

# A comparison of three methods of monitoring frog populations

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## Abstract

We tested the reliability of both human ears and remote tape recorders as means of monitoring an anuran population. We selected a single population of the Gray Treefrog (*Hyla versicolor*) to monitor through an entire breeding season. We compared estimates of the number of calling males by human listening and by remote recording, with the number of calling males determined to be present by intensive observation involving identification of every male every night. The numbers of calling male frogs estimated by both human listening and remote recorders were significantly correlated with the actual number of calling individuals ( $r^2 = 0.77$  and  $0.88$ , respectively,  $p < 0.0001$ ). We therefore can have confidence in the estimates of size of a calling male population of treefrogs provided by both listening methods, provided they are calibrated by a single intensive study. We propose that the most efficient method of monitoring, in terms of time, cost, and energy, combines the three methods we used. A remote recorder that turned on for five minutes at the same time each night, coupled with a single weekly visit to the site, would allow human listening to corroborate the recorded calls. A single night of intensive monitoring in the middle of the breeding period would allow the calibration factor to be assessed. Although there are constraints on the suitability of such monitoring methods, they should be useful in monitoring many anuran species.

## Résumé

Les auteurs ont évalué la fiabilité de l'appareil auditif et des magnétophones télécommandés pour assurer le suivi d'une population d'anoures. Une population prédéterminée de *Hyla versicolor* (Rainette versicolore) a ainsi été suivie durant toute une saison de reproduction. Les estimations du nombre de mâles chanteurs repérés par l'appareil auditif humain et par téléenregistrement ont été comparées au nombre repéré à la suite d'une surveillance approfondie requérant l'identification visuelle de tous les mâles chaque nuit. Une corrélation positive a été établie entre le nombre de mâles chanteurs évalué par les deux premières méthodes susmentionnées et le nombre réel de sujets émettant des signaux sonores ( $r^2 = 0,77$  et  $0,88$ , respectivement,  $p < 0,0001$ ). La fiabilité des estimations des populations de mâles chanteurs fournies par les deux méthodes de détection a été établie, à condition de procéder à l'étalonnage des

résultats en ayant recours à la surveillance approfondie. Les auteurs estiment que la méthode la plus efficace de surveillance au point de vue de l'économie de temps, d'argent et d'énergie, est celle qui combine les trois méthodes susmentionnées. L'utilisation d'un magnétophone fonctionnant chaque nuit durant le même intervalle de cinq minutes, combiné à une seule visite hebdomadaire sur le site d'observation, permettrait de corroborer les résultats obtenus par écoute humaine. Une surveillance approfondie effectuée durant une seule nuit choisie au milieu de la période de reproduction permettrait d'évaluer la valeur du facteur d'étalonnage. En dépit des contraintes qui influent sur la pertinence de ces méthodes de surveillance, celles-ci devraient s'avérer utiles pour la surveillance de nombreuses espèces d'anoures.

