SOME CHARACTERISTICS OF EARTHEN POND PRAWN PRODUCTION IN HAWAII

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

BACKGROUND

The production of giant Malaysian prawn (*Macrobrachium rosenbergii*) is becoming commercially important in Hawaii and expansion of current production to 200 pond-acres is forecasted for the next few years. With some development of an export market, this projected expansion can reach 400 pond-acres in the near future.

In order to insure that such development will be realized, the present system of culture needs improvement in efficiency and yield. At the present time, commercial producers in Hawaii stock their ponds with juveniles produced at the State Anuenue Fisheries Research Center during the summer and harvesting operations start early the following year. Harvesting is generally done on a monthly basis and may continue for 6 to 10 months.

The Anuenue Fisheries Research Center has established a cooperative management agreement with Mr. Gentaro Ota to collect harvesting and population distribution data from two small commercial ponds. Pond 1 is 0.23 hectare and pond 2 is 0.36 hectare in size. Data analyzed in this report were gathered from August 1970 through August 1972 from the two Ota ponds. During this period, population samples of prawns were taken on an approximately monthly basis. Sampled sizes varied from 96 to 434. Size and sex information was recorded. Harvesting operations were scheduled approximately 2 weeks apart; however, in this report the harvest data were grouped on a monthly basis. A 4.4-cm mesh seine was used in the harvesting operations. Pond 1 was stocked in August 1970 with 22,050 juveniles, an initial stocking density of 9.59 juveniles per square meter. Pond 2 was stocked in September 1970 with 76,400 juveniles which resulted in an initial stocking density of 21.22 juveniles per square meter.

ANALYSIS

Effect of Stocking Density on Male/Female Survival Rates

Tables 1 and 2 show that initial stocking density affects the overall survival rate of prawns raised in earthen ponds. The higher stocking density in pond 2 tended to reduce the survival rate in that pond. More importantly, the stocking density did not seem to have the same effect on male and female prawn survival rates.

Assuming that, of the juveniles released into ponds 1 and 2, approximately 50 percent were male prawns, then the male survival rates were 65 percent in pond 1 and 67 percent in pond 2. The difference is negligible. However, the female survival rates were 57 percent in pond 1 and only 25 percent in pond 2. It is very unlikely that such differences can be due to chance alone.

TABLE 1. MALE/FEMALE RATIO OF HARVESTED PRAWNS FROM OTA POND 1

Month of Harvest	Total No. of Harvest	No. of Male Harvested	No. of Female Harvested	Percentage of Male
1971				
March	412	412	0	100.000
April	1,256	1,212	44	0.965
May	857	752	105	0.878
June	749	528	221	0.705
July	1,116	406	710	0.364
August	1,528	757	771	0.496
September	1,062	694	368	0.654
October	766	633	133	0.827
November	765	382	383	0.500
December	726	200	526	0.276
1972				
January	619	203	416	0.328
February	980	255	725	0.260
March	653	165	488	0.254
April	588	199	389	0.340
May	545	150	395	0.276
June	812	245	567	0.302
	13,434	7,193	6,241	0.535

TABLE 2. MALE/FEMALE RATIO OF HARVESTED PRAWNS FROM OTA POND 2

Month of Harvest	Total No. of Harvest	No. of Male Harvested	No. of Female Harvested	Percentage of Male
1971				
March	561	553	8	0.9857
April	2,135	1,968	167	0.9218
May	1,321	1,150	171	0.8705
June	1,883	1,719	164	0.9129
July	2,765	2,469	296	0.8929
August	3,087	2,765	322	0.8957
September	2,804	2,386	418	0.8509
October	1,872	1,692	180	0.9038
November	2,725	2,152	573	0.7897
December	2,428	1,652	776	0.6804
1972				
January	1,791	1,191	600	0.6650
February	2,006	1,107	899	0.5518
March	1,517	928	589	0.6117
April	1,523	688	835	0.4517
May	2,284	1,196	1,088	0.5236
June	1,477	530	947	0.3588
July	1,359	683	676	0.5026
August	1,473	645	828	0.4379
	35,011	25,474	9,537	0.7276

Scheduling of Harvesting Operations

Figures 1 through 5 present the data in Tables 1 and 2 in different ways. It is clear from these figures that male prawns reached the harvesting length of 12 cm much earlier than the female prawns. Figure 1 shows that male prawns dominated the first 3 or 4 harvests. Figures 2, 3, and 4 show that the first harvest could have been delayed by one month, but more importantly, that the harvesting frequency could also have been reduced. Figure 2 shows patterns in the variations of total prawns harvested. Assuming that the cost of a harvesting operation is not greatly affected by the number of prawns harvested and that it is desirable to minimize harvesting cost per prawn, then a harvesting operation should be rescheduled when the number of prawns harvested in the previous harvest is smaller than the one preceding it. In other words, if H_1, H_2, and H_3 represent a series of three harvesting operations, then the scheduled operation for H_3 should be delayed when $H_2 < H_1$.

Effect of Density on Growth Rate

Figure 7 shows the growth in average length of prawns in pond 1 (low density) and pond 2 (high density) up to the time of the first harvesting operation. It is clear that, during the early stages of growth, the growth rate is not influenced by the stocking density of the ponds. Considering the low biomass in the ponds during these early stages of growth, this phenomenon seems to be a reasonable one.

Characteristics of Prawn Population Distribution

The frequency distribution of the prawn population before and after the first harvest in ponds 1 and 2 are shown in Figures 8 through 15. In plotting these figures, the population is divided into 20 10-mm intervals. Arithmetic means are computed and the interval within which an arithmetic mean falls is defined as the mean interval. The mean interval is then placed at the 0 position of the horizontal axes in Figures 8 through 15.

Figures 8 through 15 show the tendency for multiple peaks to exist in the male population distribution patterns. They also show the tendency for the female population to develop more uniformly, while the male population tends to develop growth leaders.

DISCUSSION

The above analyses seem to strongly suggest that male and female prawns in a pond react differently to population density stresses and that their growth patterns may also be different. To improve production efficiency, the female and male prawns should be separated at an early

stage and different management schemes and harvesting practices applied. This would mean that the present practice of stocking ponds with unsexed juveniles should be examined and experiments conducted to define optimal intensive cultural conditions to raise juveniles to the stage where sex of prawns can be easily identified.

Segregation of the sexes in animal production is not uncommon and is caused by the differences in male and female growth characteristics. Figures 8 through 15 clearly show that female prawns tend to distribute closely around a central length interval while male prawns tend to form several clusters. These tendencies have already been discovered by Fujimura and Okamoto (1970).

Tables 1 and 2 and Figure 7 strongly suggest that biomass is probably a more appropriate factor to consider, at least during early growth stages, in pond stocking than prawns/pond area. Furthermore, the main effect of high population density may be the reduction in survival rate. In a mixed population, the reduction in the survival rate of the female prawn is much more pronounced than the male prawn survival rate.

Stocking, feeding, and harvesting are three of the major management decision areas and segregation of the sexes would facilitate operations in all three areas:

1. Stocking. Using young adults in pond stocking offers several potential advantages. It would greatly reduce in-pond mortality and, since it reduces the in-pond growth period by 3 to 4 months, it would increase the efficiency in pond space utilization.
2. Feeding. During the juvenile to young adult stage, stocked prawns need high-priced fish meals (including fresh fish meals); the cost of feed may be reduced when high density tanks are used for prawns between the juvenile and young adult stages.
3. Harvesting. Reduced harvesting cost and more efficient management can be expected in sex-segregated ponds.

