

TROUT HABITAT ASSESSMENT OF THE TARN
ACADIA NATIONAL PARK

1975

ACADIA NATIONAL PARK
RESOURCE MANAGEMENT DIVISION

COPY

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ACKNOWLEDGEMENTS

The preparation of this report would not have been possible without the aid and support of Fred C. Olday, Project Director and Professor of Biology at the College of the Atlantic. The author is most grateful for his guidance throughout the course of this study from data collection to finalized report. Sincere thanks are also extended to the staff of Acadia National Park, especially Thomas Hobbs, former Chief Naturalist, and Keith Miller, Park Superintendent, for their encouragement and help in attaining equipment and support. The enthusiastic help of Leslie Smith and Fred Kerchies, fishery biologists for the Maine Department of Inland Fisheries and Game was most appreciated. Their participation in obtaining and setting a Fike net was crucial to the study of fish species composition in the Tarn. Special thanks are also due to Jonathan Gormley, Alice Levey and Tripp Royce, fellow students at the College of the Atlantic who aided in fish sampling.

Cathy Walton is gratefully remembered for accomplishing the formidable task of typing this report with its seemingly endless tables.

This study was supported by a contract (PX 1600-6-0603) with the National Park Service, North Atlantic Regional Office, United States Department of the Interior.

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INTRODUCTION

The Tarn is a shallow, weedy pond of approximately eight acres located within Acadia National Park and bordered by Dorr Mountain on its western side and by Route 3 and Huguenot Head to the east. The area falls within the township of Bar Harbor, County of Hancock, Maine.

A fishery management survey of the Tarn was conducted by the Maine Department of Inland Fisheries and Game in 1962. A regular trout management program was not recommended at that time because of the high temperature prevailing in the Tarn during the summer months. Since that time however, there have been reports of occasional large trout taken from the Tarn by local anglers. While the general characteristics of the Tarn did not appear conducive to healthy trout life, it was assumed that a more comprehensive study of the factors limiting trout survival as they exist in the Tarn would result in more comprehensive data upon which to base management recommendations.

