ECOLOGY AND BEHAVIOR OF THE CRETAN AGRIMI FOLLOWING POPULATION REDUCTION

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ABSTRACT

ECOLOGY AND BEHAVIOR OF THE CRETAN AGRIMI
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A study of the last remaining agrimi (*Capra aegagrus cretensis* Lydekker) was conducted between May and November 1975 on Theodorou Island, Crete, Greece, following the removal of 24 agrimi in 1973 and 1974.

The total population of 89 agrimi was captured and revealed a male:female ratio of 1.28:1. The total agrimi biomass on the 68-ha island was 1915.0 kg. A mathematical model of population growth and mortality indicated for both sexes that the number of animals (24) trapped by the authorities and removed from the island since 1973 replaced the natural mortality which would have been expected to occur during the two-year period.

A vegetation analysis of the island yielded density, frequency, and percentage cover data for each of 140 plant species present. The above-ground net primary production for the combined herbaceous species plus twig and leaf growth in shrubs equaled 1061 kg/ha/yr. The measured portion of the production available as forage was 618 kg/ha/yr. A chi-square matrix employed in conjunction with four of

Jaccard's indexes of association identified several distinct plant groupings.

Agrimi appeared to cease most daytime movement from June to September. During this hot dry period agrimi heavily sheltered beneath the shrubby cover of *Pistacia lentiscus*. Age- and sex-specific dominance was evidenced.

Mating began in mid-October, at the beginning of the winter rains. Fighting between males for estrous females was rare, probably due to the previously established male hierarchy.

A seawater consumption experiment and direct observations verified that agrimi partially fulfill their free-water requirements with seawater.

Continued removals of agrimi are recommended to be carried out annually to prevent overpopulation and overgrazing.

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INTRODUCTION

The agrimi (Capra aegagrus cretensis Lydekker) is a subspecies of wild goat which occurs on Crete. It exists in reduced numbers in the White Mountains of Crete and, in order to preserve the agrimi, Theodorou Island, a tiny islet offshore Crete, Greece, was stocked from successful introductions in 1928 (1 pair), 1937 (1 pair), and 1945 (1 pair) (Schultze-Westrum, 1963). A complete history of the island's agrimi was reviewed by Papageorgiou (1974). Other wild goats, known variously as C. aegagrus Erxleben or C. hircus Linnaeus (Ellerman and Morrison-Scott, 1951; Harrison, 1968), are found in parts of Turkey, Iran and Afghanistan, Iraq, in the Causasus and Turkmenia areas of Russia, and in the Baluchistan and Sind provinces of Pakistan.

Behavioral information about wild goats is sparse, with only a single study conducted on the courtship behavior of the Pakistan form (C. a. blythi Lydekker) (Schaller and Laurie, 1974). Other published observations consist only of natural history notes (Danford, 1875; Wahby, 1931; Roberts, 1967) and hunting accounts (Stockley, 1928; Maydon, 1937). Schaller and Laurie (1974) have indicated the need for concise information on the behavior of this species.

The food preferences of the agrimi on Theodorou Island were determined by Papageorgiou (1972) and, in 1973, various aspects of the population's energy relations were measured (Papageorgiou, 1974). With a total population of 97 animals, Papageorgiou found the vegetative range to be seriously deteriorated as a result of overgrazing. Following his recommendations that population numbers be reduced, the Greek Forest Service, in late 1973 and 1974, removed 24 agrimi from the Theodorou population. These animals were translocated to various local parks throughout Greece. It was intended that the removals relieve the heavy grazing pressure and enable the island habitat to stabilize and perhaps improve.

The present study was undertaken (1) to ascertain population responses of the agrimi to the reduction in density, (2) to measure the density, frequency, cover, and partial biomass of the island vegetation under reduced grazing pressure, and (3) to add to our basic knowledge of the species by documenting the behavior patterns of the agrimi.

STUDY AREA

The study area, Theodorou Island, is a 68-ha island which lies about 850 m from the northwest coast of Crete, Greece. Comprised of rugged limestone (Figure 1), the northern and western extremes of the island consist of steep cliffs, while the southern portions of the island's hilly topography exhibit less-severe slopes.

The local climate is mediterranean, with cyclonic winter rains and hot dry summers. Data from the meteorological station at Chania, 8 km to the east, indicate a mean air temperature of 18.8 C with mean annual extremes of 15.1 C and 22.6 C. Absolute extremes of 1.8 C (January, 1968) and 41.4 C (July, 1960) have been recorded there. Five 50 C alcohol thermometers placed on the island burst, however, during the summer period. The higher temperature extremes on the island were probably due to the reflectivity of the rocky limestone outcroppings and to heat absorption by the considerable exposed soils there.

Although there is no severe cold season, the winter is cool. The main growing season is spring, with the hot dry summer a relatively dormant period for plants.

Rainfall on Chania averages 691 mm per year (National Meteorologic Service, Chania, Greece), mostly falling in the winter.

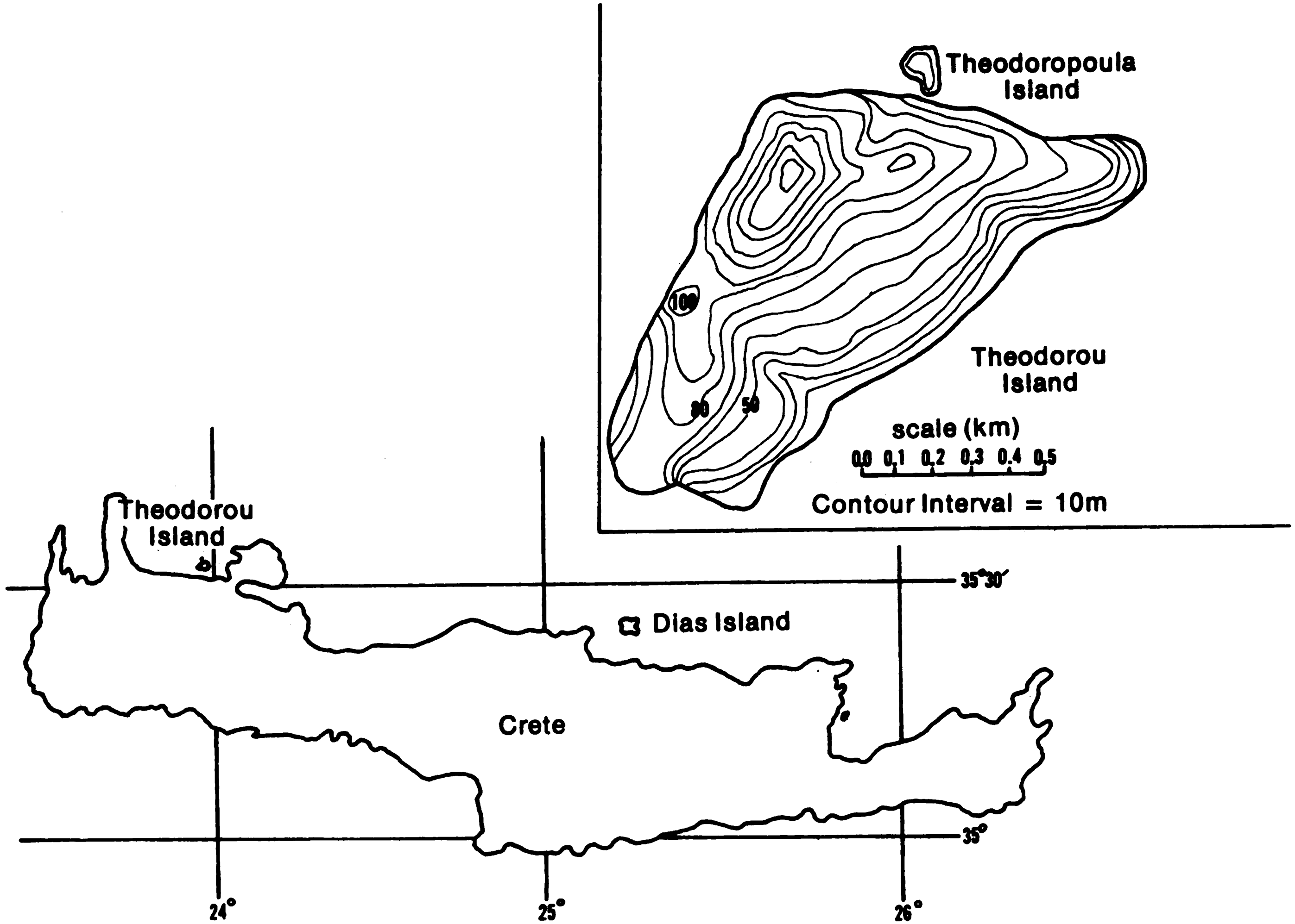

Figure 1.--Outline of Crete, Greece, showing two offshore islets and with topographic relief of Theodorou and Theodoropoula Islands (Greek Forest Service).

Only two brief showers fell on the island between May and September, 1975. Two or three months of complete summer drought are common in the area.

The soil of Theodorou Island consists of a highly eroded terra-rossa profile of which only the clayey, plastic, bright red subsoil horizon remains. In many places small pockets of subsoil are held in cupped areas of the jagged limestone.

Theodorou Island supports a shrub-forb plant community typical of the mediterranean sclerophyllous zone (see beyond). The vertebrate fauna includes the European hare (*Lepus europeus*), Norway rat (*Rattus norvegicus*), Eleonora falcon (*Falco eleonorae*), Greek partridge (*Perdix graeca*), raven (*Corvus corax*), and rock martin (*Hirundo rupensis*).

Sightings of hares and rats were quite common throughout the island. These populations have apparently increased from the uncommon sightings of tracks and feces reported in 1971 by Papageorgiou (1972). On eight occasions approximately 20 to 30 hares were seen in the agrimi corral trap during night trapping operations.

METHODS

Agrimi Capture

The entire agrimi population was trapped between 4 July and 4 September, 1975. This was after all kids had been born and before the mating season.

The trap was a 40- x 60-m fenced corral with two remotely-controlled doors (Figure 2). The area within the corral was baited daily with hay and fresh water for six weeks prior to the capture attempts. Hay and water were also provided there daily during the trapping period.

Animals caught in the corral were driven through a narrow funnel into a wooden trap box attached to the west end of the trap. There they were measured, weighed and tagged.

Trapping was conducted on a 24-hour basis during 3- to 4-day sessions. These efforts were followed by 3-day rest periods during which the agrimi had free access to water and feed in the trap area. In daylight hours, the trap doors were closed merely when a sufficient number of untagged animals had gathered there. Nocturnal trapping, however, was staggered over all nighttime hours so that activity patterns during the night could be learned. At least three hours were allowed to elapse between trapping sessions so as to minimize the influence of human activity on agrimi activity near the trap area.

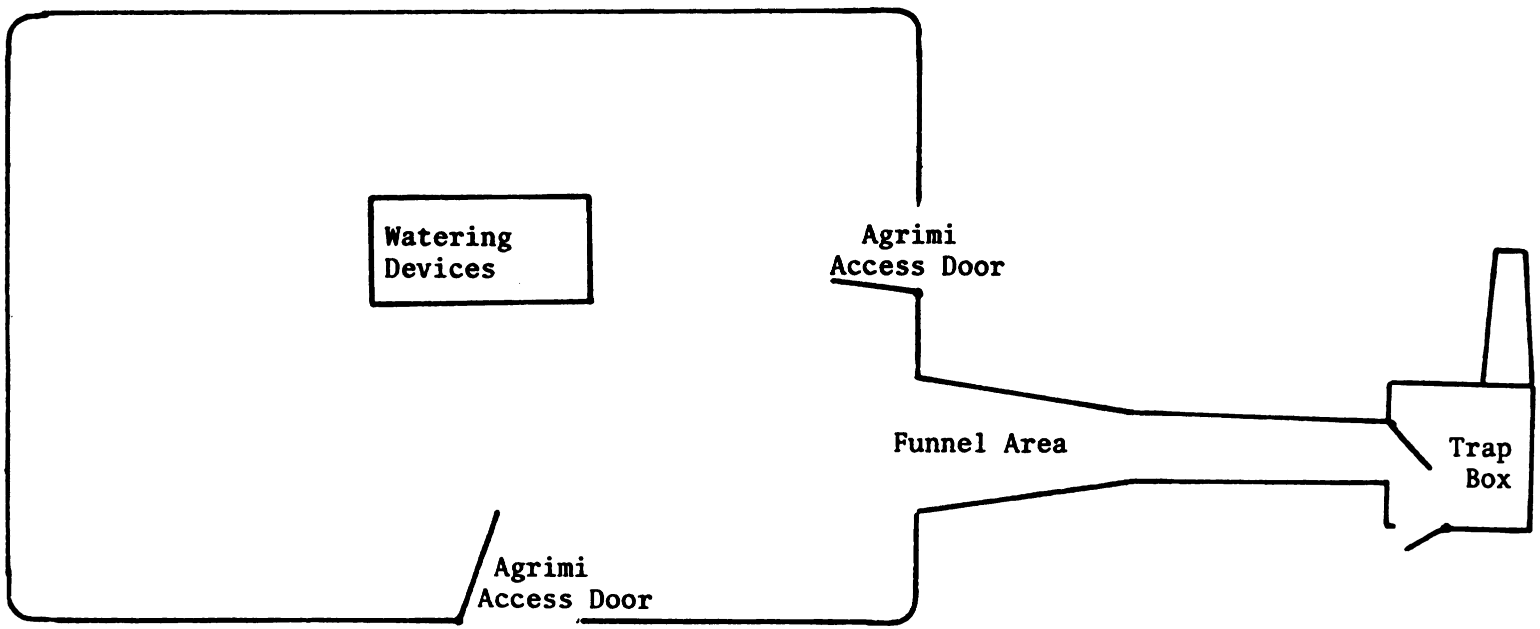

Figure 2.--Schematic drawing of trap corral used to capture agrimi on Theodorou Island, Crete, Greece.