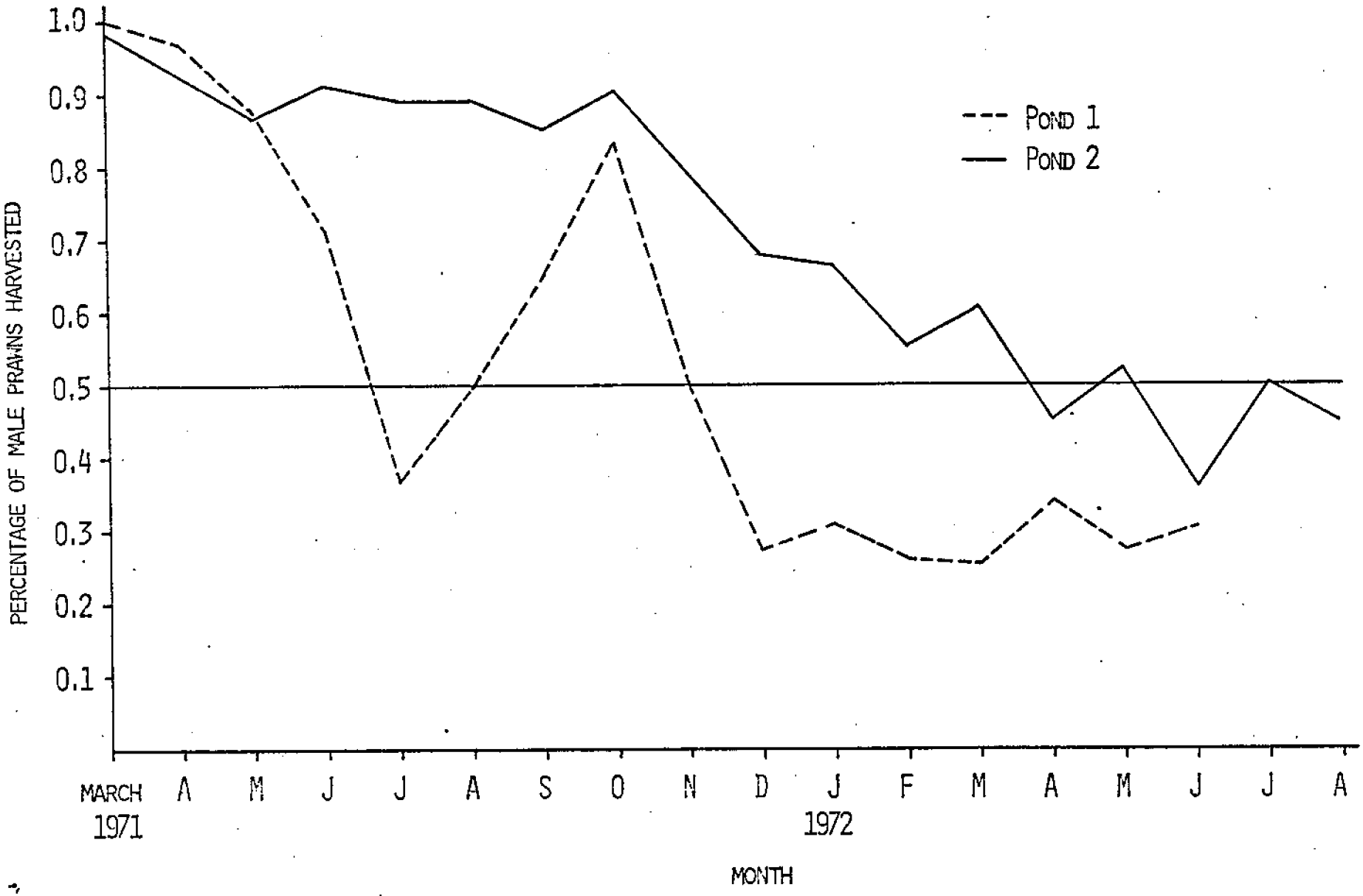

FIGURE 1. PERCENTAGE OF MALE PRAWNS HARVESTED FROM OTA PONDS 1 AND 2.

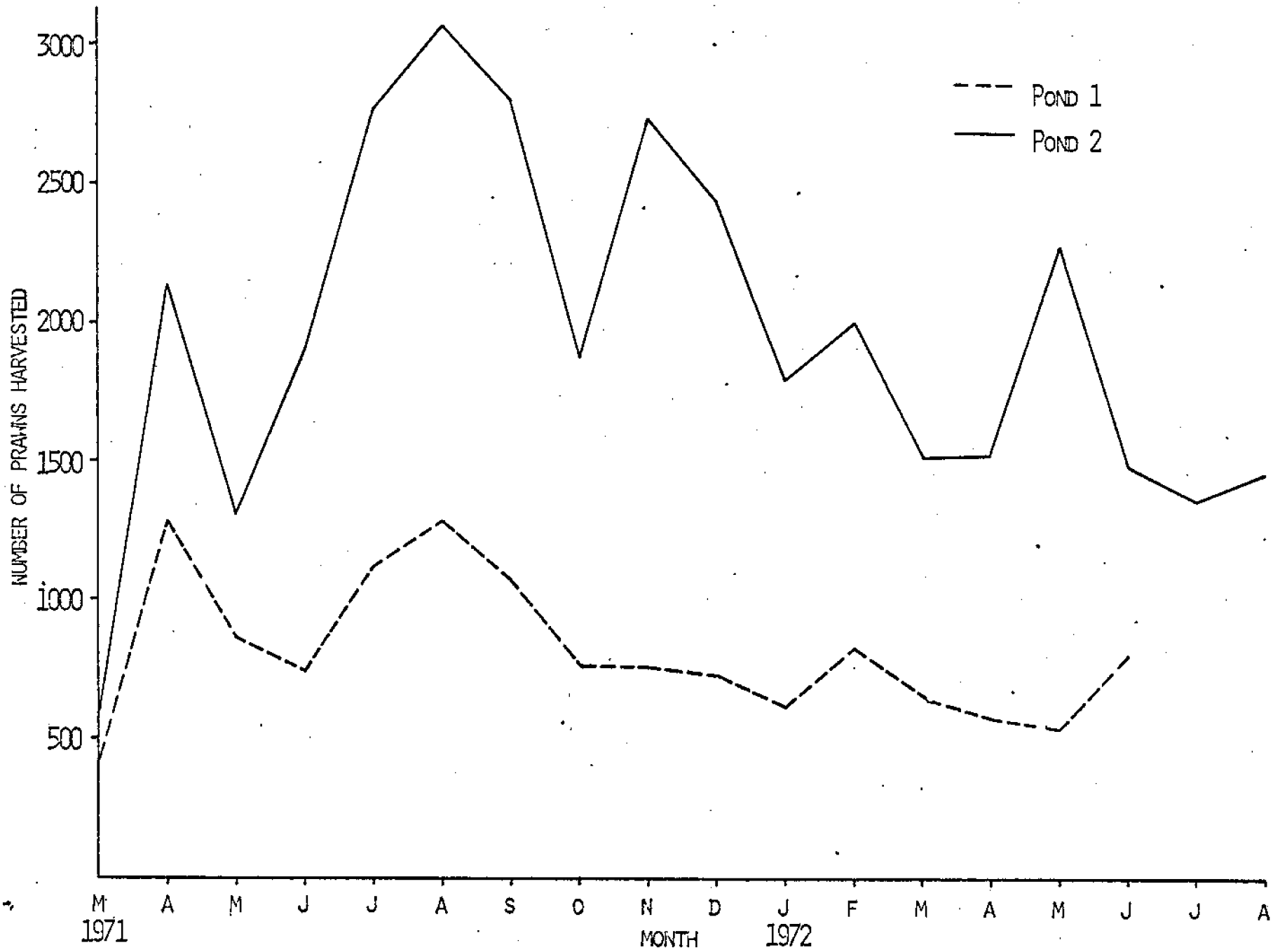

FIGURE 2. NUMBER OF PRAWNS HARVESTED FROM OTA PONDS 1 AND 2.

