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THE TROUTS OF NORTH AMERICA

General Remarks on Classification

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The trouts of North America are exceedingly difficult to classify - so difficult that scarcely two ichthyologists agree. A form that one authority recognizes as a distinct species may be regarded by another as only a subspecies, variety or race. Prof. John O. Snyder, who has studied the trouts of western North America for many years, (1940, p. 98) said of them, "In their entirety they seem to form a huge mosaic, the elements of which, as diverse as the golden trout of the High Sierra, the coast rainbow and the royal silver trout of Lake Tahoe, are difficult to separate. The picture includes not only the colors of the entire spectrum, but numerous irregularities of form, anatomical structure and habits as well. The trout present a veritable medley of geographic races or forms that make logical treatment very difficult. Attempts at systematic investigation have been made and some generally accepted species have been recognized. These attempts have been sporadic in all cases; they have been founded upon insufficient material, and they have not contributed greatly to a reasonable interpretation of the situation as a whole. The problem may now be impossible of satisfactory treatment because of depletion or near extermination of certain forms of restricted distribution and of the activities of artificial propagation in the distribution of various trouts."

The so-called steelhead trout offers an illustration of the difficulty that ichthyologists have met in classifying trouts. This form was long regarded as related to, but distinct from the rainbow trout. However, Snyder (1940, p. 101) stated "Some observers hold the belief that the steelhead is a distinct species of trout somewhat intermediate between the cutthroat and the rainbow. Such is not the case, and this statement is supported by a mass of observational and experimental evidence. A steelhead is a sea migrant of the particular species inhabiting the stream, and

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in our waters (California it may be either a cutthroat steelhead or a rainbow steelhead, and there is no occasion to apply a Linnean binomial name to a steelhead as such." (Underscoring ours). Another snarl that has caused, and still causes ichthyologists much trouble is the inadequacy of some of the early descriptions. Thus, the coast rainbow, which often has carried the scientific name, Salmo gairdneri, was designated Salmo irideus by Snyder (1940, p. 123), because he was unable to identify any particular species, with the original description of S. gairdneri, which in fact may have been based on a salmon.

The very close relationships, the apparent depletion or extermination of some species, the hybridization of others through artificial culture and distribution, together with inadequate taxonomic study, make it impractical to offer keys and descriptions of the various species, subspecies and varieties. The situation is well stated by Snyder (1940, p. 123), who already has been quoted, "As in the case of some peoples, American Indian and Asiatic Mongol for example, so with trouts, cutthroat and rainbow alike, the distinguishing traits which separate them are difficult to set down in writing. Yet when one becomes familiar with them they may usually be recognized with certainty. The shape of the head and body, the dentition, the red throat mark, the squamation, the habits, etc., are not in each case always to be depended upon. Large acquaintance with them will demonstrate the futility of attempting an identification of their species by means of artificial keys or brief descriptions." It is to be noted that Prof. Snyder even found difficulty in stating the difference between what he designated (p. 99) the "rainbow series" and the "cutthroat series," notwithstanding that he recognized several species in each series.

As it is impractical to offer descriptions of species of trout here, only the names of the usually recognized forms, together with their natural distribution, as far as known, are given.

In general, it may be said that the salmon family, of which the trouts are members, is composed of soft-rayed fishes, that is, the fins are without spines. The paired fins, corresponding to the hind limbs of higher vertebrates, known as the ventral or as pelvic fins, are attached to the abdomen, far behind the other pair of fins that corresponds to the fore limbs of higher vertebrates, known as pectoral fins. On the back, well behind the moderately large rayed dorsal fin, is a small fleshy rayless fin, called the adipose fin. The salmon in zoological classification, though they are teleosts, that is, bony fishes, are considered as of a rather primitive order, higher than the sharks with their primitive cartilaginous skeletons, but lower than the more specialized fishes,

such as the basses and cods for example, which possess very complex bony skeletons. However, the trouts, at least, have specialized in color, wherein some of them rival the most brilliant hues of fishes of tropical seas.

Trout resemble salmon superficially, but differ in many respects. The surest way to separate them is by the shorter anal fin situated behind the vent. In the trout this fin has 12 or fewer rays, whereas in the Pacific salmon it has 13 to 16 or more rays. The trout, in general, are more slender and graceful fish than the salmon.

