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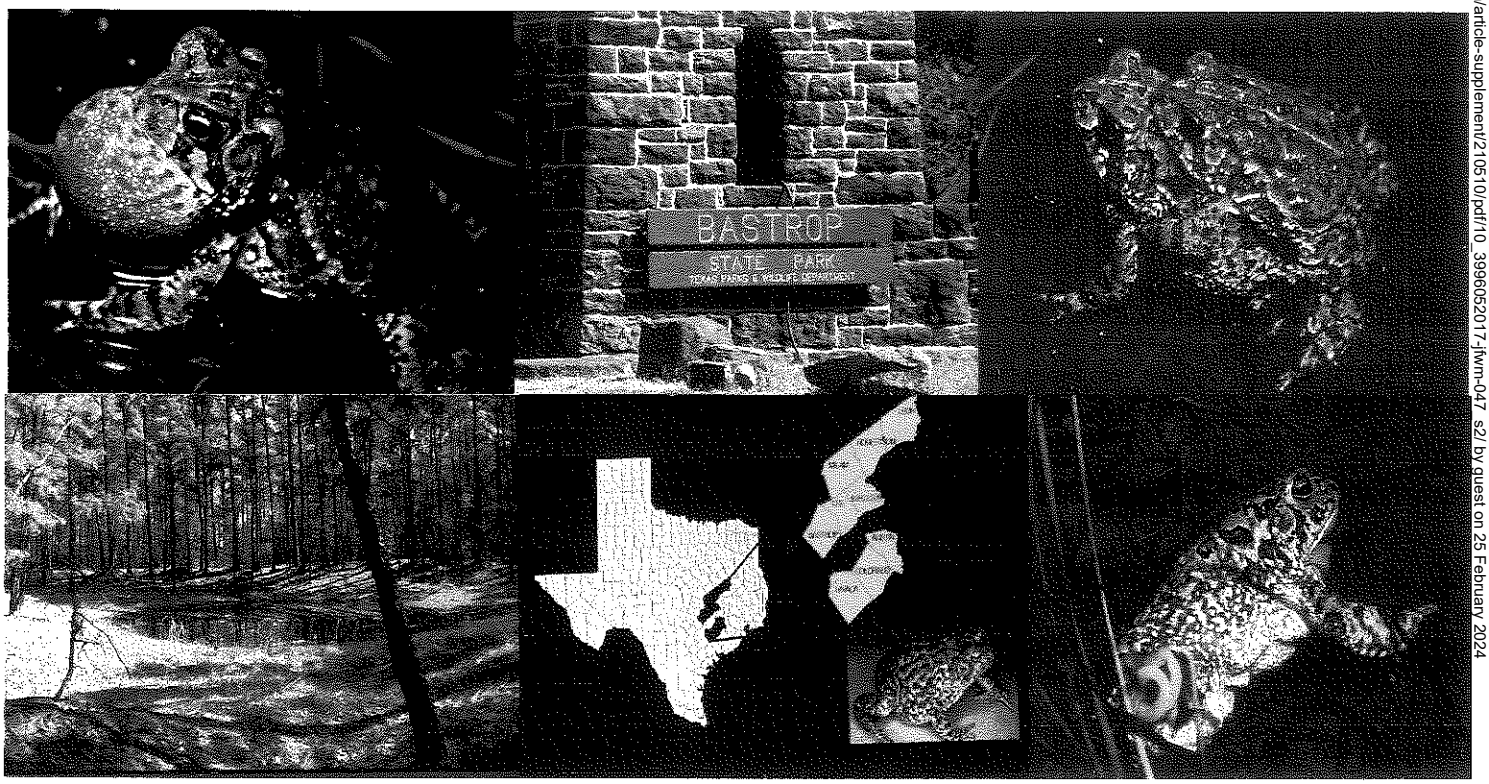
The Houston Toad in Bastrop State Park 1990 – 2002: A Narrative

Open- File Report 03-0401



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Cover:

Upper left: singing male *Bufo houstonensis*, Pond 10, 1990 (photo by Jim Godwin); lower left: Pond 10, Bastrop State Park, 1990; upper middle: entrance to Bastrop State Park; lower middle: the current range of *Bufo houstonensis*; upper right: amplexed pair of *Bufo houstonensis*, Pond 10, 1990 (photo by Jim Godwin); female *Bufo houstonensis* killed by predator, Pond 10, 1990 (photo by Jim Godwin).

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By Andrew H. Price

Texas Parks & Wildlife Department
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Open-File Report 03-0401

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Texas Parks & Wildlife Department

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The Houston Toad in Bastrop State Park 1990 – 2002

A Narrative

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BACKGROUND

In 1990 TPWD began an effort to implement some of the tasks outlined in the 1984 recovery plan for the Houston Toad. With the exception of a few anecdotal observations and a one-year study by Hillis et al. (1984) on distribution and activity during the breeding season and a one-year study at a single pond by Jacobson (1989) on breeding activity, virtually nothing was known about the natural history and ecology of this animal. This report, prepared at the behest of interested citizens, provides a partial summary of an attempt to develop some basic natural history information for *Bufo houstonensis* utilizing the most robust population of this species known to exist, the one in Bastrop State Park, Bastrop County, Texas.

METHODS

I began marking toads at ponds 9 and 10 south of Park Road 1 in Bastrop State Park (Fig. 1A&B) during the 1990 breeding season. Adults were captured when they were present at breeding choruses and implanted with PIT tags, which provided each individual with a unique identification number which lasts a lifetime. Ponds were visited every night from the third week of January through the first week of May for the first 3 years (1990-1992) in order to determine the environmental factors governing breeding activity. This information guided field activity in subsequent years. Other toads were marked elsewhere in the Park on an incidental basis. David Hernandez and I began marking toads at ponds 1 and 2 (Fig. 1) in 1996 in anticipation of an experimental controlled burn in Bastrop State Park to be able to assess the effects of fire on this species. Pond 3, located just to the east of Harmon Road and about 600 m south of Park Road 1 was added to the effort in 1999 when it was discovered that a number of toads originally marked at Pond 2 were using this one. Similarly, we began marking toads at the large lake in the park (BSPL) on a systematic basis in 2001 when we discovered a couple of toads there that had originally been marked at Pond 1. Additional data taken on each animal marked included body size and weight and other potentially significant information, such as which males were mating with which females, was gathered as the opportunity allowed.

