have been observed to take the heads almost pref-
erentially between the anthesis and seed shatter-
ing stages of maturity. Grazing heavily at these
stages also eliminates growth which can become
coarse and stemmy.

It is not known at this time whether harding-
grass exhibits a tillering pattern generally found in
perennial grasses, nor exactly what causes the re-
duced tillering near the onset of heading. These
questions should receive additional study.

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Grazing Potential in Aegean
Turkey
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Highlight
Ranges of Aegean Turkey are dominated largely by an-
nual vegetation which is replaced by shrub cover through
overuse. Removal of the shrub Poterium spinosum by
hand grubbing costs $40/acre and the returns from such
improvement will pay for this cost in just over 3 years.
Grazing on a range after 2 years protection which was
dominated by Hordeum bulbosum was leased at $2.50/
A.U.M. This land carried 1.6 A.U.M./acre. There is a
great need for a concerted range program; some practical
suggestions are made as to how this should be carried out.

The Turkish Forest Service in 1964 initiated
watershed improvement which brought about ten-
fold increases in forage production. These treat-
ments demonstrated the potential for improvement of
grazing over the foothill ranges in the Aegean
area. This is a report of observations and measure-
ments taken on these range and watershed im-
provements near Izmir in 1966.

The authors were assigned to the United Na-
tions Special Fund Project 142 of the Food and
Agriculture Organization during 1965 and 1966 in
Izmir, Turkey. The project was set up for the col-
lection and genetical screening of the economically

important plants of Turkey and the Mediterranean
Middle East and is actively engaged to that end at
the present time. Of secondary importance to the
project but of paramount importance to Turkey,
its forage division was also charged with the de-
velopment and encouragement of range research and
the promotion of forage production, particularly
in the Aegean area.

The Aegean area of Turkey is made up of 9
provinces and contains 10 million ha or almost 3/4
of the area of the country (Fig. 1). It is the land
of the Gedez and Menderes river valleys on which
civilizations have been surviving for thousands of
years. These broad flood plains support irrigated
agriculture where cotton is king and citrus and
figs are produced in abundance. The land sloping
up from the rivers and the gentler slopes produce
winter wheat and tobacco. The lighter soils are
used for viticulture and the climate is ideally suited
with its warm days and cloudless skies to drying
the native fruit. The climate of Izmir, with its
moderately wet, mild winters and hot, dry sum-
ners, is typical of the entire Aegean area (Fig. 2).

In Aegean Turkey much of the land is pastured

Fig. 1. Turkey showing the Aegean Area.
because it is too steep or too rocky to cultivate. Some areas of the more level fertile valley soils are used for year-round grazing because of accessibility to the villages. As in many countries that have evolved through a nomadic system, the harvesting of native forage is taken very much for granted, a point that has been adequately covered by Johnson (1966). Ignorance of some facts about basic plant physiology and sheer pressure for survival has driven the people to over-utilize land, resulting in all the attendant ills that now need attention. And so it is with most countries that have developed their grazing practices through a free-use system. Pressure on the land by grazing animals is steadily increasing and the ranges are downgrading (Cornelius, 1962). Livestock numbers in Table 1 show the increase over the past 20 years. Further, the area under cultivation has increased from 36 million acres to 59 million, while the grazing land has diminished by over 20 million. Data for the Aegean area are not available, but this area has come under more than its share of pressure brought about by a natural increase and accelerated by an influx of people from other less climatically favorable areas of Turkey.

Harlan (1954) showed that Turkey was carrying twice as many animal grazing units per area as the United States. He pointed out such high carrying capacities are reached at the expense of quality and partly by the efficient utilization of all feed stuffs. At that time he suggested the Turkish needs are for more forage rather than fewer livestock.

This paper has two objectives: to relate the Aegean ranges to other similar grazing lands of the world, thus fulfilling one of the objectives suggested by Tomanek (1966); it is hoped that it will stimulate interest in further studies which are so desperately needed in Turkey.

Table 1. Livestock numbers in Turkey in thousands (from summary of agricultural statistics, Publication No. 464, Republic of Turkey, 1964).

<table>
<thead>
<tr>
<th>Class</th>
<th>1944</th>
<th>1954</th>
<th>1964</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>22,450</td>
<td>26,808</td>
<td>32,654</td>
</tr>
<tr>
<td>Goats</td>
<td>12,250</td>
<td>16,121</td>
<td>15,999</td>
</tr>
<tr>
<td>Angora goats</td>
<td>4,975</td>
<td>4,958</td>
<td>5,563</td>
</tr>
<tr>
<td>Cattle</td>
<td>9,549</td>
<td>10,867</td>
<td>13,211</td>
</tr>
<tr>
<td>Buffaloes</td>
<td>857</td>
<td>1,071</td>
<td>1,292</td>
</tr>
<tr>
<td>Camels</td>
<td>104</td>
<td>89</td>
<td>46</td>
</tr>
<tr>
<td>Horses</td>
<td>1,067</td>
<td>1,214</td>
<td>1,210</td>
</tr>
<tr>
<td>Donkeys</td>
<td>1,614</td>
<td>1,710</td>
<td>1,918</td>
</tr>
<tr>
<td>Mules</td>
<td>85</td>
<td>117</td>
<td>216</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>52,982</strong></td>
<td><strong>62,956</strong></td>
<td><strong>71,620</strong></td>
</tr>
</tbody>
</table>

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This paper has two objectives: to relate the Aegean ranges to other similar grazing lands of the world, thus fulfilling one of the objectives suggested by Tomanek (1966); it is hoped that it will stimulate interest in further studies which are so desperately needed in Turkey.