The trouts are divided into two groups or genera. The largest genus, Salmo, includes the rainbow, the cutthroat (and steelheads), and the Atlantic salmon with its landlocked relatives, and an introduced European species, generally known as the brown trout. Three species or groups of species, belong to this genus, which is characterized by having black spots; by the moderately large scales, generally fewer than 200 in a lateral series; and by having a more fully toothed vomer than the other genera.

The second genus, Salvelinus, includes species related to European species that are known in Britain as charrs, consisting of the eastern brook trout, the Dolly Varden trout, the Greenland charr, the lake trout, or Mackinaw trout, and what perhaps may be regarded as sub-species of the charrs named, several of which have been recognized by some authors. The species of this genus generally have red spots, the lower fins have bright white edgings, and the scales are very small, and usually so deeply imbedded in adults as to escape notice.

The genus Salmo in the western states is composed of two groups or series, which have been designated as the "rainbow series" and the "cutthroat series" by Snyder (1940, p. 99). On the northern Atlantic seaboard and slope this genus is represented by the Atlantic salmon, and its landlocked relatives. In addition to these native species the introduced European brown and Lock Leven trout are now widely distributed in the United States.

THE RAINBOW SERIES

The rainbow series is characterized by having rather large scales, generally about 140 to 160, though a few species are said to have as many as 200, in a lateral series. Black spots as a rule are rather scattered, and in a few forms the back is so dark as to obscure them if present. Finally there is no red streak on the trout, that is, beneath the mandible,

as in the cutthroat series. The last mentioned character generally separates the two series at a glance.

The "leading species" of the rainbow series is Salmo gairdneri. This is the leading species in the sense that its description and name apparently are the oldest that can be definitely assigned to a rainbow trout. A rather large number of nominal species has been described in the rainbow series, regarded variously as species, subspecies, varieties or races by authors. The populations have not been studied to a sufficient extent to determine adequately their precise status in classification. Some of them probably are only color phases resulting from the particular environment in which the specimen or specimens studied lived. Rainbow trout, in one form or another, have been reported from as far north as Bering Sea and southward into the mountains of northern Lower California. Through fish culture the range has been greatly increased, as rainbow trout have been planted in nearly all suitable waters of the United States and in many foreign lands.

The names that follow, though the list is not complete, have been more or less definitely assigned to trouts that appear to belong to the rainbow series. Most of them no doubt apply only to local varieties or races such as exist, though generally in a less pronounced form, in species of many fresh water fishes from different river systems. However, others may apply to distinct species. The original describer, the date and place of publication, and the locality from which each nominal species was described is stated.

Salmo gairdneri Richardson (Fauna Borealis-Americana, III, 1836, p. 221) has long been used for the coast rainbow and steelheads, in place of S. irideus Gibbons (Proc. Cal. Acad. Sci., I, 1855, p. 35, San Leandro Creek, Alameda Co., Cal.).

Salmo stonei Jordan (Thirteenth Biennial Rpt. Cal. Fish Com., 1894, p. 142, McCloud River at Baird, Cal.) according to Snyder (1940, p. 125) is the Shasta trout, and is identical with S. shasta Jordan. This is the trout that received early attention by fish-culturists. Later the coast rainbow also was hatched, and the two apparently have become hybridized. The artificially hatched fish have been widely distributed in the United States and foreign lands.

Salmo gilberti Jordan (Thirteenth Biennial Rpt. Cal. Fish Com., 1894, 143, Kern River at Soda Springs, Cal.) is the Kern River trout, which supposedly is limited in its distribution to the Kern River, Cal., but is now probably extinct in its pure form.

Salmo aqua-bonita Jordan (Proc. U. S. Nat. Mus., XV, 1892, p. 481, type from Cottonwood Lakes on the east side of Mt. Whitney into which the species had been introduced), has as its natural habitat the South Fork of Kern River and Volcano Creek, Cal. This is the brilliantly colored golden trout, and presumably is identical with S. roosevelti Evermann (Bull. U. S. Bur. Fish., XXV, 1905 (1906), p. 26, Volcano Creek, Kern River Basin, Cal.).