METHODS AND MATERIALS

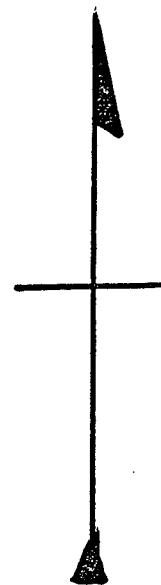
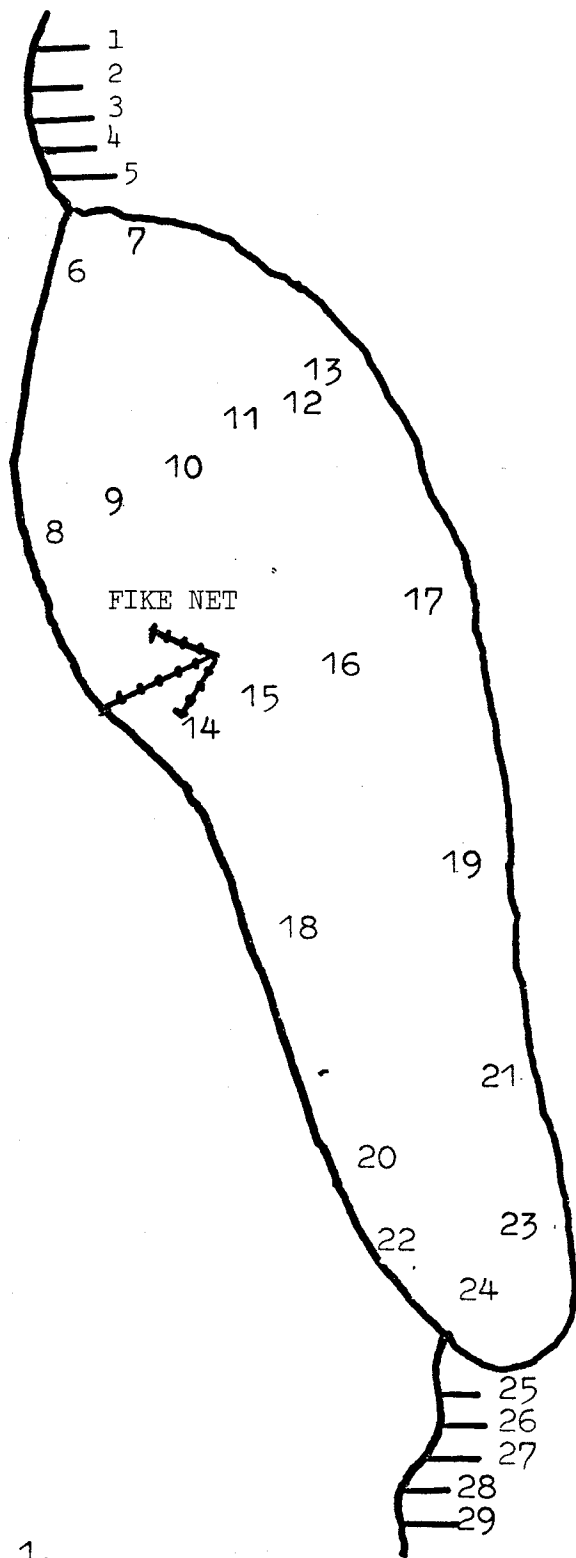
The study consisted of measuring those parameters which are limiting to trout life. Temperature, dissolved oxygen, and pH in the Tarn were measured to assess the presence or absence of physical conditions stressful to trout. Benthic macroinvertebrate populations of the Tarn, its inlet, and outlet were studied to determine food availability. The area was also examined for possible spawning grounds with depth, bottom type, and aquatic

vegetation being considered. Finally, the present indigenous fish population was sampled to determine its species composition. After all data were collected, comparisons were made with previously established environmental criteria indicating limiting and optimum trout habitat conditions. Management recommendations are based on the implications of these comparisons.

Temperature, Dissolved Oxygen, and pH

A Yellow Springs Model 54 Dissolved Oxygen Meter was used to measure dissolved oxygen and temperature simultaneously (10). At each station, readings were noted for the surface and at depths of 1.6 feet, 2.5 feet, 3.3 feet, and 4.3 feet. The dissolved oxygen meter was calibrated by using the azide modification of the Winkler Method (11). For purposes of calibration, a van Dorn sampler was used to collect water samples at a depth of 1.6 feet; these were then transferred to BOD bottles and titrated immediately. The meter was calibrated by returning to the same sampling station and adjusting the meter reading to the value determined by the titration. Locations of sampling stations are indicated in Figure 1.

A Corning Model 7 pH Meter was used to determine pH. Three samples were collected in toto at stations 6, 14, and 19 (Figure 1). A BOD bottle was lowered to a depth of 1.6 feet at each station, then raised and capped carefully to avoid introduction of excess CO₂. Samples were processed in the laboratory within one-half hour of collection.



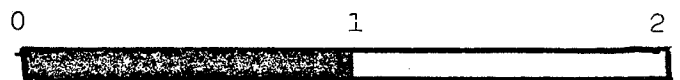
THE TARN

Bar Harbor

Hancock Co., Me.

Elevation 97'

Area: 8 acres



tenths of mile

Figure 1.

Map of the Tarn showing
sampling stations (2).

Bottom Type, Aquatic Vegetation, and Depth

The bottom sediments of the Tarn were observed from a boat and on foot. In addition, samples were taken with the benthic macroinvertebrates using an Ekman dredge.

The extent and species composition of the aquatic vegetation was determined by visual observations from a boat and on foot from shore.

A weighted line calibrated in meters was used to determine depth. Conversions to feet were made for this report.

