which salt is untaxed is imported into India free of customs duty, so long will the Indian curer be unable to compete therewith.

116. There was formerly an import duty on salt fish, but it was discontinued, I learn, for no other reason than that it yielded less than rupees 1,000 a year, and without any consideration of its connexion with pisciculture. To restore it might seem to be a retrograde return to a protectionist policy, but in the presence of an irremovable monopoly, no other course presents itself. The monopoly, however, might well be reduced to such a rate that it would

become an infinitesimal and consequently an unfelt as well as indirect pole-tax, and the equilibrium as regards Arabian salt fish being restored by an import duty equal to the monopoly price of the salt employed, much of the loss of salt revenue would probably be redeemed by increased use of salt, and the rest could well be recouped by other means, the discussion of which would be foreign to the subject of this report.

117. The estuaries which are extensive, and which, from causes above suggested, run for long distances parallel with the sea shore, are the spawning grounds of many sea fish. The mullets spawn largely in the estuaries and apparently *Cybrium Commersonii*. nowhere else. The seer seems to spawn very near the mouth of the estuaries, while others appear to ascend nearly as high as the tidal influence for the purpose. As far as they are known, the sea and estuary fish will be Appendix G. found particularized in the accompanying table, with their food, time of spawning, and the size to which they attain.

118. In the sea and estuaries, as in the rivers, numbers of immature fish are destroyed in small-meshed nets. But here also, as in rivers, the same difficulty exists in simultaneously permitting the capture of small sorts of fish, and protecting the young of larger descriptions. It would seem to require to be met in the same way by prohibiting, under Paras. 79, 80. penalties, all nets, except shrimp nets, having a mesh less than three inches in circumference, and exacting the return of the following fish to the water:—

Seer, <i>Cybrium</i> (Genus)	of 12 inches or under.
Mullet, <i>Mugil</i> (Genus)	„ 6 „
Pomfret, <i>Stromateus</i> (Genus)	„ 4 „
Sable fish, <i>Alausa</i> (Genus)	„ 6 „
Pilchard, <i>Sardinella Neohowii</i>	„ 4 „
Mackerel, <i>Scomber Kanagurta</i>	„ 4 „

119. This list might be lengthened with advantage to the fisheries and without fear of confusion among the fishermen, for they well know every fish they catch; but perhaps it may be considered vexatious to preclude the destruction of immature fish of even these few sorts. This point, though put forward, is therefore not pressed in connexion with the sea, which is so wide and still so full of life. It is also a point which will necessarily come under the byelaws proposed, and byelaws can be modified from time to time as experience of the working of the proposed restrictions is gained. The fewer the restrictions and the lighter the rents the better perhaps in the beginning, in order that there may be the less opposition.

120. It may be here stated by way of example that I have been horrified at seeing on my own table a seer fish *Cyprum Commersonii*, scarcely a span in length, no longer in fact than he might have been broad and deep had he not been immaturesly caught. Similar short-sighted destruction is witnessable daily in the fish markets. With reference to estuary fish it has been reported "I have seen basket loads of fish about the size of a man's thumb, fish of a sort which I know grow to the size of a man's thigh."

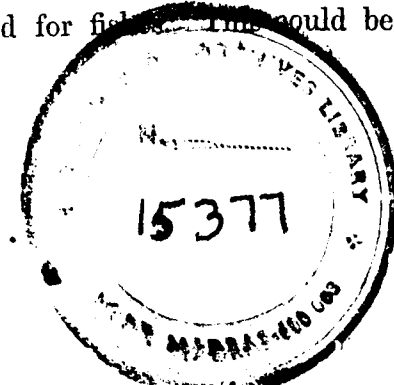
121. Nets are hung continuously day and night across the larger half of the tideways, and fish entering the rivers and passing and repassing with each tide, are thus intercepted; but as the centre, which is deep and required for the shipping, is necessarily left open, the obstruction is not complete. An open period, therefore, of 24 or 36 hours does not seem so necessary as in England.

122. There are marshes by the river side that are flooded by every high tide. The fry of sea fish frequenting the estuaries are in the habit of coasting along the very edge of the rivers, and running into all shallow places. When the

tide rises over these marshes the fry go in with it, probably finding more insect food amongst the swamp grass, and on the freshly inundated land. But when they think to return with the ebbing tide they are met by long lines of close wattle and fine leaf basket work, that allows the water to pass, but not the fry. At every tide in the day time the fry are thus waylaid, and left high and dry, thickly strewn in long lines, whence they are carried away in basket loads. The mullet suffer much in this way. They are a desirable sea fish, and the wholesale destruction of their fry in this manner should be prevented.

