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Ecological Significance of Vegetation to Northern Pike, *Esox lucius*, Spawning

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Since 1955, information has been collected from six Nebraska sandhill lakes to evaluate northern pike spawning success based on type of aquatic vegetation preferred by pike for spawning. The lakes, all located in Cherry County, were Big Alkali, Watts, Hackberry, Cottonwood, Shell, and Pelican. Several investigators have commented that pike year class strength is closely related to type and abundance of aquatic vegetation present in a lake (Clark and Steinbach, 1959; Forney, 1967). Documented information on spawning habitats is scant other than vague references to pike spawning over submerged vegetation or inundated meadows.

Fabricius and Gustafson (1958) apparently felt that the type of vegetation that forms the spawning mat was of small importance. They found the optimal spawning substrate for pike was a dense mat of short vegetation.

Frost and Kipling (1967) reported spawning grounds to have silty substrates with some stones and found eggs on vegetation consisting mainly of *Elodea*, *Myriophyllum*, and *Nitella*. They also reported that for the first few days, alevins were attached to vegetation.

Clark and Steinbach (1959) suggest that the presence of *Myriophyllum* sp. in a sand-spit pond adjacent to Lake Erie might be instrumental in providing natural spawning habitat for pike.

A comparison with pike eggs' density on plots of winter wheat and adjacent natural vegetation in New York showed egg deposit variation between undisturbed natural vegetation and seeded plots of winter wheat. Natural vegetation consisting of sedges, *Carex* sp., grasses, *Spartina* sp. and water plantain, *Alisma* sp. appeared as attractive as winter wheat as a substrate for egg disposition (Forney, 1967).

Observations by Schryer (personal communication) on pike spawning in a newly impounded reservoir in Kansas where terrestrial vegetation, including alfalfa, milo, numerous species of annual weeds, buffalo grass and blue grama, was newly inundated revealed pike eggs only in buffalo and blue grama

TABLE 1.—*Northern pike egg collections from sandhill lakes and hatchery ponds as related to vegetation, 1955–69*

Site type	Number of samples	Average number of eggs per 30 cm² sample							
		0–5	6–10	11–15	16–20	21–25	26–30	31–50	51–100
Flooded meadow (native grasses)	16								X
Flooded mowed hay[1]	9								X
Elodea-Utricularia	12							X	
Potamogeton-Chara	36						X		
Mud-dead vegetation	8		X						
Najas flexilis	32		X						
Sand-*Scirpus* sp.	14	X							
Sand-detritus	6	X							
Scirpus-Phragmites	8	X							
Myriophyllum-Ceratophyllum	14	X							

[1] Valentine Fish Hatchery Ponds (flooded mowed hay mats placed in rearing ponds as spawning aids).

grasses, indicating a preference for plants with a large amount of basal coverage.

At Lake George, Minnesota, Franklin and Smith (1963) observed that pike spawning never occurred in cattail areas, but all other vegetation types were utilized. They found the highest egg densities in mats of sterile culms of *Eleocharis* sp., and concluded that grasses, sedges or rushes with fine leaves appear to make the best substrates for egg disposition.

Kennedy (1965)[1] showed that spawning occurred in Irish lakes within depths of 38–76 cm over bottom habitat consisting of broken clumps of *Phragmites* sp. and on *Agrostis stolonifera*, *Juncus bulbosus*, *Mentha* sp., *Hippuris* sp., and *Fontinalis* sp.

Marsh grass, *Calamagrostis canadensis*, was listed by Carbine (1941) as the dominant plant in the drainage ditches flowing into Houghton Lake. Most of the pike spawning took place in these ditches.

The intent of this note is to reveal pike selectivity preferences for specific aquatic floristic associations in the sandhill region of Nebraska.