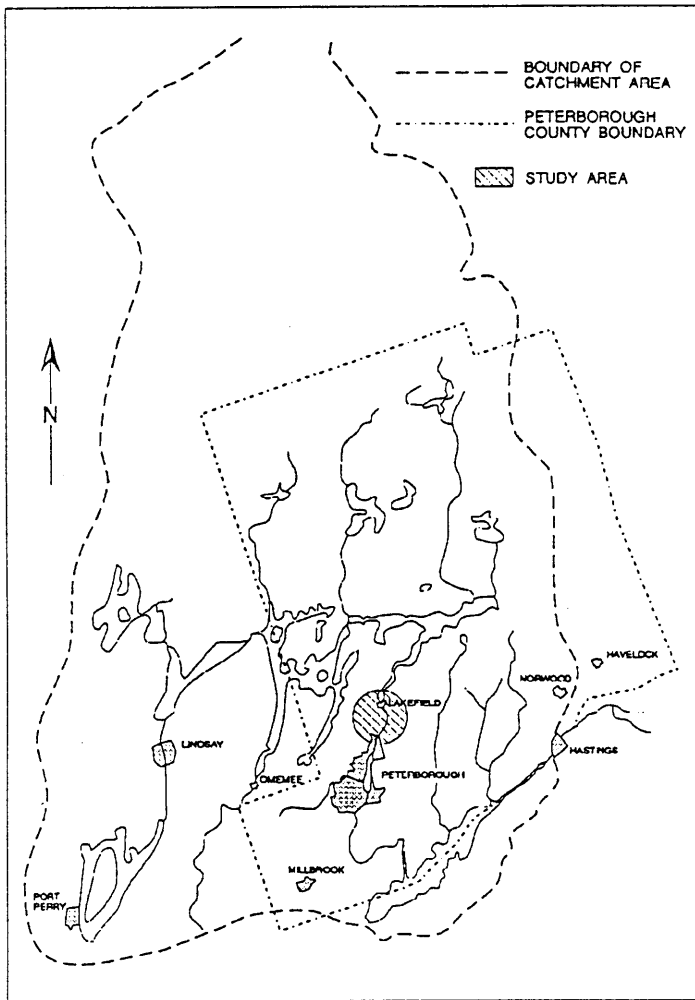
## Introduction

During the spring and summer of 1991, we attempted to count the number of calling male frogs of eight species at eight sites in Peterborough County in southern Ontario. We made the following assumptions:

- (1) Frog populations can be assessed with most accuracy by counting the number of calling males during the breeding season. Assessment outside of the breeding season is particularly difficult for nonaquatic species.
- (2) Counting the number of calling males at a site during the breeding season reflects the density of adults at that site. This assumes an equal sex ratio, which in fact is unlikely to be true of all species.
- (3) A change in the number of calling males at a particular site from year to year reflects real changes in density of adults at that site.

We monitored three ponds, three marshes, and two ephemeral swamps in Peterborough County (Fig. 1) from early April until mid-July. These sites allowed us to listen to at least three populations of seven species—Spring Peeper (*Hyla crucifer*), Gray Treefrog (*Hyla versicolor*), Western Chorus Frog (*Pseudacris triseriata*), American Toad (*Bufo americanus*), Northern Leopard Frog (*Rana pipiens*), Wood Frog (*Rana sylvatica*), and Green Frog (*Rana clamitans*) (Fig. 2)—and one population of Bullfrogs (*Rana catesbeiana*).

**Figure 1**  
Location of Peterborough County where three ponds, three marshes, and two ephemeral swamps were monitored



We counted calling frogs in three different ways:

(1) *Human listening*. Two people (DB and one other) listened at each of the eight sites, four nights per week. Each site visit lasted 15 minutes, and the listeners estimated the number of calling males of each frog species. Sites were visited in a different order on different nights, beginning after dark.

(2) *Remote recording*. We set up tape recorders at four of the sites. Each recorder was connected to a sensitive microphone and to a timer that turned the recorder on for one minute every half-hour: a 90-minute tape therefore lasted two days. Microphone, recorder, and timer were all powered by batteries. We turned or replaced tapes every 24 hours and later transcribed them, estimating the number of calling males of each species.

(3) *Intensive monitoring*. As part of her M.Sc. thesis, S. Bertram identified every calling male of a population of the Gray Treefrog every night during the breeding season at one of the sites, identifying each male by its unique dorsal pattern.

Each method allowed us to test the validity of the other two methods, and each, of course, allowed us to collect rather different data about each population. We attempted to answer the following questions:

