An Invertebrate Sampling Scheme
For Different Age Impoundments
In the New Brunswick - Nova Scotia Border Area
1972 - 1973

It has long been known that downy young depend primarily upon an animal diet for survival during the first two or three weeks of life; however, the importance of a high protein diet to adults, particularly the laying females and molting adults has only recently been fully realized. Experiments now in progress at the Northern Prairie Wildlife Research Center in Jamestown, North Dakota, have shown that such species as the pintail and mallard consistently lay two clutches of eggs on a high protein diet, while at low levels of protein, there is either no attempt to lay or resulting clutches are small and/or infertile (Swanson, 1972). Earlier studies, i.e. Holm and Scott (1954), suggested this relationship but perhaps did not fully appreciate the magnitude of its importance to the breeding habitat. Crapel (1972) has studied the food intake of female pintails during the egg laying period. He found that the hen pintail switches from vegetable matter to a pure invertebrate diet during egglaying but immediately resumes a vegetable diet at the termination of the stress period. He further suggests that because of the requirement for a high protein invertebrate diet, temporary spring water, such as the shallow flooded fields rich in invertebrates that occur in the prairies are absolutely essential to the breeding population of pintails. Work being conducted in Minnesota has measured high invertebrate populations during critical periods in beaver ponds having high waterfowl production which further suggests the importance of invertebrates to the breeding habitat. Swanson (1972) found that feeding time is also determined in part by the level of invertebrate populations. During observations of night-feeding, birds were observed to feed all night when high invertebrate populations were present.

Studies of food habits and invertebrate ecology have shown that waterfowl are basically opportunists which feed upon the most abundant and available species of invertebrates. That fact has undoubtedly accounted for much of the success of manipulations of water levels and vegetation in the past. For example, Burger (1966) obtained excellent success in brood production by impounding and flooding fields of millet at Remington Farms. Brood survival and invertebrate populations were both high following the first year of flooding. Unfortunately, studies were not undertaken to follow changes in invertebrate populations with time.

Other workers have attributed the initial success of new impoundments to plant succession. Di Angelo (1953) suggested that normal aquatic plant succession was responsible for the peak and subsequent decline of waterfowl populations on new areas. He correlated high early use of flooding projects with an abundance of pioneer plants, such as duck weeds (Lemna spp.), which are highly preferred foods for waterfowl. As succession progressed, more stable rooted aquatics appeared such as pondweeds (Potamogeton spp.), which did not produce as much food. Apparently, no consideration was given to changes in invertebrate populations with time since flooding.

More recently studies have shown that invertebrate populations are directly influenced by plant succession. Both Swanson (1972) and Krull (1970) found that invertebrates vary with vegetation type. It can be inferred from their work that the management of marshes for known waterfowl food plants may, in fact, be managing invertebrate populations that are of high value to a breeding marsh.

Based on a brief review of pertinent literature and personal contacts, it is apparent that much is known about how to produce certain habitat conditions, but relatively little thought has been given to reasons and timing for habitat management. Future studies should give more thought to when and why to manage than in the past. In that regard, invertebrate life is a factor which should receive careful evaluation to further document its importance to the breeding habitat. Most management for waterfowl food plants will also increase the number of invertebrates; however, the timing of such management may be much more critical for maintaining maximum invertebrate populations. In the study at hand, relative measurements of invertebrate populations will be undertaken to test the following hypotheses:

1. The abundance and variety of aquatic invertebrates in new impoundments decreases as the time since flooding increases.
2. The abundance and variety of aquatic invertebrates varies with vegetation types.
3. Waterfowl utilization of breeding and brood rearing habitat varies directly with the availability and abundance of aquatic invertebrate populations.

By testing those hypotheses, more insight into factors affecting availability and abundance of invertebrates should also be gained; i.e. water levels, vegetation types, etc. This in turn, should provide a better feeling for the when and why of management.

Study Areas

The study areas will include five different-age, man-made impoundments and an associated natural marsh area. Each of the six study areas contain at least three similar zones of aquatic vegetation and vary in size from 25 to 800 acres. For purposes of identification the study areas will be lettered A - F with A - E representing man-made impoundments.

Area	Date of flooding	Size(acres)
A	1965	800
B	1969	25
C	1970	40
D	1971	85
E	1972	45
F	Natural marsh	800

Figure 1 shows the location of the above areas and their relationship to each other.