Fish Species Composition

A Fike net with a 75 foot lead was set in the Tarn for a period of 5 days. A motor boat was used to set the net taut to a mushroom anchor. Each day the net was emptied, fish species and numbers recorded, and the fish returned to the Tarn. The net was then reset.

Minnow traps and angling were also used to sample the fish population; however, no different species were captured using these methods.

Benthic Macroinvertebrates

Sampling of the benthos was accomplished with a 6"x6" Ekman dredge. Each sample was washed into a bucket then taken to the laboratory where samples were strained separately through a screen with a 0.25 mm sieve opening. Specimens were identified while still alive (8, 12). A dissecting microscope was used to facilitate identification and assure complete assessment of samples.

Ten samples of 0.25 square feet each were taken from the Tarn. In addition, five samples each were taken from the inlet and the outlet.

RESULTS AND DISCUSSION

Temperature, Dissolved Oxygen, and pH

Temperature and dissolved oxygen are discussed together since colder water can contain higher concentrations of dissolved oxygen than warmer water, and, physiologically, temperature affects the rate of gas exchange in fish (7). Trout oxygen requirements change with temperature such that, as the temperature rises, so does the trout's oxygen demand. Therefore, one cannot cite the minimum or maximum dissolved oxygen concentration which will insure trout survival without specifying temperature effects and vice versa.

Measurements were taken over a period of two days, from 8:00 A.M. to 4:00 P.M., in late August of 1975 in order to determine the extreme highs in temperature and extreme lows in oxygen concentration which trout would have to endure. Table 1 presents a summary of dissolved oxygen and temperature readings with increasing depth in the Tarn. The mean surface temperature was found to be 71.1°F. with a dissolved oxygen concentration of 7.75 ppm. At the next recorded depth of 1.6 feet, the temperature dropped to 69.8°F. and the dissolved oxygen fell dramatically to 3.83 ppm. Owing to the shallowness of the Tarn, a constant temperature of 69.8°F. was maintained to a depth of 4.3 feet where readings of 69.4°F. were found. The mean percent saturation

Table 1. Average dissolved oxygen and temperature readings
in the Tarn during August 1975.

Depth (feet)	Mean D.O. (ppm)	Mean Percent Saturation	Mean Temperature (°F)
Surface	7.75 $\pm$ 0.35*	90.2 $\pm$ 3.0	71.1 $\pm$ 0.6
1.6	3.83 $\pm$ 1.12	48.0 $\pm$ 11.0	69.8 $\pm$ 0.0
2.5	3.90 $\pm$ 0.57	46.8 $\pm$ 4.2	69.8 $\pm$ 0.0
3.3	3.50 $\pm$ 0.99	43.0 $\pm$ 10.4	69.8 $\pm$ 0.0
4.3	3.90 $\pm$ 0.00	44.0 $\pm$ 0.0	69.4 $\pm$ 0.0

* Standard deviation of the mean.

of dissolved oxygen was highest at the surface with a value of 90.2%, then dropped markedly to approximately half that value at depths greater than 1.6 feet (Table 1).

Other workers have stated that 4 ppm dissolved oxygen is the safe limit for trout waters without specifying the precise oxygen requirements as they relate to temperature (7). The higher the temperature, however, the closer the dissolved oxygen concentration must approach saturation. Rainbow trout, for example, can exist at a temperature of 83°F. if the accompanying D.O. is 7.8 ppm (7). The findings of several workers compiled by Fry (6) give evidence that the lowest dissolved oxygen concentrations at which brook trout can survive for a two-week period is in the range of 0.9 ppm at 50°F. and 1.6-1.8 ppm at 68°F. Brown trout requirements are similar (7). These figures indicate tolerance of marginal conditions rather than optimum activity conditions. The temperature range of 69-71°F. found in the Tarn requires that the dissolved oxygen concentrations be near saturation for trout growth, or between 8-9 ppm instead of the existing 5-7 ppm.