During trapping operations, any animals which displayed symptoms of hypoglycemia were given an injection of glucose and immediately released. All treated animals were later observed alive.

Marking Individuals

All agrimi on Theodorou Island were captured and marked so that they could be identified individually at a distance. A 9-cm-high NASCO^{reg} nylon tag was attached to the neck by a white plastic chain collar. Females were marked by red and males by blue neck tags, both of which carried white numerals 5 cm in length. The numbers on the tags could be read with a 30X spotting scope at distances up to about 200 m.

One link of the neck chain was cut in such a way (Figure 3) that upon applying about 20-25 kg pressure a snagged adult could effect its own release. The neck chains of small animals were set

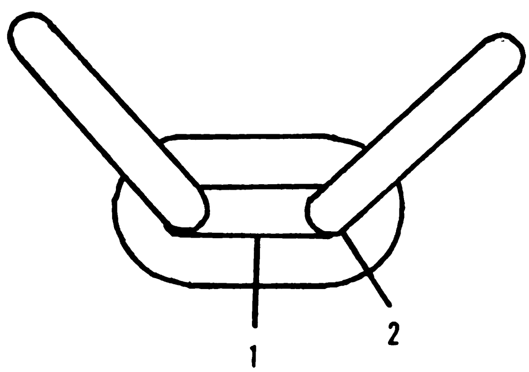

Figure 3.--Links of plastic chain used in marking agrimi in 1975 on Theodorou Island, Crete, Greece. Position 1 indicates where the release link was cut for large animals. The neck chains of smaller animals were cut at position 2 to allow release under less pressure.

for release under less pressure (Figure 3). The white neck chains themselves were highly visible and allowed tagged animals to be recognized as such at great distances.

As a backup system of identification, all agrimi also were tagged in one ear with yellow or red plastic NASCO^{reg} ear tags. Their bodies also were given a distinctive mark with a permanent black NYASOL^{reg} dye. Each animal could be identified by neck- and ear-tags and also by various recorded dye patterns. Unusual natural markings, such as distinctive color patterns or horn configurations, also assisted in the recognition of several individuals. Written descriptions of each animal were always carried by each observer in the field.

Pellet-Group Count

A pellet-group count (Smith, 1964; Rogers et al., 1958) was conducted to test the hypothesis that this method could provide an accurate estimate of population numbers in the future. Four 5-m x 50-m plots were randomly chosen and delineated. All agrimi pellet groups present at the time the plots were designated were sprayed with red or yellow paint. Thirty days later unpainted pellet groups in the plots were counted.

Mortality Data

Mortality data were collected by searching the island for skulls and other durable parts of dead animals. This search was conducted in September, 1975 after trapping was concluded.

Since a similar search had been conducted in 1973 (Papageorgiou, 1974), the remains found were for deaths during the intervening two years. Remains which were greatly deteriorated were assumed to have occurred earlier and were added to the mortality listed by Papageorgiou (1974) as having occurred before 1973.

The ages of dead animals were determined by counts of the annular horn rings.

Habitat Temperatures

Three stations were established to assess the relative microclimates under *Pistacia lentiscus* shrubs, beneath which the agrimi sheltered on Theodorou Island. Each station was under a particular shrub seen to be used often by agrimi. At each location, one shaded-bulb thermometer was placed perpendicular to and 50 cm above the ground while a second instrument was similarly placed in an open area 2 m from the shrub. The three stations were located in the east, middle, and west sectors of the island. Temperatures were read at irregular times during the day and night from 28 June to 29 September, 1975 as indicators of microclimatic differences.

Seawater Consumption

An experiment was conducted to indicate whether agrimi would accept seawater and whether they could maintain weight when drinking salt water alone.

Two male and two female agrimi were captured and housed in individual metabolism cages, each 95 x 80 x 140 cm in size. They were fed ad libitum a diet of air-dry hay and freshwater for the first seven days of captivity. On the eighth day, seawater was offered ad libitum in place of the fresh water. They were kept on the seawater regimen until it was rejected, after which they were given fresh water.

Each animal was weighed to the nearest 0.5 kg every other day throughout the experiment. Though urine and water volumes were recorded and urine samples taken, these data were discarded when they were found to have been disturbed by the Forest Service guard.

Vegetation Studies

Island vegetation was evaluated in May and June to assess the effects of the reduced agrimi population. Areas devoid of vegetation or inaccessible to agrimi because of extreme slopes were not sampled.

Areas which were deemed usable by agrimi were divided into 200 blocks of 50 x 50 m each, using a prismatic compass and rangefinder. In each of the 200 blocks, a 1/2- x 2-m^2 plot was located randomly in a similar manner. This size plot was adopted because its small size enabled accurate and convenient counting and yet was not so small as to cause large errors through edge effects. Plot size was also chosen for comparability with the previous vegetation analysis of the island (Papageorgiou, 1974).

A species-area curve (Figure 4) (Cain, 1938) in conjunction with a plot of running means for major species (Kershaw, 1964) indicated the sample size for the small density quadrats was adequate.

The sampling of biomass of abundant species was stopped at the point at which additional sampling did not substantially affect

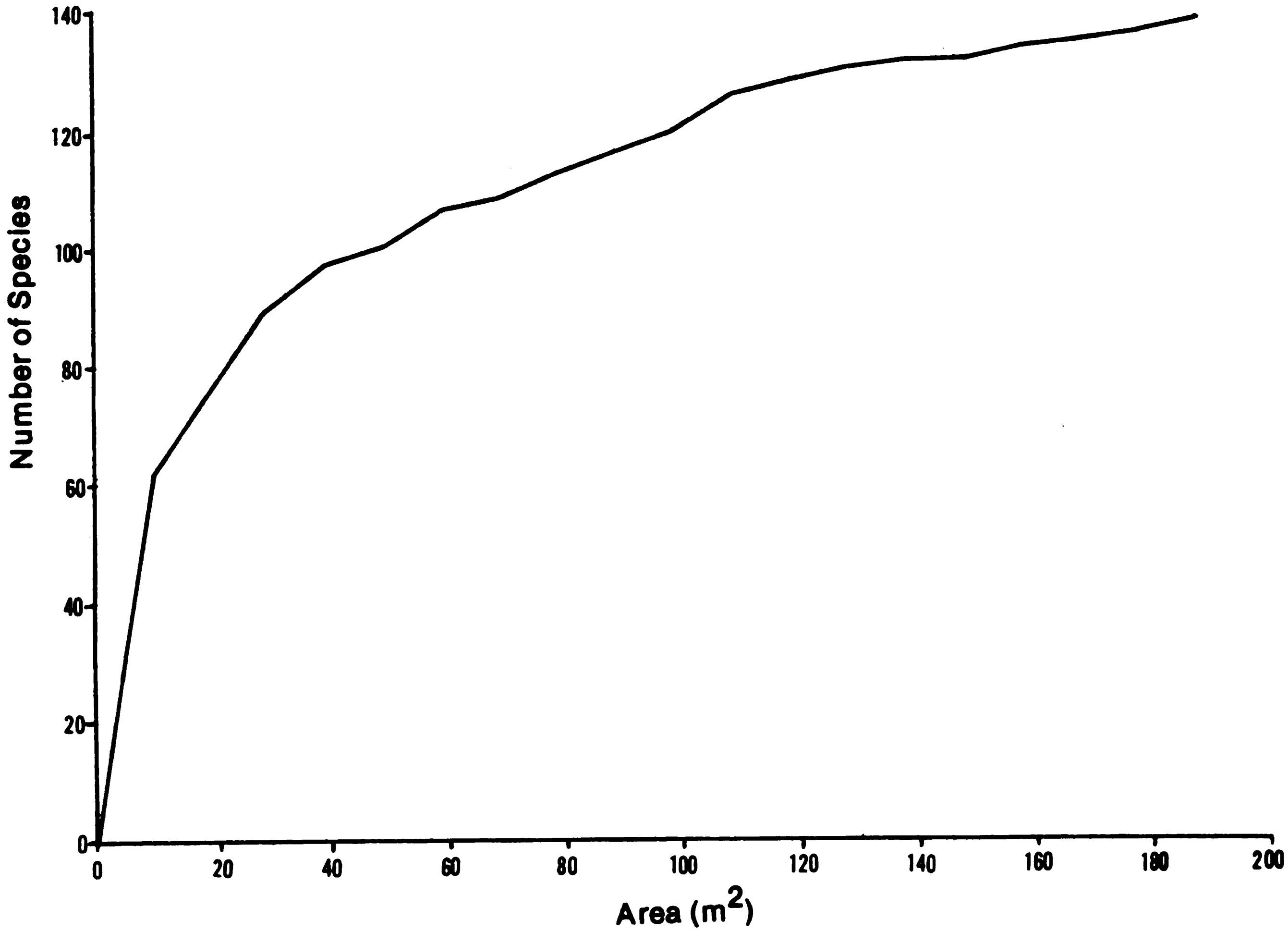

Figure 4.--Species-area curve for the vegetation present in 1975 on Theodorou Island, Crete, Greece.

the mean biomass per twig or shoot. This was tested by calculating and plotting a cumulative mean during the quadrat analysis. Less abundant species were clipped in all plots where present.

Line transect (Canfield, 1941) was used with a steel wire 2 m long and marked in 1-mm graduations was stretched across the center of each plot about 5 cm above the ground. Ground cover was measured as the vertical projection of the crown or shoot area of each species transected by that line. Ground surface devoid of living vegetation was recorded as rock surface, plant litter, or bare ground.

The density of each species found in a plot was determined by direct count of individual plants rooted within the plot. Shrub twigs within each plot were also counted.

Herbaceous plants in each plot were categorized as grazed or ungrazed and clipped during early June when most species were fruiting and appeared to be at peak standing biomass.

The above-ground net production for herbaceous plants was considered to be equal to the maximum standing biomass (Bray et al., 1959; Kilmer et al., 1960; Gilbert and Chamblee, 1959; Pieper, 1964; Koelling and Kucera, 1965; Blaisdell, 1958; Kelly et al., 1974).

Annual woody growth was not measured for shrub species. Only the annual peak standing biomass of stems and leaves was taken as a partial measurement of above-ground net production.

Plant species were identified in the spring, when flowering parts were present. Plants which could not be identified in the field were numbered and later taken either to the University of

Athens or the University of Thessaloniki for further review by plant taxonomists.

Agrimi Behavior

Direct observations were made with a 30X spotting scope, binoculars, and the unaided eye at distances of 3.0 m to 1.5 km. Notes were recorded in the field and later transcribed to data forms. Some behaviors were recorded with a 35 mm, single-lens reflex camera, using a 75-205 mm zoom lens, sometimes in conjunction with a 3X teleconverter.

Many observations were made from a small shrine located near the main trapping area and centrally sited on the south slope. Agrimi were also observed from a small blind at a bait station near the southwest shore.

Although the wild agrimi were habituated to the baited areas, any sudden movement of the observer would cause precipitate-flight. Close-range observations could have been influenced by the presence of the observer, but similar behaviors to those seen at close range also were seen at long ranges (100 m to 1.5 km). Flight distances were measured by a range finder to the nearest meter when possible.

Behavioral observations were made from 5 May until 20 November, 1975. During this period, there were over 249 hours of observations at the trapsite, and 156 hours at the secondary feeding station. An additional 446 hours of observation were spent on the open range and in three blinds located strategically on hilltops.

Statistical Procedures

Differences between all observed values were considered to be statistically significant if they could have been due to chance at under the 0.05 level. Standard deviations (SD) are presented with appropriate means unless otherwise noted.

To establish correlations between species, Jaccard's (1928) index of community similarity was applied. As an index of species association, this procedure compared conditions on sample plots with respect to the:

1. Frequency with which two species occurred together.
2. Biomasses present.
3. Correlation of the degree to which each species provided ground cover.
4. Correlation of the constancy with which each species occurred throughout the series.

A chi-square matrix using 2 X 2 contingency tables for two-species correlations allowed comparisons between the number of plots occupied by a given species and the number expected under a hypothesis of randomness (Agnew, 1961; Mueller-Dombois and Ellenberg, 1974).

An algorithm and computer program to aid in computations of the indexes of association and the chi-square matrix data was completed using a CDC 6500 digital computer.

RESULTS AND DISCUSSION

Population Analysis

Sex and Age Composition of the Population

The capture of the complete population on Theodorou Island revealed 50 males and 39 females to be present in 1975 (Figure 5) where, in 1973, Papageorgiou (1974) found that the population consisted of 50 males and 47 females. Between these dates, 5 males and 10 females were removed in 1973 and 3 males and 6 females in 1974. It seemed that the unbalanced (1.28:1) sex ratio in 1975 could have been a result of their capture and removal by the Greek Forest Service.

By categories, the 1975 population consisted of 12 kids, 5 yearlings, and 72 adults. In 1973, there were 14 kids, 13 yearlings, and 70 adults. The percentages of kids and adults remained about the same, however, the number of yearlings was much lower.

The low number of yearlings in 1975 may have been related to the poor range conditions present in 1973 (Papageorgiou, 1974). While the population reduction in 1973 may have relieved the grazing pressure somewhat, it probably did not bring an immediate improvement in the availability of forage. The low number of first-year agrimi was probably the result of high kid mortality in 1974.