Salmo whitei Evermann (Bull. U. S. Bur. Fish., XXV, 1905 (1906), p. 20, south fork of Kaweah River, Cal., into which it had been introduced) has as its natural range Soda Creek, Coyote Creek, Wet Meadow Creek and Little Kern River. This is another Golden trout, and probably not specifically distinct from the preceding one.

Salmo rosei Jordan and McGregor (Proc. Acad. Nat. Sci. Phila., LXXVI, 1924, p. 19. Lake Culver, Cal.) is called the Culver Lake trout after the lake in which it lives.

Salmo evermanni Jordan and Grinnel (Proc. Biol. Soc. Wash., XXI, 1908, p. 31, south fork of Santa Ana River, at an elevation of 8,200 feet, four miles northwest of San Gorgonio Peak) has been designated the San Gorgonio trout. According to Snyder (1940, p. 129) it may have become extinct due to the invasion of its habitat by rainbow and brown trout.

Salmo aquilarum Snyder (Bull. U. S. Bur. Fish., XXXV, 1915-16 (1917), p. 77, Eagle Lake near mouth of Pine Creek, Modoc Co., Cal.) is limited in its habitat to Eagle Lake and its tributary stream, Pine Creek. It is appropriately called Eagle Lake trout.

Salmo regalis Snyder (Bull. U. S. Bur. Fish., XXXII, 1912, p. 26. Lake Tahoe near Broadway, Nev.) is the royal silver trout, inhabiting Lake Tahoe.

Salmo smaragdus Snyder (Bull. U. S. Bur. Fish. XXXV, 1915-16 (1917), p. 80, fig. 9, Pyramid Lake, Nev.) is the emerald trout, inhabiting Truckee Basin, Nev., and is related to the preceding species.

Salmo nelsoni Evermann (Proc. Biol. Soc. Wash., XXI, 1908, p. 26, Pl. I, San Ramon River, San Pedro Martir Mountains, Lower Cal.) is designated "Lower California trout" in literature. It is said to be related to the Kern River trout, S. gilberti.

Salmo kamloops Jordan (Forest and Stream, Vol. 39, No. 19, 405, 1892) was originally described from Kamloops Lake in British Columbia and has been transplanted to other bodies of water. It reaches a large size and is highly esteemed as a game fish.

THE CUTTHROAT SERIES

The cutthroat series is distinguished from the rainbow series by Prof. Snyder (1940, p. 100) as follows: "The cutthroats are characterized by having smaller scales, more numerous black spots, and usually a red streak beneath the mandible, from the presence of which their name is derived." It may be added that there is much variation and overlapping between this series and the rainbow series in respect to the number of scales in a lateral series, as well as in the abundance of black spots.

The leading species, that is, the one first described, among the cutthroat trouts is Salmo clarki. The remarks concerning species, subspecies, varieties, etc., of the rainbow series, made on a preceding page, apply equally as well to the cutthroat series.

Cutthroat trout have been reported from coastal streams from British Columbia to Redwood Creek in Northern California. They also occur in the eastern drainage of the Sierras, and in the Colorado River.

The names that follow, though the list is not complete, have been more or less definitely assigned to the cutthroat series.

Salmo clarki Richardson (Fauna Borealis - Americana, III, 1836, p. 225, Cathlapootl River, Oregon) is the coast cutthroat trout. It is a native of the coastal streams from British Columbia to Redwood Creek, Cal., and according to Snyder (1940, p. 101) it includes the steelhead trout, in part.

Salmo henshawi Gill and Jordan, in Jordan (Manual Vertebrates, Ed. 2, 1878, p. 258, Lake Tahoe) has been called the Tahoe cutthroat trout after the lake from which it was first described. Besides Lake Tahoe it is found in Pyramid, Truckee, Webber, Donner, and Independence Lakes, and in most streams in the eastern slope of the Sierra Nevada. Salmo tahoensis Jordan and Evermann (Bull. U. S. Nat. Mus., Pt. III, 1898, p. 2870, Lake Tahoe) according to Snyder (1940, p. 133) is a synonym.

Salmo seleniris Snyder (Cal. Fish and Game, XX, No. 2, 1934, p. 105., Fish Valley Alpine Co., Cal., east of the Sierra Divide) has been designated "Piute trout." It is restricted to small streams above Llewellyn Falls in Silver King Creek, Cal.