**Methods of Measurement**

Plant composition and ground cover were determined on three range areas using 20 m line transects and a 20 x 25 cm frequency frame carrying two 20 mm loops from which vegetation density was read. Yield was hand clipped from m² quadrats and reported in green weight.

All three areas were within 20 km of Izmir, in the foothills at an elevation of between 50 and 150 m.

**Grubbing Poterium spinosum L.**

On site “A” the Turkish Forest Service, using grub-hoes and axes, removed all the weedy shrubs from the lower more gentle slopes, (Fig. 3). The most prevalent weed and the one causing greatest loss in range potential is thorny burnet, *Poterium spinosum* L. The bush was windrowed, piled and burned, and the ash spots seeded to perennial grasses. On the areas sampled, the operation had been done the previous fall. Sampling was carried out in the middle of April, with the ultimate aim of plotting the change in plant population after grazing resumed in two years time. Two questions were uppermost. Would the *Poterium* repopulate the area and if so, how fast? Line intercepts through an adjacent untreated stand showed *Poterium* with a crown cover of 46%, *Cistus salviifolius* L., 1%, and *Pistacia terebinthus* L., 11%. Little in the way of palatable vegetation

![Fig. 2. Average monthly temperature and rainfall at IZMIR, Turkey (data from monthly bulletin of Statistics, Republic of Turkey, Prime Ministry, State Institute of Statistics, May, 1966).](image1)

![Fig. 3. General view of Area “A,” grazing reserve looking from the uncleared Poterium spinosum over the grubbed and windrowed range.](image2)
Table 2. Botanical composition on selected sites in the Aegean area of Turkey presented as percentage ground cover and yield of green weight vegetation.

<table>
<thead>
<tr>
<th>Area</th>
<th>Vegetation</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perennial grasses</td>
<td>9</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Annual <em>Trifolium</em></td>
<td>23</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Annual <em>Medicago</em></td>
<td>2</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Annual grasses</td>
<td>18</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Annual weeds</td>
<td>10</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Perennial weeds</td>
<td>5</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><em>Poterium</em> sp.</td>
<td>2</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Bare ground</td>
<td>26</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Rock</td>
<td>2</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Litter</td>
<td>3</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Yield, kg/ha.</td>
<td>3,970</td>
<td>3,150</td>
<td>6,420</td>
</tr>
</tbody>
</table>

was apparent under this shrub cover but nevertheless was present in subdued form as yields of palatable forage were approximately 400 kg/ha. The cleared area, for such a short recovery time, had shown a remarkable comeback. Average percentage composition for the vegetational groups are given in Table 2. The perennial grasses which made up only 9% consisted mainly of *Poa bulbosa* L., *Dactylis glomerata* L., and *Lolium perenne* L. Annual grasses were prevalent, making 19% of the vegetation, and consisted largely of *Bromus* and *Festuca* sp. The annual clovers were mainly *Trifolium subterraneum* L. and *T. campestre* Schreb. Species of annual *Medicago* were scarce on this site. Yield from this vegetation was approximately 10 times that found under the shrub growth.

**Rehabilitation of Former Cultivation**

On a second area, “B,” the situation was much the same except that this was a northwesterly slope that some years before had been broken and cropped to tobacco. The objective was to see what vegetation would eventually predominate under complete protection from grazing. Here, *Lolium perenne* and *Cynodon dactylon* (L.) Pers. along with some *Hordeum bulbosum* L. made up the perennial grass compliment. Annual grasses, mainly annual *Bromus* and *Elymus caput-medusae* L., were very abundant. The area generally had a weed aspect with a high percentage of *Cirsium* sp., *Taraxacum* sp., *Plantago* sp., and *Antemaria* sp. Annual legumes were prevalent with *Hippocrepis unisiliquosa* L., *Hymenocarpos cirsinnatus* (L.) Savi, *Astragalus hamosus* L., *Trigonella monantha* C. A. Mey, and *Onobrychis crispa-galli* (L.) Lam, interspersed with at least 10 species of annual *Trifolium*, these being dominated by *T. campestre*, *T. angustifolium* L., *T. tomentosum* L., and *T. scabrum* L. Annual *Medicago*, particularly *M. polymorpha* var. *vulgaris* (Benth.) Shinners, *M. orbicularis* (L.) All., and *M. turbinata* (L.) All., were found on some transects. Brush cover consisting of *Poterium spinosum* and *Alhagi pseudalhagi* (Bieb.) Desv., covered up to 12% of the area. Palatable vegetation clipped on this site averaged 3,150 kg/ha. On a small rocky knob within the site which had not been cultivated, *Quercus coccifera* L. was prevalent.