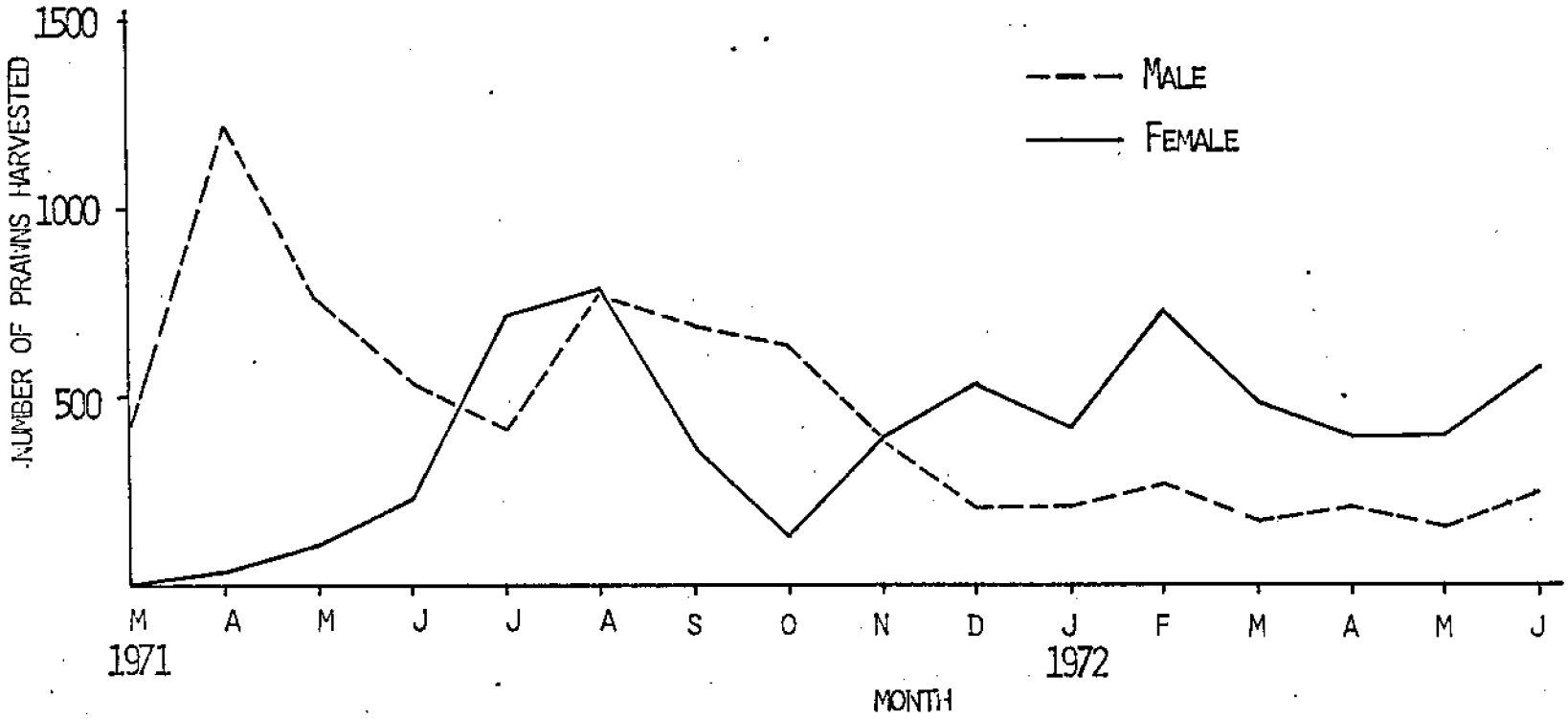

FIGURE 3. NUMBER OF MALE AND FEMALE PRAWNS HARVESTED FROM OTA POND 1.

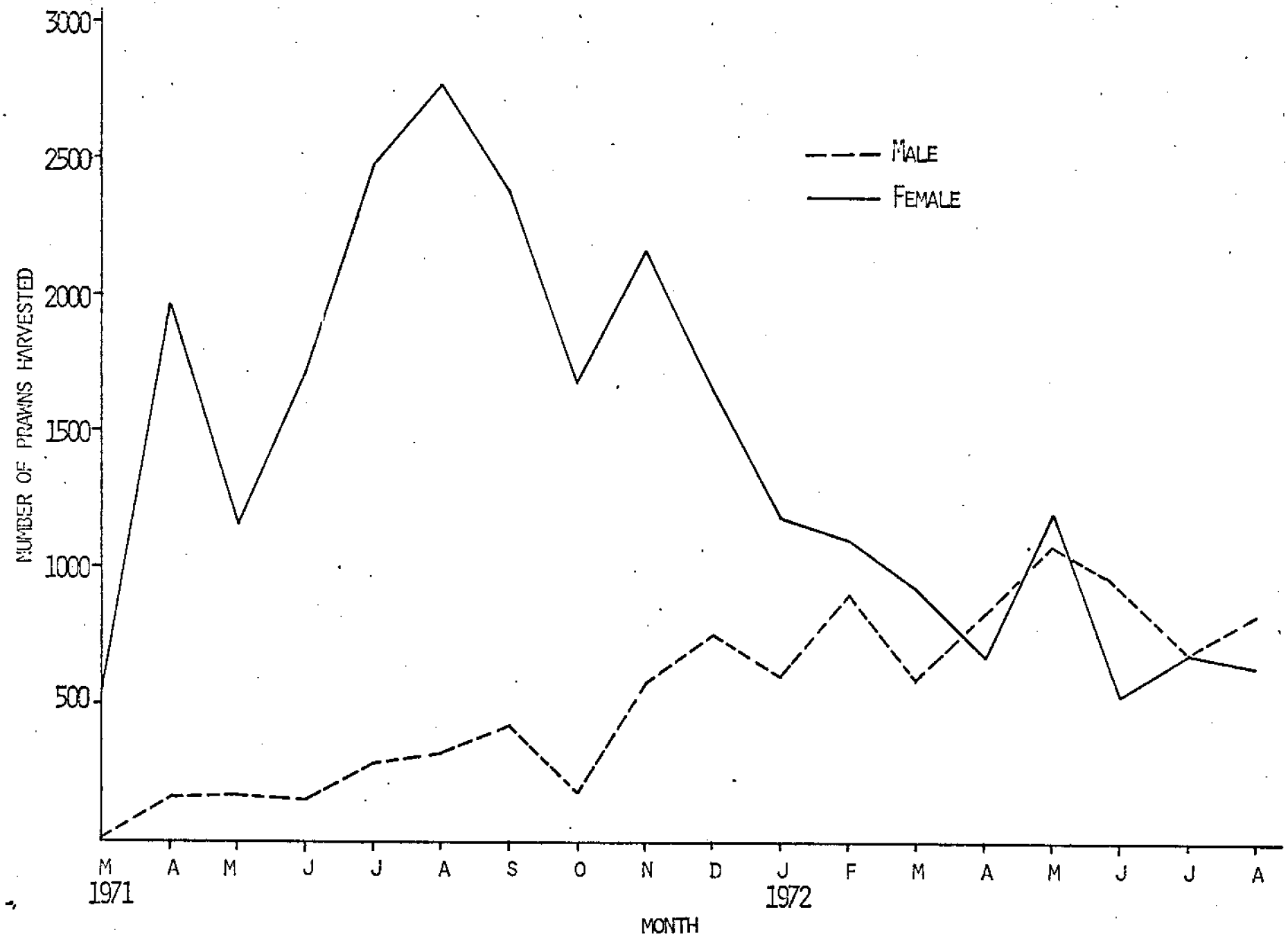

FIGURE 4. NUMBER OF MALE AND FEMALE PRAWNS HARVESTED FROM OTA POND 2.