DATA

Several important facts became readily apparent. First, the characterization of many anuran species as "explosive breeders" (Wells 1977) applies to the Houston Toad (Fig. 2a,b and 3a-c; Price and Yantis 1990, 1992, 1993; A.H. Price unpubl. data); choruses form for several nights and then disappear for intervals of several days to a week or more. Second, about one-third of the individuals participating in choruses show up once a year (Fig. 4; Price and Yantis 1990, 1992, 1993; A.H. Price unpubl. data), regardless of whether or not they are recaptured in subsequent years. This is especially true of females. Therefore, if the individuals active during the breeding season are not counted the size of the population they represent is going to be underestimated, incurring significant consequences for effective management and conservation actions (Simberloff 1988, Vucetich et al. 1997). Houston Toads are rarely active at this time unless ambient temperatures are warm (more than 55^0F overnight and over the previous night unless intervening daytime temperatures are

at least 70°F), relative humidities are high, and cloud cover obscures the moon during the week or so preceding the night it is full (Fig. 2a,b and 3a-c; Price and Yantis 1990, 1992, 1993; A.H. Price unpubl. data). Choruses rarely form unless the relative humidity exceeds 70%. Rainfall enhances activity, but chorus formation will be delayed until heavy rainfall abates.

Table 1 summarizes the data for Pond 9 and 10 through the end of the 2002 breeding season. The number of new toads marked during any particular year is given where the row and column for that year intersect, with females given first. For instance, in 1995 103 new females and 220 new male were marked. The number of toads marked in previous years recaptured in 1995 can be determined by going up in the column for males and back (left) along the row for females. The number of recaptured toads that were originally marked in a specific year can be read for males and females by reading along the row and up the column, respectively. Thus, in 1995, 74 males were recaptured that were originally marked in 1994 and 17 males were recaptured that were originally marked in 1993. Similarly for females in 1995, 6 originally marked in 1994 were recaptured. Totals for the year are then determined by adding the cells in the column for males and the row for females, and these figures are shown in the "#" column and row, respectively. Thus males captured in 1995 equaled 311 (220 + 74 + 17) shown in that column for the 1995 row. Similarly, 109 females (103 + 6) were captured in 1995, shown at the bottom of the column for 1995. Finally, the number of toads marked in any given year that survived to be recaptured in subsequent years can be read in the cells along the row to the right of the original cell for males and along the column below the original cell for females. Thus, of the 220 males originally marked in 1995, 62 were recaptured in 1996, 18 in 1997, 6 in 1998, and none in 1999. Similarly, of the 103 females originally marked in 1995, 14 were recaptured in 1996 4 in 1997, and none in 1998. It can then be seen through inspection of this matrix that generation time for the Houston Toad population in this system is short, with essentially complete turnover within 3 years.

These data are represented in graphical form in Figures 5 and 6. They can be interpreted in at least three ways. Figure 5 shows a significant decline in both males and females in this population of Houston Toads, and predicts its extinction in the short term. Figure 6 shows the same decline, but suggests a different interpretation. The Houston Toad population measured was robust and steady for the first 6 years of the study, followed by a significant adjustment downward to a lower steady state for the remaining years to date. This adjustment was dramatic and precipitous, and coincided with the onset of a severe regional drought between the 1995 and 1996 breeding seasons. The profound effects of the drought can readily be seen by examining the percentage of recaptures for each breeding season. Recruitment was high for the first 6 years; most of the toads captured were new recruits into the breeding population. Recruitment into the breeding population following the drought was much lower, and the data suggest that there was essentially no recruitment (ie. the previous year's cohort was lost) in 4 of the years measured. In addition, most of the toads recaptured were stressed as indicated by body condition; they had not grown or had actually lost weight from the previous year, unlike toads recaptured during pre-drought years which had grown and/or put on weight in succeeding years (unpubl. data). The implication is that if climatic conditions improve the population may rebound to pre-drought levels (see below). This leads to the third interpretation of the data, and that is what we are observing is only a segment of a long-term cycling of the population as is common in most organisms that have been measured over time. Whether this cycle has been perturbed to the point where this population crashes to extinction can only be determined by continued monitoring.

Toad Movements

Movements of individuals between breeding units is of critical importance in metapopulation dynamics of terrestrial organisms (Frankham 1995, Mills and Allendorf 1996, Hedrick and Kalinowski 2000, Semlitsch 2000), and movements in anurans in seasonal climates are significantly constrained by intrinsic ecophysiological characteristics (Shoemaker et al. 1992, Semlitsch 2000, Rothermel and Semlitsch 2002, Schwarzkopf and Alford 2002). It is therefore vital to maintain suitable habitat between breeding sites in order to allow these movements to take place. The fact that Houston Toads make these movements is demonstrated by the following data:

Distances between major breeding sites on Figure 1, as measured using the scale indicated, are as follows: between Bastrop State Park Lake (BSPL) and pond #1 = 0.9 mi. (1.4 km) straight line map distance; between BSPL and pond #9 = 1.15 mi. (1.85 km) straight line map distance; between BSPL and pond # 10 = 1.0 mi. (1.6 km), straight line

map distance; between pond #1 and pond #9 = 1.0 mi. (1.6 km) straight line map distance; between pond #1 and puddle #3 (the gravel pit on Fig. 1) = 0.6 mi. (0.95 km), straight line map distance. Note that the last four categories represent inter-drainage movements.

Individual toad movements include the following:

1. Toad # 4136575023, male, first marked at pond #1 990208, last recaptured there 010221, subsequently recaptured at BSPL 010323.

2. Toad # 41366D5472, male, first marked at pond #1 000224, subsequently recaptured at BSPL 010220.

3. Toad # 414C347260, male, first marked at pond #9 990311, last recaptured there 010207, subsequently recaptured at BSPL 010311.

4. Toad # 414C602345, female, first marked at pond #9 990312, subsequently recaptured at BSPL 010215 (NOTE: was not recaptured during the 2000 breeding season).

5. Toad # 414C666E28, male, first marked at pond #9 990225, last recaptured there 000321, subsequently recaptured at BSPL 010215.

6. Toad # 414C70003D, male, first marked at pond #10 990305, last recaptured there 000322, subsequently recaptured at BSPL 010221.

7. Toad # 413664656F, male, first marked at pond #1 010311, subsequently recaptured at BSPL 010401.

8. Toad # 7F7D343373, male, first marked at #9 950210, subsequently recaptured at pond #1 970218 (NOTE: was not captured during the 1996 breeding season).

9. Toad # 7F7D371E18, male, first marked at pond #3 950306, last recaptured there 950404, subsequently recaptured at pond #1 960430.

10. Toad # 7F7D354211, male, first marked at pond #3 950404, subsequently recaptured at pond #1 970218 (NOTE: was not captured during the 1996 breeding season).

A number of intra-drainage movements at the beginning of the study were listed in Price and Yantis (1992). A number of additional such movements have occurred subsequently, but are not detailed herein.

FINAL POINTS

Unlike other closely related, relictual species of *Bufo* exhibiting population declines (Blaustein et al. 1994, Corn 1998, Sherman and Morton 1993, Stebbins and Cohen 1995), the Houston Toad has been and remains common and abundant in Bastrop State Park and the surrounding sandy-soil habitat of Bastrop County (Hillis et al. 1984, Price and Yantis 1990, 1992, 1993, A.H. Price unpubl. data). Like other relictual species of anurans which have not declined and for which there are good data (e.g. Banks et al. 1994, Beebee et al. 1990, Hitchings and Beebee 1996), such isolated populations can persist and may even thrive provided sufficient quality habitat is available.

