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WILD AND FREE-ROAMING HORSES AND BURROS

Current Knowledge and Recommended Research

Phase I Final Report

Committee on Wild and Free-Roaming
Horses and Burros
Board on Agriculture and Renewable Resources
Commission on Natural Resources

interpretation of nutritional status is particularly critical to understanding the lifetime productivity of females.

Equid Demography

The reproductive performance and longevity of an individual animal is partly a function of its genetic make-up, and partly its environment operating through its nutrition, physiology, and behavior. The collective performance of numerous individuals considered together as a population is expressed as a natality or fecundity rate, and as a survival rate. Such rates can be expected to vary annually to some degree within a population as yearly environmental conditions vary, and between populations as genetic make-up and environments differ.

These rates, in turn, interact to produce more synthetic population traits like age and sex composition, and rates of population change. The latter parameter alone discloses much about a species' ecological and evolutionary characteristics. It provides an indication of the demographic cushion with which it can absorb such environmental pressures as predation and competition, or human exploitation. Such related parameters as the net reproductive rate (average number of female young produced by the average female in her lifetime), mean generation length, and average reproductive value of an individual female at a given age all provide insights into the species' potential evolutionary plasticity.

From the practical standpoint of equid management, estimates of herd increase rates disclose the rates at which animals must be removed in order to hold them at some decided-upon level. Or alternatively, such rates make it possible to predict rates of herd growth in the absence of any artificial controls. They may also provide checks on the validity of census methods. Since this has been a controversial subject in North American equid management, we devote considerable attention to the subject in the sections below.

The Wild Horse

(1) Fecundity. Considerable work has, of course, been done on reproductive patterns in domestic horses. But very little information is available on natality rates in free-roaming wild horses. The rates that characterize well-managed, confined domestics may constitute the maxima of which the species is capable under optimum nutritional and breeding conditions, and under protection from the elements. The available data from wild herds indicate lower rates, doubtless the cost of field breeding, less-than-optimum nutrition, and the rigors of range life.

(a) Age at first female breeding. Although ovulation and conception begin at 1 year of age in domestic fillies, there appears

to be a high fetal loss in mothers of this age. In one study (Ginther 1979) of mares confined to pens or small pastures and fed supplementary diets, 69 percent of the yearling females conceived but only 44 percent delivered at age 2.

In all the published material we examined, we found only one instance of conception at 1 year of age and foaling at 2 in wild horses. This was reported by Tyler (1972) who, in a study of New Forest ponies in Britain, observed one such case in 107 2-year-old mares over a 3-year period. Elsewhere, no 2-year foaling was observed in the following studies:

(i) Boyd (1980) in a 2-year study of a 400-horse herd in Wyoming.

(ii) Keiper (1979) in a 5-year study of Shetland ponies on Assateague Island (Maryland-Virginia), the population averaging about 300 animals.

(iii) Welsh (1975) in a 3-year study of 227 to 306 wild horses on Sable Island, Nova Scotia. Youngest mare seen copulating was 26 months of age.

(iv) Feist and McCullough (1975) in a 1-year study of 270 horses on the Pryor Mountain Wild Horse Range, Montana.

(v) Nelson (1979) in a 1-year study of 116 horses in the Jicarilla District of the Carson National Forest, New Mexico.

(b) Age-specific and herd fecundity. In one study of confined and well-fed domestics (Ginther 1979), the percentages of mares foaling rose from around 65 percent in the younger animals to values of 81 to 89 percent in ages approaching 12, then declined to 50 at age 20. In total, about 80 percent of a mixed-age herd became pregnant, while about 70 percent bore young. Since the gestation period is approximately a year, and mares experience post-partum ovulation and conception, these percentages approximate the percentage of mares in a mixed-age herd that could be expected to produce young each year. Removal of the younger animals, and keeping the herd stocked with the more fecund, 8 to 12-year-old animals could increase the expected annual foaling rate.

An important paper by Speelman and others (1944) summarizes reproductive rates of domestic mares raised under western range conditions near Miles City, Montana. These authors reported the foaling rates of 209 mares, each observed through several breeding seasons, so that a total of 953 individual breeding cycles was observed over a 15-year period. Range forage was the primary food source, and foals ran with mares until weaning, when they were given grain and hay until 1 year of age. From 1 year to maturity, and thereafter, pastures provided most of the food. No supplemental food was given except during periods of exceptionally severe weather or during work periods.