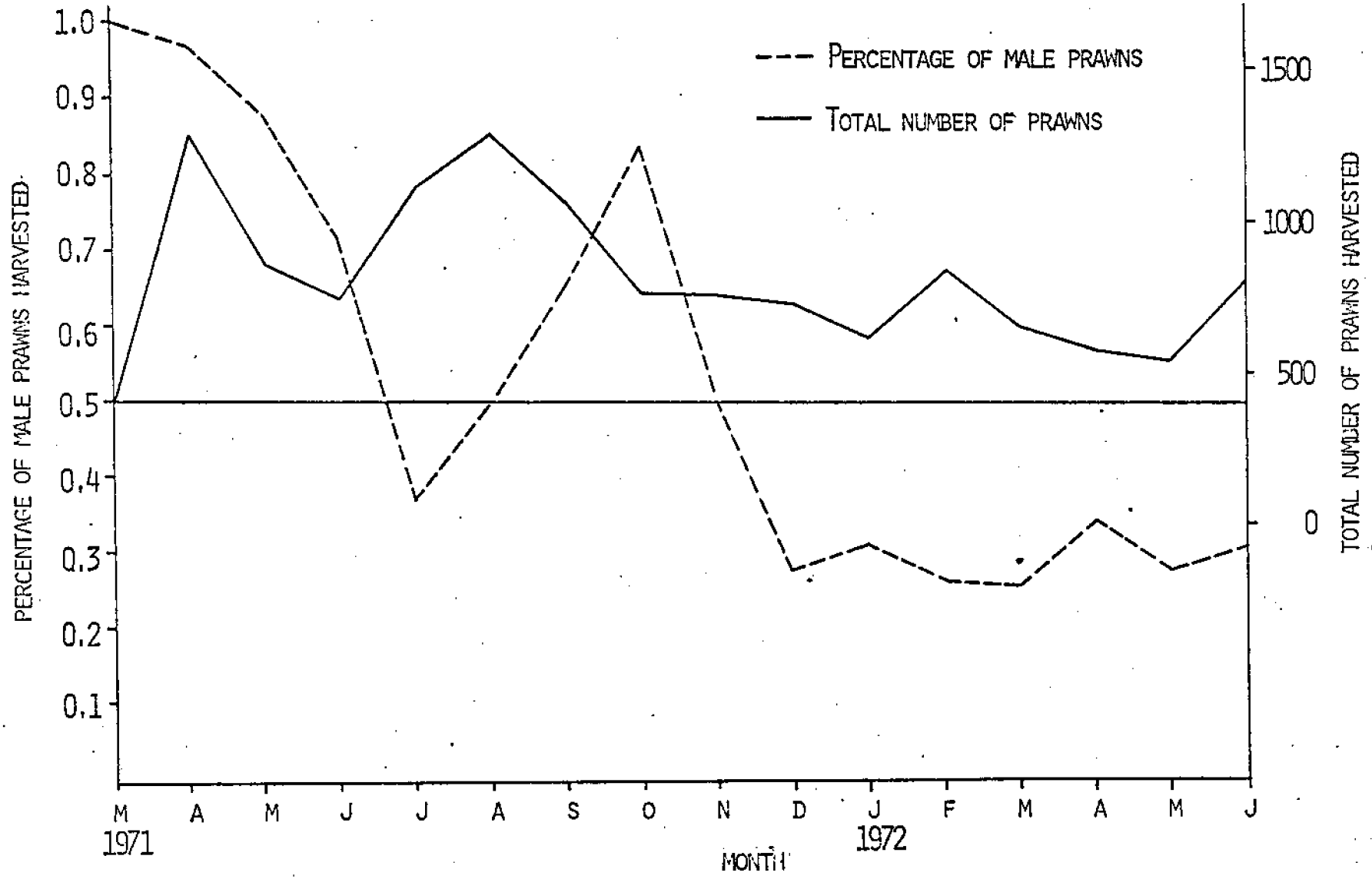

FIGURE 5. NUMBER OF PRAWNS AND PERCENTAGE OF MALE PRAWNS IN EACH HARVEST (POND 1).

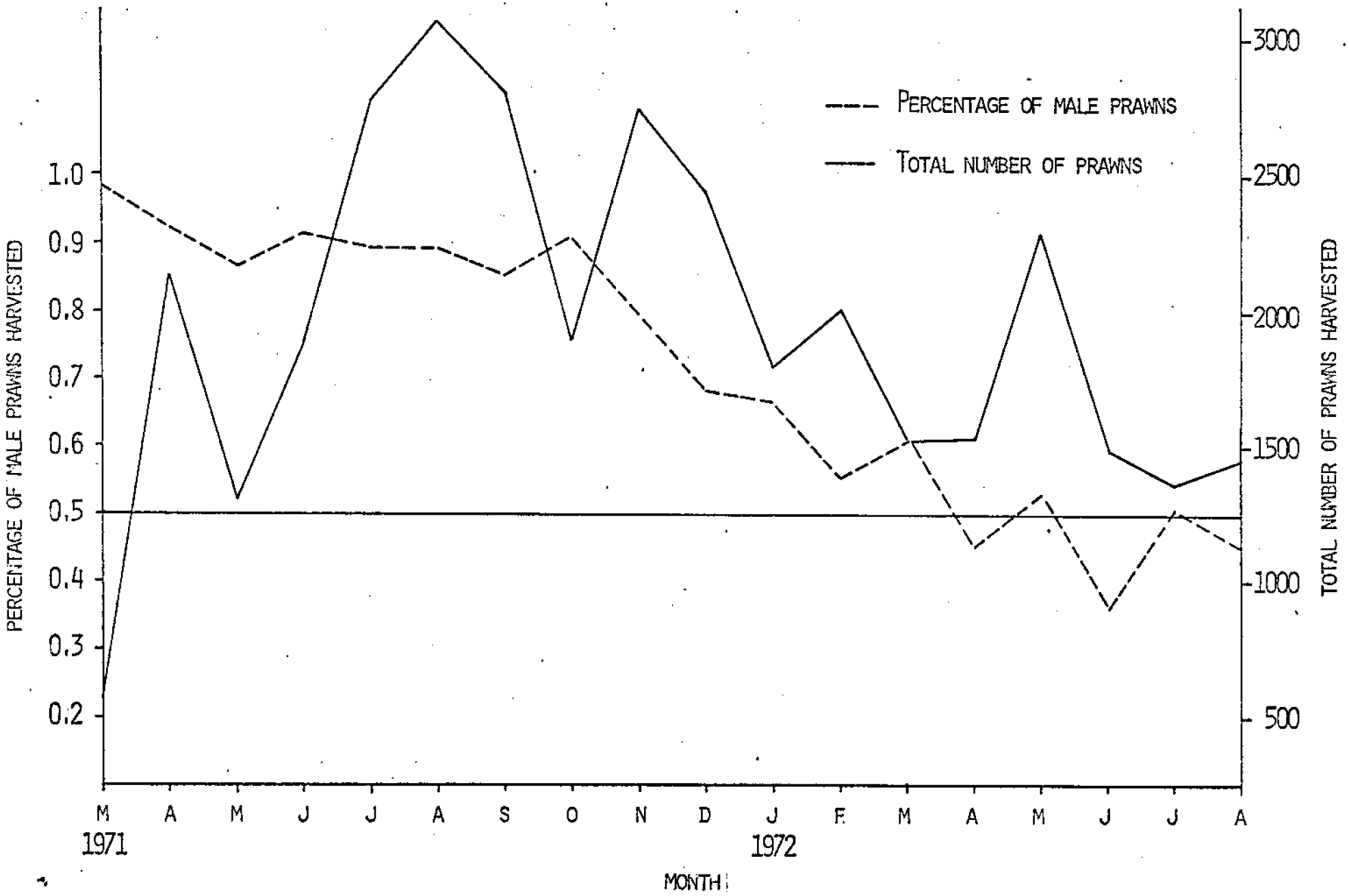

FIGURE 6. NUMBER OF PRAWNS AND PERCENTAGE OF MALE PRAWNS IN EACH HARVEST (POND 2).