**Shrub Removal and Terracing**

The third area, “C,” had been hand terraced into meter-wide ditches every 5 meters up the slope with the weedy brush being grubbed and burned. Trees, *Pinus pinea* L., had been planted along the inside slope of the terrace. Protection had been afforded the area for 2 years. It occurred on a very rocky SE slope with favorable moisture conditions which may have accounted for its excellent forage production. The figures in Table 2 show 24% perennial grasses. The site was dominated by *Hordeum bulbosum* which reached a height of 130 cm (Fig. 4). Other grazing plants of importance were *Dactylis glomerata*, *Cynodon dactylon*, and *Agropyron semicostatum* (Steud.) Nees ex Boiss. This site had the lowest percentage of bare ground but the highest percentage of rock for the three areas studied. It was interesting to observe that *Trifolium subterraneum* occurred in relative abundance under such a heavy perennial stand which yielded a total green weight of 6,400 kg/ha.

These few initial figures from the 3 sites indicate the rich ground cover of the Aegean ranges and because of the preponderance of annuals changes in vegetative composition may be wrought very rapidly.

**Cost and Returns**

The rehabilitation of Turkish ranges will require both labor and expense. The Turkish Forest
Service determined that the cost for grubbing, pil-ning, and burning the brush along with windrowning rocks on the contour was approximately 1,000 Turkish lira (TL)/ha or about $40/acre. The return to the grazer for beef is about 3 TL/kg, (13¢/lb). If we assume that 400 kg of green forage will produce roughly 10 kg of beef, then each improved hectare is giving a return of 300 TL/year which will require three grazing seasons before cost of improvement has been returned. The cost of improvement cannot and should not be borne by grazing alone as watershed values are paramount when such an operation is begun.

Adjacent to site “C” was 22 ha of land that had been treated similarly two years previously and the grazing rights were auctioned. It was bid at 2,500 TL (approximately $250). This was estimated to provide 100 animal unit months of grazing at a cost of 25 TL/A.U.M. ($2.50/A.U.M.). The yield, air dry from the adjacent area, was approximately 2,400 kg/ha. Assuming that an animal would require 400 kg of dry matter per month, including a safe carryover, then grazing capacity was 182 A.U.M.’s and had been slightly underestimated.

It is noteworthy that such a high value is placed on grazing and serves to emphasize the real need for a concerted program to improve and maintain such an important resource.

**How can a Program be Made to Work?**

Before success in proper land use in Aegean Turkey can be achieved there must be—

1. An increase in land control by a responsible authority such as the Forest Service.

2. A developmental research program set up to provide answers and information on such questions as:
   a. What is the carrying capacity of various ranges?
   b. What is the ecological classification of different areas according to climate, soils, and species present?
   c. Can capacity be increased economically by weed and brush control, range seeding, or range fertilization?

3. A concerted educational effort to make villagers aware of the high relative value of good forage in terms of lamb, beef, and milk products to improve and keep up adequate protein nutrition.

4. Emphasis on forage production to take the pressure off hard-used rangeland during the summer months. Forage can and should be grown in rotation with cotton. Forage could enter the cereal-tobacco rotation to take advantage of the winter rainfall. The common rotation at present allows the land to be fallow from cereal harvest in July through to the following May when tobacco is planted. Some initial trials showed that 2,000 kg/ha could be harvested for green feed in that period of time. It was pointed out that this practice may injure the quality of the tobacco, particularly if a legume was grown. It is high time that countries with inadequate nutrition for their people started to look at the food requirements rather than the dollar export value of such commodities as tobacco and cotton, profit from which usually finds its way into foreign pockets.

5. Some form of quality control and standards for meat, comparable to those in developed European countries, particularly if surpluses are achieved and export to this ready market is desired.

6. An examination of the animals themselves to determine if they are efficient. Feed conversion figures should be determined for the various breeds. If these are less than elsewhere, then breeding programs could be established whereby better blood could be introduced.

It must be emphasized that these simple matters are not up to F.A.O. or any other world organization. These things must be the desires and aims of the people of Turkey. It is up to them to undertake this work. They have the facilities, the trained personnel, the extension organizations to do this job. They will undoubtedly need the help and encouragement of some of us, but it is their country and their responsibility to make a better place for their expanding populations.

In this paper we have attempted to demonstrate that the lands of the Aegean are tremendously productive and quick to improve if given a chance. We have tried to say that there is hope for Aegean Turkey, through good planning and a conscientious effort on the part of her trained people to adequately feed her expanding flocks and herds. There is still time to reverse the land deterioration if action is taken now.

**Acknowledgments.** The authors wish to thank Mr. Kuddusi Savran of the Turkish Forest Service in Izmir and Mr. Naim Dincer of the United Nations Special Fund Project 142, counterpart in forage research, both of whom helped form some of the opinions expressed.

**LITERATURE CITED**