Individuals of many anuran species undertake long-range migrations or dispersal from breeding sites as an integral portion of their life-cycle (e.g. Fowler's Toad (*Bufo fowleri)*, up to 2 km, Breden 1987, 1988; Common Toad (*Bufo bufo*), up to 1.6 km (Germany, Sinsch 1988) and up to 3 km (Switzerland, Heusser 1968); Natterjack Toad (*Bufo calamita*), up to 1.1 km straight line distance, up to 2.6 km total distance during a breeding season, Sinsch 1992; Crawfish Frog (*Rana areolata*), up to 2 km, Lazell et al. 1988; Houston Toad, *Bufo houstonensis*, A.H. Price, data given above). It follows therefore that the quality of surrounding terrestrial habitat is just as significant as the aquatic habitat in the

conservation of pond breeding amphibians (Buhlmann et al. 1992, Dodd 1997, Dodd and Cade 1998, Pope et al. 2000). Since pond breeding species live in the terrestrial habitat surrounding [the] breeding site[s], the number of adults returning to breed each year should reflect the quality of that habitat over time (Semlitsch et al. 1996, Semlitsch 1998, 2000).

The Houston Toad has been around since at least the Pleistocene (Blair 1972) and has patently adapted to the drought cycles characteristic of this region of central Texas (Hafner 1993, Sorenson et al. 1976, Winkler 1990). It is reasonable to assume that the Bastrop County population has been as robust as the one in Harris County since at least the end of pre-settlement times, which coincides with the onset of artificial water impoundments in the region. Both populations were subject to the last major regional drought which took place in the decade of the 1950s, yet only the Bastrop County population survived it. A major and significant difference between the two is the almost complete destruction of suitable habitat for the Harris County population concomitant with the rapid urban expansion of the city of Houston during that decade. Indeed, there is a consistent negative association with the presence of urban land in other anuran guilds examined (Knutson et al. 1999). It is therefore reasonable to conclude that, given the importance of both sufficient breeding and non-breeding habitat and the ability to exchange individuals between breeding sites set forth above, the population of Houston Toads found in Bastrop County should persist if these ecological requirements can be met. These intuitive conclusions are bolstered by a Population Viability Analysis using the data gathered during this study (Hatfield et al. in press): the more toads there are in the breeding population (carrying capacity, K, a reflection of the amount of habitat) and the greater the probability that individual toads can disperse between breeding sites, the more likely the population will be able to withstand catastrophes (such as drought) that would otherwise drive a small, fragmented population to extinction.

ACKNOWLEDGEMENTS

Many people deserve my thanks, some of whom I'm sure I'll forget, so my apologies up front. I thank Jim Dixon for introducing me to the Houston Toad, Jim Godwin for introducing me to PIT-tagging, and Jim Yantis for introducing me to the ecology of the post-oak woodlands of east-central Texas. My good friend David Hernandez has been instrumental in this work. He started out helping me in 1992 when one of my discs shattered just before the beginning of the field season (Help! I've fallen and I can't get up!), and by the time he moved to Nevada in 2001 knew as much about the Houston Toad as anyone alive (although he probably wouldn't admit it). Others who have provided material field support include Lee Ann Linam, Martin Whiting and Barbara Adkisson-Price. Brent Leisure, superintendent of Bastrop State Park, has always provided me with every possible assistance, and pulled my vehicle out of the sand at least once. I've enjoyed interacting with many citizens and landowners over the years, but I'd especially like to thanks Jim Small for his kindness and help both realized and unrealized. Funds for the first 3 years of this project were provided under Section 6 of the Federal Endangered Species Act and USFWS personnel, particularly Lisa O'Donnell, have supported my efforts over the years. Finally, it's been a long haul full of experiences both pleasant and unpleasant, and to all of those who have contributed, thank you.

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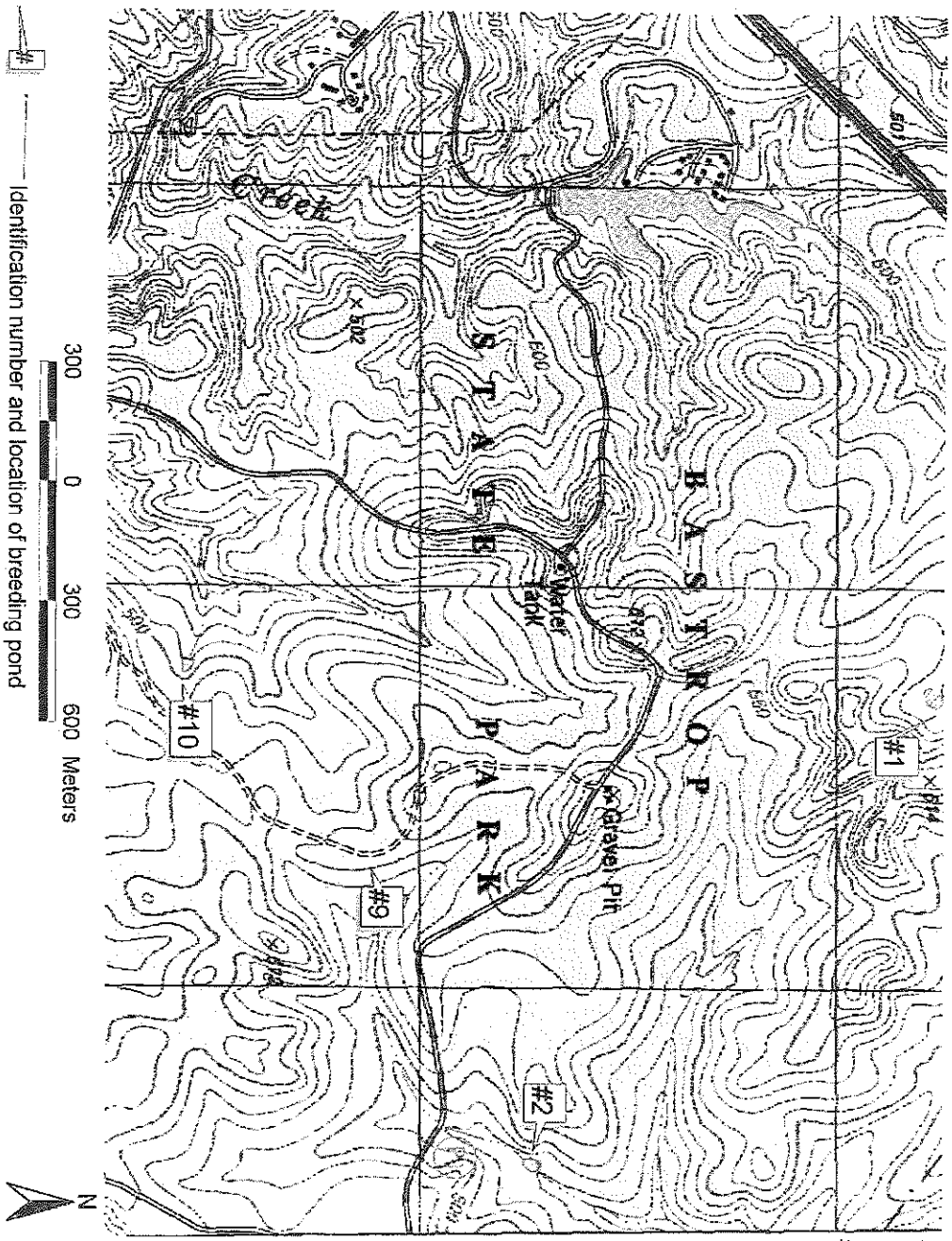