Three dominant vegetation zones are defined for each area. The zones are designated as follows:

Submerged and floating leaf aquatics - Emergent vegetation is essentially absent from this zone. Pondweeds (*Potamogeton* spp.), duckweed (*Lemna* spp.), bur-reed (*Sparganium* spp.), and smartweed (*Polygonum* spp.) are the important characteristic species.

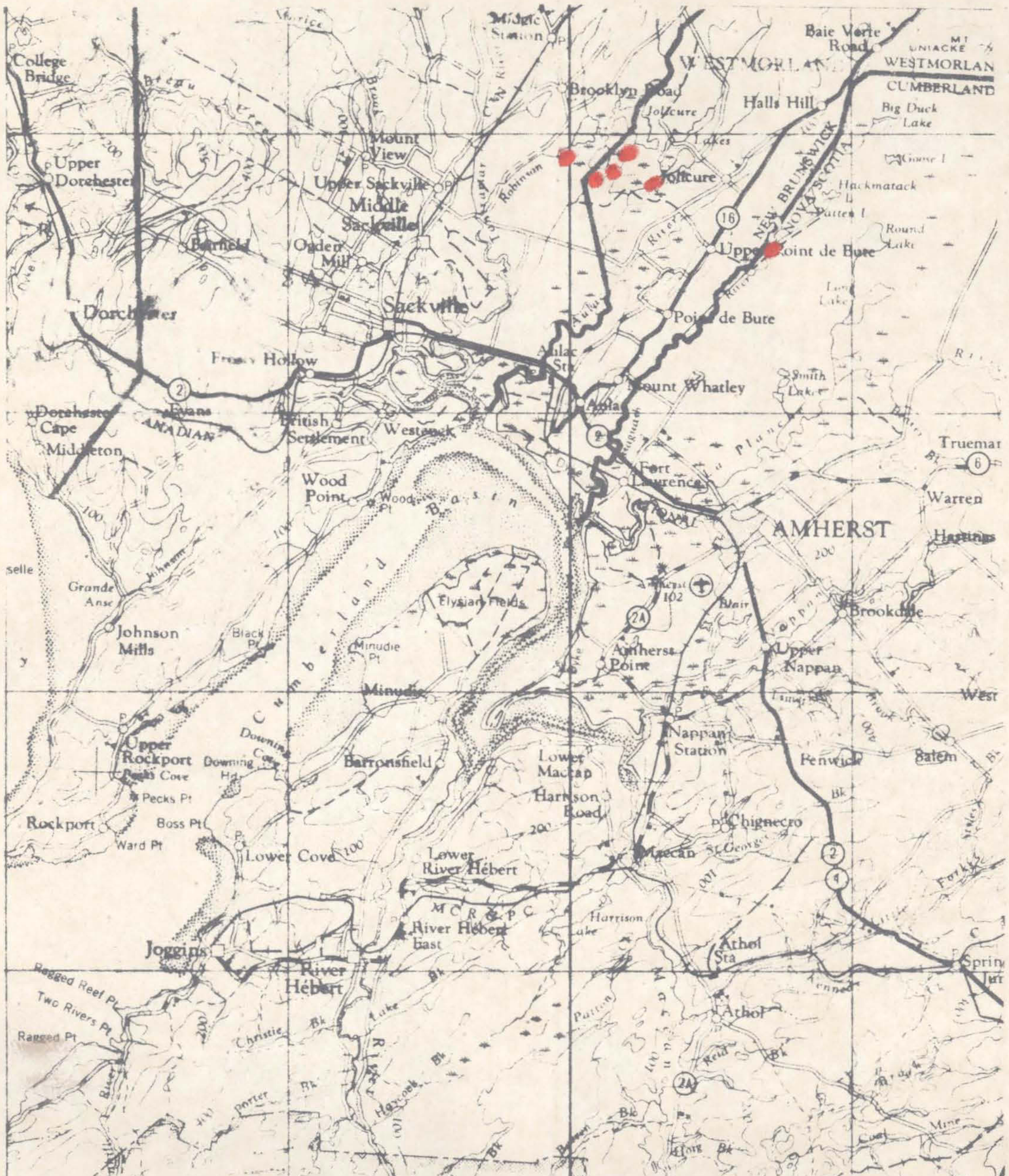


Figure 1. Location of invertebrate sample areas in the New Brunswick - Nova Scotia Border Area.