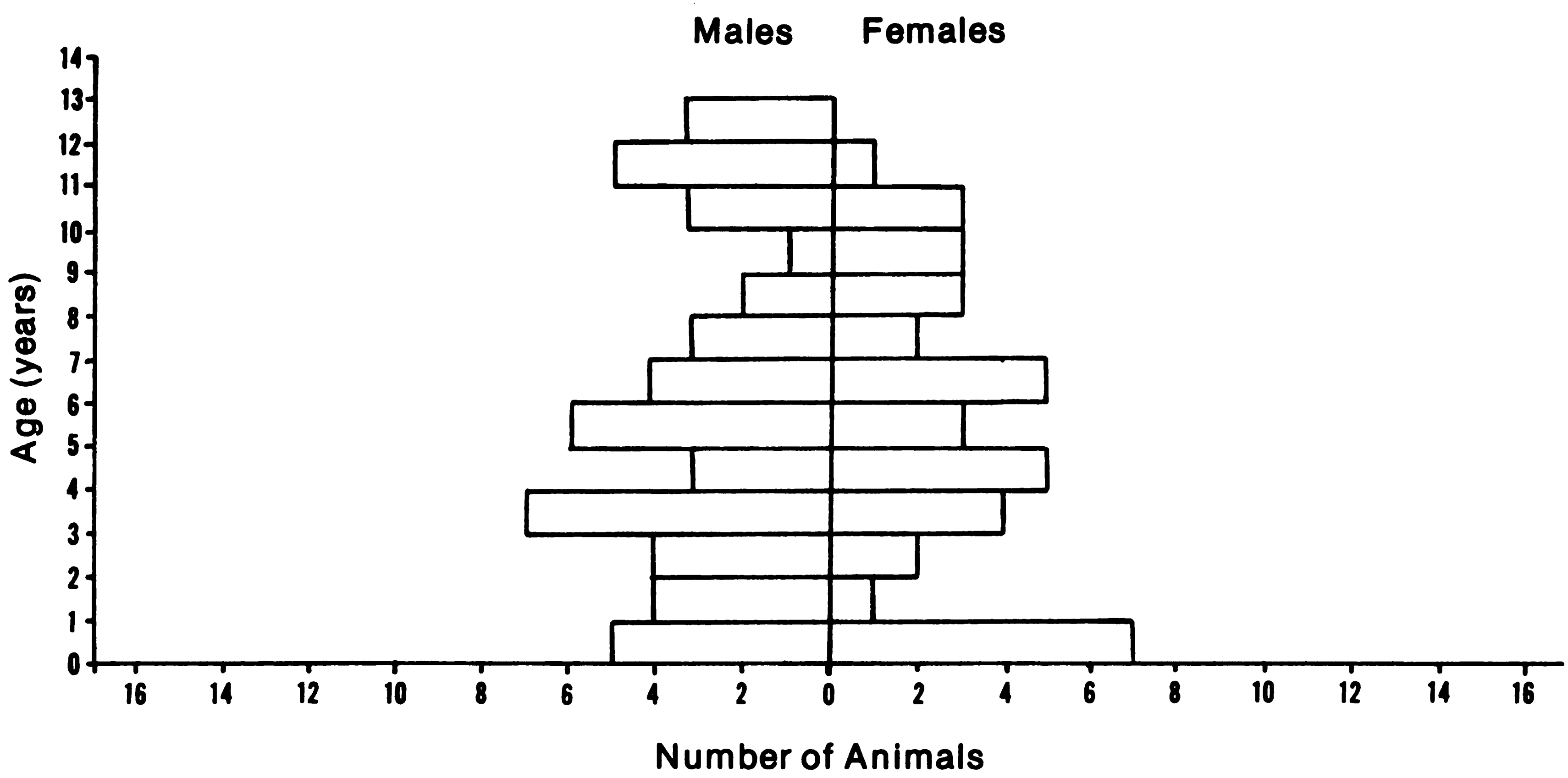

Figure 5.--Age and sex composition of the living agrimi population on Theodorou Island, Crete, Greece, August, 1975.

In contrast, the normal crop of kids in 1975 may well have been a response to the population reduction since some time had elapsed which would have permitted range improvement. The increased amount of forage available per agrimi may have also improved the condition of the agrimi which allowed higher natality.

Natality

Twelve kids were present and captured, 5 males and 7 females. The only unaccompanied kid observed was a male about 2 months old in late July.

The 11 females, each with a kid, ranged in age from 3+ to 8+ years, with a mean of 5.6 ± 1.8. No twins have been observed on Theodorou Island.

There were 1.67 adults per kid, 2.40 kids per yearling, and 2.78 adult females per kid.

The number of breeding-age females per kid was 2.0 in 1975 and similarly 1.78 in 1973 (Papageorgiou, 1974). Thus only about half of these females have offspring in any one year which survive through the summer months.

Mortality and Removals

A search of Theodorou Island on 28-30 August located the remains of 4 adults and 7 kids which had died since 1973. Since the fragile skulls of kids may break down rapidly or be consumed by rodents, it is probable that the 7 skulls found underestimated the extent of kid mortality.

Ten more heavily decayed skulls also were found of animals that had evidently died prior to 1973 and which had been missed during the previous searches of Papageorgiou (1974).

No animals were lost to emigration due to the 850-m barrier of deep seawater which separated Theodorou Island from Crete.

The 24 agrimi which had been removed plus the 4 adult agrimi, which had died since 1973, accounted completely for the adults enumerated in 1973 (Figure 6).

A hypothetical model (Tables 1 and 2) of the agrimi population was constructed, based on age-specific mortality data obtained by Papageorgiou (1974) as amended by 1975 mortality findings. This model was used to estimate the projected effect of natural mortality on the 1973 population over a two-year period had there been no removals.

The expected numbers of males and females surviving until 1975 from the 1973 population was about 28 and 33, respectively (Tables 1 and 2). Actual survival was 31 and 41 for the 1973 females and males, respectively, for those agrimi remaining on Theodorou Island. An undetermined number of those animals removed from the population and placed in parks from 1973 to 1975 also survived.

The high number of surviving agrimi indicate that the expected natural mortality between 1973 and 1975 was replaced almost completely by the removals. In fact, the 41 males alive in 1975 were significantly greater than the 33 expected to survive.

The greatest differences in male survival came in the older age groups. Mortality data prior to 1973 indicate that no male lived

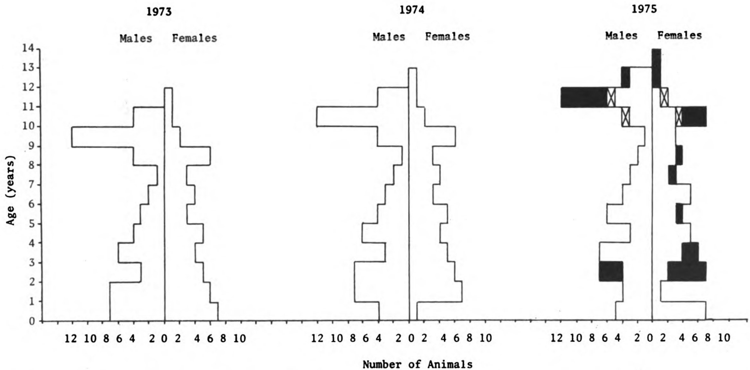

Figure 6.--Age and sex composition of the living agrimi population on Theodorou Island, Crete, Greece: August, 1973 (Papageorgiou, 1974); 1974, without mortality or removals included; August, 1975, plus mortality (crosses) and removals (black) which occurred since 1973.

Table 1.--Calculation of the expected natural mortality over a two-year period for the 1973 male agrimi population on Theodorou Island, Crete, Greece.

Age	Expected Survival Rate in Age Interval*	No. Alive in Each Age Interval		
		1973	1974	1975
0-1	0.75	7	--	--
1-2	0.95	7	5.25	--
2-3	0.90	2	6.66	5.00
3-4	0.95	6	1.80	6.00
4-5	0.94	4	5.67	1.70
5-6	0.94	3	3.76	5.33
6-7	0.93	1	2.81	3.53
7-8	0.93	1	0.93	2.62
8-9	0.77	4	0.93	0.87
9-10	0.40	11	3.08	0.71
10-11	0.25	3	4.40	1.23
11-12	0.00	1	0.76	1.11
12-13	0.00	--	0.00	0.00
Totals		50		28.10

*Data from Papageorgiou (1974) amended by 1975 findings.

Table 2.--Calculation of the expected natural mortality over a two-year period for the 1973 female agrimi population on Theodorou Island, Crete, Greece.

Age	Expected Survival Rate in Age Interval*	No. Alive in Each Age Interval		
		1973	1974	1975
0-1	0.74	7	--	--
1-2	0.95	6	5.19	--
2-3	0.95	5	5.70	4.93
3-4	0.94	4	4.74	5.40
4-5	0.94	5	3.78	4.47
5-6	0.94	3	4.69	3.55
6-7	0.93	4	2.81	4.40
7-8	0.86	2	3.73	2.62
8-9	0.75	6	1.71	3.20
9-10	0.56	2	4.50	1.29
10-11	0.40	1	1.11	2.50
11-12	0.00	1	0.40	0.44
12-13	0.00	0	0.00	0.00
Totals		46		32.80

*Data from Papageorgiou (1974) amended by 1975 findings.

more than 10 years of age. However in 1975, 8 males older than 10 years were captured, therefore, there was an increase in the longevity of the males.

Biomass of the Agrimi Population

Based on the living weights of animals captured, the total biomass of the 89 agrimi was 1915.0 kg. This is 260.8 kg less than the figure reported for 97 agrimi in 1973 (Papageorgiou, 1974). If a value of 1.8 kcal/g live weight is assumed for agrimi tissue (Papageorgiou, 1974), the energy contained in the agrimi standing crop on the 89-ha island translates to 4.94 kcal/m.

The 1975 data (Figure 7) indicated a sizable reduction in the 0- to 7-year old age classes. Since nutritional needs tend to be highest in the very young of all species (Church and Pond, 1974), the reduced rates of growth in the younger 1975 animals indicates that there was a probable decline in nutrients available to these animals. Such a decline between 1973 and 1975 indicates that, despite the removal of some animals, the nutrient supply of range forage probably did not improve.

The productivity of a model cohort of 1000 agrimi was calculated from the previously-collected mortality data of Papageorgiou (1974), amended by the more recent observations and integrated with growth-weight information from 1975. The total lifetime production of male and female cohorts was 25,660 kg (Table 3) and 17,018 kg (Table 4), respectively. Secondary production for the average male and female agrimi was 3.92 and 2.56 kg per year, respectively.

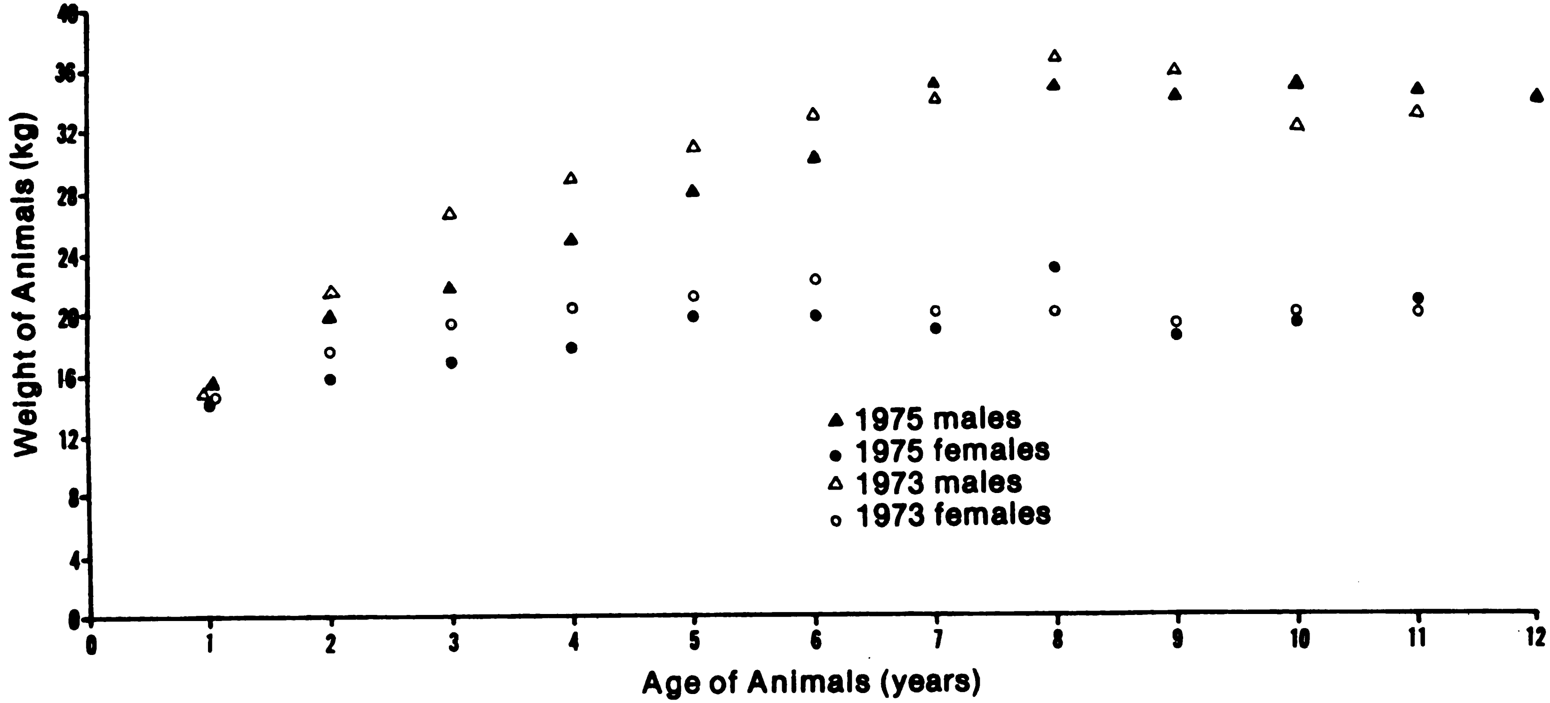

Figure 7.--Growth-weight curves for the 1975 agrimi population compared to those of 1973 (Papageorgiou, 1974). Theodorou Island, Crete, Greece.