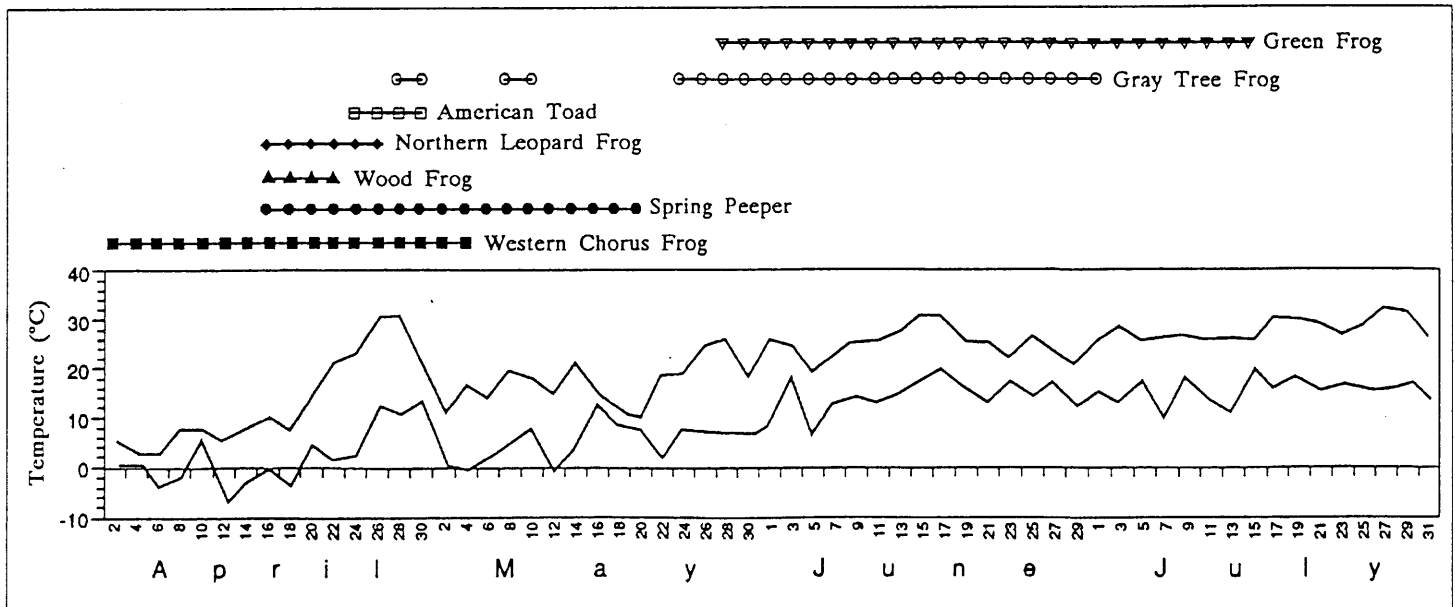
(1) Are the calling activities of different populations of the same species similar between sites during the calling season?

(2) Can remote recorders provide information comparable to what human listeners can provide?

(3) Does either human listening or remote recording give an accurate estimate of the true number of calling males in a population?

(4) What is the most efficient method of assessing population density of calling males with an acceptable margin of error?

**Figure 2**  
Time periods in which males of seven species were heard calling in Peterborough County and associated air temperatures



## Methods and results

### Human listening

Numbers of males were easy to assess when they were low but became increasingly difficult to estimate as they became larger; accuracy certainly decreased. The variation that occurred in estimated numbers between sites and between nights must be considered with care, if used at all, for the time of visiting a site confounds other critical effects, such as temperature or time in breeding season.

On the other hand, human listening allows accurate assessment of seasonal patterns of onset, period of peak activity, and cessation of calling. Despite the potential inaccuracy at high densities of calling males, it allows an estimate of relative numbers that is likely to be useful.

By monitoring as frequently as four times per week, then averaging the number of calling males per night per week, a fairly clear picture of the season emerges. Our data indicate that a single species will call with a similar seasonal pattern at different sites, as illustrated by the seasonal calling activity of Spring Peepers at three sites (Fig. 3).

### Remote recording

The four recording units functioned relatively well, particularly once we became accustomed to their limitations. The sensitive microphones were also sensitive to high humidity, and April was very wet. We also had to learn from experience how long the various batteries would last, and, as a result, none of the four units ran nonstop for the two- to three-month period. Estimating the number of calling males by listening to the tapes is challenging—estimates are probably accurate when numbers of callers are

low but increasingly less accurate as numbers increase beyond about 10.

Besides providing an estimate of the number of calling males of each species at each of the four sites, the tapes provide detailed data on the diurnal calling activity of each species. The tapes also make it possible to assess with some confidence the effect of temperature or stage in breeding season on relative numbers of calling males. An example is a comparison of the estimated number of calling males of a population of Gray Treefrogs on two nights, one cool and one warm (Fig. 4).