Figure 1A- Topographical View

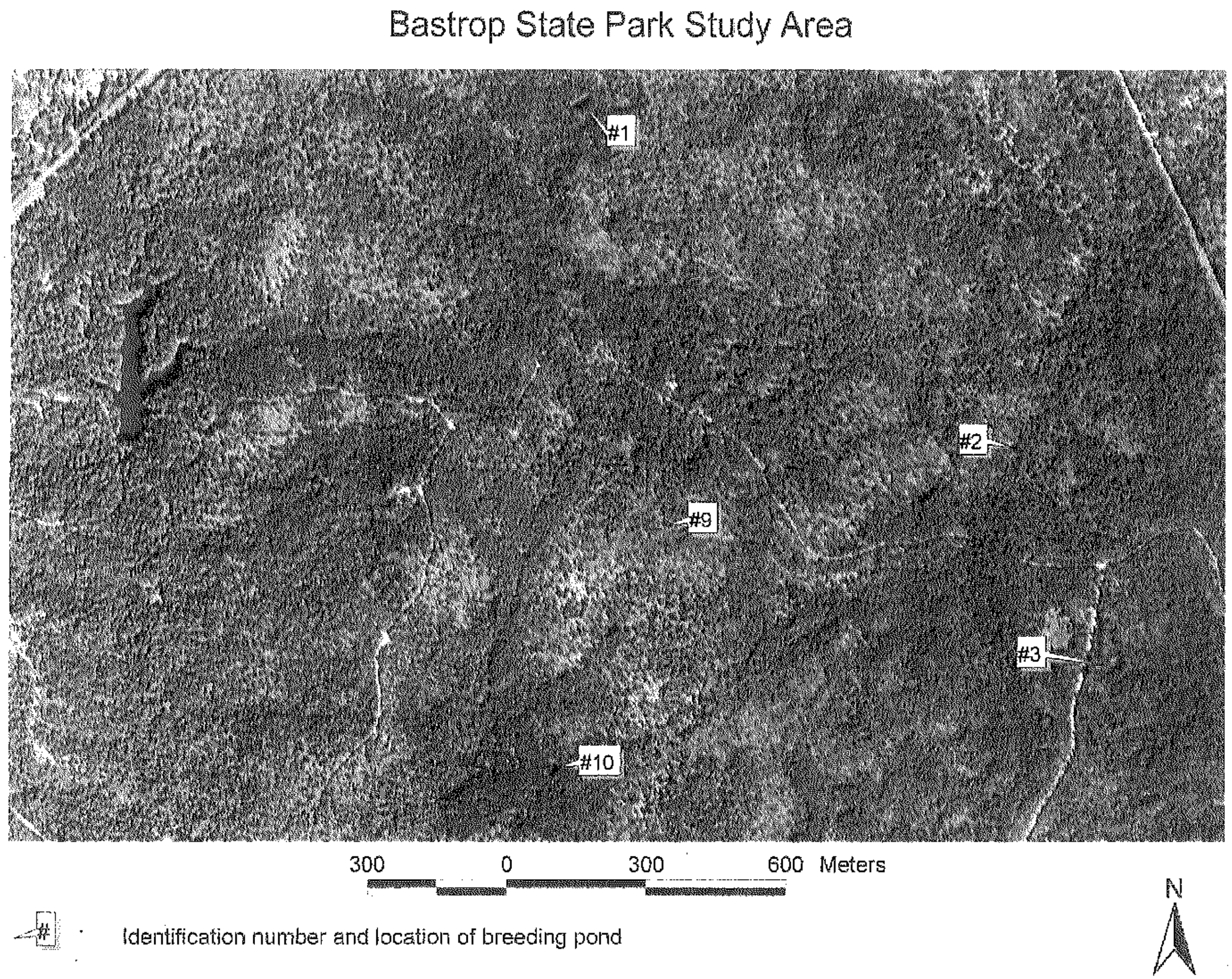


Figure 1B- Aerial View

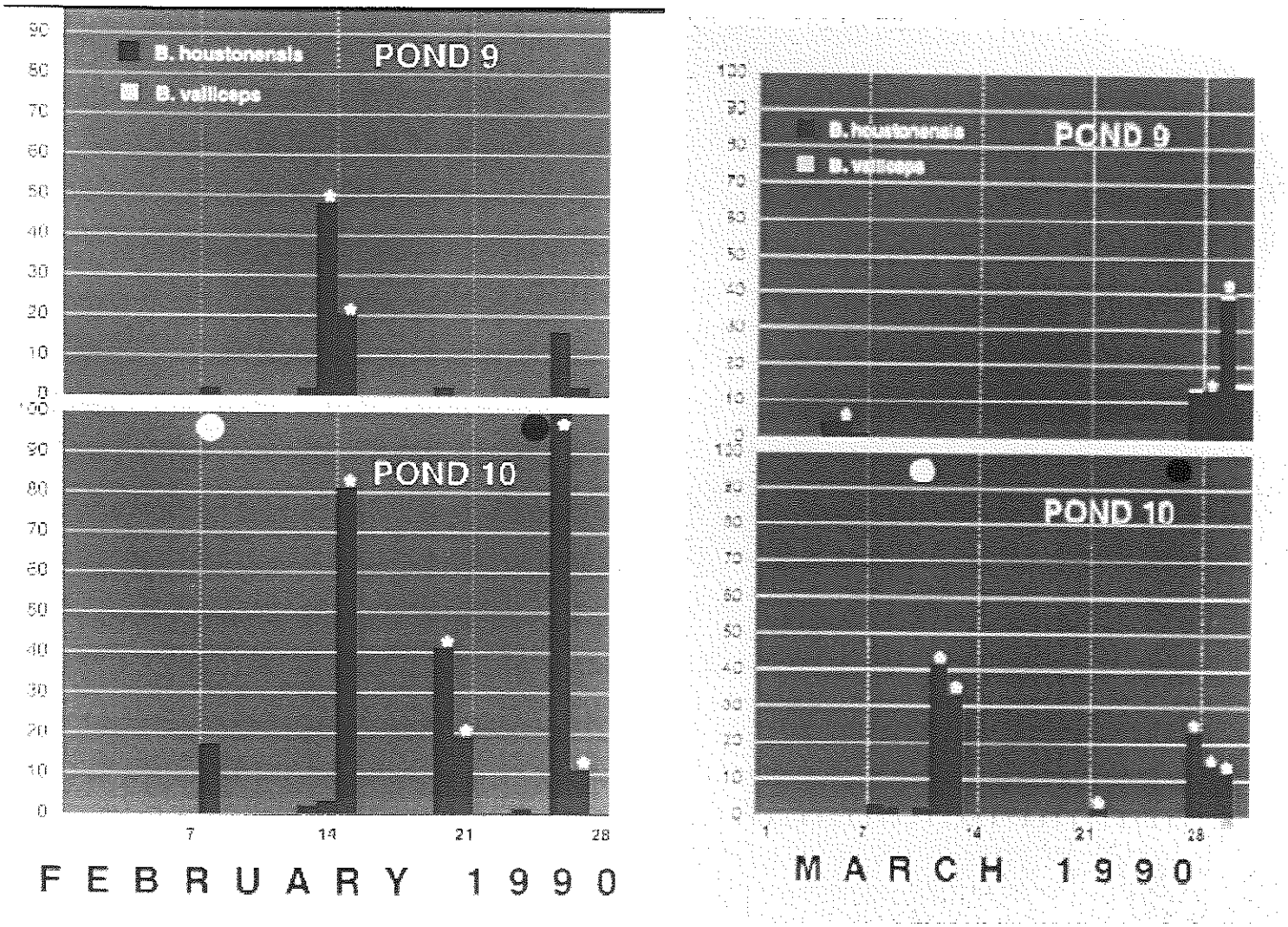


Figure 2A. Number of Houston Toads present at two breeding ponds in Bastrop State Park during February and March 1990. The light and dark circles are the full and new moons, respectively. Asterisks