Table 3.--Production data for the male agrimi on the island of Theodorou, Crete, Greece, 1975.

Age x (years)	A No. Alive At the Start of Age x*	B No. Dying Between Ages x and x-1	Average Weight at Beginning of Age x (kg)	C Increment of Weight Between Age x and x-1 (kg)	D Average Weights Between Ages x and x-1 (kg)	E Weight Change From Age x to Midpoint of Interval x (kg)	Population Weight Changes L = Living Population (A) x (C)	Population Weight Changes M = Mortality (B) x (E)	Total Population Weight Changes (L) + (M) (kg)	Total Population Weight Losses as Mortality (B) x (D) (kg)
0	1000		1.08**	1.08**			1080.00		1080.00	
1	787	213	15.35	14.27	8.22	7.13	11230.49	1518.69	12149.18	1150.86
2	757	30	19.73	4.38	17.54	2.19	3315.66	65.70	3381.36	526.20
3	666	91	21.56	1.83	20.65	1.00	1218.78	91.00	1309.78	1876.15
4	636	30	24.87	3.31	23.22	1.65	2105.16	46.50	2151.66	696.60
5	606	30	28.25	3.38	26.56	1.69	2048.28	50.70	2098.98	7096.80
6	515	91	30.60	2.35	29.43	1.17	1210.25	106.47	1316.72	2678.13
7	485	30	35.20	4.80	32.90	2.30	2328.00	69.00	2397.00	987.00
8	455	30	35.00	-0.20	35.10	-0.10	-91.00	-3.00	-94.00	1053.00
9	364	91	34.40	-0.60	34.70	-0.30	-218.40	-27.30	-245.70	3157.70
10	181	183	35.13	0.73	34.76	0.37	132.13	67.71	199.84	6361.08
11	60	121	34.62	-0.51	34.88	-0.26	-30.60	-31.46	-62.06	4220.48
12	30	30	34.13	-0.49	34.38	-0.25	-14.7	-7.50	-22.20	1031.40
13	0	30	34.13	0.00	34.13	0.00		0.00	0.00	1023.09
Total	6542	1000							25660.56	25559.30

*Based on data for the total population of 89 animals.

**Mean weight at birth.

Table 4.--Production data for the female agrimi on the island of Theodorou, Crete, Greece, 1975.

Age x (years)	A No. Alive At the Start of Age x*	B No. Dying Between Ages x and x-1	Average Weight at Beginning of Age x (kg)	C Increment of Weight Between Age x and x-1 (kg)	D Average Weights Between Ages x and x-1 (kg)	E Weight Change From Age x to Midpoint of Interval x (kg)	Population Weight Changes: L = Living Population (A) x (C)	Population Weight Changes: M = Mortality (B) x (E)	Total Population Weight Changes (L) + (M) (kg)	Total Population Weight Losses as Mortality (B) x (D) (kg)
0	1000		1.08**	1.08**			1080.00		1080.00	
1	781	219	14.10	13.02	7.63	6.47	10168.62	1416.93	11585.55	1670.97
2	750	31	15.70	1.60	14.90	0.80	1200.00	24.80	1224.80	461.90
3	719	31	16.63	0.93	16.17	0.46	668.67	14.26	682.93	501.27
4	688	31	17.78	1.15	17.21	0.57	791.2	17.67	808.87	533.51
5	625	63	19.80	2.02	18.79	1.01	1262.5	63.63	1326.13	1183.77
6	594	31	19.94	0.14	19.87	0.07	83.16	2.17	85.33	615.97
7	563	31	19.05	-0.89	19.50	-0.45	-501.07	-13.95	-515.02	604.50
8	407	156	23.03	3.98	21.04	1.99	1619.86	310.44	1930.30	3282.24
9	282	125	18.53	-4.50	20.78	-2.25	-1269.00	-281.25	-1550.25	2597.50
10	157	125	19.53	1.00	19.03	0.50	157.00	62.50	219.5	2378.75
11	63	94	20.8	1.27	20.17	0.63	80.01	59.22	139.23	1895.98
	0	63			20.17					1270.71
Totals	6629	1000							17017.37	16997.07

*Based on data for the total population of 89 animals. **Mean weight at birth.

Differences in age-specific weights for 1973 and 1975 were not significantly different for either sex.

Based again on the value of 1.8 kcal/g live weight, the average gross energy per year fixed by each agrimi in the hypothetical population was calculated to be about 5832 kcal.

Pellet-Group Count

A pellet-group count revealed that the 89 agrimi deficate at a rate of 13.02 ± 1.80 pellet groups per day. Future pellet-group counts computed with this value could be used to estimate agrimi numbers.

Vegetation Analysis

Vegetation provides the agrimi with food, cover, and some moisture. Vegetation, or the lack of it, is also a major factor influencing erosion and ground temperatures.

The vegetation of Theodorou Island comprised a mediterranean "disclimax" community, degraded by grazing and possibly fire, as evidenced by numerous charred remains of shrubs. One hundred and forty plant species (Table 5) were tallied. Only 120 of these, however, have yet been identified. The density, above-ground net production and extent of crown cover were determined for each of the 132 herbaceous species. Density, cover, and the net production of twig and leaf annual growth were measured for the 8 shrub species (Table 5).

A large portion of the island was devoid of vegetation. Bare ground, rock surface and dead plant litter made up 12.70, 19.69, and

Table 5.--The density, frequency, cover, and above-ground net production of 140 plant species found on Theodorou Island, Crete, Greece, June, 1975.

Species	ID No.	Density (No./ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
<u>Shrubs</u>:						
Cistus incanus	1	51000(5350)	17.5	1.035	53.029	53.029
Colycotome villosa	2	258550(2000)	18.0	4.168	49.998	2.077
Euphorbia paralias	4	137000(500)	10.0	2.448	68.509	
Phlomis fruticosa	5	18300(5400)	25.5	2.480	81.858	34.442
Poterium spinosum	49	1003450(21700)	62.5	15.135	161.262	161.262
Pistacia lentiscus	54	617850(3100)	31.0	17.247	315.090	315.090
Thymus capitatus	63	1916300(13600)	44.0	11.152	134.132	
Olea oleaster	118	50	0.5	0.050	0.125	0.125
TOTAL SHRUBS:		4002500(51650)		53.715	864.003	566.025
<u>Forbs and Grasses</u>:						
Scilla maritima	3	6150	26.0	0.563	22.384	
Asterolinum linum-stellatum	6	7900	8.0	0.000	0.110	
Cercestium sp.	7	4850	2.0	0.011	0.084	
Picris sp.	8	11750	26.5	0.009	1.014	1.014
Circium sp.	9	950	7.0	0.020	2.653	2.653
Fumana vulgaris	10	6000	10.5	0.054	1.376	1.376

Table 5.--Continued.

Species	ID No.	Density (No./ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
Scorpiurus subvillosus	11	1800	9.0	0.000	0.538	0.538
Allium subhirsutum	12	1750	7.0	0.003	0.088	0.088
Lolium loliacem	13	900	3.5	0.000	0.059	0.059
Brira media	14	1700	4.5	0.018	0.067	
Nigella damascaena	15	2400	10.5	0.002	0.120	0.120
Lotus sp.	16	1200	6.5	0.000	0.059	0.059
Aegilops caudata	17	5750	21.5	0.002	0.459	0.459
Trifolium stellatum	18	4450	17.0	0.008	0.222	
Teucrium microphyllum	19	12200	21.0	0.118	14.866	14.866
Prasium maius	20	1450	4.5	0.000	0.680	0.680
Bromus sp.	21	3300	19.0	0.000	0.132	
Taraxacum sp.	22	7300	19.5	0.026	0.434	0.434
Lotus sp.	23	1150	9.0	0.000	0.172	0.172
Asparagus acutifolius	24	1200	10.0	0.000	4.044	4.044
Urospecurium picroides	25	3600	18.0	0.000	0.537	0.537
Erythraca maritima	26	4250	12.0	0.004	0.042	0.042
Erodius sp.	27	5800	11.0	0.040	0.512	
	28	2750	14.0	0.718	47.986	
Medicago sp.	29	6200	18.0	0.000	0.495	0.495

Table 5.--Continued.

Species	ID No.	Density (No./ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
Trigonella sp.	30	2250	10.5	0.017	0.192	
Atractylis cansellata	31	11550	26.5	0.038	0.921	0.921
Salvia virids	32	3250	17.0	0.004	0.192	0.192
Milium vermarle	33	3500	11.0	0.018	1.182	1.182
Anthemis arvensis L.	34	1800	6.0	0.000	0.120	0.120
Tordylium apulum	35	6100	20.0	0.006	0.488	0.488
	36	6450	22.5	0.006	0.386	0.386
Castridium lentigum	37	18350	40.0	0.006	0.540	
Brachypodius distachyos	38	36200	39.5	0.014	1.775	1.775
Festuca sp.	39	20150	40.0	0.114	2.008	2.008
Knautia integrifolia	40	9650	27.0	0.003	1.234	1.234
Knautia hybridia	41	850	4.5	0.000	0.107	0.107
Trifolium aureum	42	20000	45.0	0.006	0.394	0.394
Scheropoa rigida	43	17450	30.5	0.006	0.344	
Bromus sp.	44	67100	51.0	0.047	1.998	
Dactylis glomerata	45	7600	27.0	0.002	1.648	1.648
Valantia murulix	46	78600	64.0	0.022	3.914	3.914
Trifolium scabrum	47	12600	39.0	0.002	0.501	0.501
Bromus sp.	48	53900	61.5	0.074	4.299	4.299

Table 5.--Continued.

Species	ID No.	Density (No./ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
Hypochoerus aetnensis	50	49950	66.5	0.009	1.985	1.985
Crucianella graeca	51	46000	65.5	0.011	1.831	1.831
Crepis neglecta	52	39950	44.0	0.012	0.791	0.791
	53	9100	31.0	0.008	0.608	0.608
	55	21750	42.0	0.008	3.251	3.251
Linaria pellisseriana	56	49200	51.5	0.012	2.450	2.450
Asteroliman linium-stellatum	57	56700	30.5	0.001	0.559	
Plantago sp.	58	568800	44.0	0.430	22.739	22.739
Plantago amplexicaulur	59	448850	42.5	0.206	22.369	22.369
Malva cretica L.	60	17300	41.5	0.010	1.027	1.027
Torilis nodosa L.	61	25250	30.0	0.009	1.003	1.003
Trifolium suffocatum L.	62	26150	38.5	0.002	1.042	1.042
Stipa tortidas	64	51850	39.0	0.080	2.585	2.585
Siderilis roriana	65	11150	30.0	0.006	0.332	0.332
Anagallis caerulea	66	29400	52.0	0.049	2.340	2.340
Bare rock	67	0	0.0	19.696	0.000	
Bare ground	68	0	0.0	12.701	0.000	
Leaf litter	69	0	0.0	9.536	0.000	
Hymenocarpus circinnaby	70	950	5.5	0.000	0.019	0.019

Table 5.--Continued.

Species	ID No.	Density (No./ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
Sherardia arvensis	71	2750	7.5	0.005	0.026	
Cymbopogon hirtus Janch	72	450	3.5	0.000	0.004	
Onomis sp.	73	1400	3.0	0.000	0.042	0.042
Evax exiques	74	15700	10.5	0.002	0.156	
Lagoecia cuminoides	75	16950	14.5	0.019	1.173	
Galium graecum L.	76	2550	11.5	0.016	0.026	
Filago gallica	77	6150	6.0	0.000	0.246	
Chlora serotina	78	2950	5.0	0.000	0.029	
	79	3550	8.5	0.025	0.632	
Bupleuzum sp.	80	4600	5.0	0.001	0.138	0.138
Cheilauthes fragrans	81	450	3.5	0.000	0.104	
Tamus sp.	82	7000	9.0	0.000	0.349	
	83	20800	7.5	0.006	0.206	
Andropogon hirtius	84	17800	27.0	0.229	3.746	
Hymenocarpus circinatue	85	1950	9.0	0.001	0.058	
Hedypnois pdymorpha	86	7500	16.5	0.004	0.221	
Pinus brutia	87	50	0.5	1.263	0.115	
Capparis rupestris	88	700	1.0	0.000	0.424	0.424
Crupina vulgaris Cass.	89	1450	1.5	0.000	0.242	0.242

Table 5.--Continued.

Species	ID No.	Density (No. ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
Plantago arenavia	90	550	0.5	0.008	0.016	
Malcolmia frerucosa S.S.	91	50	0.5	0.000	0.005	
Avra capillaris Host.	92	2800	2.0	0.001	0.005	
Bromus sp.	93	400	0.5	0.000	0.060	
Trifolium sp.	94	100	0.5	0.000	0.003	
Ceterach officinarum	95	100	0.5	0.000	0.100	
Phagnulon graecum	96	50	0.5	0.000	0.050	
Physanthylis tetraphylls	97	300	2.5	0.000	0.300	
Knautia sp.	98	50	0.5	0.000	0.040	0.040
Vicia tennifolia	99	100	1.0	0.000	0.100	
Antirhinum orontium L.	100	100	0.5	0.000	0.200	
Quaciutha verrucosa	101	350	2.5	0.000	0.005	
Urospecnium picroides	102	150	1.5	0.000	0.150	0.150
Psoralea bituminosa	103	50	0.5	0.000	0.005	0.005
Psoralea sp.	104	50	0.5	0.000	0.010	
Anthemis sp.	105	50	0.5	0.000	0.100	
Sonchus sp.	106	50	0.5	0.000	0.010	
Orobauche sp.	107	50	0.5	0.000	0.010	
Kickria commutata	108	50	0.5	0.000	0.010	

Table 5.--Continued.