Salmo pleuriticus Cope (Hayden's Geol. Surv. Mont., 1871 (1872), p. 471, headwaters of Green River, Wyo.) is the Colorado River trout, to which its natural distribution seems to be confined.

Salmo lewisi Girard (Proc. Acad. Nat. Sci. Phila., VIII, 1856, p. 219, Falls of Missouri River) often is designated the Yellowstone trout. It inhabits Yellowstone Lake, the upper Missouri, and the middle and upper Columbia drainage. Its range has been somewhat extended through artificial propagation and distribution.

Salmo utah Suckley (Monogr. Salmo, 1861 (1874), p. 136, Utah Lake) is known as the cutthroat trout of Utah Lake, and is reported from the lakes and streams west of the Wasatch range, in Bear, Provo, Jordan and Sevier Rivers, as well as Utah Lake.

Salmo virginalis (Girard) (Proc. Acad. Nat. Sci. Phila., VIII, 1856, p. 220, Utah Creek and at Sangre de Cristo Pass, Colo.) is the Rio Grande trout, which is said to range from the upper Rio Grande southward into the mountains of Chihuahua, Mexico.

Salmo stomias Cope (Hayden's Geol. Surv. Wyo., 1870 (1871), p. 433, South Platt River, locality unknown) the green trout, is reported from the headwaters of the Arkansas and Platt Rivers.

Salmo macdonaldi Jordan and Evermann (Proc. U. S. Nat. Mus., XII 1899 (1890), p. 453, Twin Lakes, Cal.) is designated the yellowfin trout, and is found in the headwaters of the Arkansas River.

The following are related to, and probably scarcely distinct from Salmo clarki: S. jordani Meek (Pub. Field Col. Mus., Zool. Ser., I, 1897 (1899), p. 229, Lake Southerland, Wash.); S. declivifrons Meek (*ibid.*, p. 230, Lake Southerland, Wash.); S. bathoecetor Meek (*ibid.*, p. 227, Crescent Lake, Wash.); S. crescentis Jordan and Beardslee (Proc. Cal. Acad. Sci., 2d ser., VI, 1896, p. 207, Crescent Lake, Wash.); S. beardslei Jordan and Seale (Proc. Cal. Acad. Sci., 2d ser., VI, 1896, p. 209, Crescent Lake, Wash.); S. gibbsi Suckley (ann. Lyc. Nat. Hist. N. Y., VII, 1858, p. 1, Fort Dallas, Columbia, Yakima, John Day and Boise Rivers).

THE ATLANTIC SALMON AND LANDLOCKED RELATIVES

The Atlantic salmon, in contrast with the other members of the genus, have the vomerine teeth little developed, and the scales are large, generally fewer than 120 in a lateral series. Although these fish are popularly known as salmon, morphologically they are trout, and are so classified.

The Atlantic salmon, Salmo salar, was described very early. It has been designated the type of the family Salmonidae, and it is also the type of the genus Salmo. Several nominal American species related to S. salar, the Atlantic salmon, have been described. However, the late Dr. William C. Kendall, in his *Fishes of New England* (1935, p. 116) recognized only one species, namely, the lake salmon, more usually referred to as the landlocked salmon, S. sebago. Concerning the distinguishing characters of the Atlantic salmon and the lake salmon he said, "While there are a few single structural characters which will usually enable one to identify his fish, if he knows what these characters are, the real recognition character is the fish itself. The lake salmon embodies a different ensemble of proportions from that of the sea salmon. These proportions are variable in fish of different sizes, ages and sexes. In other words, the general make-up of the lake salmon is different from that of the sea salmon. Correlated with that difference is the difference of habits, habitat, and physiology, and these are inseparable in each." Dr. Kendall offered tables of proportions and enumerations from which it may be concluded that only average differences exist. The most important one is the proportionate depth of the caudal peduncle, stated as follows (p. 137):

"Average for the least depth of the caudal peduncle not over 73 percent of the distance from the adipose to the base of caudal and not over 66 percent of the distance from the anal to caudal----Atlantic salmon (Salmo salar).

"Average for the least depth of the caudal peduncle more than 73 percent of the distance from the adipose to the base of caudal and more than 66 percent of the distance from anal to caudal----Lake salmon (Salmo sebago)."