The 953 matings produced 567 pregnancies (59.6 percent) and 568 foals (one set of twins was born). Age-specific fecundity of these animals is shown in Table 2.3. Here, as in the study reported by Ginther (1979), fecundity rises as the mares age from 3 to 7 years, reaches a maximum in about the 8- to-11-year class, then declines somewhat in the older ages. But the foaling rates are generally lower in these range-reared animals.

These authors cited comparable statistics from other studies with percentages varying from 42.3 to 72.0 for herd means. In their own studies, annual mean percentages for the entire herd varied from 43.5 to 73.7.

Statistics of comparable volume and detail are not available for wild horse herds, but 3-year-old, 4-year-old, and herd foaling rates have variously been reported in the studies cited above. The manner of reporting has not been uniform among the studies, making comparison somewhat difficult in places. But it seems worthwhile detailing these results, recalculating where possible some of the authors' data in order to allow maximum comparison:

(i) Tyler (1972) detailed the age composition of the mares on her study area in each of the 3 years of her study (see her Table 1). The number of mares 3 years and older totaled 198, 211, and 219 in 1966, 1967, and 1968, respectively. She also reported the number of foals born in each of these years at 99, 109, and 84. These values produce annual foaling rates for 3-year-olds and older of 50, 52, and 38 percent. She states that "Most mares foaled for the first time when 3 or 4 years old, but some not until they were 5 years old." But since the foaling performance of these different age classes was not given, no other rates can be calculated. It should be pointed out that the colt foals were removed each year from this population, somewhat similar to the situation on Chincoteague National Wildlife Refuge, as discussed below.

(ii) Boyd (1980) reported that 11 percent (N = 9) of the 3-year-old mares under observation in 1978 foaled, 33 percent (N = 12) in 1979. In these years the percentage of 3-year-old and older mares foaling was 78 and 53; of the 4-year-olds and older, 86 and 55.

(iii) Keiper (1979) observed two populations on Assateague Island: (1) Those on the Assateague Island National Seashore (AINS, northern portion of island) which were unmanaged and allowed to pursue their own demographic structure and performance; (2) those of the Chincoteague National Wildlife Refuge (CNWR, southern portion of island) which were privately owned, mixed around each year presumably for husbandry purposes, and from which the foals were removed at the end of each summer for sale.

Table 2.3. Age-specific Percentages of Mares Bearing Foals Each Year in Range-Reared Domestic Horses (data from Speelman and others 1944).

Age[1]	No. Mares	% Bearing	Age[1]	No. Mares	% Bearing	Age[1]	No. Mares	% Bearing
3	4	25.0	9	78	65.4	15	24	50.0
4	99	56.6	10	67	67.2	16	18	61.1
5	125	57.6	11	56	69.6	17	12	41.7
6	105	58.1	12	47	57.4	18	7	0
7	96	60.4	13	40	50.0	19	2	0
8	94	70.2	14	29	58.6	20	2	50.0
						?	48	54.1

[1]This is the age at foaling. The foals were sired 1 year earlier.

Keiper reported foaling rates and numbers of mares for the two populations in his Table 4 as follows:

Year	AINS	CNWR
1975	58.8(17)	70.9(38)
1976	64.3(14)	81.0(37)
1977	70.5(17)	75.0(37)
1978	70.0(20)	---
1979	43.5(23)	70.8(24)
Mean	61.4	74.4

He attributed the differences between the two populations to the foal removal on CNWR, and resulting relaxation on the mares' physiological resources of not having foals suckling through the subsequent pregnancy. One might also speculate that the annual foal removal could have produced an older mare population with higher fecundity. The CNWR age composition was not given, and hence it is impossible to calculate age-specific fecundity rates for the population.

Such rates can be approximated for AINS, although we have encountered some difficulty in discerning the consistency between Keiper's Tables 1 and 4. He states in the footnote to Table 1 that all foals on AINS were from "mature" (4 and older) mares except for three born to 3-year-olds. The 5-year summary in this table lists 85 mature mares and 52 foals, for a foaling rate of 61 percent, the same mean as in Table 4 (see above). But Table 4 shows a 5-year total of 91 mares and 55 foals. Since the 5-year total of "immature" mares was 74 (his Table 1), and somewhere between a third and a half of these were probably 3-year-olds, the 91 in Table 4 cannot have been the combined 3-year-olds and older.

Since the 91 is close to the 85 "matures" in Table 1, we assume the fecundity rates in Table 4 and above are those for 4-year-olds and older, and are so recorded in our Table 2.4. If we assume conservatively that a third (25) of the 5-year total of 74 "immatures"

in his Table 1 were 3-year-olds and add these to the 85 "matures," then the 52 foals constituted approximately a 47 percent 5-year-average foaling rate for the 3-year-olds and older (52/110 X 110). This would also imply a 3-year average 3-year-old foaling rate of somewhere around 12 percent (3/25 x 100).