### Intensive monitoring of one population

The quality of data obtained by monitoring every calling individual of a population every night for the entire breeding season is, of course, unusually good. Such monitoring is also labour intensive, demands a high level of commitment, and restricts observations to a single site. It does, however, give us an idea of the true number of males calling in a breeding population, in comparison with the estimates provided by the other two methods. Once again using the Gray Treefrog as our example, intensive monitoring indicated that 84 different males called at a site during the breeding season, some individuals calling on many more nights than others (Fig. 5). The other two methods simply could not provide that information, telling us only that 30 or more males might be calling on any one night (Fig. 6).

Although such intensive monitoring is unrealistic to expect of anyone except a graduate student, it really needs to be done at least once per species in order to “calibrate” any other method involving estimations; the detailed data the method provides may radically modify the whole picture

Figure 3  
Seasonal calling activity of Spring Peepers at three sites

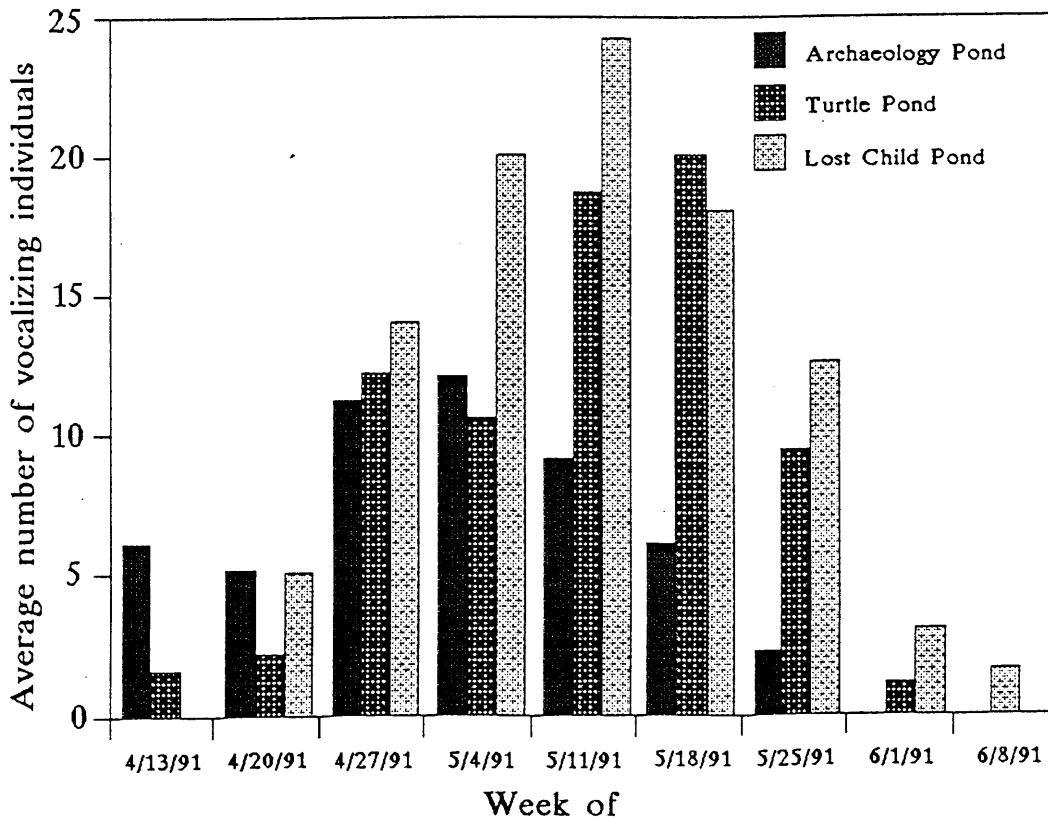


Figure 4  
 Estimated number of calling males of a population of Gray Treefrogs on two nights of monitoring