123. It has been thought in England that the numbers of sea fish frequenting a shore were greatly affected by the over fishing of their natural food, the shrimp. The mullet lives largely on shrimps and sand-worms. A small plot of some four or five acres in the Mangalore backwater was therefore buoyed off to be left undisturbed for shrimps to breed in. This might perhaps be done with advantage in every estuary.

124. Shrimps may be looked upon rather as a luxury or sweet morsel for men than as real food, while to many fishes these little scavengers are the proper and main sustenance. It is unwise, therefore, of men to take the food out of the mouths of useful fish for the sake of a petty luxury to himself, and thus to starve the latter, and consequently defraud himself of a better supply of food in them. It would be wiser to recognise that shrimps are to man only a luxury, and, recognising it, to treat them as a luxury and not a necessary of life, and consequently to have no compunction about making them so expensive as to be within the reach only of the few, and thus to save them from the many, and leave them to answer the more useful end of being food for fish. They could be con-



veniently done by making the tax on shrimp-nets just so heavy as materially to discourage shrimping. It would seem to be simple justice and wisdom to the sea fisheries, and no real hardship to men.

125. The same remarks have nearly equal applicability to prawns and prawn curries, and not only to Canara and India, but to all sea fisheries.

126. A pisciculturalist in America has gone so far as to advocate the artificial hatching of salmon for the sole purpose of providing a food calculated to induce the bigger sea fish to frequent the tidal rivers in larger numbers. If the fry of such valuable fish can with advantage be deliberately sacrificed for such an end, by turning them into tidal waters at an age at which they are not calculated to escape their devourers, much more would it seem desirable to provide less valuable fish at less cost for the same purpose. A glance at the map will give the best idea of the number of small streams running into the tidal waters. In these small streams, and the rice fields fed therefrom, are spontaneously bred a countless number of small fish of many sorts. These are now waylaid in cruives in rice fields. If they were allowed to find their way into the tidal waters the number and size of the sea fish frequenting the estuaries would probably be greatly enhanced. The protection of the smaller sorts and fry of sea fish by prohibiting meshes less than 3 inches in circumference is also calculated to increase the food and consequently the numbers and size of the larger sea fish.

127. The crab, with one large and one small claw, mentioned as the calling crab of Ceylon by *Gelasimus tetragonon*? Edw. Sir J. Emerson Tennent, is extraordinarily numerous in the estuaries on this coast. At low tide the sands swarm with them. They are the food of sea fishes, and for some of them are the best bait that can

be used. ~~Sand worms~~ *Corithium* are equally numerous and useful, and a small shell-fish, also useful as food for some fishes, might easily be gathered in cart loads at low tide.

128. Sardines or young pilchards, whichever they may be called, used to visit this coast in such numbers that they were the ordinary diet of convicts, and the cocoa-nut trees were manured with them. For nine years, however, they had disappeared as pilchards and herrings unaccountably do from the English seas also; and only stray individuals were caught at intervals. But this year they have reappeared in shoals, and have for the last eight months been daily captured in such numbers, and with such ease, that all the consumption of the large town of Mangalore and of the interior could not raise the price above three pies, say a farthing and a half a hundred. A canoe full has been ordinarily caught in an hour and a half or two hours, with a single casting net, and the rocks in the neighbourhood are completely covered with these small fish, besmeared with salt mud and exposed to dry in the sun.

129. As was to be expected the firm fleshed seer, the porpoise, and other large fish have followed in their wake, and sea fish of all sorts have this year abounded. But rays, hammer-headed and other sharks are generally plentiful on this coast. There is also no lack of the delicate pomfret, mullet, and Indian whiting.

130. Oysters are to be found in several places both in the sea and in the estuaries. But where their abode is in shallow water at low tide they have hitherto been all removed before they are half grown, and left dependant for renewal on such parent oysters as may chance to have a neighbouring

Particularly at Mulky, Kundapur, Kasargod, Mangalore, Cumblar.

habitat in deeper water. An attempt is being made to protect all under 2 inches in diameter, and then to permit their collection under superintendence at fixed periods. No one can be induced to rent the beds on any conditions. It would seem that they must first be shewn to be valuable by demonstration of the take obtainable after some protection. The spat in the estuaries is very plentiful, and groins, stone-faced embankments, rocks, and everything stationary in the water, is covered with cultch, for they all seem to die when less than inch in diameter. The natives think that the freshes in the monsoon kill them. The rivers are then certainly discoloured, and the floods overpower the tides.

131. The Mulky oysters have been found to contain pearls, though it is doubtful whether they are of any value, for they are more opaque than the ordinary pearl, and are generally black. One white pearl I had hoped to forward in order that it might be ascertained whether they possess any value or not, but it has unfortunately been lost. The existence of these pearls has only very recently become known to me, or more specimens would have been procured. For this one I am indebted to a friend.