(iv) Welsh (1975) provided the most detailed analysis of the fecundity of a wild horse herd, summarizing foaling rates over a 3-year period for 3-year-old mares, 4's, and the 5's and older which he called "adults." The results are as follows, the sample sizes given parenthetically after each rate:

	% Foaling By Year			
Age	1970	1971	1972	Mean
3	0(6)	19(16)	0(6)	11(28)
4	0(1)	50(6)	25(8)	33(15)
5+	63(76)	84(76)	52(45)	69(197)

In order to compare these with the results of other studies, which have combined results in slightly different ways, it is of interest to calculate the rates for 4-year-olds and older, and for 3-year-olds and older. We have done so as follows for the above columns:

3+	58(83)	71(98)	42(59)	60(240)
4+	62(77)	82(82)	47(53)	66(212)

(v) Feist and McCullough (1975) considered all mares 4 and older to be "adults," the 2- and 3-year-olds to be "immatures." In the year they observed the Pryor Mountain herd, 78 adult mares bore 33 foals, a foaling rate of 42 percent. In addition, two foals were produced by 3-year-olds. Although the 3-year-olds were not enumerated, the immature age class numbered 27 and we can hypothesize conservatively that about 10 of these were 3-year-olds. On this assumption, the 3-year-old foaling rate was somewhere near 20 percent, and the rate for all mares 3 years and older would be approximately 35/88 x = 40 percent.

(vi) Nelson (1979) observed 21 foals born to 38 "mature" (4 years and older) mares, a rate of 55 percent. Apparently no foals were born to younger mares. "Immature" animals numbered 14, and if as many as 5 of these were 3-year-olds, then the rate for all mares 3 years and older would be on the order of 21/43 x 100 = 49 percent.

(vii) Hall (n.d.) presented sex and age composition on the Pryor Mountain herd in 1971, and reported that 18 foals were seen in the area. Mares made up 40 percent of the herd of 80. Of the 80, 9 were 10 years or older, 42 were 4 to 9. Since 3-year-olds made up 9 percent of the herd, they numbered 80 x .09 = 7. If we apply the 40 percent female percentage, then the number of mares in each of these age classes approximated 4, 17, and 3, and totaled 24. The foaling

rate for 3-year-olds and older therefore was on the order of 18/24 x 100 = 75 percent. There is no way to subdivide the rates any further.

All of these statistics are summarized in Table 2.4, and several generalizations seem justified. First, fecundity rates in wild horses appear to increase with age, at least in the first half to two-thirds of life, as we have seen is the case in confined and range-reared domestics. In the studies summarized in Table 2.4, the percentage of 3-year-olds foaling has varied between years and areas from 0 to 33 percent, and has averaged 13 percent. Most of the studies have not reported the rates for 4-year-olds, and the three values cited in Table 2.4 may or may not be typical. Judging by the abundant representation of rates for 4-year-olds and older, and for 5-year-olds and older, the rates in this latter class commonly rise above 60 percent, in individual years exceeding 80.

Because of these age-specific differences in fecundity, the rate one uses to express the performance of a given herd depends on the age classes included. The rate for the 5-year-olds and older animals can be expected to be higher than that for the 4-year-olds and older (the "adults" or "mature" animals of several authors), and in turn the rate for the 3-year-olds and older will be lower than that for the "matures." This is evident in Table 2.4. Furthermore, the rate for a herd will depend on its age composition: a herd with a large number of 3- and 4-year-olds is likely to have a lower rate than one with fewer of these ages and a greater number of older animals, other things being equal. Comparison between herds and years can only be precise when these variables are standardized.

Within these constraints, herd fecundity rates for the areas and years covered by the studies in Table 2.4 vary between 38 and 78 percent for the 3-year-olds and older animals, and average 54. The rates for the 4-year-old and older segments of the population vary between 42 and 86, and average 61.

Why fecundity in wild horses should be lower than that of confined domestics, and should vary markedly between years in some herds (cf. Welsh 1975, Boyd 1980), has been the subject of considerable speculation in the literature.

Several authors surmise that the main source of variation is not fertility, but the ability of the mare to carry a viable fetus to parturition. This ability, in the speculation of some, varies with weather conditions, food supplies, and perhaps the age of the mare. One gets the impression from reading the literature that reproduction is a heavy drain on the mare's physiological resources, and that added stress can result in abortion.