indicate nights on which females were present.

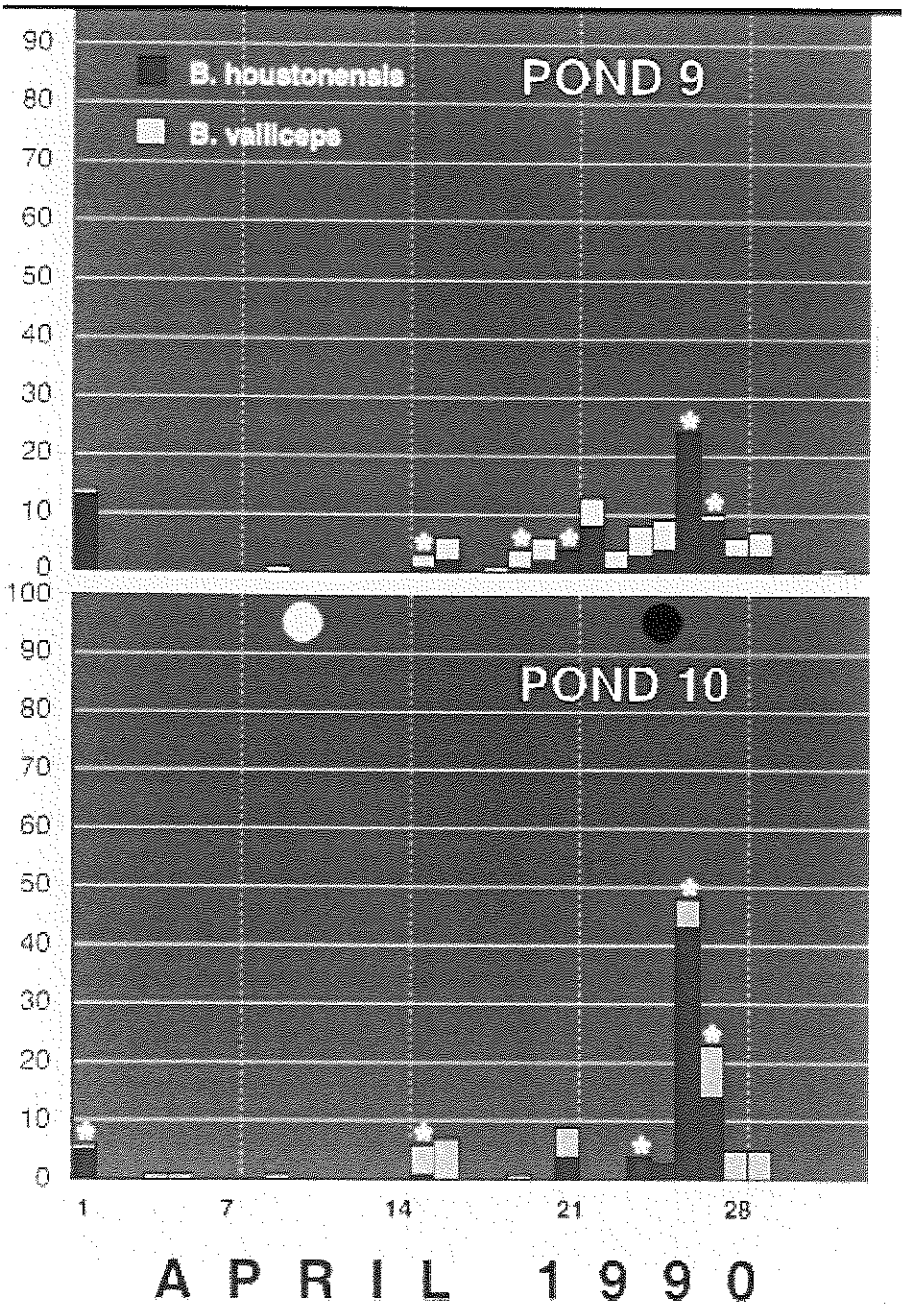


Figure 2B. Number of Houston Toads present at two breeding ponds in Bastrop State Park during April 1990. The light and dark circles are the full and new moons, respectively. Asterisks indicate nights on which females were present.

