II.—GENERAL PLAN OF INQUIRIES PROSECUTED.

For the purpose of securing greater precision in the inquiries prosecuted in reference to the natural history of the fishes and the influences exerted upon their multiplication, a general plan was drawn up, with the assistance of Professor Gill, which was followed, as far as practicable, in the investigations. For greater facility the same features were thrown into the form of questions, answers to which were entered by their corresponding numbers, as shown in the testimony. This systematic arrangement of the subject and the corresponding questions are as follows, it being understood that some particular kind of fish is usually under discussion:

MEMORANDA OF INQUIRY RELATIVE TO THE FOOD-FISHES OF THE UNITED STATES.

A. Name of the fish in question in different localities.
B. Geographical distribution.
    At present time.
        Change of location with season of year.
    In former times.
        Supposed cause of any permanent change.
C. Abundance.
    At present time; in different seasons and localities.
    In former times; in different seasons and localities.
    Supposed cause of variation in abundance.
    Probable change in the future.
D. Size.
    Maximum length, girth, and weight.
    Average length, girth, and weight.
    Rate of growth.
    Length and weight at age of one, two, three, &c., years.
    Difference of sexes in this respect.
E. Migrations and movements.
    Arrival and departure.
    Period of stay.
    Certainty of arrival.
    Route of movement coming and going.
    Number and times of runs or schools in one season, and differences, if any, in the runs.
    Difference in time of arrival of the sexes and ages.
    Feeding of fish after arrival.
    Summer abode.
    Winter abode.
    If anadromous; when they enter the fresh water and when they leave it.
    If anadromous; what the movements up and down fresh waters of adults or of young.
    Rate of progression of schools in fresh or salt water.

Relation of movements to tides.
Depth of water preferred by schools or single fish.
Temperature and general condition of water preferred.
Favorite localities in any region; whether bottom be sandy, rocky, muddy, grassy, &c.

F. Relationships.
To its own species; whether gregarious, solitary, grouped by age or sex at any season, predaceous, &c.
To other animals; whether preyed upon by them, feeding upon them, &c.
Special enemies, friends, or companions.

G. Food.
Nature.
Mode of taking it.
Time of taking it.
Quantity consumed.

H. Reproduction.
Interference with spawning by lines, nets, &c.
Age of male and of female, respectively, when capable of reproduction.
Change in physical condition, (color, shape, fatness, &c.)
Date of spawning and its duration, as relating to the individual as well as to the species.
Preferred localities for spawning, as to place, temperature, &c.
Special habits during spawning season.
Special habits before or after spawning.
Ratio of mortality in old fish from spawning.
Number of successive years of capacity for spawning.
Nesting-places.
Are nesting-places prepared? If so, whether of grass, stones, sand, &c., or cleared areas, and whether made by one sex only, or both.
If ridges or furrows are formed, how made?
The eggs.
Mode of fecundation.
Where laid.
Where and how attached, if at all.
Whether covered up, and how, or whether exposed in water.
Number laid by one fish at one time, and the number during lifetime.
Size and color.
Special enemies.
Guarding of eggs by either sex.
The embryo and young fish.
Time necessary for development.
Ratio of fish hatched to number of eggs laid.
Proportion of young fish attaining maturity.
Movement after birth; whether remaining on spawning-ground, and how long, or whether changing from fresh to salt, or salt to fresh water, &c., and when.
General appearance and successive changes.
Rate of growth.
Special food.
Enemies and diseases of eggs and young.
Relation of parent fish of either sex to young; whether protective, predatory, &c.

I. Diseases.
K. Parasites.
L. Artificial fish-culture.
M. Protection by law.
N. Capture.
    Methods.
        By lines.
        By nets.
            Floating or movable, (seines, gill-nets, &c.)
            Fixed, (traps, pounds, weirs, dams, &c.)
        Other methods of capture.
        Bait.
        Influence of modes of capture on abundance.
    Season of capture.
        By lines.
        By nets.
        Otherwise.
    Time of tide when taken.
    Statistics of capture.
        By lines.
        By nets.
        Otherwise.
    Value of fish taken.
    Disposition of fish taken.
O. Economical value and uses.
    For food, (fresh, salted, smoked, dried, &c.)
    For oil.
    For manure.
    For other purposes.
    Price, in its variations with place, season, and year.
    Export and trade, in their variations with place, season, and year.
P. Remarks relative to foreign or domestic allies.

QUESTIONS RELATIVE TO THE FOOD-FISHES OF THE UNITED STATES.

A. NAME.

1. What is the name by which this fish is known in your neighborhood? If possible, make an outline sketch for better identification.

B. DISTRIBUTION.

2. Is it found throughout the year, or only during a certain time; and for what time?
3. If resident, is it more abundant at certain times of the year; and at what times?

C. ABUNDANCE.

4. How abundant is it, compared with other fish?
5. Has the abundance of the fish diminished or increased within the last ten years, or is it about the same?

6. If diminished or increased, what is the supposed cause?
7. What is the amount or extent of the change in abundance?

D. Size.

8. What is the greatest size to which it attains, (both length and weight,) and what the average?
9. State the rate of growth per annum, if known; and the size at one, two, three, or more years.
10. Do the sexes differ in respect to shape, size, rate of growth, &c.?