In order to evaluate the Tarn further as a trout habitat, it would be necessary to know the duration of high temperatures since there is a limit to the stress which can be placed on a trout population (6). It is most probable that high temperatures are reached early in the summer in the Tarn, owing to its shallow depth, discussed later in this report.

The Tarn's pH of 5.0 is considered to be near the lower limit for trout (9).

Bottom Type, Aquatic Vegetation and Depth

Well-aerated gravel beds of even temperature are required by trout for spawning. The Tarn bottom is very soft mud with a thick accumulation of organic detritus and thus provides unsuitable spawning conditions. In addition, large logs and algae-covered tree branches line the bottom of the Dorr Mountain side of the Tarn. The inlet and outlet do have some small areas of gravel which could be utilized for spawning, but stream improvement would be necessary for access to and from the Tarn itself.

More than half of the Tarn surface is covered with pond lilies (Nuphar advena (Ait.) Ait.f. and Nymphaea odorata Ait.) during the summer months. Figure 3 shows the extent of this growth. The occurrence of these aquatic plants is largely due to Mt. Desert Nurseries which planted 1000 water lilies in the Tarn in 1939 (1). A lesser patch of arrowheads (Sagittaria latifolia Willd.) also occurs near the Route 3 shore.

The Tarn has a maximum depth of 4.3 feet, while most of the Tarn is no deeper than three feet. Being so shallow, the pond is subject to rapid heating. It is the lack of depth which also makes the Tarn conducive to weed growth. Figure 4 depicts the bottom morphometry of the Tarn.

Fish Species Composition

During the two week sampling period in August 1976, no trout were collected by the several means employed. Data for rough fish collected in the Fike net over a five day period is given in