Salmo salar Linnaeus (*Syst. Nat. Ed. X*, 1758, p. 308, seas of Europe) is the common Atlantic salmon, and is known from both coasts of the north Atlantic, originally extending at least as far south as Delaware on the American side; now depleted in the United States and only occasionally taken as far south as Cape Cod.

Salmo sebago Girard (*Proc. Acad. Nat. Sci. Phila.*, VI, 1853, p. 380, Sebago Lake, Me.) has been designated the lake salmon by Kendall (1935, p. 104), though it is more generally known as the landlocked salmon. It is reported by this author (1936, p. 106) as inhabiting waters in eastern North America within the latitudinal range of the sea salmon, though found within these limits from disconnected localities.

BROWN TROUT

Salmo trutta Linnaeus (Syst. Nat. Ed. X, 1758, p. 308, Europe) is the brown trout of Europe which was introduced by fish culturists, together with the Lock Leven trout, Salmo levenensis, which if originally actually distinct from the brown trout seems to have become hybridized with it in America, leaving no clear distinction. The brown trout has been widely distributed in the United States.

THE CHARRS

The charrs of North America belong to the genus Salvelinus. The word charr is an Anglo-English word that is seldom used in American English, except in books. The American name is brook trout. They are recognized by their extremely small scales, 200 to 350 in a lateral series, often embedded in large specimens; by the red spots (not black or gray); and by the white edgings of the lower fins. The body often is mottled above. Although several nominal species have been described, few are recognized by modern authorities.

Salvelinus fontinalis (Mitchill) (Trans. Lit. Phil. Soc. N. Y., I, 1815, p. 435, near New York City) is the brook trout, also known as Eastern brook trout, and as the speckled trout. It ranges from Saskatchewan and Labrador south to the headwaters of the Savannah River, and has been widely distributed by fish culturists.

The following probably are subspecies or varieties of the brook trout: Salvelinus agassizi Garman (Nineteenth Rept. Mass. Fish Comm., 1855, p. 20, Dublin Pond, N. H.); S. aureolus Bean (Proc. U. S. Nat. Mus., X, 1887, 628, Sunapee Lake, N. H.); S. timagamensi Henn and Rinkenbach (Annal. Carnegie Mus., XVI, 1925, p. 131, White Pine Lake, St. Lawrence Basin, Ontario); S. oquassa (Girard) (Proc. Boston Soc. Nat. Hist., IV, 1854, p. 262, Oquassa or Oquossoc Lake, Me.); and S. marstoni (Garman) (Science, July 14, 1893, p. 23, Lac de Marbre, Ottawa County, Quebec).

Salvelinus stagnalis Fabricius (Fauna Groenlandica, 1780, p. 175, Alpine ponds of Greenland) the Greenland charr, is known from Labrador to Greenland, and possibly beyond these regions.

It is probable that the following nominal species are only subspecies or varieties of the Greenland charr: Salvelinus rossi (Richardson) (App., Ross's Voy., LVI, 1835, and in Fauna Borealis-Americana, III, 1836, p. 163, Regent's Inlet, Boothia Felix); S. naresi (Gunther) (Proc. Zool. Soc. London, 1877, p. 476, fresh water lakes near Discovery Bay); and S. arcturus (Gunther) (ibid., p. 294, Victoria lake, Floeberg Beach).

Salvelinus malma (Walbaum) (Artedi Pisc., 1792, p. 66, Kamchatka) is the Dolly Varden trout of the Pacific slope of America. Its general range, assuming that S. spectabilis (Girard) is only subspecifically distinct, extends from Kamchatka to the upper tributaries of the Sacramento River, California.

Salvelinus spectabilis Girard (Proc. Acad. Nat. Sci. Phila., VIII, 1856 (1857), p. 218, Ft. Dallas, Oreg.) apparently is a variant of S. malma, the Dolly Varden trout of America. Several other species have been named which apparently are not valid.

The Great Lakes trout is readily recognized by its gray spots, lack of bright colors, and by the deeply forked tail.

Salvelinus namayacush (Walbaum) (Artedi Pisc., 1792, p. 68, Hudson Bay) is called the Great Lakes trout, Mackinaw trout, namaycush, masamacush, longue, and tongue. Its range includes the Great Lakes region, lakes of northern New York to Maine, the headwaters of the Columbia and Fraser Rivers, streams of Vancouver Island, and northward to the Arctic Circle, possibly introduced in the West.