Species	ID No.	Density (No./ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
Erodium sp.	109	100	0.5	0.000	0.020	
Palenis spinosa	110	150	1.0	0.000	0.150	
Knautia sp.	111	100	1.0	0.000	0.100	0.100
Reichardia picroids	112	50	0.5	0.000	0.010	0.010
Spergularia sp.	113	550	0.5	0.000	0.007	0.007
Plantago sp.	114	550	2.0	0.000	0.035	
Festuca sp.	115	100	0.5	0.000	0.029	
Crepis sp.	116	250	0.5	0.000	0.057	
Tragopogon sp.	117	250	1.0	0.000	0.038	0.038
Cyclamen sp.	119	250	0.5	0.000	0.025	0.025
Adonis sp.	120	50	0.5	0.000	0.005	
Brachypodium sp.	121	100	0.5	0.050	0.018	
	122	50	0.5	0.000	0.010	0.010
	123	200	1.5	0.000	0.001	
	124	50	0.5	0.000	0.001	
	125	200	1.5	0.000	0.001	0.001
	126	50	0.5	0.000	0.010	
Silene sedoides	127	50	0.5	0.000	0.001	0.001
	128	200	1.0	0.000	0.020	

Table 5.--Continued.

Species	ID No.	Density (No./ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
	129	50	0.5	0.000	0.002	0.002
	130	450	0.5	0.000	0.700	
	131	100	0.5	0.000	0.200	0.200
	132	50	0.5	0.000	0.010	
	133	150	1.5	0.000	0.003	
	134	100	1.0	0.002	0.100	0.100
	135	50	0.5	0.000	0.001	
	136	200	1.0	0.000	0.002	
	137	200	1.0	0.000	0.020	
	138	50	0.5	0.000	0.001	
	139	2100	1.0	0.000	0.005	
	140	50	0.5	0.000	0.001	
	141	50	0.5	0.000	0.001	
	142	100	0.5	0.000	0.001	

Table 5.--Continued.

Species	ID No.	Density (No./ha)[a]	Frequency (% plots)	Cover (% total)	Net Production (kg/ha/yr)[b]	Forage Production (kg/ha/yr)[c]
Biscutella didyma	143	50	0.5	0.000	0.010	
TOTALS				100.000	1061.011	618.737

[a]Forbs and grasses = Number of plants
Shrubs = Number of stems (number of plants)

[b]Peak-standing biomass of forbs and grasses plus annual twig and leaf growth of shrubs.

[c]That portion of net production consumable by the Theodorou Island herbivores.

9.54 percent, respectively, of the island surface. Thus, about 42 percent of the agrimi habitat offered no useful vegetative forage or cover.

The total above-ground parts of herbs plus the twig and stem annual growth of shrubs weighed 1061.01 kg/ha when air dried.

With 2.17 plants per m^2, Poterium spinosum, a small spiny shrub, had the greatest density. Where it occurred, the small aromatic shrub, Thymus capitatus, attained the second highest density at about 1.36 plants per m^2.

Pistacia lentiscus, a large evergreen shrub, and Poterium spinosum contributed the most cover at 17.24 and 15.14 percent of all ground cover, respectively.

Pistacia lentiscus, Poterium spinosum, and Thymus capitatus comprised 57.5 percent of the measured biomass, with individual values totaling 315.09, 161.26, and 134.13 kg/ha, respectively.

The portion of the measured production which consisted of species showing evidence of being eaten and which was available as edible forage for the island's herbivores totaled 618.73 kg/ha/year. This total includes forage from 59 species and is 44 percent higher than the value of 429.50 kg/ha/year reported by Papageorgiou (1974). The 1973 measurement, however, was based only on ten plant species.

Papageorgiou (1974) considered forage production to equal the sum of the mean number of twigs or plants per plot times the mean dry weight per twig or plant. If this criterion is used, the forage production for the six major agrimi forage species (Pistacia lentiscus, Phlomis fruticosa, Colycotome villosa, Scilla maritima, Cistus incanus, and Olea oleaster) rose from about 363 kg/ha/year in 1973 (Papageorgiou, 1974) to about 522 kg/ha/year in 1975. This substantial improvement in forage production was probably the result of the reduced grazing pressure by agrimi.

A study was made to determine if the island's vegetation was a homogeneous mixture of species. Analysis revealed, however, that the island's plant species grew in some interesting patterns and groupings.

Among the island's dominant shrub species (Table 5), Poterium spinosum and Thymus capitatus occurred together in a significant positive correlation, yet both showed significant negative correlations with the third major shrub, Pistacia lentiscus. The woody species, Cistus incanus, was negatively correlated with all three shrub species.

The spiny shrub, Colycotome villosa, and Phlomis fruticosa were found not to be significantly correlated with any of the other shrub species, and only significantly correlated with five herbaceous species. All shrub species, except Colycotome villosa, showed significant relationships with the presence of and amount of surface of bare ground or rock. Phlomis fruticosa, however, was positively correlated with plant litter, a finding which agrees with the field observation that this species generally grows in less-eroded areas where some plant litter is present.

The indexes of association for cover for Thymus capitatus and Poterium spinosum with nearby bare ground were very high at 0.590 and 0.717, respectively. The chi-square values comparing these two species with bare ground and rock surface were also significant.

These two species largely occurred in areas of high erosion and denudation, on the less-sloping central areas of the island.

The presence of Euphorbia paralias was found to be significantly related to the presence of Pistacia lentiscus, and negatively related to the presence of Poterium spinosum. P. lentiscus did but E. paralias did not show a significant relationship with T. capitatus.

Euphorbia paralias occurred almost exclusively on and was a major constituent of the vegetation on steeply-sloping areas on the periphery of the island. It showed a significantly negative relationship with the presence of nearby rock surface and bare ground.

Pistacia lentiscus was found to be significantly related to bare ground surface and surface covered by plant litter. It also showed a significant negative relationship with the presence of nearby rock surface.

There was high degree of association between many species pairs. To illustrate, 23 of the 35 highly-associated species were diagrammed (Figure 8). In this diagram, Valantia murulix (46) appears to be highly associated with all but two of the species considered. This major grouping primarily occurred on the less-sloping portions of the island.

The highly-abundant shrub, Poterium spinosum, was found to be a member of the group in Figure 8 and was significantly related with 16 other members. It may, therefore, be discerned that both shrubs and herbs may be included in one "ecological group" (Whittaker, 1967), growing together in the same habitat and showing closely similar distribution patterns.

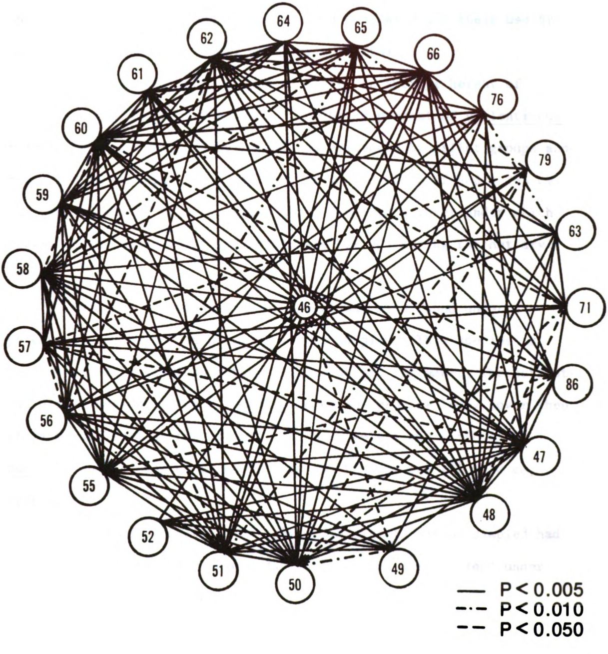

Figure 8.--Species diagram partially showing the association of 35 of the most important plant species found on Theodorou Island, Crete, Greece, 1975. Correlations were determined with a chi-square matrix analysis. Numbers represent species ID numbers from Table 5.

Wildlife Use of Shrub Cover

About 150 plants of each of the six major shrub species on Theodorou Island were randomly chosen and evaluated for their use by wildlife as cover after Gysel and Lemmien (1955).

Pistacia lentiscus shrubs exhibited an average height of 96 ± 40 cm and width of 588 ± 321 cm. The 32 percent of P. lentiscus shrubs that were utilized by agrimi, as evidenced by pellet groups and hair, had an average height of 140 ± 25 cm and width of 888 ± 265 cm. The dense crown of this evergreen shrub provided a cover under which agrimi could remain relatively cool (see beyond) during the hot dry season.

Evidence of utilization by agrimi was also found under 44 percent of the Euphorbia paralias shrubs sampled. This species is deciduous and is leafless between late June and September, the hottest and driest season. Thus E. paralias does not provide leafy cover when it is needed most by the agrimi. The mean height and width of E. paralias used by agrimi as cover were 145 ± 22 cm and 170 ± 38 cm, respectively.

About 63 percent of the Colycotome villosa shrubs sampled had hare fecal pellets under them. Rat pellets were also evident under about 10 percent of these shrubs.

Poterium spinosum provided a dense leaf cover for small mammals, however, due to its characteristic inverted-cone shape it offered only marginal protective cover from ambient conditions and possibly predatory birds.

Thymus capitatus was heavily utilized by hares and rats with pellet groups of each animal under almost every shrub sampled. The structure of these shrubs was such that a 5- to 10-cm space existed between the ground and the dense crown, which provided a natural cavity for hares and rodents.

Olea oleaster formed a dense thicket of branches which was impenetrable by small mammals.

Samaria Gorge Vegetation

A field trip was made to the agrimi's original range in the Samaria Gorge National Park in order to examine the vegetation of the region and possibly to observe agrimi. The narrow gorge itself is 17 km long and is located in the White Mountain range of Crete, about 60 km from Theodorou Island.

The tree layer in the mountains around the gorge consisted of sparsely scattered junipers (Juniperus phoenicia), pines (Pinus brutia), and oaks (Quercus ilex). The principal shrubs were Quercus ilex, Satureia thybra, Phlomis lanata, Salvia sp., Verbasium spinosum, Olea oleaster, Colycotome villosa and Pistacia lentiscus. The most common herbs were Carlina sp., Brira media, Trifolium aureum, Dactylis glomerata, Scilla maritima, Asparagus acutifolius, Andropogon hirtius, Cirsium sp., Cupressis sempervirons, Urospecurium picroides and Cistus cretica.

The vegetation within the park boundaries did not appear to be heavily grazed in recent years, but areas immediately outside the park were heavily cropped by domestic sheep and goats.

All but one of the herbaceous plants and four of the shrubby plants found also occur on Theodorou Island. All of these species showed a lack of positive association with other plant species on Theodorou Island, and are not included in the dominant group of 35 species depicted in Figure 8. On Theodorou Island, most of these species are heavily grazed and appear to be decreasing in abundance. It seems likely that these species are remnants of a different flora which once occupied the island.

Due to pressures exerted by local residents, the park officials of Samaria Gorge National Park have allowed several herds of domestic goats to graze in the park. According to park officials these herds totaled about 500 to 1000 animals. Although park rules forbid the grazing of domestic animals, the practice was passively accepted in 1975. This activity, if continued, will certainly detract from the available forage supply, and, at worst, may allow disastrous interbreeding between domestic goats and wild agrimi.

Behavioral Analysis

Activity Patterns

Agrimi displayed distinctive seasonal and daily activity patterns. During the cool season, from October to May, agrimi on Theodorou Island were active both day and night, as evidenced by observations and trap data. In the hot dry summer months of June to September, however, they almost eliminated daytime movements (Figure 9).