STUDY SITES

A total of 155 (30 × 30 cm) sites were sampled from six natural lakes and three hatchery ponds. Lakes and ponds ranged in size from 3 to 410 ha and varied in water quality characteristics from fresh (< 200 mg/l alkalinity) to slightly alkaline (200–900 mg/l alkalinity). The lakes contained standing crops of pike of about 30–65 kg/ha. Forage species, i.e., bluegill, *Lepomis macrochirus*, black bullhead, *Ictalurus melas*, black crappie, *Pomoxis nigromaculatus*, green sunfish, *Lepomis cyanellus*, and carp, *Cyprinus carpio*, were scarce to common in all lakes during the study period.

METHODS

Areas of vegetated and nonvegetated lake shoreline were randomly sampled with a modified 30 × 30 cm surber bottom sampler and a 30 cm wide push-net during the peak of the pike spawning season. Samples were collected from depths of 20–45 cm. The incubation period for the eggs in natural lakes varied from 8 to 12 days depending on water temperature. An Eckman dredge was tried but discarded because of its inherent failure to close with vegetation in the grab. Duplicate sweeps at the same site were made to check efficiency. Approximately 94% of all eggs deposited on a site were collected during the first 30 × 30 cm sweep. Collected samples were washed through a U. S. standard sieve (No. 30) screen and the eggs counted under magnification.

RESULTS AND DISCUSSION

Greatest egg densities were found on flooded native prairie grasses, i.e., sand bluestem, *Andropogon hallii*, little bluestem, *A. scoparius*, porcupine grass, *Stipa spartea*, sideoats grama, *Bouteloua curtipendula*, and sandlove grass, *Eragrostis trichodes* (Table 1). In the absence of such flooded grasses, similar numbers of eggs were found on mowed hay and broken hay bales left on the ground and inundated during the March–April pike spawning period. Both flooded grasses and mowed hay were especially attractive for pike in Big

[1] Spawning of pike in four Irish lakes in 1965. Unpublished M.S.

Alkali and Mother Lakes, two large, slightly alkaline lakes where about 95% of the submergent aquatic vegetation consisted of scattered stands of sago pondweed, *Potamogeton pectinatus*. Although both lakes have extensive emergent vegetation, i.e., *Scirpus* sp., *Phragmites* sp., *Typha* sp., and *Sagittaria* sp., such plants were seldom utilized as spawning sites.

Watts Lake, a 102-ha, slightly alkaline lake, was extensively searched for pike eggs in 1960 and 1961. About 78% of the eggs collected were found in beds of bushy pondweed, *Najas flexilis*, which comprised only about 18% of the submergent plant association in the lake. The dominant submergent species were milfoil, *Myriophyllum spicatum* and coontail, *Ceratophyllum demersum* which occurred in dense stands throughout the lake. The *Myriophyllum-Ceratophyllum* group in Watts Lake was one of the least productive egg collection sites (Table 1).

The two bays in Watts Lake where *N. flexlis* was the dominant plant produced an average of eight eggs per 30 cm^2, whereas the extensive shoreline growth of *Scirpus* sp., *Phragmites* sp., and open water stands of *Myriophyllum-Ceratophyllum* contributed only about one egg per 30 cm^2. The sandy-silt bottom region, without vegetative cover, averaged less than one egg per 30 cm^2 and clearly represented the least desirable substrate for the deposit of pike eggs.

Frame and gill nets were set in Watts Lake amidst various habitats during the spawning season. Nets set in two bays with stands of *N. flexlis* caught 765 adult pike compared to a total catch of 56 in all other habitats. During 1960–61, Schoenecker[2] estimated the spawning pike population for Watts Lake at 1,391–3,912 fish. Apparently a high proportion of the population were attracted to stands of *Najas* during the spawning period.

Of the 16 vegetated sites examined in Pelican, a 405-ha, slightly alkaline lake, about 90% of the pike eggs were found deposited over inundated grasses and shallow water growth of *Elodea* sp. and *Potamogeton pectinatus*. Extensive growth of *M. spicatum* and *C. demersum* contained less than 5% of the total eggs collected in Pelican Lake during 1963–64. The remainder of the eggs were recovered from scattered stands of curleyleaf pondweed, *Potamogeton perfoliatus richardsonii*.