132. The discovery of these pearls leads to the question whether pearl bearers may not be more widely distributed in Indian waters than has been hitherto known, and whether it may not be well to entertain the possibility and refer it for local inquiry to collectors of maritime districts. Such an inquiry will be inexpensive, and cost very little trouble; it will be no great matter therefore if it prove fruitless.

Rents.

133. As the waters are more fertile than the land, it is
Para. 10. obviously unequal that they who reap the products of the former should be free, while the cultivators of the latter are taxed for the ruler's share. Much more is it

unequal that fishermen should have the free use of waters that have been and are being rendered more fertile by the care and money of the State, while the ryot has to pay by the acre for the liberty of laying out his own capital on the very waste. The State has surely as great a claim to share in the wealth taken with such ease out of its waters, as in the profits wrung with labour from the soil. Indeed it might be argued that the burden of taxation could not be equally proportioned to the fisherman and the cultivator unless the former paid a water tax many times heavier than the land assessment. But on the other hand the take of the fisherman is not as storable and portable a commodity as the crop of the farmer; the market which the former has to look to is therefore more limited and uncertain. In this country of few railways and a salt monopoly, this is peculiarly the case. Moreover it would seem impolitic to impose high rates in a matter in which poaching is so easy, for the higher the rates the greater will be the inducement to poach, and a heavy demand will have a tendency to defeat its own object. Furthermore fishermen are habitually an improvident and therefore a poor class where they might be in easy circumstances; it is doubtful, therefore, whether an adequate rent would not in the first instance press somewhat heavily on them even though it fall eventually on the consumer.

134. Under all these circumstances it seems advisable to make the taxation light and tentative at first, and with this view the rates proposed in this report for present use will be considerably less than those provided in the draft act for future application.

135. The next question is the manner of taxing the fisheries, and the main considerations seem to be the cheapest way of collecting the tax, and the safest and least vexatious way of imposing it. As the produce to be taxed is gene-

rally speaking not confined to fixed acres on which a direct assessment can be laid, but is a roving one, liable to be taken at all hours by day or night, in the wide sea, in the rivers, and in the estuaries, the difficulty of constantly watching so wide an area, and bringing the tax home to all fishers, will be so great that it will for the whole district, or even for a taluk, require too large a machinery to be worked by any one man, particular if that man be a paid Government official who has no direct interest in being specially energetic. On the other hand the renting out of the exclusive right of fishing in any large extent of water would undoubtedly cause much hardship to the poorer classes who had been accustomed to derive their living therefrom. Men who, not only from habit and education, but also from caste, had been fishermen from long ages past could not abandon one profession for another when it pressed hardly upon them; it is difficult for the European, it is tenfold more so for the Asiatic. The renter would have only to exclude them in order to bring them to starvation or to any terms he might choose to impose.

136. The middle course between these two difficulties would be to fix the Government claim on each net or other means of capture, and then to farm out the liberty of collecting those claims. The renter would thus be restricted from raising the tax at will, would be precluded from interfering in any way with the man that paid through him the fixed Government claim, and it would obviously be his interest to let none of those claims escape him.

137. The labour and consequent expense, however, of overtaking every unlicensed fisherman would be very great, and after a certain point out of all proportion to the tax to be collected thereby, and thus there must always remain a large margin of poachers whom no one is sufficiently interested to pursue. The greater the propor-

tion of poachers the greater the proportion of the cost of collection to the tax collected, and the less proportionately the advantage obtained by the honestly paying fisherman; for the expenditure on conservancy is likely to be regulated in future years with some regard to the receipts. Hence it seems desirable to devise means of making the extra cost of collection fall as far as possible on those by whom it is caused. With this view it is proposed to charge a heavy rate of interest on arrears, and penalties on evasions of tax, the whole of such interest being payable to the renter, and the half of such penalties to the informer whether he be the renter or not. The details of the above scheme would be as follows:—

138. The collector would first divide the sea, estuary, and river fisheries into convenient lengths before advertising them for sale. For this purpose the simplest arrangement would seem to be to keep the sea, the estuaries, and the rivers distinct; to let the sea board in lengths extending from the south bank of one river to the north-bank of the next, the mouth itself being covered by the licenses of either renter; to let each estuary singly and entire from the sea to the highest point of tidal influence; to let the rivers according to managies. This being the general scheme, modifications might be made, if desirable, in consultation with the villagers and persons proposing to be renters.

139. The taxes collectable by the renters must also be fixed, and the following rates are proposed:—

Per Annum.