HABITATS OF TROUT

Clear cool streams and lakes, with the temperatures of the water below 70° F., are the chief abode of trout. However, some species such as the Atlantic salmon and the coast rainbow and coast cutthroat habitually descend to the sea for a part of their lives. Others, like the eastern brook trout and the Dolly Varden trout, run down to the sea only in the northern parts of their range. Still others spend their entire lives in fresh water, either because they are land-locked, or from choice.

Barriers erected by man in streams have interfered with the migration of those species that habitually run out to sea, and later return to spawn. This interference with migration, and the pollution of streams and lakes, have caused a decline, or even the extermination of trout in some waters.

FOOD OF TROUT

Trout are carnivorous, feeding chiefly on insects, both adults and larvae. However, they take many other foods also, including fish eggs, and young fish of many kinds. It has been said that they feed on "anything that moves and some things that do not," seeking food anywhere between the bottom and the surface.

SPAWNING

The favorite spawning grounds of the trout are gravelly areas in swiftly flowing streams. Most species spawn during the autumn or winter. The eggs are relatively large, and by comparison with many other fishes few in number, requiring a comparatively long time, six weeks more or less, to hatch, the incubation period being greatly lengthened by low temperatures and shortened by higher ones. The young, as they emerge from the egg, carry a large yolk-sac upon which they subsist for quite a long time. However, when the yolk is all absorbed the fish in nature must find their own food. This is a very critical stage of life, for if food of the proper kind and size is not at hand the fish perish.

Natural reproduction among several species of trout, as indicated elsewhere, has been aided by artificial culture. No other group of fish has received so much attention by the fishculturist.

GROWTH, AGE AND SIZE ATTAINED

Trout, like other fish, grow fast if an abundant supply of food is obtainable, if the environment in other respects also is favorable, and becomes stunted if the reverse is true. The age and rate of growth of any individual can be fairly accurately determined, by an experienced investigator, from the scales. If the rings on the scales are far apart rapid growth is indicated; if close together growth has been slow. During the winter, when growth is greatly retarded, the rings become crowded and form what is known as an "annulus." The investigator determines the age of the fish from the number of annuli on the scale.

It is, of course, understood that all species of trout do not grow equally large. The eastern brook trout and the Dolly Varden trout generally run small, usually not much more than 12 to 15 inches in length. Yet, tremendously large individuals, weighing 10 to 14 pounds, have been reported. Rainbows weighing upward of 20 pounds, and cutthroats of 40 pounds or so have been taken. Atlantic salmon weighing 70 to 100 pounds, and Great Lakes trout weighing 50 to 80 pounds, have been caught. Of course, fish of the sizes stated are exceptions. The average weight of individuals of these species, taken by anglers, probably does not exceed an eighth and in some cases not a tenth of the weight given.

COLOR

Adult trout of most species, particularly when approaching the spawning season, are brilliantly colored. Young trout, to the contrary, are relatively plain, except for dark bars or blotches on the side, known as "parr marks." As many as 10 or 12 marks may be present in some species. They sometimes persist for two or three years, and occasionally remain in adults. Color markings, as shown elsewhere, are important in recognizing species.

GAME AND FOOD QUALITIES

All species of trout are game fishes, and, exclusive of the Great Lakes trout and the Dolly Varden trout, are protected in United States waters as such. In game qualities all species are not equally good. The eastern brook trout is regarded by some as among the best of all game fishes. The related Dolly Varden trout of the west, on the other hand, is not highly regarded as a game fish. It is said to be a bit slow in taking the bait, and not overly demonstrative when hooked.

The quality of the flesh, although ranking high as a whole, is claimed to vary among species. Again the eastern brook trout ranks as near the best, and is considered by some anglers as superior to the rainbow trout.

Sport fishing always has ranked high as a wholesome pastime. The trout, of course, are valued chiefly as sport fish, and as already stated are propagated, protected and reserved, with few exceptions, for that purpose. Great refinement of apparatus and technique for trout fishing has been achieved. Much has been written on the merits of different kinds of lure, and on how to fish. Scarcely two authors agree, which perhaps is fortunate as that leaves it to the initiative of each angler to perfect his own apparatus and technique, which after all makes the sport more interesting.

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