Sparce emergents - Emergent vegetation covers from 20 to 40 per cent of this zone with the above submerged and floating leaf species occurring throughout. Soft stem bulrush (*Scirpus validus*), Calamagrostis (*Calamagrostis* spp.), spiraea (*Spiraea* spp.), bur-reed (*Sparganium eurycarpum*), and Carex (*Carex* spp.), are dominant emergent species which characterize this zone.

Dense emergents - Emergent vegetation covers more than 75 per cent of this zone with submerged and floating leaf aquatics either completely lacking or occurring very sparcely. The same species characterize this zone as above.

All three vegetation zones occur under similar conditions of soil and water, and contain with few exceptions the same species composition from one area to the next. As plant succession progresses; however, more and more of the emergent type vegetation appears and the more desirable submerged and floating-leaf food plants are crowded out.

Concurrent with the invertebrate sampling will be a continuation of plant transects initiated in 1971 to identify trends in plant succession. That information will be useful in evaluating and predicting the rates of increase and ultimate peaks of invertebrate populations associated with various vegetation zones and different age impoundments. Vegetation maps constructed from recent aerial photographs will provide a total measure of vegetation zones within each impoundment.

The continuation and expansion of soil and water analyses will provide additional factors with which invertebrate populations can be compared. Except on artificially fertilized plots, no significant changes in soil and water chemistry is expected over the two year period.

In order to determine brood utilization of the vegetation zones being examined, intensive observation of brood feeding behaviour will be undertaken. Those observations should identify preferred areas of feeding activity for which information on invertebrate populations will be obtained. If time and personnel permit, a few broods and/or brood hens will be colour marked to permit the observation and identification of individual brood movements over the study areas.

Methods and Materials

Three types of invertebrate traps will be used to sample each of 18 points distributed over the six areas previously described. The use of three trap designs is necessary to effectively sample all species and stages of invertebrates which may be present in the study areas. By this approach, a technique can be adapted to sample each life form (i.e. forms having similar habitat, periods of activity, modes of locomotion, etc.). The trapping techniques to be used are artificial substrates, activity traps, and emergence traps. The latter two traps are types which have been used successfully by Swanson (1972) in marsh habitat. The artificial substrate is a standard Dendy type sampler composed of nine plates giving a total surface area of 2 square feet. Designs are appended.

In each of the six study areas, one sample site per vegetation zone will be established giving a total of three sites per area. Each sample site will, in turn, utilize one of each type of invertebrate trap giving a total of nine traps per study area. Substrate samples will be collected at two-week periods; however, it will be necessary to collect samples from both activity traps and emergence traps every two or three days to prevent decomposition and loss to predacious insects. In the latter cases, samples will be accumulated and counted at the end of every two weeks. A total of 54 samples will be collected over the six study areas every two weeks beginning on May 15 and continuing through August 15. Samples will be preserved immediately upon collection in 80 per cent ethanol.

Invertebrates collected will be separated at the family level using a binocular microscope and counting wheel designed by Swanson (1972). Both volumetric and frequency of occurrence measurements will be taken. An analysis of variance will be applied to compare differences which may exist between invertebrate populations in different age marshes and vegetation types.

Project Expenses

Sampling will be carried out under my supervision by one technician (Eg.-6) and a summer student and will involve approximately 25 per cent of the time expended in the management program during 1972-73. In addition the following materials and personnel are required:

1. Laboratory technician	- 10 months over a two year period	at $500/month	$5,000.00
2. Artificial substrates	- 36 at $2.00 each		72.00
3. Activity traps	- 36 at $ .70 each		25.20
4. emergence traps	- 36 at $3.00 each		108.00
5. Specimen vials	- 1 case		31.50
6. Miscellaneous	- chemicals, counting devices, sieves, etc.		100.00
	Total cost		$5,336.70

or $2,668.35 per year.

The laboratory technician is not absolutely essential to the project since samples can be stored over long periods thereby permitting processing by permanent staff as time permits.

Literature Cited

Burger, G. V. 1966. Impoundment management for waterfowl at Remington Farms. Proc. N.E. Section of the Wildl. Soc.; Boston, Mass. Jan. 16-19: 14pp.