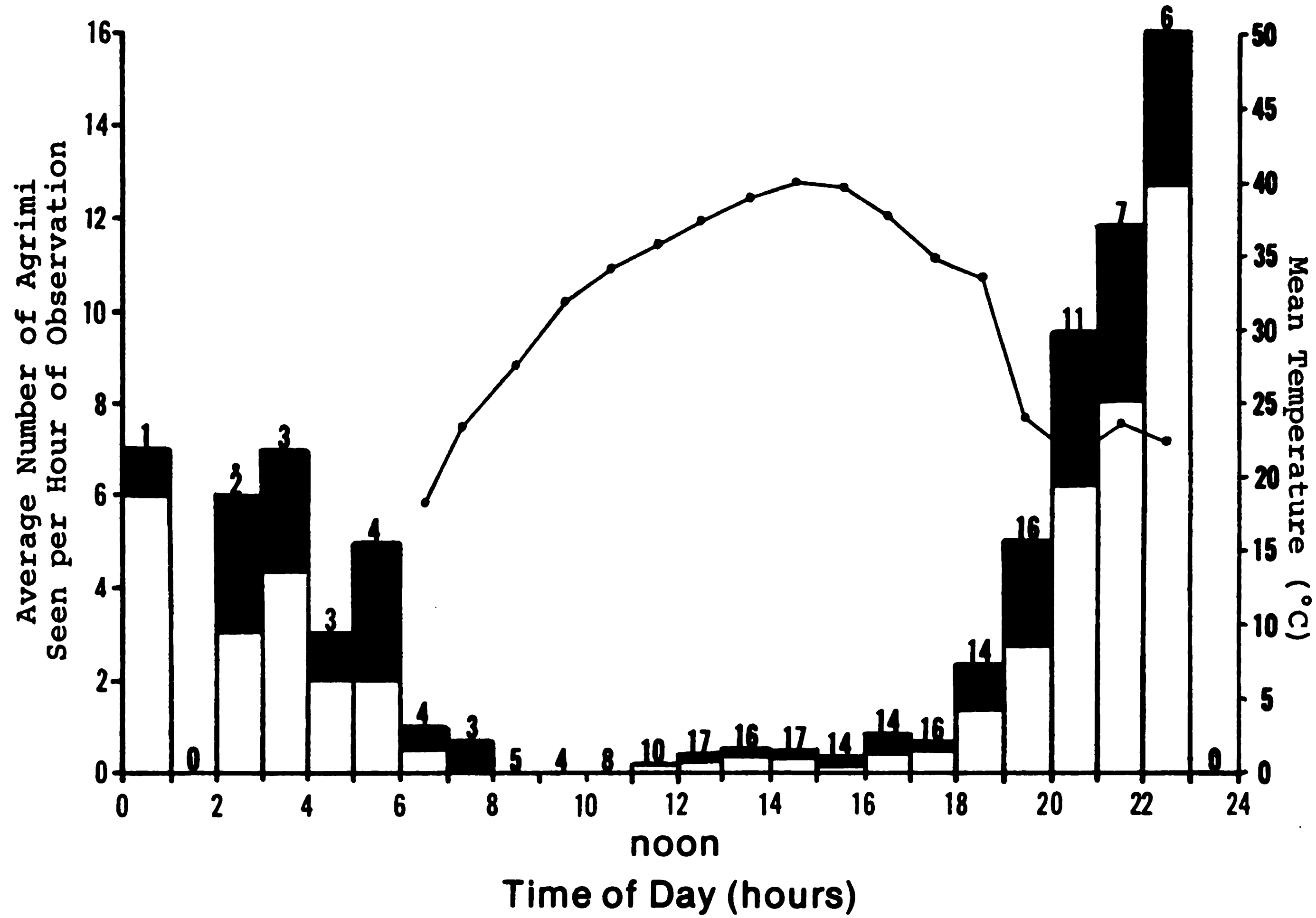

Figure 9.--Number of agrimi seen per hour of observation at trapsite in feeding areas, and near blinds. Nighttime values are from observation at the trap, June to September, Theodorou Island, Crete, Greece, 1975. Solid and open bars represent female and male portions of activity, respectively. Black dots represent mean air temperatures (°C). Numbers above columns indicate hours of observation at that time.

Following a peak just after sunset, there was a steady decrease in activity during the summer nights and a pronounced drop in movements at sunrise.

Agrimi in summer largely spent the daylight hours in the shade of a rock or, more commonly, under the cover of a *Pistacia lentiscus* shrub (Figure 9). On at least ten occasions, agrimi under the shrub were seen to feed on forbs and grasses or on new shoots of the shrub itself.

On five occasions, an agrimi was seen to spend the entire daytime under a single *P. lentiscus* shrub, exiting only at sunset when ambient temperatures had decreased substantially.

Thermoregulatory Behavior

Agrimi evidently used the dense shade of *Pistacia lentiscus* shrubs in an effort to keep cool. Daytime temperatures measured under three shrubs used by them were significantly lower and exhibited significantly less variation than did nearby ambient temperatures (Figure 10).

An agrimi exposed to the high ambient temperatures at worst might incur a lethal heat load and at best would metabolize energy at a higher rate in order to maintain constant body temperature.

Seawater Consumption

Accelerated loss of body-moisture also seems likely to be an important factor influencing the activity pattern of the agrimi. Free water is almost nonexistent on the island except for small quantities made available from a 4- x 6-m cistern which collects

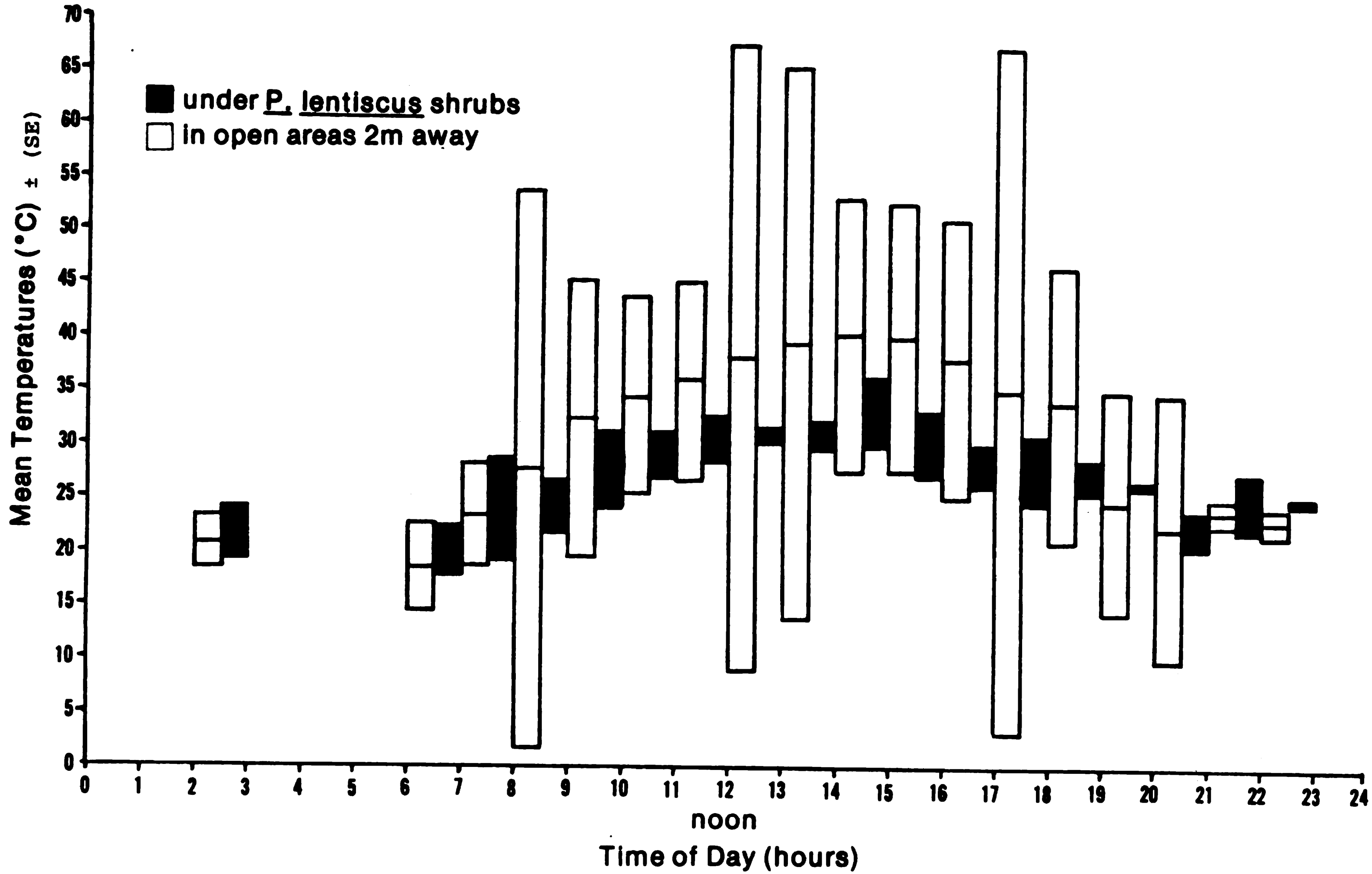

Figure 10.--Mean temperatures ± (SE) C at three shaded-bulb stations located 50 cm above ground under *Pistacia lentiscus* shrubs and in nearby open areas, Theodorou Island, Crete, Greece, June to September, 1975.

rainwater from the shrine roof in the winter. Water from the cistern is piped to troughs in the trap area on an irregular basis. During the 1975 study period, the water from the cistern was totally expended by mid-August. After this, agrimi apparently relied upon free-water in plants, metabolic water, and seawater.

Historically, mariners often introduced goats to remote inhospitable islands as a potential source of fresh meat for shipwrecked sailors. Though scientists and other travelers have been amazed that these animals have survived on small arid islands with no permanent sources of freshwater for drinking (Eibl-Eibesfeldt, 1961; Napier, 1929; Roughley, 1966; Williams and Rudge, 1969), the only evident explanation is that the goat, which is presumably the domesticated form of the agrimi, can utilize seawater. They have been seen drinking from the sea. This is true particularly on the Galápagos Islands (Eibl-Eibesfeldt, 1961; Nelson, 1968; Slevin, 1931), but also on Esk Island of the Palm group off the east coast of Australia (Dunson, 1974). Dunson believed that such behavior also could be associated with algal feeding, or with the imbibition of only token amounts of seawater by sodium-deficient animals. But goats may indeed have the capacity for renal salt excretion that is efficient enough to enable them to regularly drink seawater.

Papageorgiou (personal communication) on at least two occasions saw agrimi on Theodorou drinking seawater. During the present study, this behavior was observed on 5 June, 15 July, and 23 August. On each occasion, an animal was seen to drink from a small pool of seawater near the ocean. An inspection revealed that algae were not present in these pools. It also seems unlikely that the food plants of these goats were sodium-deficient in view of their proximity to the sea.

An experiment was conducted to establish whether or not caged agrimi would voluntarily consume seawater and if they could maintain weight balance drinking only seawater. All specimens lost weight during their first four days of captivity, though fresh water was available and was used. Their weights tended to hold steady, however, from the fifth through the seventh days (Figure 11).

On the eighth day, when seawater was offered ad libitum instead of fresh water, all four agrimi readily accepted it, drinking quantities comparable to the amounts of fresh water normally taken. Over seven days, the mean fresh water consumption for the two females had been 1469 ± 233 and 1104 ± 180 cc/day, respectively, while over the ensuing 5 to 9 days, seawater consumption was slightly higher at 1504 ± 17 and 1424 ± 295 cc/day, respectively. Fresh water consumption by the two males averaged 1416 ± 311 and 1669 ± 356 cc/day, while seawater consumption again was higher at 1707 ± 84 and 1835 ± 86 cc/day, respectively. This increase was probably due to the insatiability of the agrimi while on the seawater regimen.

After 5 to 9 days (Figure 11), the agrimi refused both air dry forage (of only 2-3% moisture) and seawater. To avoid any possibility of permanent damage, each animal then was returned to a diet of fresh water and dry hay for several days. They were then released and observed to be well.

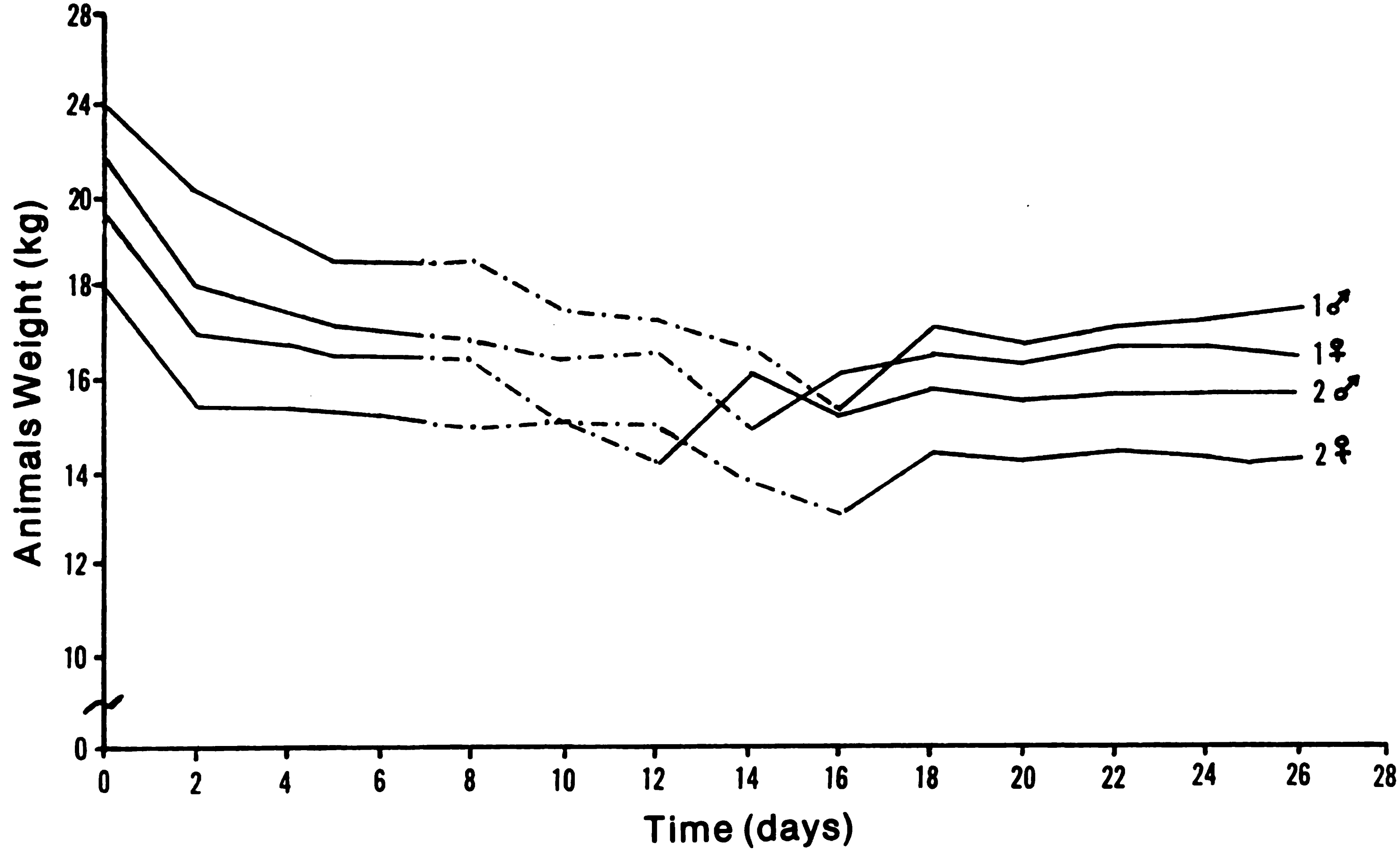

Figure 11.--Weight changes in four captive agrimi during a seawater consumption trial on Theodorou Island, Crete, Greece, in 1975. Solid lines denote the periods of fresh water availability, while dotted lines indicate an ad libitum seawater regimen.