E. Migrations and Movements.

11. By what route do these fish come into the shore; and what the subsequent movements?
12. By what route do they leave the coast?
13. Where do they spend the winter season?
14. When are the fish first seen or known to come near the shore, and when does the main body arrive; are the first the largest; are there more schools or runs than one coming in, and at what intervals?
15. When do the fish leave shore, and is this done by degrees or in a body?
16. Is the appearance of the fish on the coast regular and certain, or do they ever fail for one or more seasons at a time, and then return in greater or less abundance; if so, to what cause is this assigned?
17. How do the runs differ from each other in number and size?
18. Which sex comes in first; and how far advanced is the spawn in the female on first arriving?
19. Will either sex, or both, take the hook on first arriving; and if so, is there any period of the stay of the fish when they refuse it?
20. If they refuse the hook at first, how soon do they begin to take it after arriving?
21. Do the schools of fish swim high or low; and is their arrival known otherwise than by their capture; that is, do they make a ripple on the water; do they attract birds, &c.?
22. What is the relation of their movements to the ebb and flow of the tide?
23. Does spawn ever run out of these fish taken with a hook?
24. Answer same question in regard to fish taken in nets or pounds; is the spawn ever seen in any quantity floating about inside of nets?
25. Are these fish anadromous; that is, do they run up from the sea into fresh water for any, and for what, purpose?
26. If anadromous, when are they first seen off the coast; when do they enter the mouths of the rivers, and what is the rate of progression up stream?
27. If anadromous, what the length of their stay in fresh water, and when do they return to the sea, or do they become exhausted by breeding and die?
28. Do the different sexes or ages vary in this respect?
29. Do these fish come on to the breeding-grounds before they are mature; or do you find the one or two year old fish with the oldest?
30. What are the favorite localities of these fish; say whether in still water or currents, shallow or deep water, on the sand, in grass, about rocks, &c.?
31. What depth of water is preferred by these fish?
32. What the favorite temperature and general character of water?

F. RELATIONSHIPS.

33. Do these fish go in schools after they have done spawning, or throughout the year, or are they scattered and solitary?
34. Have they any special friends or enemies?
35. To what extent do they prey on other fish; and on what species?
36. To what extent do they suffer from the attacks of other fish, or other animals?

G. FOOD.

37. What is the nature of their food?
38. Are there any special peculiarities in the manner of feeding of these fish?
39. What amount of food do they consume?

H. REPRODUCTION.

40. Is there any marked change in the shape or color of either sex during the breeding-season, or any peculiar development of, or on, any portion of the body, as the mouth, fins, scales, &c.?
41. Are there any special or unusual habits during the spawning-season?
42. Is spawning interfered with by lines or nets, or otherwise?
43. At what age does the male begin to breed, and at what age the female?
44. For how many years can these fish spawn?
45. Does the act of spawning exert an injurious effect?
46. Where do these fish spawn, and when?
47. Can you give any account of the process, whether males and females go in pairs, or one female and two males; whether the sexes are mixed indiscriminately, &c.?
48. Is the water ever whitened or colored by the milt of the male?
49. What temperature of water is most favorable for hatching?
50. At what depth of water are the eggs laid, if on or near the bottom?
51. What is the size and color of the spawn?
52. What is the estimated number for each fish; and how ascertained?
53. Answer the question for one season, and for the lifetime.
54. Do the eggs, when spawned, sink to the bottom, and become attached to stones, grass, &c.; or do they float in the water until hatched?
55. Do the fish heap up or construct any kind of nest, whether of sand, gravel, grass, or otherwise; and if so, is the mouth, the snout, or the tail used for the purpose, or what; and if so, how is the material transported; or do they make any excavation in the sand or gravel?
56. Do they watch over their nest, if made either singly or in pairs?
57. When are the eggs hatched, and in what period of time after being laid?
58. What percentage of eggs laid is usually hatched?
59. What percentage of young attains to maturity?
60. What is the rate of growth?
61. Do the parents, either or both, watch over the young after they are hatched?
62. Do they carry them in the mouth or otherwise?
63. What enemies interfere with or destroy the spawn or the young fish; do the parent fish devour them?

64. Are the young of this fish found in abundance, and in what localities?
65. On what do they appear to feed?

I. Artificial Culture.

66. Have any steps been taken to increase the abundance of this fish by artificial breeding?

K. Protection.

67. Are these fish protected by law or otherwise?

L. Diseases.

68. Has any epidemic or other disease ever been noticed among them, such as to cause their sickness or death in greater or less number?
69. When have these epidemics taken place, and to what causes have they been assigned?

M. Parasites.

70. Are crabs, worms, lampreys, or other living animals found attached to the outside or on the gills of these fish?

N. Capture.

71. How is this fish caught; if with a hook, what are the different kinds of bait used, and which are preferred?
72. If in nets, in what kind?
73. At what season and for what period is it taken in nets, and when with the line?
74. What would be the average daily catch of one person with the hook, and what the total for the season?
75. Answer the same question for one seine or pound of specified length.
76. Is the time of catching with nets or pounds different from that with lines?
77. Is it caught more on one time of tide than on another?

O. Economical value and application.

78. What disposition is made of the fish caught, whether used on the spot or sent elsewhere; and if the latter, where?
79. What is its excellence as food, fresh or salted?
80. How long does it retain its excellence as a fresh fish?
81. To what extent is it eaten?
82. Is it salted down, and to what extent?
83. Is it used, and to what extent, as manure, for oil, or for other purposes, and what?
84. What were the highest and lowest prices of the fish, per pound, during the past season, wholesale and retail, and what the average; and how do these compare with former prices?
85. Are these fish exported; and, if so, to what extent?
86. Where is the principal market for these fish?
87. Name and address of observer.
88. Date of statement.