Crapel, G. 1972. Personal communication. N.P.W.R.C., Jamestown, N.D.

Di Angelo, S. 1953. Aquatic plant succession at certain waterfowl flooding projects in Michigan. Unpubl. MSc. Wildl. Mgmt. Thesis, Univ. of Mich., Ann Arbor. 112pp.

Holm, E.R. and M.L. Scott. 1954. Studies on the nutrition of wild waterfowl. New York Fish and Game J. 1(2):171-187.

Krull, J.W. 1970. Aquatic plant-macroinvertebrate associations and waterfowl. J. Wildl. Mgmt. 39(4):707-717.

Swanson, G. 1972. Personal communication. N.P.W.R.C., Jamestown, N.D.

Figure 2. Activity trap for aquatic invertebrates.

Note: Set horizontally just below the surface of the water.
Suspended from string.

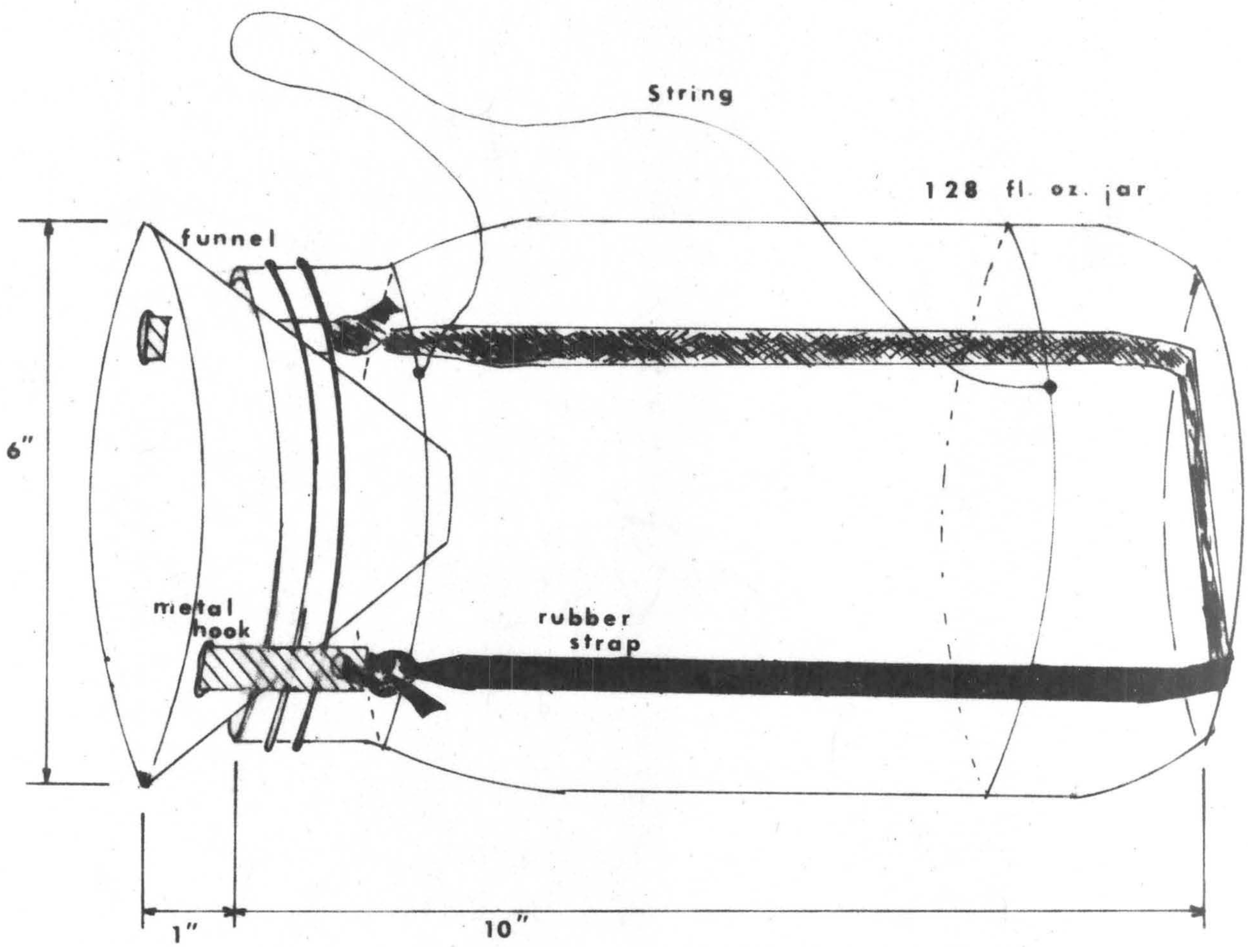


Figure 3. Dendy bottom sampler for aquatic invertebrates

Note: Set on bottom to permit attachment of bottom dwelling invertebrates such as snails and chironomids.