For every drag or wall net of 100 feet in length or under, and for every such additional length or under, provided the mesh is more than 12 inches in circumference:

If used in fresh water only -	-	-	Rs. 3
If used in the sea and estuaries	-	-	„ 4

* Per annum.

For every drag or wall net of 100 feet in length or under, and for every such additional length or under, provided the mesh is less than 12 inches in circumference :

If used in fresh water only	-	-	Rs. 5
If used in the sea and estuaries	-	-	6
For every casting net, if used in fresh water only	-	-	" 2
" " " the sea and estuaries	-	-	" 3
For every shrimping or other small net	-	-	" 24
For anglers and spearers	-	-	" 1
For every fishing boat, inclusive of all nets and lines used therein	-	-	" 8
For every general license to fish with all descriptions of legal nets and lines throughout the district	-	-	" 12

140. The rates are arranged in the scale they are, because the sea and estuary fisheries are much more fertile than the fresh water fisheries, and a higher tax is laid on small-meshed than on large-meshed nets, because the former should pay in some proportion to their destructiveness in the capture of immature fish.

141. Fathers take their boys of all ages out with them to aid them in their fishing excursions, and when sick or otherwise engaged, send them out in their place. To avoid the latter being interfered with by the renters, and to guard against the tax being repeated on different members of the same household, it is proposed that a license taken out by the father shall cover all the unmarried members of his household.

142. To prevent an accumulation of taxes on one individual, anyone having paid one rate on a drag net, for instance, should be liable to half rate only on any casting net that he may possess, and should be free of all the other lower rates; or in other words, having paid one full

rate should be liable for half only of any other lower rates, and should be free of all the net rates, and a man having a boat should by one payment be free of all vexatious details.

143. As it may not always be convenient to a fisherman to confine himself to the limits of a single renter, it is proposed that he should pay the full rates to the first renter, and that that should be the renter whose fishery is nearest to the fisherman's usual residence; that the second renter from whom he may desire to take out a license shall only be entitled to claim half rates, and the third renter quarter rates, and that no other renters shall be entitled to claim any tax at all, but shall be bound to grant a free license on the payment of the value thereof, say one anna; or that if the fisherman desire to make all the payments at one place, the first renter shall be able to include the other renters areas in his license or receipt, it only being necessary for him to forward intimation thereof to the other renters concerned within 24 hours; and that any first renter shall be able to grant a general license for the whole district, always sending intimation thereof to all other renters and to the collector within 24 hours. This intimation and these licenses could be easily given on printed forms.

144. For the protection both of renters and fishermen, it would seem desirable that every fisherman should be entitled, on payment of his tax, to receive from the renter a receipt or license, and that he should be obliged to produce it whenever required, and be liable to penalty if found fishing without it, just as if he had not taken out any license.

145. It may seem hard that even anglers should not be free; but one rupee a year or one anna four pies a month, say twopence a month, does not seem much to demand of men that get as much as 12 annas for a single mahseer. Mulletts are much caught with a hook and line; trots are

commonly used, and eels and other fish can be easily taken by night lines. Few men, if any, fish with one line at a time, they have generally one in each hand and one under one foot. The number of habitual anglers is very great, and a considerable return may be expected from this one source alone. To prevent hardship to casual fishermen, however, a license for 30 days fishing might, if desired, be made grantable for two annas, but it is not recommended.

146. The land tax is made payable by monthly instalments, in order that it may not be so much felt by the poorer classes, and that funds to meet it may be realised by the cultivator from time to time by sale of crop or other means. The same arrangement might be followed with reference to the above rates, but to save the renter from being troubled with a multitude of accounts and receipts for trivial sums, the proviso might be made that no sum less than eight annas (one shilling) should be paid in any instalment.

147. The instalments of tax (i.e. kists), would fall due on the first day of the months fixed, and it would be the duty of all persons fishing to ascertain their liabilities, and to offer payment in due time. Fishermen would be the more careful to do this if all arrears were subject to an interest of one anna per mensem in the rupee. This interest should be collectable by the renter in the same way as the rest of the tax, the receipt thereof being similarly acknowledged by him. To guard against abuse of this power, it might be open to any fisherman to refuse to pay such demand except under the order of a magistrate, and to apply within ten days to the magistrate to stay the recovery thereof by distraint. If the magistrate found the demand to be a just one, he should adjudge a penalty of not less than double the demand and double the stamp fees, and award the half thereof to the

January.
February.
March.
April.
May.

renter. If the magistrate found the demand to be an unjust one, the same judgment should be given against the renter. The same rule might apply to anyone not having taken out a license, or having taken a license for a false description or number of nets.