All specimens lost considerable body weight while drinking seawater (Figure 11), but regained some of their original bulk after fresh water became available. No diarrhea was observed.

Dunson (1974) determined that although ferral goats would voluntarily drink seawater, body weights could not be maintained where their foods contained only 9-13 percent moisture. Goats living on Esk Island (Palm group, east coast of Australia) in the dry season were found to maintain themselves well on food plants of 52-67 percent water content if seawater also was available.

Major food plants on Theodorou Island ranged from about 41 to 73 percent moisture (Table 6). Thus it seems likely that agrimi on the island probably gain enough free water from food plants with occasional seawater consumption, to maintain a positive water balance in the dry season. The cistern on the island provides a supplemental source of fresh water, however, its presence may not be necessary to the agrimi's survival.

Flight Behavior

Agrimi on the open range stared at a source of alarm while in a frozen standing position with mane held somewhat erect. The ears usually were rotated in an effort to appraise any disturbing sounds. While in this posture, agrimi sometimes gave a deep snort.

Disturbances precipitated varying responses which seemed to be related to the nearness of the disturbance. If a human was spotted approaching at 300 m or more, an agrimi would walk away, occasionally stopping to gaze back. If disturbed within a 100-m range, agrimi tended to run.

Table 6.--Percentage of moisture of some major forage species of agrimi, Theodorou Island, Crete, Greece, July 1975.

Species	Approximate % Moisture of Grazed Plants
Pistacia lentiscus	55.63
Colycotome villosa	52.15
Phlomis fruticosa	41.09
Poterium spinosum	48.62
Cistus incanus	72.62

In most cases, agrimi ran up steep hillsides in a zig-zag manner. Agrimi used both speed and climbing ability to elude a pursuer.

The alarm and flight behavior of agrimi startled from under the cover of *Pistacia lentiscus* shrubs was quite different from that exhibited on the open range. Agrimi under cover had shorter flight distances. These varied according to circumstances but averaged 14 ± 11 m for males and 48 ± 30 m for females. Sheltered agrimi tended to sit tight until the flight distance was met. They then would bolt from their cryptic shrub cover and usually run on a straight course directly away from the intruder.

The actions of a female with kid when frightened on the open range was similar to that of all females. The kid followed close behind her. When flight was effected from under a shrub, however, a mother agrimi would usually bolt and run at an angle away from the source of the disturbance. The kid usually remained quietly behind and only took flight when approached at a distance of about 3 m. The adult's action is probably an adaptation to draw danger away from the more-vulnerable young animal. A similar response was noted in the pronghorn (*Antilocapra americana*) by Autenrieth and Fichter (1975).

Social Behavior

Most social behaviors were observed during trapping sessions and at feeding stations. Although the agrimi may have been assembled unnaturally under these circumstances, their groupings would occur apart from baited areas during the mating season or at isolated water sources.

Most of the year, agrimi stayed as solitary individuals. Animals of similar age and sex were observed feeding and moving together mainly during trapping and feeding operations. Two to five agrimi were seen to travel together across most of the island's length (0.8 km) to the trap area, keeping about 5 m from each other.

Several groups which frequented the trap area had relatively constant membership, but neither their place of origin nor their social organization upon departure could be determined. One daytime observation was of five males which had arrived at the trap together but departed individually in different directions and at different times. Other groups observed similarly may just come together by coincidence.

Male-Male Interactions

Interactions observed in the field and at feeding stations between males indicated a linear hierarchy which was dependent on the ages of the animals involved (Table 7). Older, and consequently larger, males always appeared to be dominant.

Observations at the feeding stations and at trapsite indicated that the oldest males always dominated areas where food and water were concentrated. Within the trap corral when older males were present, many younger males and females entered to feed only after long hesitation. Even after they entered, subdominant animals fed along the perimeter fences and drank only when all of the more-dominant males were at least 5 m from water.

A typical sequence of events occurred whenever a subdominant male encountered an older and more-dominant male at the feeding station. The latter animal usually initiated the interaction by vocalizing a "growl." If this did not induce the subdominant to move away, a head gesture and sometimes a short successful charge by the dominant animal usually followed.

The dominant males' body position during such an interaction was usually standing erect on all four legs, either with the tail held horizontally back or in a lowered drooping position. His ears usually were erect. The dominant male occasionally initiated the interaction from a head-down feeding position.

A subdominant male in the vicinity (5-10 m) of an older male exhibited a submissive posture to a degree which seemed to be dependent upon the net differences in their ages. Submissiveness usually was indicated by the ears held back and the tail between the legs. Subdominant males crouched their bodies only on the rare occasions when they approached (less than 2 m) an older male.

Table 7.--Relative frequency of aggression (head gesturing, lunging, chasing, and butting only) among different age classes of both sexes. The number of interactions won are arranged horizontally, the number lost, vertically.

Age (years)	11-13				9-11				7-9				5-7				3-5				1-3				0-1				Total No. of Agressions	Total No. of Agrimi
	FF	FM	MM	MF	FF	FM	MM	MF	FF	FM	MM	MF	FF	FM	MM	MF	FF	FM	MM	MF	FF	FM	MM	MF	FF	FM	MM	MF		
11-13	0	0	1	0	3	0	2	0	0	0	0	1	0	0	0	2	0	0	3	4	0	1	0	0	0	0	1	0	18	11
9-11					0	0	0	0	0	0	1	0	2	0	0	7	2	0	1	8	0	0	2	0	0	1	4	1	29	10
7-9									0	0	1	0	1	0	3	1	1	0	0	3	0	0	0	0	0	0	0	0	10	6
5-7								1				1	4	0	0	2	2	0	2	2	0	0	0	0	0	0	2	0	16	12
3-5												2	2				4	0	0	1	0	0	1	0	2	1	0	0	13	9
1-3								2													0	0	0	0	0	0	0	0	2	2
0-1																1									0	1	0	1	3	3
Totals			1		3		2	1			2	4	9		3	13	9		6	18		1	3		2	3	7	2	91	53

FF - female aggressive toward another female.

FM - female aggressive toward a male.

MM - male aggressive toward another male.

MF - male aggressive toward a female.

Males of the same age appeared to be mutually tolerant of each other most of the year. A distance of about 2 m usually was maintained between codominant males. When one codominant male approached another too closely, the latter usually made a low growl to warn the encroaching animal away.

In the trap area and at the bait station, the older males dispersed rather evenly over the prime feeding area and effectively maintained a "dominance barrier" against less-dominant animals. Younger subdominants either fed along border areas or waited until the more-dominant animals had left.

Female-Male Interactions

Females were usually observed moving alone or with their kid on the open range. Females were only rarely observed with a group of males or with another female. Females which approached the trap area where males were feeding usually did so cautiously with bodies in a somewhat lowered posture and tails tucked firmly between their legs. Females only entered the trap area when all males were at least 7 m from the entrance. The females then darted through the entrance and fed in remote corners of the corral.

Regardless of the age or relative size of the female, all were observed to be totally subdominant in encounters with any males at least one year of age.

Males exhibited aggressiveness toward females with head and horn gestures. Such a gesture consisted of a stationary animal dipping its head and horns in the direction of another animal. In most cases, a gesture was enough to send the female out of the immediate area. If the initial gestures failed, a step or short charge in the direction of the female usually induced the latter to depart.

Actual aggressive contact between a male and a female was observed on only one occasion, when a female failed to heed the signals of a large male. The male charged, knocked the female down with his horns, and literally ran over her. After the interaction, the male went back to feeding. The female slowly arose and left the feeding area.

The only display of aggression by a female toward a male was observed when an 8-year-old female did not yield to the aggressive gestures of a smaller 2-year-old male. The two animals rose on their back legs to a standing position and then fell toward each other, clashing their horns. The female subsequently turned and fled. The male pursued her for about 7 m and then returned to feeding.

On an occasion in September, a male kid exhibited aggressive behavior toward a 7-year-old female by butting her with his head. The female responded by butting the kid. The kid then fled from the pursuing female to its nearby mother. Thereupon, the single female broke off pursuit and began feeding again.

Trap data (Figure 9) indicate that the female:male ratio increases through the early morning hours. Many female agrimi probably avoid encounters with more-dominant males by feeding in the morning after the males have eaten and departed.

Female-Female Interactions

Females on the open range were mostly observed traveling alone or with their kid.

At the feeding area and trapsite, females exhibited a social dominance hierarchy based on age similar to that shown among the males (Table 7). The status was maintained by aggressive actions in the form of head gestures, chases, or butting.

An aggressive action only observed among females was a "stomping" gesture. A female would raise both her front feet about 10 cm above the ground and stomp them both down simultaneously. This behavior was usually accompanied by a loud snort. Stomping behavior also was exhibited by female agrimi in metabolism cages, as an aggressive action toward their caretaker.

There was only one observation of actual butting between females. Both individuals were without kid and were approximately of the same age and weight. The bout consisted of two butts with the horns, after which one of the females rapidly left the feeding area.

Female-Kid Interactions

"The urge to follow" has been recognized in young birds (Hess, 1962; Hinde, 1961; 1970; Thorpe, 1961; Tinbergen et al., 1965; Van der Kloot, 1968). It has also been described by Portman (1961: 149) as occurring in ungulates immediately after birth. Young wildebeests have been noted to walk and run closely beside their mothers as early as 4-5 minutes after birth (Talbot and Talbot, 1963:46).

The distinction between approach and following in ungulates seems to be unclear and may depend on the activity of the mother

(Autenrieth and Fichter, 1975:30). In early summer (May-July), shortly after the birth season, an approach behavior was commonly observed. For example, when a female stopped moving, the kid would approach sometimes to attempt nursing. More often, it would just stop and look around until the mother moved on. By late fall (October-November), kid and mother would graze together, 5-10 m apart, with the mother setting the general direction of movement. This then appeared to be following behavior rather than the approach pattern observed earlier. It was not until 3 October, that two kids were seen running about 10 m ahead of their mothers as they approached the feeding station.

Nursing was not observed on the open range but several (15) bouts took place at the trapsite. In every case, the kid approached its mother from one side or from between the front legs, and butted at the udder with its muzzle until a nipple was found. No tail wagging or kicking by the kid was observed during nursing.

Nursing was usually brief, lasting only about 3-5 minutes. Kids of various ages at the trapsite usually consumed hay both prior to and after nursing. A kid with a dried umbilical cord still attached was observed to consume bait at trapsite in early July. No nursing was observed after 25 September.

The agrimi mothers role during nursing was largely passive: she stood in a normal upright position and might have even continued feeding if food was in reach. There was no hunching of the back as in the pronghorn (Autenrieth and Fichter, 1975:58), nor was there any

sign of active participation as shown by the kudu cow which, according to Walther (1964:455), directs the calf to the udder by licking.

Females were seen to stop a nursing bout by making a rapid lurch forward and then walking away from the kid, or by checking the kid with her head.

No kids were observed feeding from females other than their mothers. When a kid approached another female, it was usually repelled by aggressive head gestures and brief charges. During the 15 bouts seen, no female allowed a kid other than her own to nurse. This was unlike the pronghorn which may allow several alien young to approach and feed (Autenrieth and Fichter, 1975).

Mating Season

The breeding season of ungulates, like that of most species, is usually timed so that the extra energy needed for reproduction is available and so that the young are born in a suitable time of the year.

On Theodorou Island, the first substantial rains fell in the early October after a five-month dry period. Daytime temperatures dropped significantly at this time. Within two days of these first rains the island's vegetation became greener as a few species started vegetative growth. Fresh water became readily available to agrimi in numerous rock basins.

In 1975, the agrimi mating season began in mid-October, 5 to 10 days after the first rains. Its beginning was signalled by anatomical, as well as physiological and behavioral changes. In males, an 8-10 cm high gray mane along the neck and back became prominent.

The breeding period of native ungulates varies with the climate and nutrition of the region (Fraser, 1968). Many times the time of mating is related to the rainy season (Talbot et al., 1965).

Proper timing of kidding is essential for survival of the agrimi in its original range throughout the White Mountains of Crete. Mating there in late fall assures that kids will be dropped in early spring, after the harsh snowy winter and when chances of survival are greatest. It may be a factor, too, that the sexual drive of agrimi, like that of domestic buffalo (Hafez, 1953) and cattle (Hafez and Lindsay, 1965), also may be suppressed by the heat of summer.