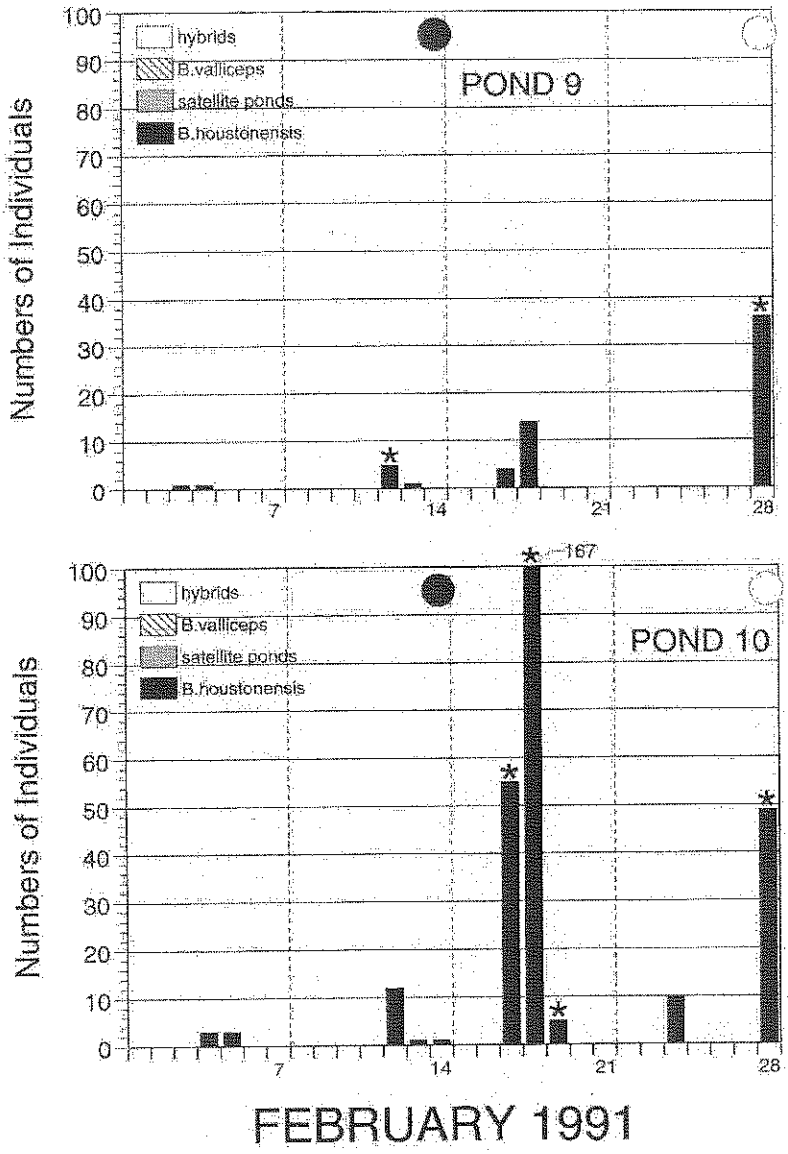


Figure 3A. Number of Houston Toads present at two breeding ponds in Bastrop State Park during February 1991. The light and dark circles are the full and new moons, respectively. Asterisks indicate nights on which females were present.

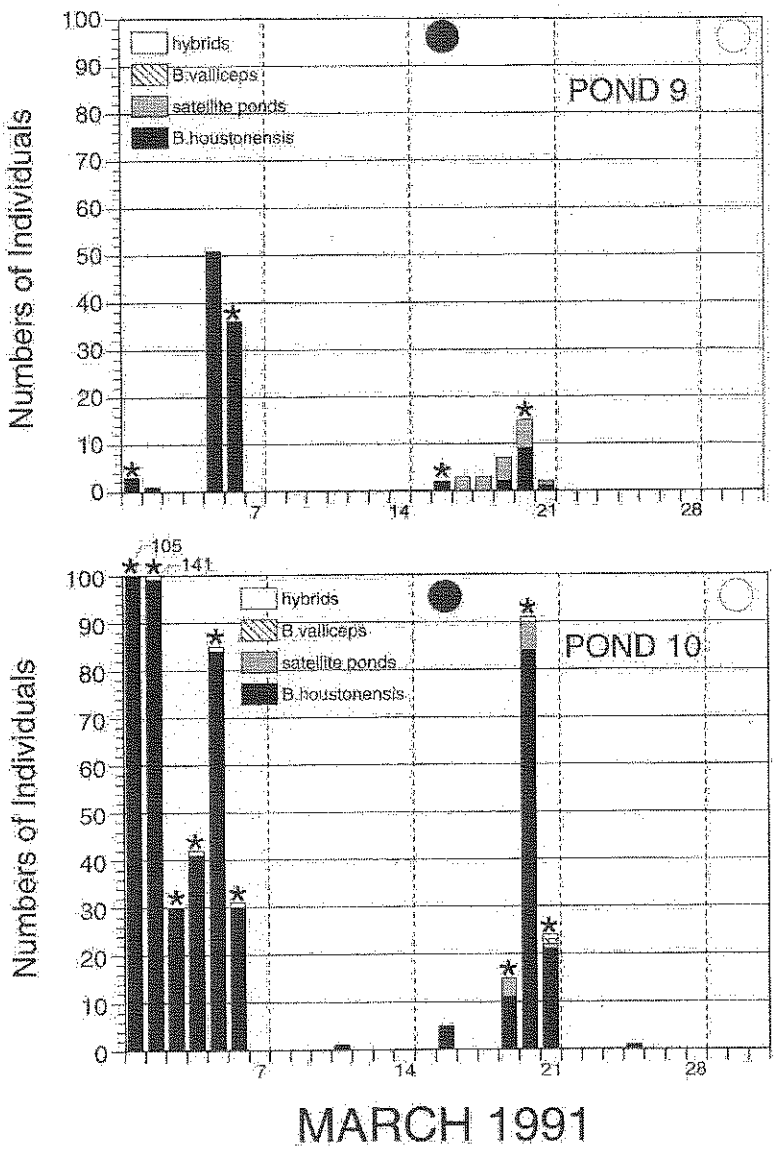


Figure 3B. Number of Houston Toads present at two breeding ponds in Bastrop State Park during March 1991. The light and dark circles are the full and new moons, respectively. Asterisks indicate nights on which females were present.