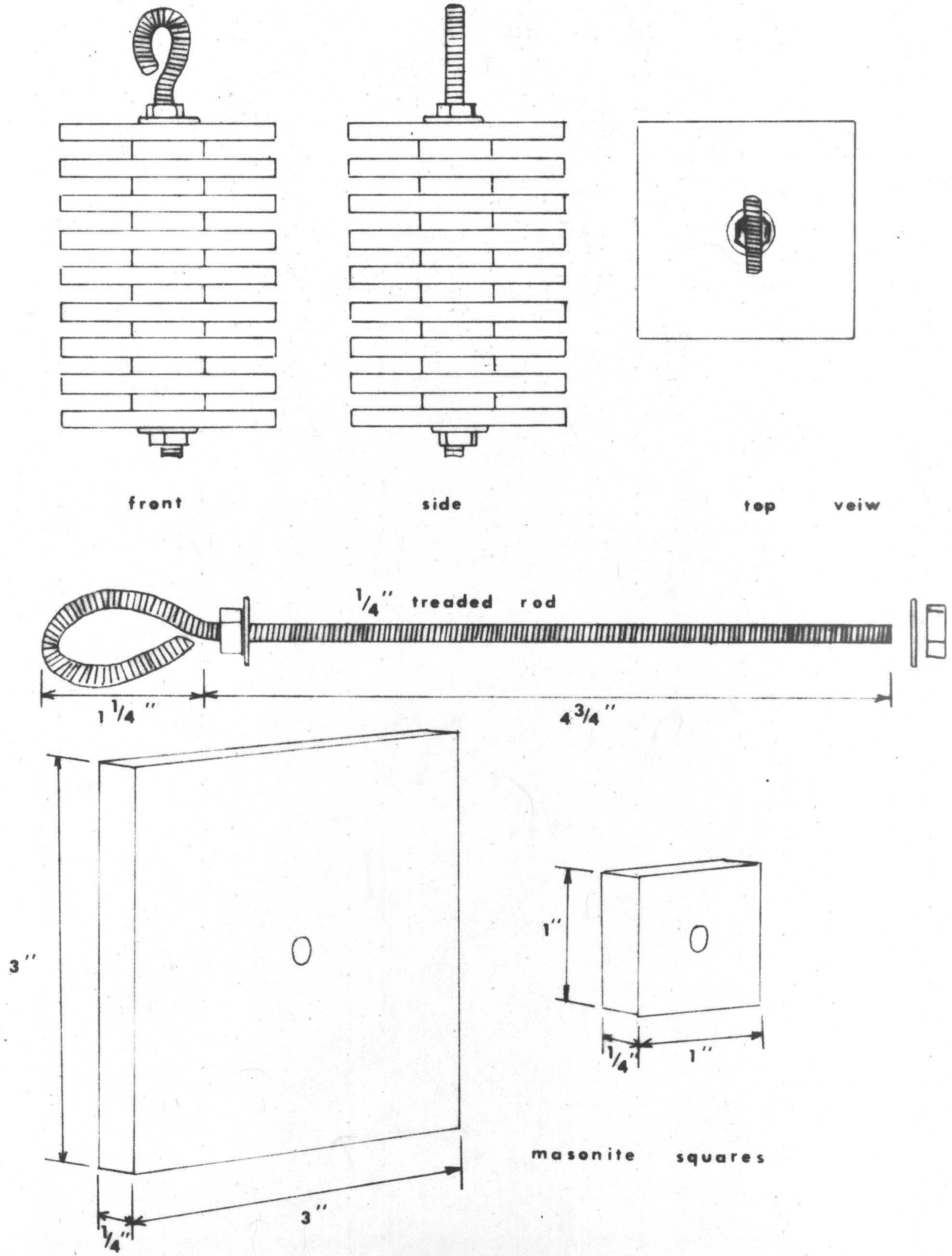
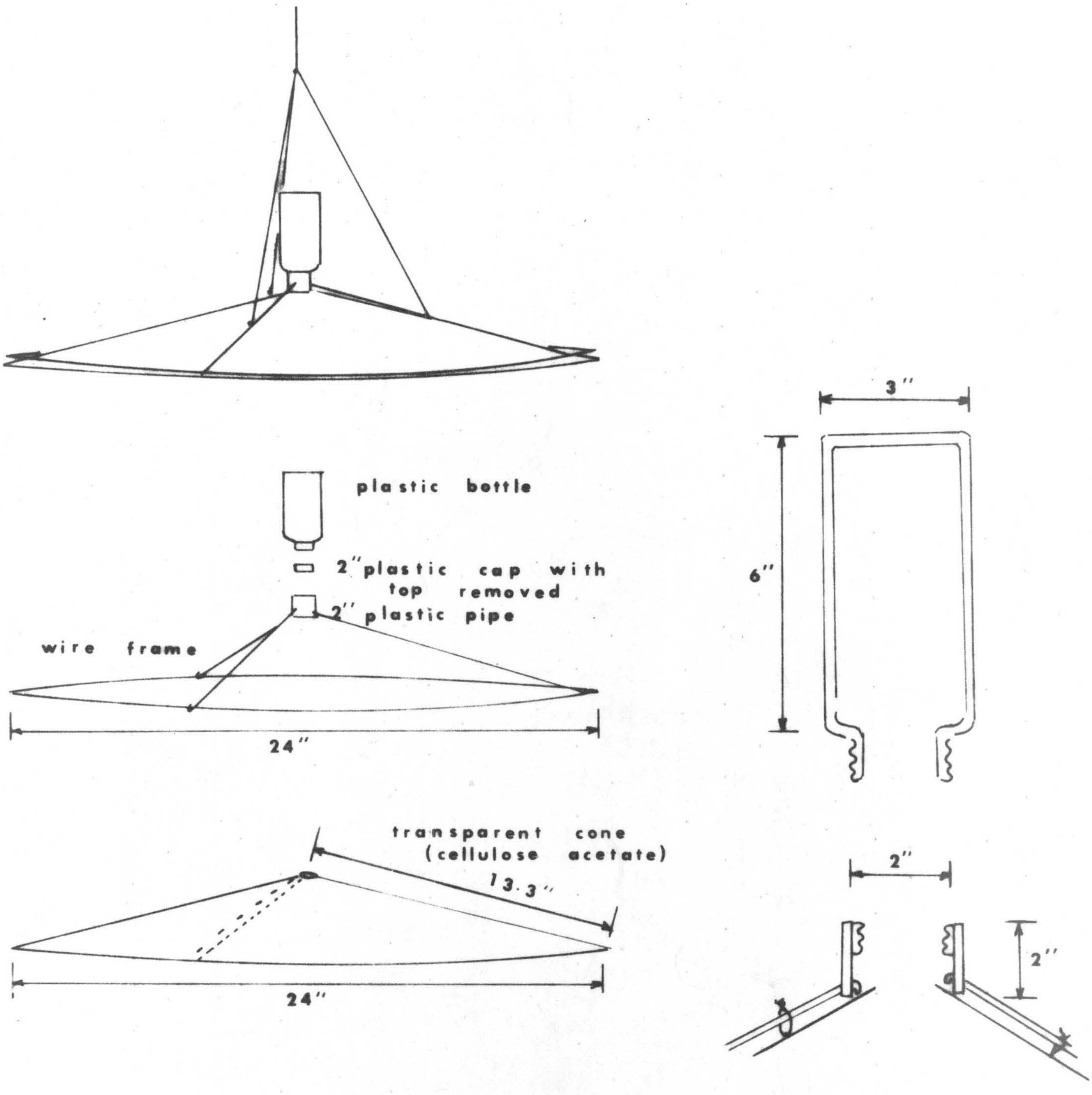


Figure 4. Emergence trap for aquatic insects.



Note: Cone is set just under the water surface in such a manner that the water line is located about one-third of the way up the bottle. An air pocket is trapped inside to catch invertebrates emerging from the bottom to the surface. Designed to catch chironomids, mayflies, mosquitoes, etc.