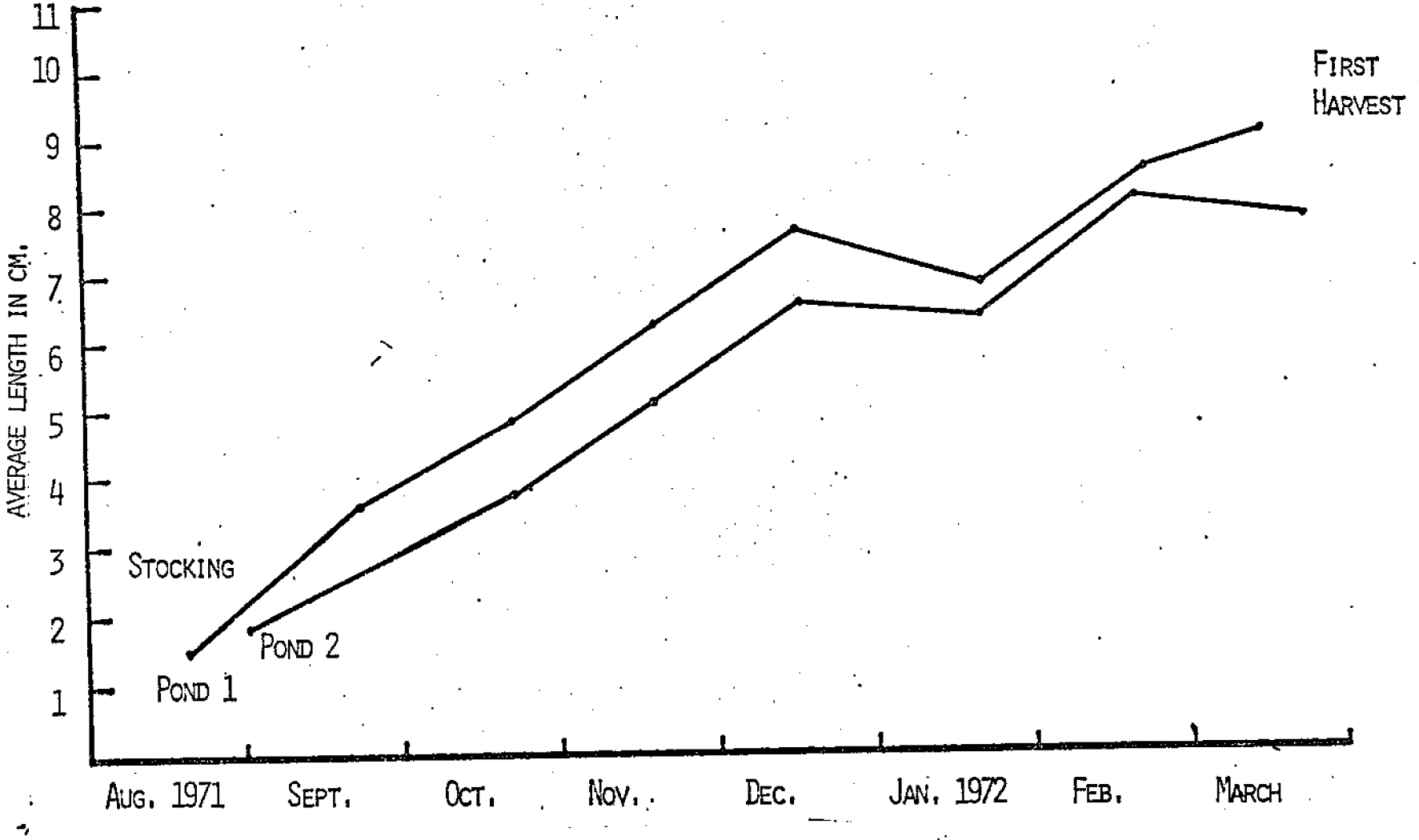

FIGURE 7. AVERAGE GROWTH RATE.

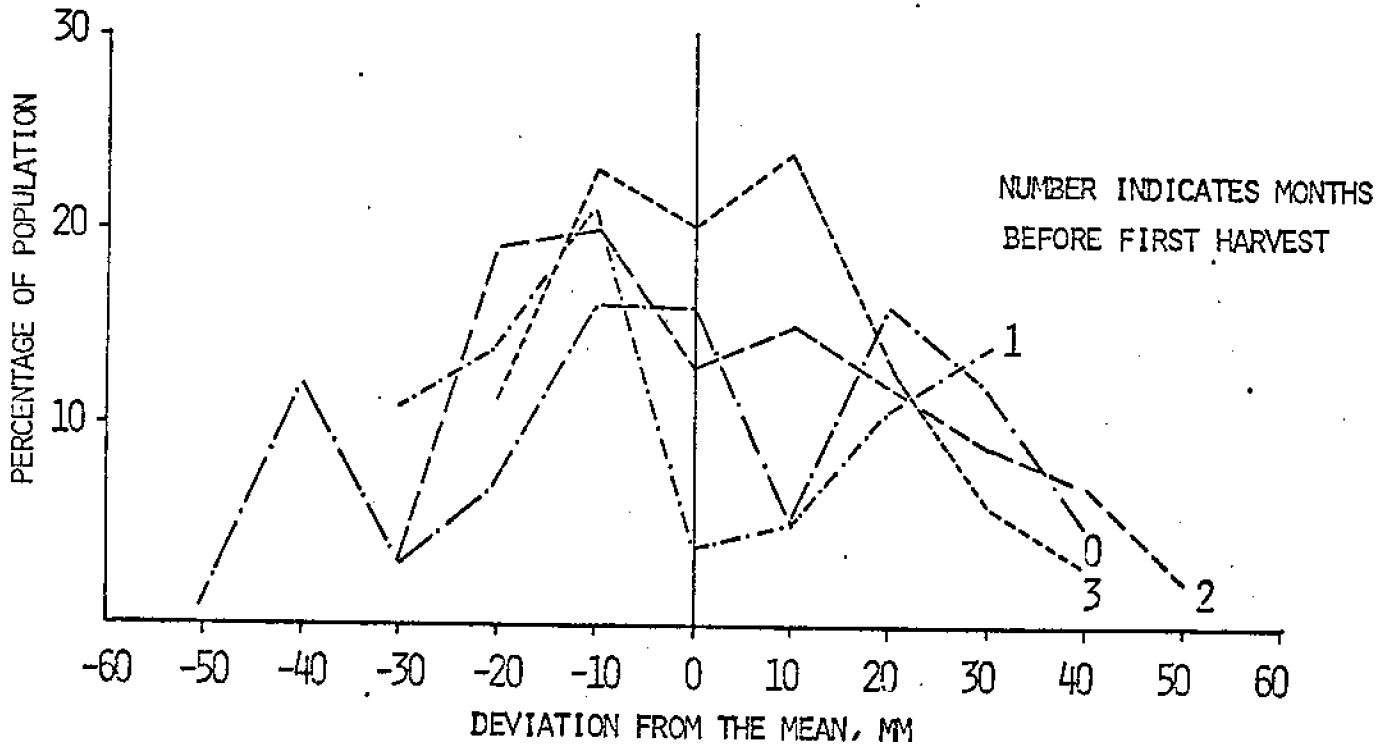

FIGURE 8. CHARACTERISTICS OF PRAWN POPULATION DISTRIBUTION. POND 1, MALE, BEFORE HARVEST.

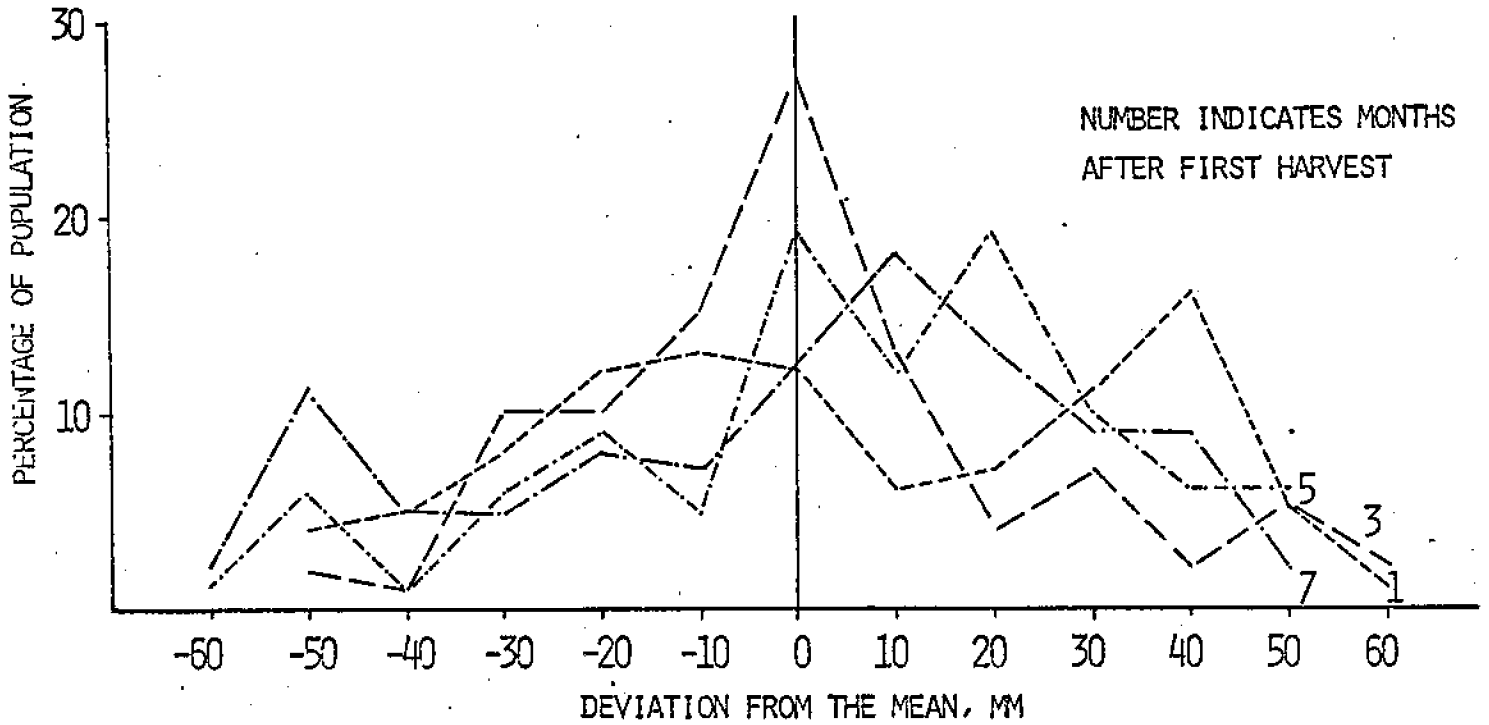

FIGURE 9. CHARACTERISTICS OF PRAWN POPULATION DISTRIBUTION: POND 1, MALE; AFTER HARVEST.