Peckham,[3] following a pike mark and recovery study on Pelican Lake during 1966–70, estimated that the spawning pike population varied between 12,800 to 28,300 fish.

Spawning pike used *Chara* sp. almost exclusively in Shell Lake, a 79-ha, slightly alkaline lake in Cherry County. Of the eight sites examined among *Chara* sp., *M. spicatum*, *C. demersum* and *P. perfoliatus richardsonii* growth, *Chara* sp. contained 92% of the eggs collected with no eggs found in samples among *C. demersum* and *M. spicatum*.

Water quality, spring water levels and temperatures, and the species of submergent aquatic vegetation present within individual lakes all influence pike spawning success in the sandhill region. Aside from adverse low water temperatures, which may delay or prohibit spawning, the direct effects of alkalinity limiting biological production in both temporal and permanent sandhill lakes is paramount (McCarraher, 1971). Excessive alkalinity, > 900 mg/l, appears to restrict distribution of some species of aquatic vegetation, i.e., *M. spicatum*, *C. demersum*, *Utricularia* sp., and *Anacharis canadense*. The elimination of the latter two species from alkaline waters is perhaps significant since we have found them to be important spawning sites for pike in sandhill lakes. *P. pectinatus* and *Chara* sp. are often the only submergent plant substrate available in lakes where alkalinity varies between 900–1,200 mg/l. Such alkaline lakes often have closed drainage basins with little spring flooding of adjacent meadow grasses. Within these lakes the *P. pectinatus–Chara* sp. association provides pike spawning habitat of good quality (Table 1). However, the pike populations are usually eliminated from alkaline lakes when the total alkalinity exceeds 1,000 mg/l, CO_3 alkalinity > 200 mg/l and pH > 9.6 (McCarraher, 1962). Thus, alkalinity not only directly influences the survival and distribution of aquatic vegetation in the sandhill

[2] Schoenecker, William. 1962. Unpublished report, Nebraska Game and Parks Commission.

[3] Peckham, Richard. 1970. Unpublished report, Nebraska Game and Parks Commission.

lakes, but also influences the growth, reproduction and survival of pike.

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LITERATURE CITED

CARBINE, W. F. 1941. Observations on the life history of the northern pike, *Esox lucius*, in Houghton Lake, Michigan. Trans. Amer. Fish. Soc. 71: 149–164.

CLARK, C. F., AND F. STEINBACH. 1959. Observations on the age and growth of the northern pike, *Esox lucius*, in East Harbor, Ohio. Ohio J. Sci. 59(3): 129–134.

FABRICIUS, E., AND KARL-JACOB GUSTAFSON. 1958. Some new observations on the spawning behavior of the pike, *Esox lucius*. Rep. Inst. Freshwater Res. Drottningholm 39: 23–54.

FORNEY, J. L. 1968. Production of young northern pike in a regulated marsh. N. Y. Fish Game J., 15(2): 143–154.

FRANKLIN, D. R., AND L. L. SMITH, JR. 1963. Early life history of the northern pike, *Esox lucius* L., with special reference to the factors influencing the numerical strength of year classes. Trans. Amer. Fish. Soc. 92(2): 91–110.

FROST, W. E., AND C. KIPLING. 1967. A study of reproduction, early life, weight-length relationship and growth rate of pike, *Esox lucius* L., in Windermere. J. Anim. Ecol. 36(3): 651–693.

MCCARRAHER, D. B. 1971. The small playa lakes of Nebraska, their ecology, fisheries and biological potential. Playa Lake Symp. Trans., International Center for Arid and Semi-Arid Land Studies, Texas Tech. Univ., Lubbock, Texas.

———. 1962. Northern pike, *Esox lucius*, in alkaline lakes of Nebraska. Trans. Amer. Fish. Soc. 91(3): 326–329.

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