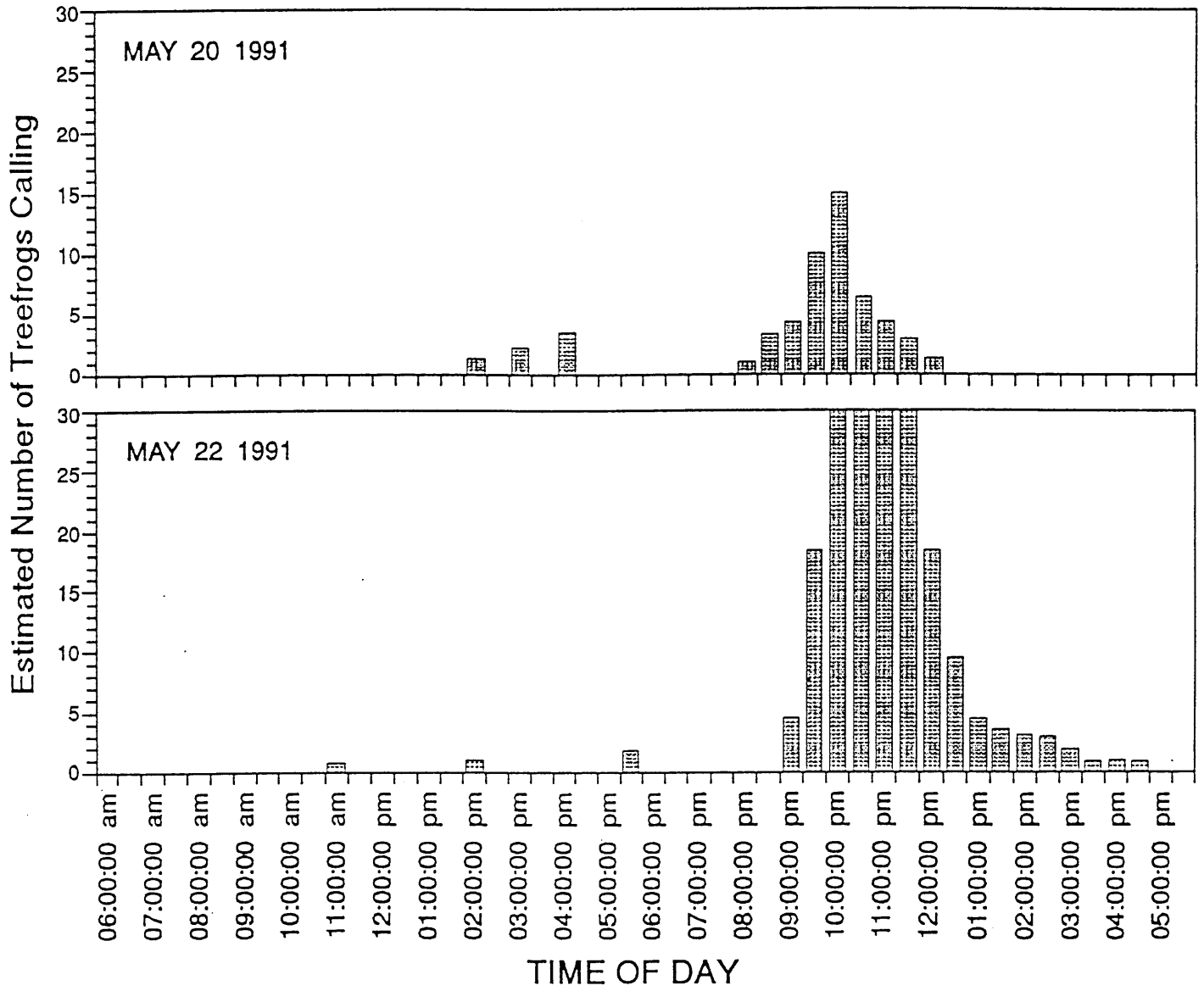
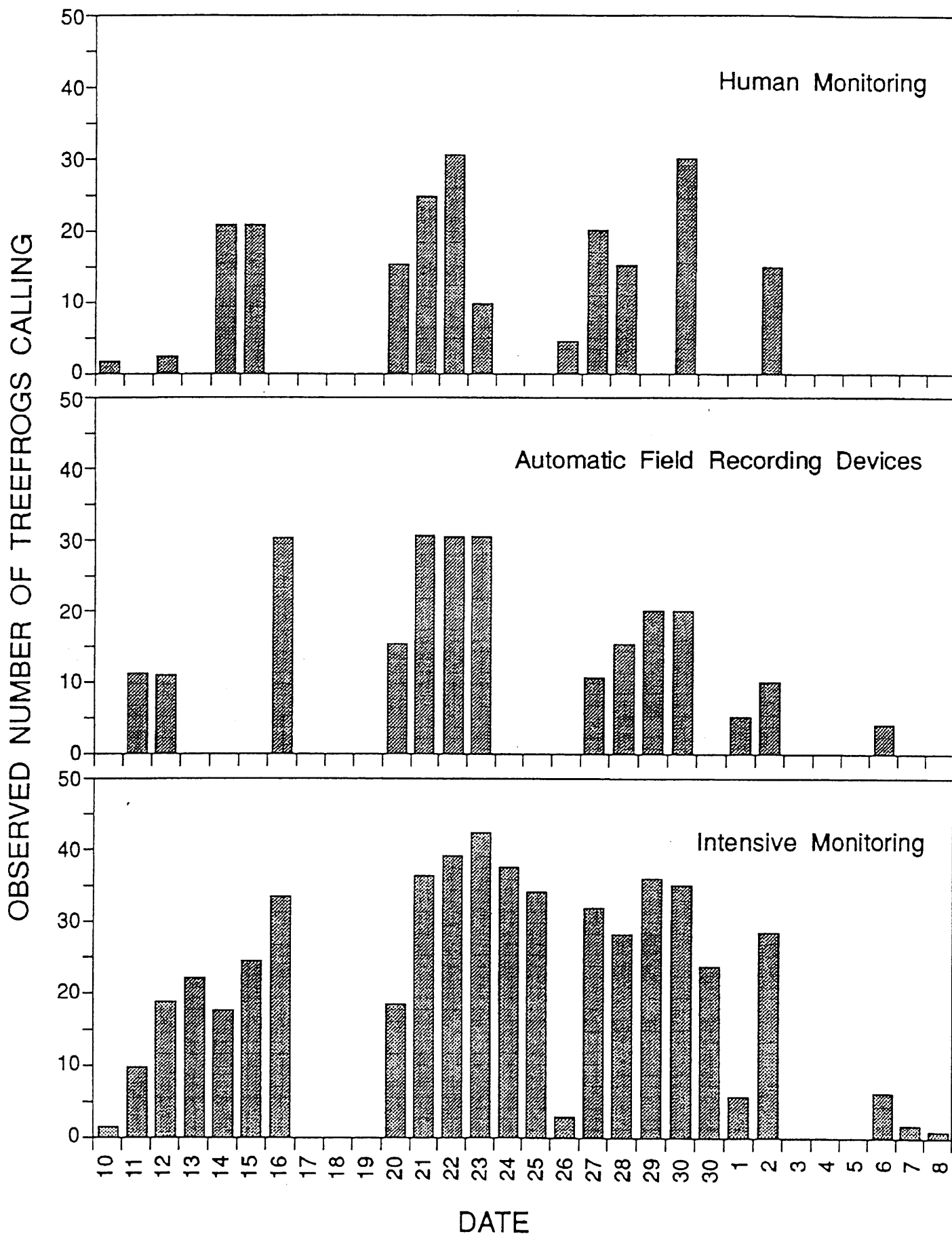




Figure 6  
 Comparison of numbers of Gray Treefrogs heard calling by three monitoring methods



for that species. Some species would be much more difficult than others to monitor in such detail, but even a single night of intensive monitoring could be useful: for example, a single evening of monitoring all males in a small population of the American Toad indicated that the number of callers present was several times larger than the number estimated by our other monitoring methods.

### **Overall conclusions**

If we compare the three methods of monitoring Gray Treefrogs at the single site where all three were used, asking only how many males were calling each night, when did the breeding season begin, and how long did it last, the methods provide quite similar data. Much of the night-to-night detail that the recording units can provide is probably not relevant. However, a recorder that listens to a calling population for just one to two minutes a night would be considerably easier and cheaper to maintain than a human listener, especially in more remote sites. A human could visit the site once a week to service the recording unit and listen to calls, but more frequent visits and more extensive recording may not be necessary. It is true, however, that a very dense and loud population of one species could mask the calls of uncommon species, and the recording units should be used judiciously. Additionally, however, each species, in each region, also needs intensive monitoring at least once, even briefly, in order to provide some correction factor that can be applied to the other monitoring methods to make them meaningful.