148. In the event of no appeal being made to a magistrate, the renter should equally with Abkarry and other renters be able to realise in the same manner as arrears of land revenue.

149. The sum bid at auction would of course be payable by the renter to the collector in the same instalments, and he would be bound by a contract entered into in the usual manner.

150. Besides these rates, by the payment of which anyone may obtain a license to fish in common with others, a few exclusive fisheries might be let by auction sale, if specially desired, and if not calculated to be a hardship to the public.

151. At Todikan and Cicily the portions of the river Paras. 56, 57, 58, 59. hitherto preserved by the temple authorities on account of the fish esteemed sacred might be exempted from the liability to be fished by ratepayers, and be kept as heretofore in charge of the temple authorities, and utilized as above proposed for piscicultural purposes. Similarly at Bantwal the whole breadth of the river for 50 yards above and below the temple steps might be exempted from the rates, and left free of charge to the temple authorities.

152. The total income derivable from the above sources can for the first year only be roughly conjectured, for though the number of fishermen and the number of nets can be ascertained, it is difficult to say in what light

renters will view the proposed arrangements, whether they will be sanguine of easy collections, or discouraged by the anticipation of many difficulties. Not till renters have taken and worked the new species of farm for one year, will their profits and losses be removable from the region of speculation to that of calculation, and not till then can any amount of real competition be anticipated at the auction sales. For the first year, therefore, it cannot be expected that the Government revenue from this source will be large, whatever the profits of the renters may be. But if the renters do well it will become known, and the rents will next year sell for something nearer their true value. It is, however, roughly estimated that the first year's income will be about Rs. 5,000. In this amount is included the portion of the penalties not allotted by the magistracy to the informer or aggrieved person.

See Appendix C.

Pisciculture to be made a separate Department.

153. If the receipts obtained by the above-proposed means do not equal the expenditure, exception cannot fairly be taken on that ground, for it is not reasonable to expect that a Government, any more than an individual, can commence a new undertaking without some outlay at the first. The only proper question is, what amount of outlay is called for, and promises a reasonable return. This amount being placed to the debit of pisciculture in India, there is good ground for confidence that at no distant period it will be repaid with interest. It will be much more satisfactory that pisciculture should be fairly put upon its trial by the keeping against it of a strict profit and loss account, much more satisfactory than that the proceeds should be lost sight of as hitherto, by being merged in the general revenues, and that every outlay required for its proper advancement should be so sparingly

doled out as to defy success, and should be looked upon as an encroachment on the Imperial revenues. If piscicultural accounts had, as now advocated, been hitherto kept separate, there would be now a weighty balance in their favour, for large sums have been annually taken therefrom from the very commencement of our rule in India, and have been applied, without any return whatever, to other purposes; have been absorbed into the Imperial revenues.

154. This absorption into the Imperial treasuries of all the proceeds of local improvements, is the most disheartening course that can well be pursued to any administration. Whether the administration be a local government or a collectorate, the depressing tendency is the same. Whether the subject of depression be a local road cess, a revised ryotwary settlement, an improved forest conservancy, an extended irrigational scheme, or, as in the present instance, pisciculture, the result is the same. It is impossible that all the many people, nations, and languages, that have gone to make up the vast empire of India, can be so cast in one stereotype mould, that one course of administration shall be equally fitting to all. It is naturally nearly as impossible for any single secretary, set of secretaries, or even council sitting in Calcutta or the India House, to comprehend the varied wants of all, and comprehending, to give to each its due weight. To a local ruler who is in a position properly to appreciate the wants of his peculiar charge, it is disheartening to a degree, to see golden opportunities compelled to yield to the Juggernaut of over centralization, and measures forced on him that, though possibly wise elsewhere, are suicidal and baneful there. Or to put the case in its least objectionable form, what encouragement is there for a ruler to impose on his own people a tax, by which he might hope eventually to benefit them, if the benefit is to be taken away and given to others; and not only that, but his own people burdened

again to make good the maladministration of others? This is the result of over-centralization; it is disheartening to the ruler; it is repressive to the ruled. If truly Imperial matters, such as the maintenance of armies and navies, of fortifications, of political relations, were separated from others, a rateable contribution imposed on local governments for their support, and the rest of the local proceeds left to local administrations, not only would the suppressive weight of over-centralization be removed, and local administrations have encouragement to progress, but the practical results of different systems of taxation could then be much more fairly tried than on paper, and the faulty ones would be compelled to see and correct their own deficiencies, instead of relying from time to time on the support of healthy administrations for the re-adjustment of their finances.