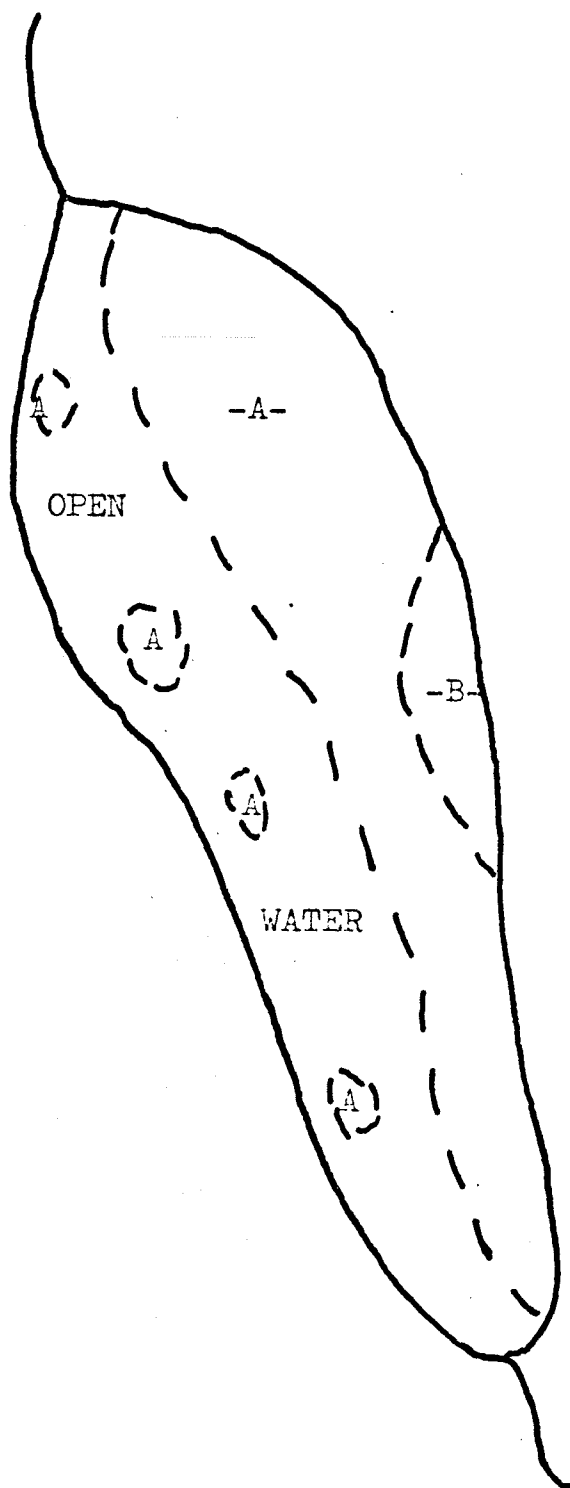


Figure 3. Aquatic vegetation
of the Tarn

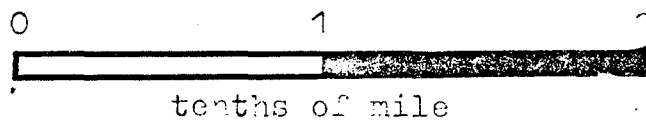
LEGEND

A = water lilies

B = arrowhead

THE TARN

Bar Harbor Hancock Co., Maine
Elevation 97' Area: 8 acres



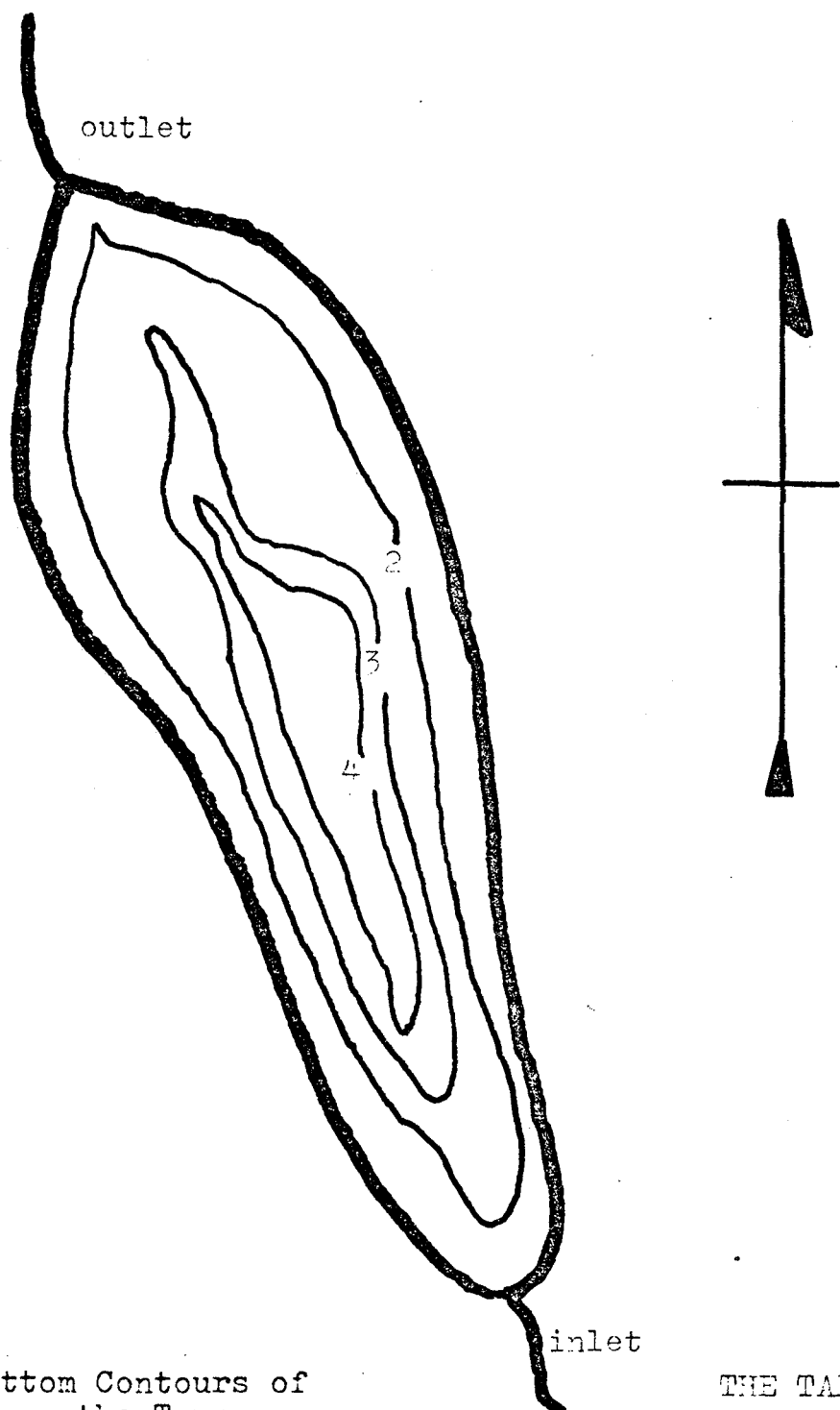
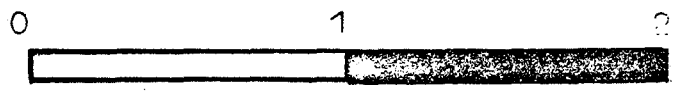