Thus Boyd (1980), citing published abortion rates of 10 percent in domestic horses, suspected the difference in foaling rates between her 2 years of study to have been due to variations in abortions and stillbirths resulting from the mild winter preceding the first study year, and a severe winter prior to the second. Keiper's (1979) suggestion that the higher foaling rate on CNWR was due to the removal of foals and release of mares from lactation, and consequent lower abortion rate was mentioned earlier. To Tyler (1972), abortions seemed "common" among New Forest ponies during late autumn, winter,

TABLE 2.4 Age-Specific and Herd Percentages of Mares Bearing Foals in Seven Wild Horse Studies. (See text for discussion of each and derivation of statistics.)

Source	Location and Year	% (and No.) of Mares Foaling by Age Class				
		3YO	3YO+	4YO	4YO+	5YO+
Feist & McCullough (1975)	Montana, 1970	20(10)[1]	38(88)[1]	-	42(79)	-
Hall (n.d.)	Montana, 1971	-	75(24)[1]	-	-	-
Boyd (1980)	Wyoming					
	1978	11(9)	78[2]	-	86[2]	-
	1979	33(12)	53[2]	-	55[2]	-
Welsh (1975)	Nova Scotia					
	1970	0(6)	58(83)	0(1)	62(77)	63(76)
	1971	19(16)	71(98)	50(6)	82(82)	84(76)
	1972	11(6)	42(59)	25(8)	47(53)	51(45)
Keiper (1979)	Maryland					
	1975	-	-	-	59(17)	-
	1976	-	-	-	64(14)	-
	1977	-	-	-	71(17)	-
	1978	-	-	-	70(20)	-
	1979	-	-	-	44(23)	-
	5-year mean	12(25)[1]	47(110)[1]	-	-	-
Nelson (1979)	New Mexico, 1977	0(5)[1]	49(43)[1]	-	55(38)	-
Tyler (1972)	Britain					
	1966	-	50(171)	-	-	-
	1967	-	52(167)	-	-	-
	1968	-	38(186)	-	-	-
Unweighted Means		13	54	25	61	66

[1]These values were calculated on the basis of certain assumptions. See text for derivation.

[2]No sample sizes given. The entire herd numbered 373 and 398 in the 2 years.

and early spring and could have been the major factor contributing to the low foaling rate. She actually saw nine aborted foals.

Welsh (1975) surmised that the differences in foaling rates between his 3 years of study (Table 2.4) were due to differences in abortion, these in turn resulting from poor nutrition and differences in severity of the three winters. The first was severe at the beginning but then eased, the second was mild throughout, and the third was long and severe throughout. Nelson (1979) observed differences in foaling between females that did and did not have access to revegetation areas. Females with access to these foaled a month earlier. They comprised 64 percent of the mature female population but contributed 73 percent of the foals.

Indications of a tenuous balance between the mare and her resources and the foal and its viability are suggested from several observations by these authors. In Welsh's study, the postnatal mortality of foals born to 3- and 4-year-old mares was higher than that for foals born to older females. In the first and third years of his study, abortion rates were higher and foal mortality lower, suggesting that the weak foals were lost before birth. In the second year, the abortion rate was lower, fecundity higher, but postnatal foal loss was the highest of the 3 years. In the middle year, half of the mares that foaled died, but only 18 percent of those that did not foal died.

While not endorsing the idea for her study, Boyd (1980) cites several authors (Klingel 1969c, Tyler 1972, Moehlman 1974, Nelson 1979) who have suggested that wild equid mares may commonly foal in alternate years. The phenomenon might reflect their inability to recover reserves sufficiently to bear a foal each year. She noted that older mares that foaled in May 1978 did not foal again until late 1979. One veterinarian has told us that if range-reared domestic mares are bred at 2 years of age and foal at 3, they are not likely to foal again at 4. It is not known whether these tendencies explain the fact that none of the herds summarized in Table 2.4 continued to foal during each year of observation at rates markedly above or below the means for the age classes.

Techniques are available for assessing pregnancy status of freshly captured wild mares and hence to allow estimates of probable natality rates. Appropriate data could be collected, in part, in connection with the adopt-a-horse program and with the projected burro removal operations. A single trained person with the capture teams could accomplish requisite sample collection and examination of the females. This could also be made a part of a capture program for marking purposes. It would be an essential part of field-testing contraceptives, since implanted pregnant animals would continue a normal pregnancy, delivery, and lactation but not return to heat. The effects of the contraceptive would not be evident until the following year in such animals.

(c) Foaling season. In captivity, some female domestic horses ovulate year-round with a cycle length of 21 to 22 days, but most tend to be seasonal depending on latitude. In the wild, this seasonality