155. This may appear a digression from the subject of this report; but pisciculture has, in the very year under report, suffered from the suppressive system above contended against, about one third of the small sum (300*l.*) sanctioned for its commencement, having been abruptly retrenched for Imperial purposes. It is hoped, therefore, that it may be held fair to urge that it should not be in future subject to such hindrances, and on the principles above advanced, I am particularly anxious that this new subject of pisciculture should have a fair opportunity of creating for itself a stable and progressive existence, should in short be fairly started, and have the command of its own funds; and if doubts are entertained as to pisciculture being ever remunerative, they are hailed as only an extra reason why it should stand on its own merits.

156. But beyond having the command of its own funds, there is another ingredient necessary to success. It is equally necessary that these funds should be properly

administered. Pisciculture seems to be a subject in which but few are interested, to which few therefore have given attention, and few consequently are calculated to advance. Conflicting views are held on the subject, generally in inverse proportion to the amount of attention given to the subject; unity of action throughout the presidency can therefore scarcely be expected, unless one person be selected in each presidency to give his whole attention to the subject. There will be considerable labour, moreover, in organizing a system at the outset, and it is not to be expected that each collector of a district, whatever his bent may be, shall be inclined or able to spare time or energy enough from his other multifarious duties, so far to master the subject as to introduce a thorough system of pisciculture in his district. Again, there must occur in the application of the proposed law, many references which the Board of Revenue, with its ever increasing duties, can scarcely be expected to meet. For instance, it is provided in the English salmon law that an appeal from the decision of the Commissioners shall lie to the Home Office; is the Board prepared to accept the position of the Secretary in the Home Office, and to decide all such appeals; or would it be preferable that they should be considered by an inspector-general of pisciculture for the presidency? It would seem desirable that for the collection and submission of general accounts, the administration of funds, the organization and introduction of a system of renting, of preservation, of pisciculture, the consideration of references, the supply of information, and the decision of appeals, there should be one officer for the presidency, he being subject to the orders of the Board, so that collectors might refer matters in which they could not agree with the proposed inspector-general of pisciculture, and thus be in a position to temper departmental energies when found to clash with the general welfare of their people.

Miscellaneous.

157. In the foregoing paragraphs there may be found opinions at variance with others advanced by Dr. Day and others. Without for a moment questioning the possibility or even high probability of many mistakes having crept into the conclusions drawn from observations extending over one year only, conducted often by proxy and somewhat hurriedly, under the pressure of multifarious other duties, still it may be well to point out that it does not follow as a sequence that because a writer on the east coast fisheries thinks one thing and a writer on the west coast fisheries another, one of the two must necessarily be in the wrong. Differences of opinion occur in England also, though, from the smallness of our island home in comparison with the vast empire of India, the rivers in the former are subject to fewer and less marked climatic differences than those in India. The monsoons also that annually visit the east and west coasts of India are dissimilar.

158. While therefore seeking just as much for others as for myself an unbiased consideration of the views severally advanced, I at the same time utterly disclaim such presumption as the idea of having in a new study passed in a single year beyond the region of mistakes, and arrived by a step at perfection. I also trust that allowance may be made for my not having been free, either in the pursuance of the study or in the framing of this somewhat hurried report, to bring to the task an undivided and uninterrupted attention, but having been charged the while with the multifarious and onerous duties always connected with the administration of an Indian district. It should also be remembered that the Indian pisciculturist labours under peculiar disadvantages, for he has to work through the medium of a foreign language, and without the aid as in England of a thousand intelligent observers all ready to

communicate freely through the medium of special papers like "Land and Water," or the "Field." It is hoped, moreover, that fault will not be found at considerable sacrifices having been made to brevity, out of consideration for the value of the time of the officials whose duty it may be to read this report.

159. My one coadjutor also, though able to give Mr. Samuel Ball. his whole time, came to the subject as new as myself, and there was at first necessarily some groping in the dark. But he has uniformly given patient, energetic, and intelligent attention to his duties, and has thereby acquired so much knowledge of his subject and of the district, that he is obviously the right, as well as the only man, to be employed in the conduct of any future piscicultural measures that may be hereafter sanctioned. The many and peculiar languages of this district, with all of which he is conversant, also point him out as preferable to any stranger. To any Collector coming newly to the district, his local knowledge would also be invaluable.

Fishing.

160. On this subject it will suffice to state that, if properly approached, the mahseer rivers of Canara yield as good if not better sport than the salmon rivers of Great Britain. Remarks on this subject, though calculated to increase the interest of pisciculturalists in the subject, might still be considered somewhat out of place in an official report, they are therefore suppressed.

Acknowledgments.

161. In conclusion I have to acknowledge cordially the kind aid of friends. For the scientific names of the shells, frogs, and water weeds I am indebted to Major R. Beddome.