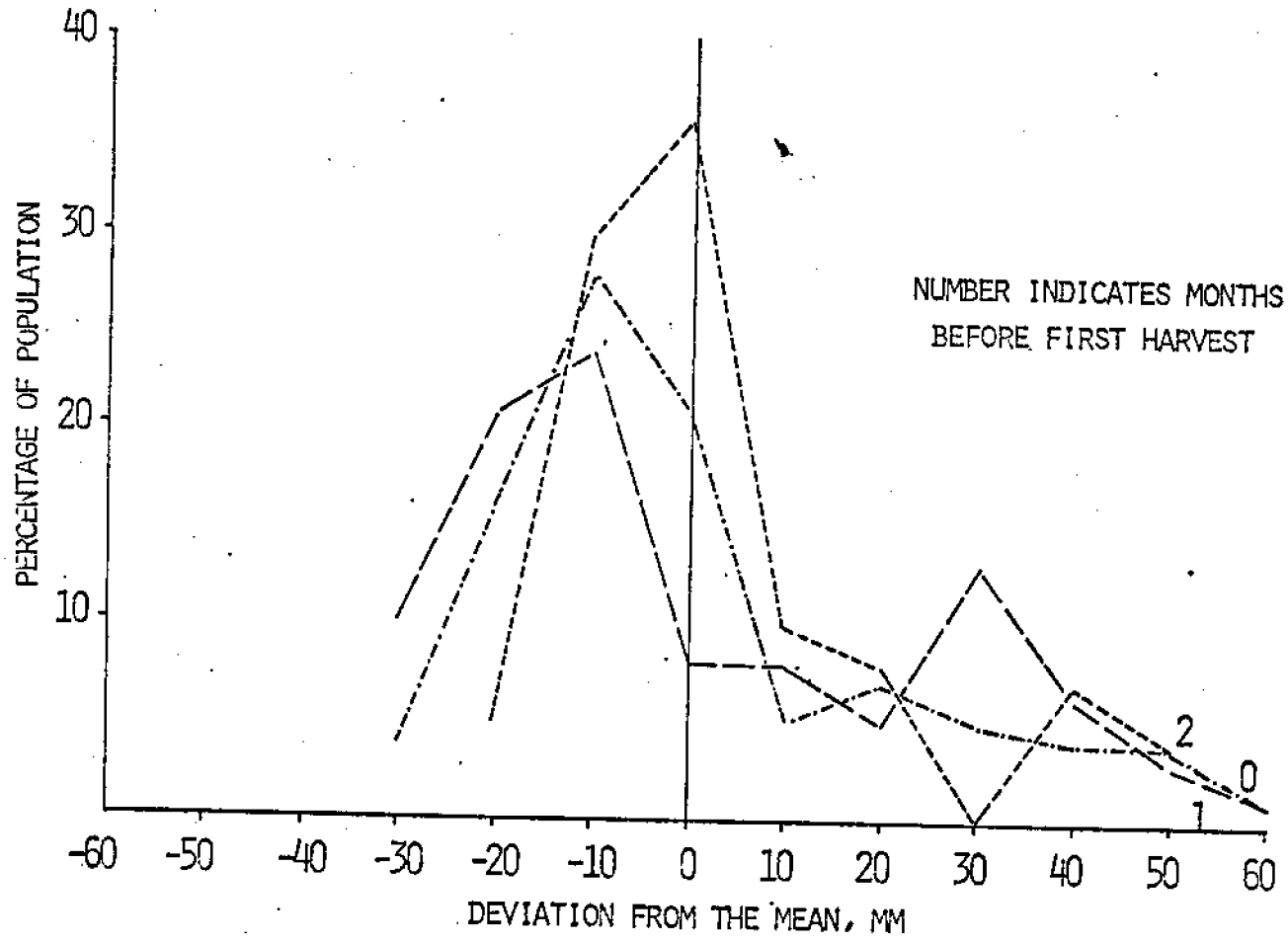

FIGURE 10. CHARACTERISTICS OF PRAWN POPULATION DISTRIBUTION: POND 2, MALE, BEFORE HARVEST.

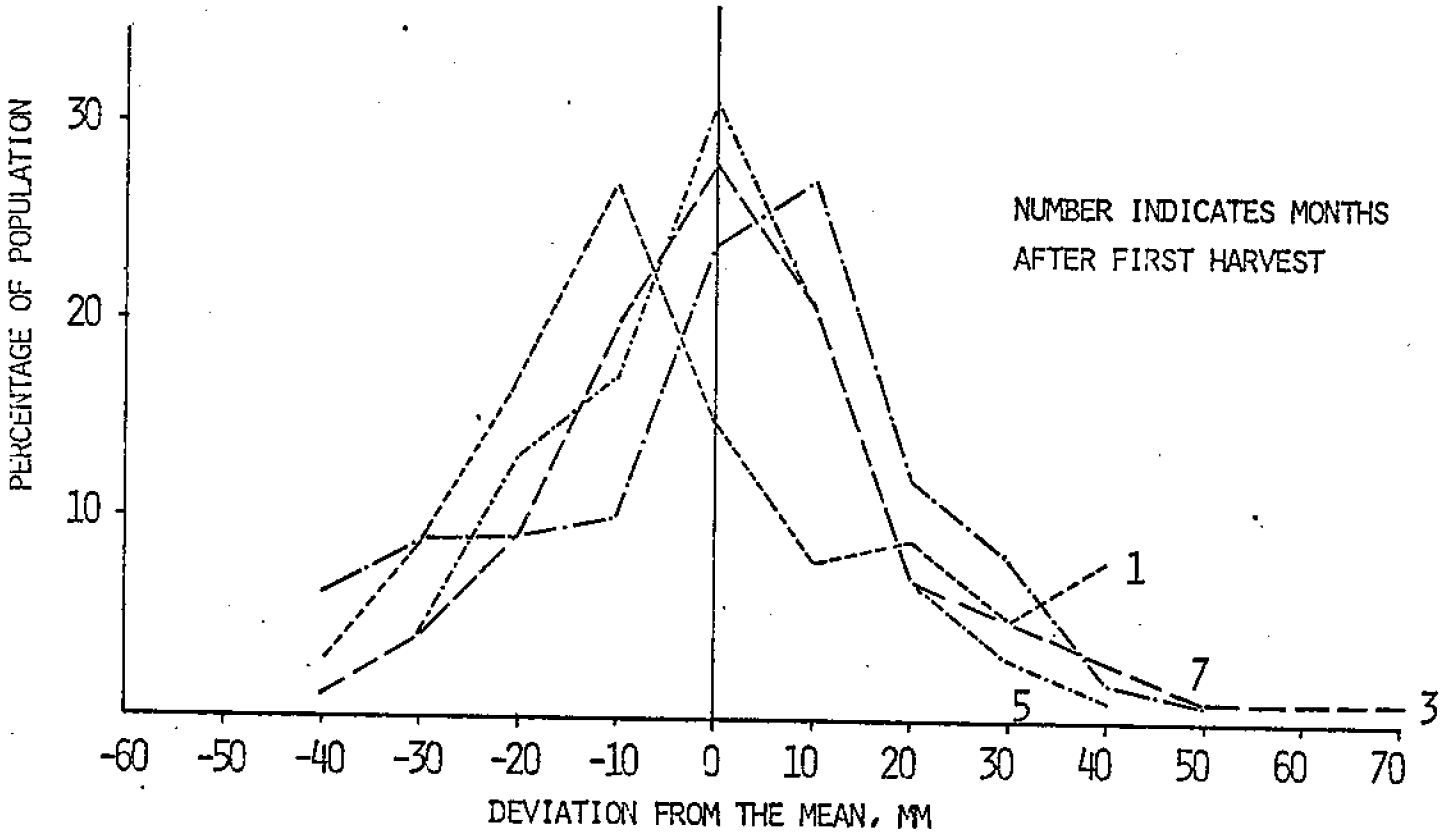

FIGURE 11. CHARACTERISTICS OF PRAWN POPULATION DISTRIBUTION: POND 2, MALE, AFTER HARVEST.