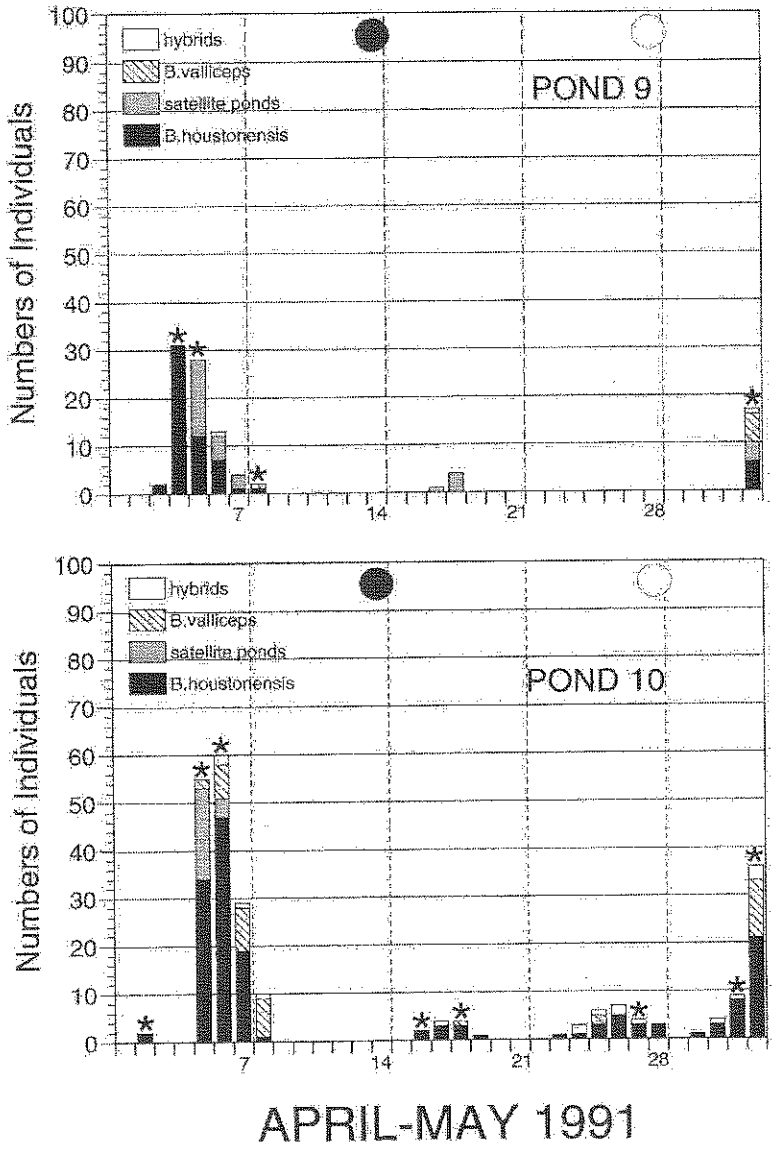
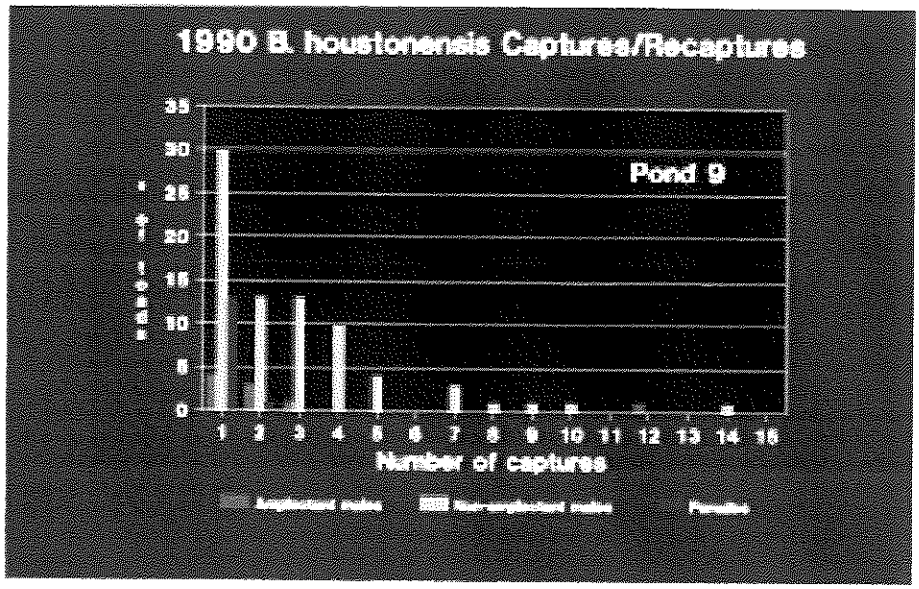


Figure 3C. Number of Houston Toads present at two breeding ponds in Bastrop State Park during April and early May 1991. The light and dark circles are the full and new moons, respectively. Asterisks indicate nights on which females were present.



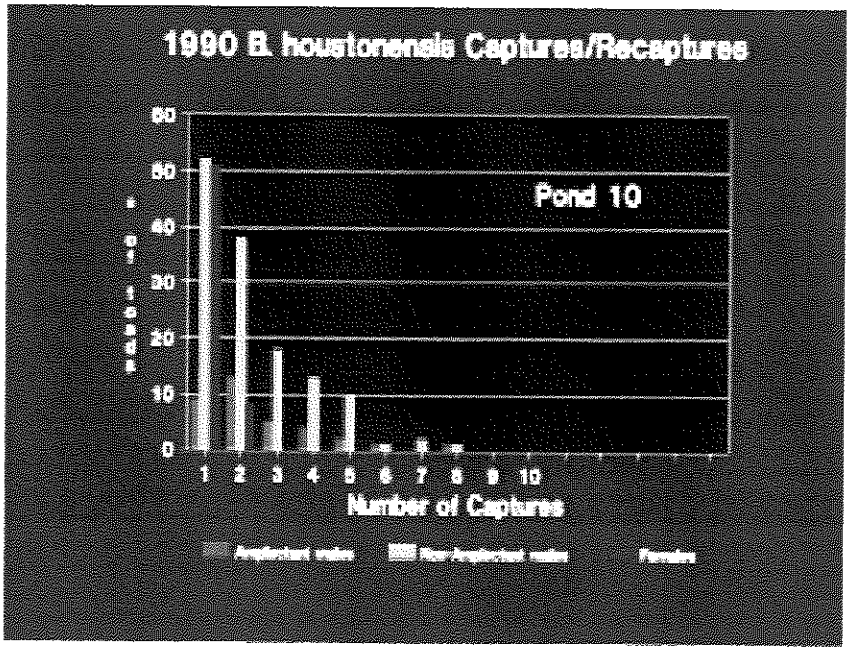


Figure 4. Frequency with which individual Houston Toads were captured during the course of the 1990 breeding season at two study ponds in Bastrop State Park.