For the proper name of my chief fish, the mahseer, I have to thank Dr. Day, and almost all the scientific names of fishes are quoted from his work on the fishes of Malabar. Captain Ross Thompson, R.E., kindly gave me the Mulky pearl, and first informed me of their existence. As has been seen in the part of the report that touches on that subject, Mr. J. Russel obligingly co-operated in the matter of coffee pulping.

I have the honour to be,

Sir,

Your most obedient servant,

H. S. THOMAS,

Collector.

APPENDIX A.

This map has not been printed because of the expense of producing it; but it is hoped that the Board and Government will be pleased to refer to the one manuscript copy herewith submitted, because it is believed that no verbal description can carry to the mind so clear an impression of—

Firstly.—The network of rivers in the district, and their consequent importance as an integral part thereof.

Secondly.—The multitude of destructive weirs and the consequent importance of dealing with them.

Thirdly.—The multitude of small streams entering the estuaries, and the consequent extent of the facilities which they offer for improving the estuary and sea fisheries.

Fourthly.—The great extent of tidal water in the rivers.

Fifthly.—The manner in which Mysore and Coorg are concerned in them.

Sixthly.—The character also of the rivers descending rapidly from the mountains.

Seventhly.—The formation of the sea coast.

APPENDICES B, C, D, E, and F.

For economy's sake, Appendices B, C, D, E, and F, also are submitted in manuscript instead of in print.

APPENDIX G.

LIST OF FRESH-WATER FISHES in SOUTH CANARA, showing the size they attain, their Spawning Time and Food, the Fish being classified, with reference to para. 78, under the heads Herbivorous and Predaceous.

In the expression of vernacular sounds the principle of spelling followed is that laid down in Government Order, 13th September 1859, No. 1,404.

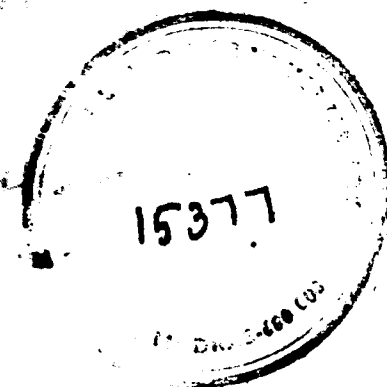
Consecutive No.	Colour and No. of Bands attached.	Scientific Name.	Canarese Name.	Tulu Name.	Malayalam.	Hindustani.	Size it attains, in inches.	Spawning Time.	Food.
1	Red. 10	HERBIVOROUS. Labeo calbasu (H. B.)	Kari minu, or Káke minu.	Kari min, or Kakki min.	Karta min	—	24	Said to be December, January, and February.	Aquatic weeds and minute crustaceans; intestines full of slime; essentially bottom feeders.
2	9	Labeo (new species) -	Mul-vél	Mul-vél	—	—	18	Do.	Do.
3	6	Discognathus lamta -	Kal-murá, Kal-mogú.	Kal-muru, Kal-muja.	Kamáu	—	8	Ascertained by examination to be May, June, and July.	Aquatic weeds, worms, shrimps, and grain. A very slow mover while feeding. Mouth so peculiarly formed as to make it impossible to feed, except quite on the bottom; feeds amongst stones on clear bottoms.
4	11	Chanos argenteus -	Há-minu	Pú min	—	—	36	Said to be April, May, and June.	Aquatic weeds, and probably small insects, so minute as not to be discoverable by the aid of a good magnifying glass, for the intestines are filled with mud.

5	—	Barbus labecula -	Katládi, or Katla beḍé.	Katládi	Katládi	—	14	Said to be October, November, and December.	Aquatic weeds, leaves, and twigs of trees and plants growing on the margin of the river; grasses. Bottom feeder.
6	8	Barbus carnaticus (Jerdon).	Sá-mánu	Ché-min, or Chá-min.	Té-min	—	18	Ascertained to be September, October and November.	Aquatic weeds, grasses, grass seed, twigs, and leaves of trees and plants growing on the margin of the river; worms, shrimps, crabs, flies, beetles, grasshoppers, and occasionally small fry. Bottom feeder.
7	7	Barbus conirostris -	Kúrlí, or Kuváí.	Kúrlí	Púrlí	—	18	Ascertained to be December and January, and again in June.	Aquatic weeds, insects, and crustaceans frequenting them; grasses, leaves, and twigs of trees and plants growing near the water; worms, shrimps, crabs, beetles, grasshoppers, and occasionally small fish; flies.
8	5	Barbus (new species) -	Káján, or Háí Karé.	Káján	Karpela, or Pulián.	—	8	Ascertained to be June and July, and again in December and January.	Aquatic weeds and insects found in them; grasshoppers, beetles, and grass seed; flies; surface feeder.
9	4	Barbus Sarana (H. B.)	Kiján, or Háí Karé.	Kiján	Pullán	—	9	Ascertained to be December and January, and again in May and June.	Aquatic weeds and crustaceans found in them. Grass and grass seed; twigs of water plants; worms; shrimps; grasshoppers; flies.