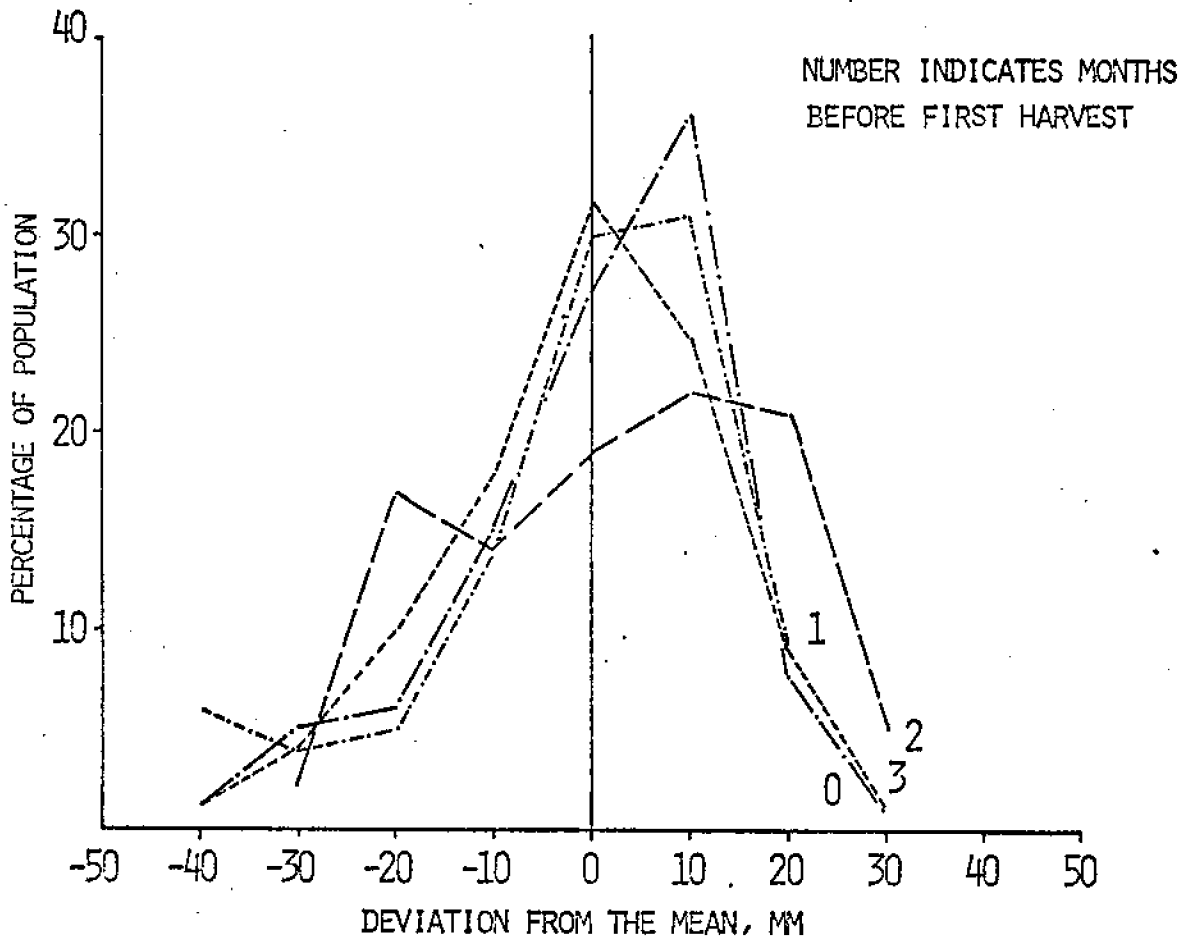

FIGURE 12. CHARACTERISTICS OF PRAWN POPULATION DISTRIBUTION: POND 1, FEMALE, BEFORE HARVEST.

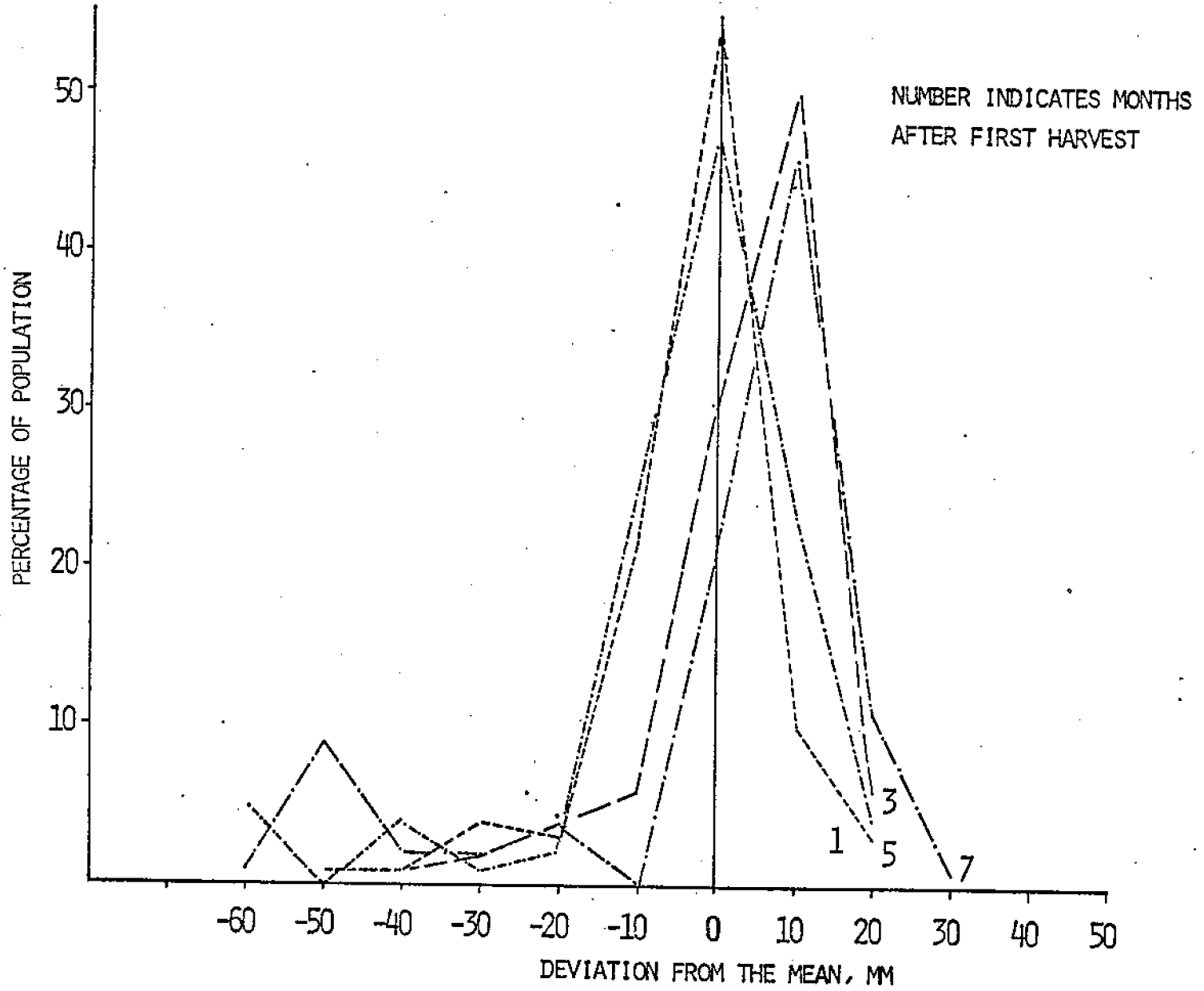

FIGURE 13. CHARACTERISTICS OF PRAWN POPULATION DISTRIBUTION: POND 1, FEMALE, AFTER HARVEST.