Figure 4. Bottom Contours of
the Tarn
Depth in Feet

Bar Harbor Hancock Co., Me.
Elevation 97' Area: 8 acres



tenths of mile
contour intervals 1 foot

Table 2. No different species were captured using other methods. According to Smith (personal communication) Fike nets are known to be effective in capturing trout if present.*

The rough fish population is, of course, important to consider as possible trout food and as competition. A warm, stagnant habitat with high summer temperatures may encourage the proliferation of rough fish to the detriment of trout when conditions are on a survival level for trout (5). If the Tarn were physically suitable for trout, then the key factor most affecting trout growth and survival would be competition.

Without heavy management of the rough fish population under such conditions, small trout would be out-competed for invertebrate food. Even potential forage fish which are suitable food only for large trout, would endanger the survival of the young salmonids.

Benthic Macroinvertebrates

Table 3 gives the composition of the benthic macroinvertebrate population sampled in August 1975. Unaccounted for as food sources are drift organisms, terrestrial insects and seasonal abundances of certain foods.

The productivity of macroinvertebrates is low in the Tarn as compared with its inlet and outlet. Tricopterans, a favorite food of trout according to Needham (9), are available almost exclusively in the streams.

* Leslie Smith, Fishery Biologist, Maine Department of Inland Fisheries and Game.

Table 2. Fish species collected in Fike Net in the Tarn.

Fish species	Day 1		Day 2		Day 3		Day 4		Day 5		Average	
	No.	% comp.	No.	% comp.	No.	% comp.	No.	% comp.	No.	% comp.	No.	% comp.
American Eel <u>Anguilla</u> <u>rostrata</u>	24	3.6	7	0.4	57	17.4	21	2.0	19	0.6	25.6	4.8
Spotted Killifish <u>Fundulus</u> <u>diaphanus</u>	610	90.0	1894	93.5	260	79.5	940	91.0	2870	95.8	1315	90.0
Golden Shiner <u>Notemigonus</u> <u>crysoleucas</u>	---	---	18	0.9	6	1.8	12	1.5	14	0.5	10.0	0.9
Common Shiner <u>Notropis</u> <u>cornutus</u>	2	0.3	10	0.5	---	---	20	1.9	30	1.0	12.4	0.9
Spotted Bullhead <u>Aplocheilichthys</u> <u>nebulosus</u>	8	1.2	---	---	4	1.2	6	0.6	---	---	3.6	0.6
Striped Bass <u>Morone</u> <u>saxatilis</u>	27	4.0	96	4.7	---	---	34	3.3	54	1.8	42.2	2.8
Total Fish	671		2025		327		1033		2997		1410	

Note: On days 1 and 3 snapping turtles were taken in the net.