The main mating season of domestic goats on Crete is in August. The difference in peak mating season between domestic goats and agrimi may reduce the potential for cross-breeding. This danger remains, however, as exemplified by the obviously hybridized goat population on the island of Dias near Iraklion, Crete, where agrimi were introduced without the complete elimination of domestic stock.

Courtship Behavior

At other times, males usually carried their tails in a hanging position. During the rut, however, the tails of adult males were held upright or stiffly horizontal. Fraser (1968) thinks that these positions may help to dissipate odors from the tail glands.

The vertical tail position was common for adult males when in the presence of a female in heat. Young males near adult females, however, displayed erect tails only on a few occasions, probably due to their being subordinated by nearby older males.

On five occasions, male agrimi were observed to lower their hind quarters and to unsheath an erect penis. Three times this was in the presence of females. On two of these occasions, the male appeared to muzzle or lick the penis. In two other instances, the agrimi male urinated on the ground. No directional spraying of urine on any part of the body was observed, as reported for the wild goat of Pakistan by Schaller and Laurie (1974).

During the first week of October, the male dominance over females was pronounced, but during the second week of the month there was a transition to courtship behavior.

Then, the males followed females at a distance of 3-5 m. When a female stopped, usually the attendant male also halted and maintained a head-up standing position with body erect and tail vertical. Alternatively, the male approached the female with his ears back, and the mane usually bristled. The latter approach was observed only toward females and never toward males, as reported by Schaller and Laurie (1974) for the Pakistan wild goat.

It has been suggested (Schaller and Laurie, 1974) that such displays "are a means of showing off, or trying to impress another animal, whether it be male or female." It is possible that such behavior helps to establish dominance between two males. However, it would seem unlikely that there is adaptive significance in agrimi males "showing off" or trying to "impress" other males when a social hierarchy, which is established by aggression, determines which animals mate.

After a male approached the female in an upright position or in the low-stretch, he usually sniffed and muzzled the females perineal region, often wagging his tail. During this behavior, the female usually moved away or stood motionless for a few seconds before walking a short distance. Females also wagged their tails.

Usually the male followed the female and repeated his behavior. On four occasions the male did not follow, whence the female circled and passed near (0.5 m) the male, wagging her tail. In each such instance, this behavior rekindled the male's interest in her. These females always passed near the same male even when several other males were present.

During a typical low-stretch approach by a male, the female would remain still. The male would raise his muzzle and curl his lips up in flehmen behavior. This posture was maintained for a few seconds or repeated several times. A male was often observed to direct this behavior toward a group of several females when they were congregated at the feeding station.

Vaginal sniffing by the male was not seen to elicit urination in agrimi females as has been observed in the Pakistan wild goat (Schaller and Laurie, 1974) and domestic goat (Shank, 1972).

Though recorded (Schaller and Laurie, 1974) for another wild goat population, kicking, twisting, and shoving were not observed in Theodorou Island agrimi. Schaller and Laurie (1974) observed females poking male wild goats with their horns during courtship. No agrimi females exhibited such actions toward males during the mating season.

In late October and early November, rut behavior became intense. Single males were observed to follow single females over the island for an entire day. Still later, sniffing and quiet following was then replaced by running "rape chases." Males were observed to stand alone or in small groups on the high ridges and hilltops of the island. When a female was seen, a chase would begin.

On 8 November at 1504 hours, for example, a female was seen to leave the cover of a Pistacia lentiscus shrub. Immediately a male ran from a nearby ridge and began to chase her. The female tried to elude him by running in a circuitous manner at what appeared to be her maximum speed, and then darted into P. lentiscus shrubs. The male followed only centimeters behind the female. Often his head touched her rump.

On several occasions, the female actually entered the shrubs, whence the male usually stopped and stood alertly outside for a few moments. Sometimes, he pursued the female into the shrub.

The male appeared to mount the female briefly while both were in the shrub. The female then bolted and was further pursued by the male. This pattern was repeated and the chase was observed to continue over 1.5 km until both animals were out of sight.

Only one male agrimi was observed to chase a female at any given time, but displays and chases were made by more than one male with respect to individual females.

Similar behavior noted by Hediger (1955) for the chamois (Rupicapra rupicapra) involved "brutal" chasing of females. Ibex males, on the other hand (Fraser, 1968), showed a mute and motionless

courting behavior in which, having climbed to the top of a look-out point, the male made typical rutting noises in the direction of the females.

The only agrimi males seen to participate in courting and mating were in the 8-13 year age group. No following, chasing or mounts were attempted by younger males. With this age-specific pattern of mating, males must be at least six years old in order possibly to contribute their genes to the population.

A single observation was made of a male attempting to mount a male kid. This 12-year-old male followed the kid and attempted to mount him, but the kid immediately ended the interaction by running to his mother about 15 m away.

On 7 November a large kid was observed attempting to mount his mother. This behavior was preceded and followed by the kid rubbing his body against the female's side. Only 49 minutes later this same kid attempted to nurse its mother, but she avoided him by rapidly walking away. Mounting of this kind is known to occur also in very young lambs, pigs, calves and kids (Fraser, 1968).

Collias (1956) found that both sexes of domestic goats exhibited full patterns of sexual behavior before they were fully grown.

Mating Season Dominance Behavior

During the rut, changes in dominance behavior patterns were noted at the feeding station. Older males, ordinarily tolerant of each other, contested for dominance during the mating season. Social status was established by aggressive displays and by actual combat.

Aggressive displays between older males consisted of head and horn gestures. Occasionally a brief charge would be successful, however, this usually precipitated actual combat.

Butting might occur between two males standing side by side with their heads close. They would twist their torsos and lower their horns to butt each other.

Fighting also was initiated between two males of similar size and stature when they came close to each other, particularly if an estrous female was nearby. During combat, both males would stand erect on their hind feet and fall toward each other, clashing their horns loudly.

These violent clashes were repeated in rapid succession, until one of the males left the immediate area. Generally one or two contacts ended the conflict but, on one occasion, two 11-year-old males were observed to make contact five times in succession.

Most (87%) combats occurred prior to mating season or during the first week of the rut. During the main rutting period, aggressive behavior in the presence of a female was at a minimum. This was like the Alpine ibex (Nievergelt, 1967), wherein males established rank by fighting before the rut and underwent a minimum of strife during the rut.

Combat behavior observed in the agrimi was in contrast to that of the Pakistan wild goat, where dominance displays and actual combat occurred only during the rut (Schaller and Laurie, 1974). Why the agrimi and its close Pakistani relative should be dissimilar is not clear.

Female-Kid Interactions During the Rut

The rut appeared to be a time when agrimi mothers and kids ended the parent-child relation and became permanently separated. This was observed on two occasions when a female with a kid was chased by a male. The kids in both instances were unable to keep up with the adult agrimi and became separated from their mothers.

During the rut, kids were observed on hilltops and ridges bleating for their mothers. In one instance a female, which was known to have become separated from her kid the previous day, bleated loudly as she wandered near the feeding station.

During the rut, at least five females were seen to become separated from their kids. All of these kids were later seen grazing alone on the open range.

Sexual Territories

Signposting and marking to indicate sexual territory has been widely recognized in Cervidae (Graf, 1956; Hennig, 1962; Marshall, 1956). These animals often de-bark trees to give evidence of territorial claims and also may secrete various olfactory signs of identity.

Large males were observed on six different occasions during the rut vigorously rubbing pine trees (*Pinus brutia*) and shrubs (*Pistacia lentiscus* and *Euphorbia paralias*) with their horns. Such actions broke limbs and removed bark. Throughout the island, many *E. paralias* shrubs were noted to have been de-barked. Since it did not occur near the ground, this de-barking was not the result of rodent activity and must be attributable to agrimi.

Whether territorial boundaries are ever enforced could not be determined with certainty. On several occasions during the rut, however, as many as five male agrimi were observed in close proximity to each other on ridge tops and displayed no evident aggressive attitudes.

MANAGEMENT RECOMMENDATIONS

Carrying Capacity

Theodorou Island forage production of all plant species which showed signs of agrimi feeding was about 618 kg/ha/year or 250 kcal/m^2/year. If agrimi require about 773,106 kcal/year as determined by Papageorgiou (1974), it is possible that the island could have supported a maximum of 162 average-sized animals in 1975. This value may be somewhat high, since some of the forage if not eaten at the most favorable time becomes unavailable due to drying and hardening of protective spines. It is also possible that some requirement other than energy may be in short supply, such as protein, which may vary in availability throughout the year.

If the general rule for temperate-zone management is applicable (Stoddart et al., 1955), then 50 percent of both the vegetative forage and its reproductive parts may be removed without permanent damage to the range. On this basis, and if agrimi can maintain normal health on their present diets, then a maximum of 80 average-sized animals or about 1500 to 1700 kg of biomass could be maintained on the range indefinitely.

Population levels should be maintained, however, that allow for range improvement to a fully-restored undisturbed condition. At the proper level, the population would have a high level of reproduction, good physical condition, and an increased average longevity.

Management Policy

Management policies directed toward relieving pressure on the island's forage resources in 1973 and 1974 has resulted in the removal mainly of breeding-age females. Since one male may mate with several females, males could be removed in larger numbers than females. Males should not be reduced too drastically, however, because their genetic variability may be important to the population.

Post-reproductive females consume nutrients and make no further contribution to the population's gene pool. Females over age 9 might well be removed.

Large-scale vegetative manipulation should only be carried out after thorough trials on small test areas. Consideration of the "ecological group" concept should be made if the plant habitat is to be manipulated. Plant species of the same ecological group (see page 39) probably have similar ecological requirements and may even be partially dependent on others in the group. In consequence, an attempt to remove an unwanted species such as *Thymus capitatus* or *Poterium spinosum* might create unfavorable conditions for the entire ecological group, including desirable grass and forb species.

It must be remembered though, that no vegetative manipulation can be expected to be successful unless feeding pressure on the range by agrimi is alleviated on a sustained basis.

If the agrimi on Theodorou are to have a secure future, affirmative action must be taken. Additional biologists should be added to the local Forest Service staff to enable continuation of the program of habitat and population analysis. Specific duties of such personnel would be (1) to construct and maintain exclosures and maintain study transects so as continually to assess range trends and habitat manipulation techniques, (2) to conduct an annual population census and make necessary removals, (3) to conduct a rodent control program which will not endanger agrimi, (4) to build runoff aprons and collection tanks or otherwise to provide adequate fresh water for the agrimi on a year-around basis, and (5) to monitor environmental factors which might affect the population.

Agrimi in excess of the island's carrying capacity could be translocated to various parks and zoos, thereby providing a symbol of Greece for display throughout the nation and elsewhere in the world.

SUMMARY

A study of the agrimi (Capra aegagrus cretensis Lydekker) was conducted between May and November 1975 on Theodorou Island, Crete, Greece, following the removal of 24 agrimi in 1973 and 1974. The study was undertaken (1) to ascertain population responses of the agrimi to the removals, (2) to measure the response of the island's vegetation to the reduced grazing pressure, and (3) to document the behavior patterns of the agrimi.

The total population of 89 agrimi was captured and revealed a male:female ratio of 1.28:1. This unbalanced ratio was the result of the capture and removal of more female than male agrimi.

Based on living weights of the 89 agrimi captured, the total population biomass equaled 1915 kg. The 1975 data indicated a sizable reduction in the mean weights of the 0- to 7-year-old age classes.

A mathematical model of population mortality indicated for both sexes that the number of animals trapped by the Greek Forest Service and removed from Theodorou Island since 1973 equaled the natural mortality which would have been expected to occur during the two-year period. The greatest differences in male survival came in the older age groups, where there was an increase in longevity. Mortality data prior to 1973 indicate that no male lived more than ten years, however in 1975, eight males older than ten years were captured.

A vegetation analysis of the island yielded density, frequency, and percentage cover data for each of the 140 plant species present. With 2.17 plants per m^2, Poterium spinosum, a small spiny shrub, had the greatest density. Thymus capitatus, a small aromatic shrub, attained the second highest density at about 1.36 plants per m^2.

Pistacia lentiscus, a large evergreen shrub, and Poterium spinosum contributed the most to cover at 17.24 and 15.14 percent of all ground cover, respectively. About 42 percent of the agrimi habitat was devoid of all vegetation.

The above-ground net primary production for the combined herbaceous species plus annual leaf and twig growth in shrubs equaled 1061 kg/ha/yr. The measured portion of the production available as forage was 618 kg/ha/yr. The forage production for six major agrimi forage species rose from about 363 kg/ha/yr in 1973 to about 522 kg/ha/yr in 1975. This substantial improvement was probably the result of the reduced grazing pressure by agrimi.

A chi-square matrix employed in conjunction with four of Jaccard's indexes of association identified several distinct plant groupings. The most interesting was a group of 35 highly-associated species, which included the island's most numerous plant, Poterium spinosum.

Agrimi appeared to cease most daytime movement from June to September. During this hot dry period, agrimi heavily sheltered beneath the dense cover of Pistacia lentiscus to stay cool. Three temperature stations indicated that the daytime temperatures under these shrubs were significantly less and were much less variable than were ambient temperatures.

An age- and sex-specific dominance was evidenced with old males being the most dominant segment of the population. This hierarchy among males was established prior to the rut, probably to minimize strife during the rut.

Mating began in mid-October, at the beginning of the winter rains. A sequence of mating behaviors were observed which increased in intensity throughout the rut.

A seawater consumption experiment and direct observations verified that agrimi partially fulfill their free-water requirements with seawater.

The suggested carrying capacity for the 68-ha island was about 80 average-sized animals or about 1500 to 1700 kg of biomass. Management policy for these agrimi should be directed toward relieving pressure on the island's forage resources through planned annual removals of agrimi.

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