



Installation of Building Paper in Test Boxes

Each sample was judged by the federal grain supervisor and a member of the cereal technology department.

**Building Paper Used:**

Tar paper, 15 pound Asphalt Felt, Black Jack, Black Shield and Sisalkraft were the building papers used on the floors of these boxes. Wheat was stored on a plain wood surface in one group of boxes.

**Results:**

All of the samples taken from the floor and 6 inches above the floor were found to show no sign of odor that would classify them objectionable on the market.

Appreciation is extended to M. J. Johnson, Grain Supervisor, Food Distribution Administration, and L. D. Sibbitt, Cereal Technology Department, for assistance in grading the samples.

## Habits of Our Toads

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**T**HE abundance of toads has caused an unusual amount of local interest during the last 3 years. It has not been uncommon to observe on damp or rainy days thousands of small toads hopping on highways, in gardens and fields in search of food. The question is often asked, "Where do they all come from so soon after rain?" It would seem that these creatures literally rained down from the heavens. The fact is they are always with us, and it is only when favorable temperature and moisture conditions prevail that they are normally observed.

While several kinds of toads occur in North Dakota, the great plains toad, *Bufo cognatus* Say, is by far the most abundant, and this discussion will deal principally with this form. The American toad, *B. americanus* Holbrook, and the Manitoba

toad *B. hemiophrys* Cope, are less frequently observed. The central plains spadefoot, *Scaphiopus hammondi bombifrons* (Cope), may also occur here. The great plains toad can be recognized from our other species by a triangular bony eleva-

tion on top of the head between the eyes and by a rather large sharp-edged tubercle on the undersides of the hind feet.

### Breeding Habits

Very little has been recorded on this species in our Northern Great Plains. The most complete information on its habits has been recorded by Dr. Arthur N. Bragg<sup>1</sup>, although his observations were based upon conditions in Oklahoma. We cannot assume that this species will behave similarly here. However, his observations are of considerable interest and will give an indication of what we might expect under our conditions. The following account of the biology of the great plains toad is taken largely from Dr. Bragg's observations in Oklahoma.

Like most amphibia, this species can only breed when water is present. Typical breeding areas are temporary rain-filled depressions on high plains. In Oklahoma, old buffalo wallows which frequently become filled with rain water are favorite breeding places. Under our conditions, water-filled depressions in fields and roadsides are often inhabited by breeding toads.

The breeding season extends from April to September in its southern range, while farther north it extends from May to July 1. Apparently, *B. cognatus* breeds only after rain and only if the temperature is not too low. Surprisingly enough, it will not breed without rain although water may be present. Furthermore, it has not been known to breed in permanent ponds. The eggs are laid in the water in two long strings. Each egg is enclosed in a jelly-like capsule. There are about 20,000 eggs in each clutch, the number depending upon the size of the female. Temperature determines the incubation period; however, eggs will normally hatch into tadpoles in 50 hours. Freezing weather does not harm them.

### The Young Toads

The tadpoles feed upon algae (microscopic plants), dead insects and other decomposing animal and vegetable matter. In this regard they might be considered as scavengers. They may remain in the larval or tadpole stage for 6 weeks. If they have reached a size of a little more than an inch in length or if the pond is rapidly drying up, they may change to the terrestrial or land form much earlier. When the time comes to change from the aquatic to a terrestrial existence, the tail gradually disappears and legs develop. The recently developed toads begin feeding upon insects and other small invertebrates immediately upon leaving the water. Their early growth is extremely rapid. They feed largely at night, although when damp, cloudy weather prevails, they are found actively foraging for insects at all times. When it becomes hot and dry, they burrow into the ground and there await more favorable conditions. This accounts for the sudden appearance of tremendous toad populations soon after rain, although they may be a considerable distance from any pond. It is likely that *B. cognatus* can withstand dry weather for several months. The Wrights<sup>2</sup> observed this species suddenly coming out of their burrows in Sierra Blanca, Texas, following the first rain in that vicinity for 6 months. The rate of growth is directly dependent upon their ability to obtain food. Sexual maturity may be attained in 2 years under favorable conditions, but some may require 3 to 4 years. Size, however, is not always a criterion of age, for small toads are often found which may be mature. Although this species may reach 4½ inches in length in certain localities, toads exceeding 3½ inches in length are rare in North Dakota.

From this review of their habits, it can readily be seen that due to their ability to remain inactive in their burrows, thus withstanding drought conditions, together with

their faculty to range considerable distances from their breeding grounds and their propensity for seeking out and devouring injurious insects, they are indeed a friend to

the farmer and gardener. For an account of their feeding habits, the reader is referred to the following article in this issue of the Bi-Monthly Bulletin.

References:

- (1) Bragg, Arthur N. Observations on the Ecology and Natural History of Anura I. Habits, Habitat and Breeding of *Bufo cognatus* Say. *American Naturalist* 74(753): 322-349 (554): 424-438 (1940).
- (2) Wright, Anna Allen and Albert Hazen Wright. Handbook of Frogs and Toads. Comstock Publishing Co., Inc., Ithaca, New York, 286 pages (1942).

## Toads Feed Upon Sweet Clover Weevils\*

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**P**ROF. A. H. KIRKLAND (3,4), a Massachusetts biologist, made the astounding statement that a single American toad was worth annually about \$20. This figure was based upon the number of injurious insects, mostly cutworms, devoured daily and the loss caused by these insects to agriculture. More recently, Bragg (2) from Oklahoma stated that the great plains toad, *Bufo cognatus*, our most common toad in North Dakota, had an annual value of \$25. He valued the American toad *Bufo americanus*, also occurring here, at \$15. The authors placed these high values on toads due to their feeding upon cutworms, serious pests of gardens and field crops. Under the conditions of the Oklahoma study, the first insects appearing in the spring were cutworms. The hungry toads coming out of hibernation fed readily upon them, as there were few other insects this early in the spring upon which to feed. Beetles, ants and spiders were more frequently taken during the summer.

It would be difficult to evaluate in dollars and cents the beneficial effects of our North Dakota toads. They have been particularly abundant the last 3 years due undoubtedly to increased rainfall. This has resulted in the creation of numerous temporary prairie ponds which furnished ideal breeding areas for our species. In any attempt to estimate the value of toads, such factors as their abundance, feeding habits and prevailing crop prices should be taken into consideration. Toads are hearty eaters and apparently exercise little choice in the insects they devour, but will gorge themselves with all available in-

sects. Should they destroy all cutworms in a valuable garden they are worth considerable.

Studies on the feeding habits of the great plains toad were begun at this station when it was observed under field conditions that this toad was feeding upon adults of the sweet clover weevil, a new and serious pest of sweet clover. The following report is the result of stomach analyses of 74 great plains toads from 1 inch to 2¼ inches in length collected in or adjoining sweet clover fields from the following North Dakota localities during the summer of 1943:

\*Progress report on Bankhead-Jones Project No. 28, "Biology and Control of the Sweet Clover Weevil" [*Sitona cylindricollis* (Fabr.)].