Table 3. Average numbers of benthic macroinvertebrates per square foot of the Tarn, its inlet and outlet.

Type of Organism	Inlet		Tarn		Outlet	
	Mean Number of organisms per sq. ft.	Per cent total or- ganisms	Mean number of organisms per sq. ft.	Per cent total or- ganisms	Mean number of organisms per sq. ft.	Per cent total or- ganisms
Decapoda	0.80 $\pm$ 1.79*	1.7	0.00 $\pm$ 0.00	0.0	0.00 $\pm$ 0.00	0.0
Tipuloidea	4.08 $\pm$ 4.10	8.5	0.00 $\pm$ 0.00	0.0	4.10 $\pm$ 3.01	8.2
Chironomidae	2.40 $\pm$ 2.19	5.0	14.40 $\pm$ 5.60	39.2	1.70 $\pm$ 3.80	3.4
Tricoptera	19.20 $\pm$ 2.30	40.0	1.70 $\pm$ 3.58	4.6	26.40 $\pm$ 4.24	53.1
Coleoptera	13.30 $\pm$ 3.55	27.6	5.85 $\pm$ 5.65	15.9	12.50 $\pm$ 2.90	25.1
Turbellaria	1.60 $\pm$ 2.19	3.3	3.13 $\pm$ 5.12	8.5	0.00 $\pm$ 0.00	0.0
Hemiptera	6.54 $\pm$ 3.80	13.6	0.00 $\pm$ 0.00	0.0	5.00 $\pm$ 5.47	10.1
Hirudenea	0.00 $\pm$ 0.00	0.0	0.80 $\pm$ 1.48	2.2	0.00 $\pm$ 0.00	0.0
Anisoptera	0.00 $\pm$ 0.00	0.0	0.85 $\pm$ 2.69	2.3	0.00 $\pm$ 0.00	0.0
Nematoda	0.00 $\pm$ 0.00	0.0	10.00 $\pm$ 7.16	27.2	0.00 $\pm$ 0.00	0.0

* Standard deviation from the mean.

The factor of food is further discussed in the summary in relation to other parameters.

SUMMARY

When considered together, the parameters studied provide their own implications. The Tarn is shallow, muddy-bottomed and weed-choked in the summer. The open water area is decreasing each year and the bottom sediments are building up as well. Temperatures are high, dissolved oxygen and pH are low. Trout growth would be inhibited by the daily and seasonal fluctuations in temperature present in so small a pond (9). There is also formidable competition for a relatively small amount of invertebrate food. Because of increased metabolic rate caused by the high temperatures, trout would, according to Hoar and Randall (7), require both greater oxygen and more food. Implications are that, while large trout entering the Tarn could survive, small fish introduced would face most unfavorable growth conditions. If it were not for the rough fish population, the Tarn might be considered at best a sub-marginal habitat for trout.

In contrast to the Tarn, optimum trout conditions would include swifter flowing or deeper water, a well aerated gravel bottom, more available invertebrate food, less competition and a dissolved oxygen concentration near saturation.

RECOMMENDATIONS

Very radical changes would have to be made in the Tarn to develop a trout fishery. In consideration not only of the cost,

but also of maintaining the indigenous qualities of the area, I recommend no attempt to make these changes. The introduction of water lilies may have altered the original natural features of the pond, yet the Tarn seems eminently more suited to these plants, than to trout. Because of the physical conditions which exist, the rough fish would best be encouraged since access for anadromous species is afforded to the ocean via the outlet.

While the introduction of warm-water game fish such as bass might be possible, it would not be desirable to encourage more fishing in such a small, accessible area. On the other hand, for the persevering fisherman, any trout caught in the Tarn are likely to be sizable transients!

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