The Relation of Stock Pond Vegetation to Geological Formations in Marshall County, Oklahoma[1]

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The stock ponds, or "tanks", in Marshall County, Oklahoma are artificial impoundments varying in area from less than an acre to about five acres. Most of them are located on clayey soils, but a few have been constructed in sandy areas. The clay loam soils were derived from Weno clay, Fort Worth limestone, Duck Creek limestone or Kiamichi clay; all are geological formations in the Grand Prairie Area (Gray and Galloway, 1959). The sandy soils had their origin in Trinity or River sand. The purpose of the investigation was to locate one typical pond in each of the above geological formations, to determine the physical factors in each "tank", to list the plants in, and around, each pond and to correlate the pond vegetation with physical factors and the geological formations.

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METHODS

In order to gain some familiarity with the area the senior author corresponded with, and later visited, the county agent of Marshall County and the Agricultural Stabilization and Conservation Office. The latter office provided complete county aerial photos which proved of great assistance in locating suitable ponds. The geological formation of each pond chosen was verified by consulting a county geological map (Bullard, 1918). However, it was necessary to visit over 100 ponds throughout the county before ultimate selection of "tanks" in the proper geological formation, with sufficient plants and with a minimum of disturbance by livestock, was accomplished.

At each pond, the following data were taken: maximum water depth, type of soil, livestock activity, water level fluctuation, turbidity, pH, zonation, species and kinds of plants. Water depths and water levels were determined by a string and bubble level; turbidity was ascertained by means of the Secchi disk, and pH was determined by an electric pH meter. All other data were determined by observation. [2]Plants were collected and placed in the herbarium of The University of Oklahoma Biological Station.

RESULTS AND DISCUSSION

At the time of the study (1964), no pond was less than seven or more than 10 years old (Table I). Four of the ponds possessed bottoms and shorelines of clay loam, whereas two of them were based on sandy loam. Livestock activity varied from none to moderate, although it seems probable that it had little effect on the number of species (Table I). The number of species varied indirectly with the amount of water level fluctuation, the greatest number (42) occurring in the pond (in Weno Clay) with the least fluctuation. Species number also varied directly with the degree of clarity of water (Table I). These findings agree with those of Penfound (1953) who concluded that "Of the lake basin factors, amplitude of water levels and turbidity are paramount."

The correlation of the number of plant species with geological formations is not as evident as with physical factors. It might be expected that the ponds in the clay loams, a part of the Grand Prairie, would be highly turbid, but this was not true (Table I). The sandy geological formations were very different from each other in turbidity and number of species (Table I). The Trinity sand possessed a pH of 8.0 to 9.7 whereas the River sand had a circumneutral pH of 6.8. It seems probable that the alkaline Trinity had abundant mineral cations to flocculate colloidal clay micelles and thus to reduce turbidity. Since the River sand is circum-

TABLE I. ENVIRONMENTAL DATA ON PONDS IN MARSHALL COUNTY, OKLAHOMA

Geological Formation	Age of Pond	Soil Type	Stock Use	Fluct. (Ft.)	Secchi, **(Ft.)	pH	Species
Weno Clay	10	*C.L.	Light	0.6	9.1	8.3	42
Fort Worth lime	10	C.L.	None	3.9	8.4	9.1	19
Duck Creek lime	7	C.L.	Heavy	3.8	2.3	8.8	18
Kiamichi clay	8	C.L.	None	2.0	2.3	8.4	20
Trinity sand	8	S.L.	Mod.	0.9	9.4	9.1	26
River sand	10	Sand	None	2.9	0.2	6.8	12

*C.L., Clay loam; S.L., Sandy loam. **Disappearance of Secchi disk.

[2]All names according to Waterfall, 1962.

neutral it seems probable that there are insufficient cations for flocculation and clarification of turbid water. Support for this view came from the deflocculation and clearing of water when 5 ml of concentrated sulfuric acid was added to a liter of turbid water from the pond in River sand.

Of the 68 species encountered in this investigation, 45 were wetland species found above the summer pool level, or in the recession zone after the water level had receded (Table II). There were relatively few aquatic species, mainly of the emergent type. Many species were found only in ponds with clay bottoms and a few species were encountered only in "sandy" ponds (Table II).

TABLE II. STOCK POND SPECIES ENCOUNTERED IN THE SIX PONDS INVESTIGATED.

	Number of Species		
Type of Species	Total	Clay only	Sand only
Wetland	45	21	6
Emergent aquatic	14	8	1
Floating leaf aquatic	3	0	0
Submerged aquatic	6	2	1
Total Species	68	29	8

The greatest number of species occurred in one pond only, fewer species were common to two, three, four or five geological entities and only one species *(Salix nigra)* was found in ponds in all geological formations. Many species were common to the clay loam ponds and to the "tank" in the Trinity sand, possibly because of the presence of calcareous lenses in the Trinity sand.

SUMMARY

The vegetation of six stock ponds in Marshall County, Oklahoma, was studied in relation to physical factors and to the geological formations in which they occurred. One each of the ponds was located in clayey soils derived from Weno clay, Kiamichi clay, Fort Worth limestone and Duck Creek limestone. The other two ponds were situated in sandy soils derived from Trinity and River sand formations. The species encountered in this investigation comprised 45 wetland taxa, 14 emergent aquatics, 3 floating leaf plants and 6 submerged species. The number of species was positively correlated with low water-level fluctuation and low turbidity and more closely with physical factors than with geological formations. Of the 68 species, many (23) were found in only one pond, progressively fewer species were common to an increasing number of "tanks" and only one species was encountered in ponds of all six geological formations.

LITERATURE CITED

Bullard, F. M. 1918. Geologic map of Marshall County, Oklahoma. U. S. Geol. Surv. Bull. 736.

Gray, Fenton and H. M. Galloway. 1959. Soils of Oklahoma. Okla. State Univ. Misc. Publ. 56, 65 p.

Penfound, Wm. T. 1953. Plant communities of Oklahoma lakes. Ecol. 34:561-583.

Waterfall, U. T. 1962. *Keys to the Flora of Oklahoma,* 2nd Ed. Okla. State Univ. Res. Found., Stillwater, Okla.