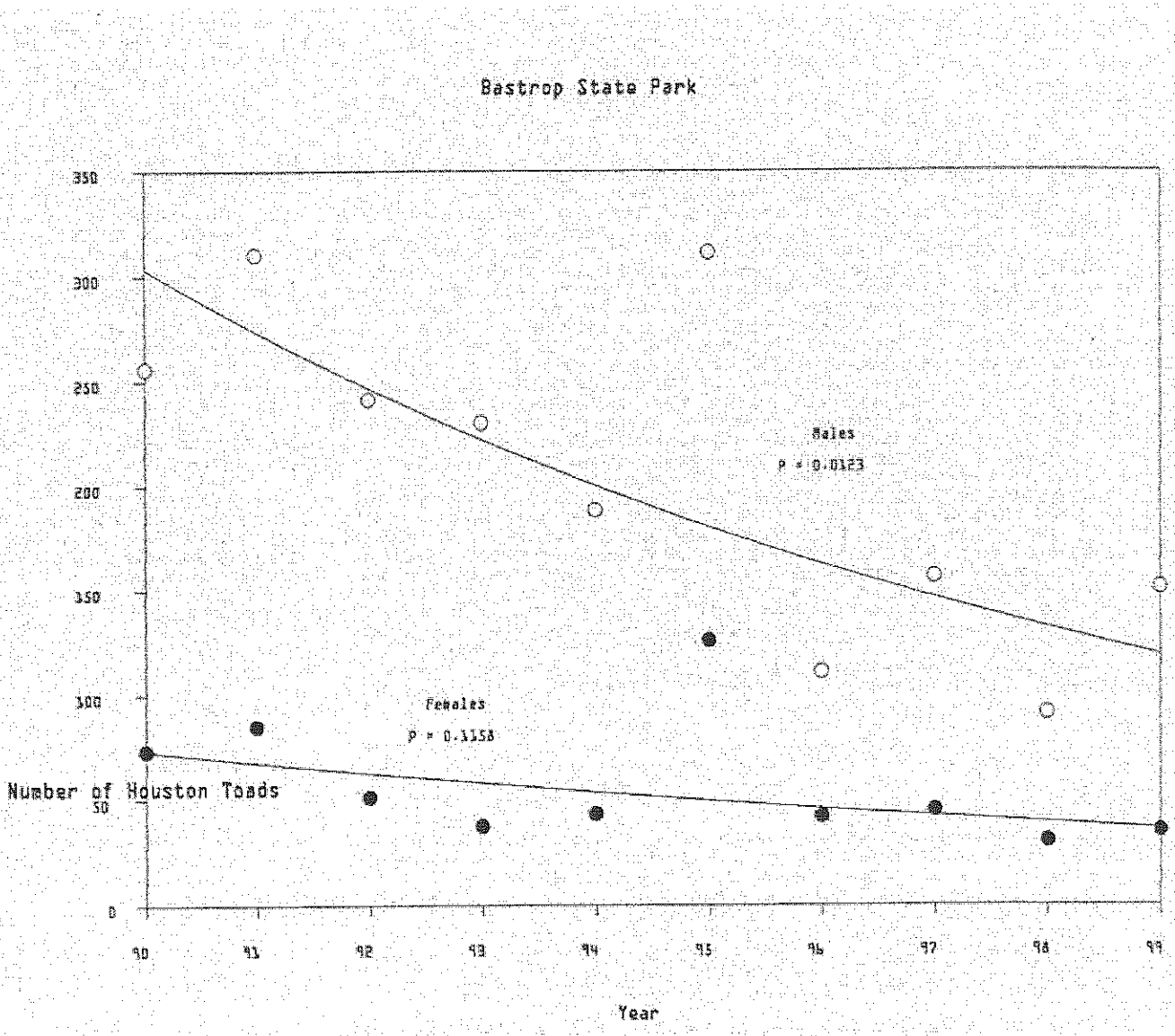


Figure 5

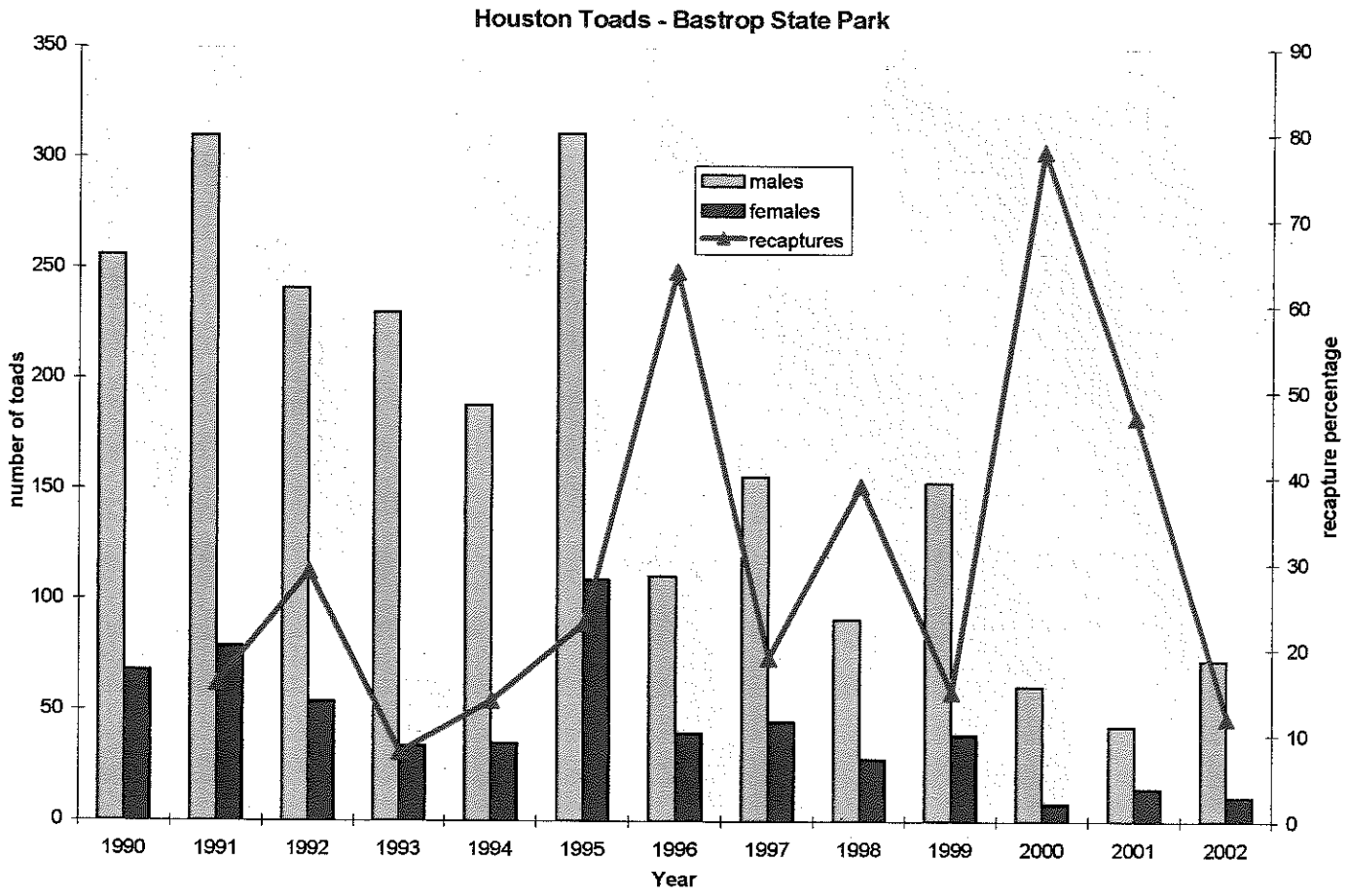


Figure 6

Houston Toad Totals

F M	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002		# Males	% Recap.
1990	68 256	57	8												256	
1991	7	72 253	70	2											310	18
1992		8	46 163	20	3										241	32
1993				34 208	27	17	5	1							230	9.5
1994				2	33 158	74	14	5							188	16
1995					6	103 220	62	18	6						311	29
1996					3	14	23 30	9	1						111	73
1997						4	1	40 123	32	6	2				156	21
1998								6	22 52	20	9	5	2		91	43
1999								2		37 127	40	16	3		153	17
2000										3	5 10	4	2		61	84
2001											2	13 18	2		43	58
2002												1	10 64		73	12
# Females	68	79	54	34	35	109	40	45	28	39	8	15	11			
% Recap.		9	15	0	6	6	43	11	21	5	38	13	9			
Total M+F	329	395	292	267	231	437	156	201	121	191	69	58	84			
% Recap.		16	29	8	14	23	64	19	39	15	78	47	12			

Table 1