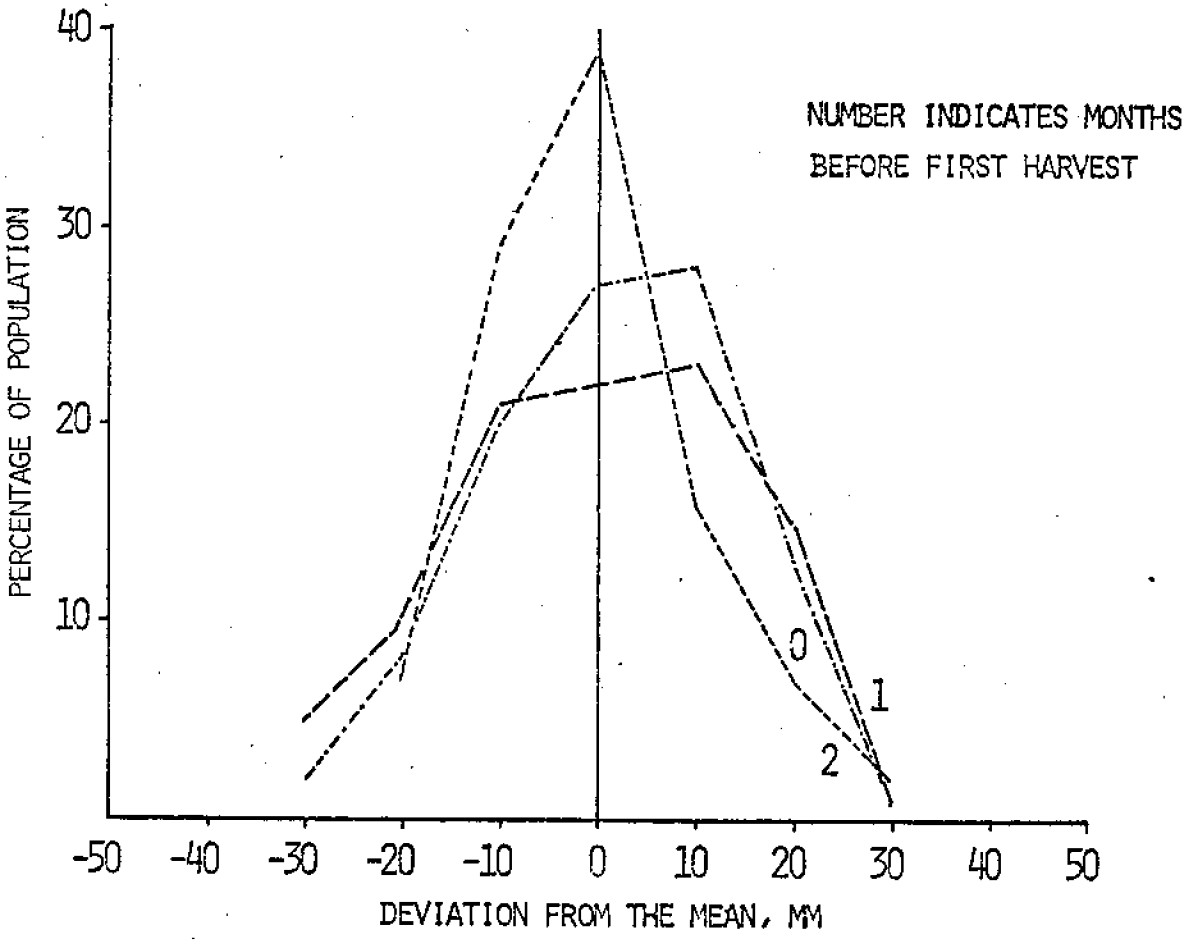

FIGURE 14. CHARACTERISTICS OF PRAWN POPULATION DISTRIBUTION: POND 2, FEMALE, BEFORE HARVEST.

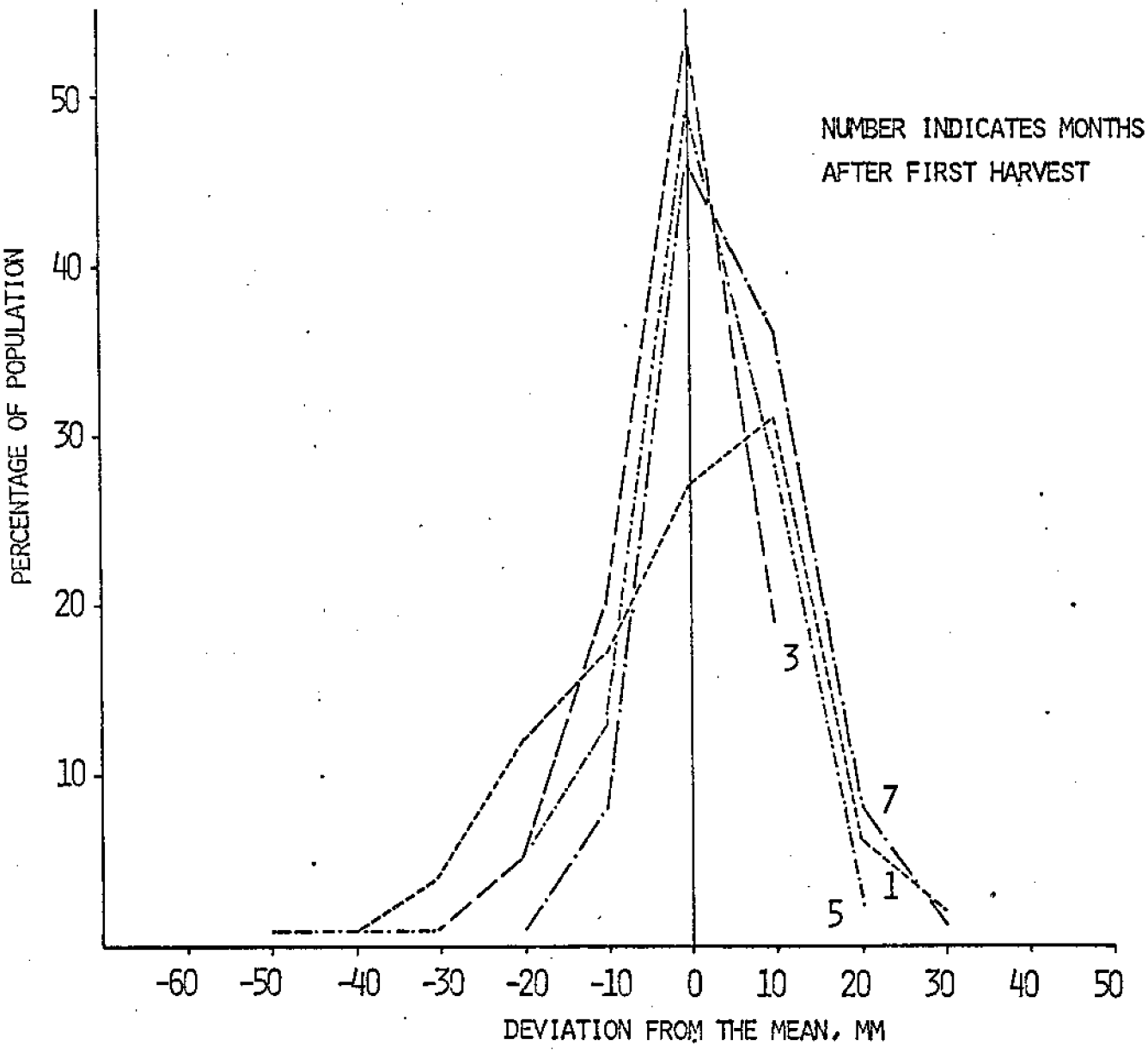

FIGURE 15. CHARACTERISTICS OF PRAWN POPULATION DISTRIBUTION: POND 2, FEMALE, AFTER HARVEST.