SEA FISHES.

Scientific Name.	Tulu Name.	Size attained, in inches.	Spawning Season.	Remarks.
<i>Lates calcarifer</i>	Koloji - •	34	Said to be Sept. and Oct.	—
<i>Ambassis commersonii</i>	Attataru	7	Ascertained to be Feb. and March.	—
<i>Chrysophrys calumara</i>	Yeri	10	Said to be March and April.	Mainly an estuary fish. Feeds on fish and night soil found amongst rocks.
<i>Trichiurus malabaricus</i>	Pambol	36	Ascertained to be Oct. and Nov.	—
<i>Scomber kanagurta</i>	Bangade	9	Ascertained to be Oct. and Nov.	Indian mackerel.
<i>Cybbium commersonii</i>	Anjil	36	Ascertained to be Jan., Feb., and March.	Commonly known as the Seer. Their fry frequent the mouths of estuaries, and the parent fish probably spawn therein.
<i>Cybbium guttatum</i>	Bari-min	18		
<i>Stromateus sinensis</i>	Manji	9	Ascertained to be Nov. and Dec.	White pomfret; a flat fish.
<i>Stromateus argenteus</i>	Boldu-manji	6		
<i>Stromateus cinereus</i>	Boldu-manji	6	Ascertained to be Nov., Dec., and Jan.	The grey pomfret, a flat fish.
<i>Stromateus niger</i>	Kari-manji	9	Do	The black pomfret, a flat fish.
<i>Caranx mate</i>	Vot-Pare	34	Said to be Sep. and Oct.	—
<i>Caranx melanostethos</i>	Kaduvai	10	Do.	—
<i>Chorinemus tooloo</i>	Palai-min	24	Said to be Nov. and Dec.	—
<i>Equula insidiatrix</i>	Per-Kuruchi	2	Do.	—
<i>Equula daura</i>	Kuruchi	6		
<i>Gobius viridi punctatus</i>	Abroni	9	Ascertained to be Nov. to Jan.	An estuary fish.
<i>Teuthis vermiculata</i>	Kallur	18	Ascertained to be Nov. and Dec.	—
<i>Nandus marmoratus</i>	Ici-min	9	Do.	—
Doubtful	Kane	13	May and June	"Indian whiting."
<i>Mugil cuneatus</i>	Kekan-mala	18	Ascertained to be Feb., March, and April in the estuaries.	Mullet.
<i>Mugil engel</i>	Daddal-mala	9		
<i>Mugil poecilus</i>	Bal-pare	9		
<i>Mugil cunnumboo</i>	Kande-mala	18		
<i>Belone caudimaculata</i>	Kandhi	36	Ascertained to be Jan. and Feb.	Do.
<i>Belone annulata</i>	Suri-kandai	24	Ascertained to be Jan. and Feb.	—
<i>Hemiramphus xanthopterus</i>	Votte-kombu-kotti	9	Ascertained to be Feb. and March.	—
<i>Arius gogora</i>	Galla-Tede	24	Ascertained to be April and May.	—
<i>Osteogobius militaris</i>	Uuka-Tede	24		
<i>Batrachcephalus nuno</i>	Bengodi-Tede	9		
Doubtful	Bol-yade	9	—	—

Scientific Name.	Tulu Name.	Size attained, in inches.	Spawning Season.	Remarks.
<i>Engraulis pinnatus</i>	Yerabdi	9	Ascertained to be Sept. and Oct.	—
<i>Engraulis pinnatus</i>	Yerabdi	6	Said to be Oct. and Nov.	
<i>Engraulis auratus</i>	Doddammang	6	Said to be Oct., Nov., and Dec.	Hammer shark. head
<i>Engraulis malabaricus</i>	Mangay	8		
<i>Engraulis taty</i>	Vale mangay	6	Do.	Dog fish. Saw fish.
<i>Centracion Zygaena</i>	Kobbi tate	5 ft.	Do.	
<i>Mustelus Lewis</i>	Tate	10 ft.	Do.	Ray.
<i>Pristis semiaegittatus</i>	Kombu-tate or Yetti balliar.	10 ft.	Do.	
<i>Trygon Uarnak</i>	Pili-sorake	3 ft.	Said to be Dec. and Jan.	Ray.
<i>Pteroplatea micrura</i>	Pakki-sorake	3 ft.	Do.	



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