Mountainous Areas and Astragalus Sp. during the Climate Change

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Abstract:

Mountains function as water reservoirs of Earth by receiving precipitation. In fulfilling this function mountains in the Eastern Anatolia, especially in the sections without tree cover, use the advantage of Astragalus species and of similar species. Climate change is resulting shifts in precipitation patterns such as rain instead of snow and severe rainfalls in transition seasons in high mountains. In this context, the importance of ground covering plants such as Astragalus and similar species is increasing. However, destruction of the land which is habitat for the Astragalus species has also increased parallel to the population grow in recent years. In this paper, general information is given about the scale of climate change in high mountains on the case of Başkale district in City of Van according to the meteorological records in the district center. Accordingly, needed national policy and local strategies to prevent the destruction of Astragalus species and similar plants from the changing precipitation patterns due to the climate change.

Key Terms: water resources, climate change, step plants, Eastern-Anatolia

Introduction:

Mountains consists sources to most of the rivers in the world and 40% of world population is living in river basins which are originating from mountainous areas in different places on the earth. Despite nearly 26% of the population of world is living on mountains or hillsides, mountain based sources provides food source to more than half of the world population. Mountains called as “water towers” according to precipitation storage and providing disproportionate amounts of runoff in comparison to lowland areas. Hence, mountains provide vital resources and conditions for all living things by holding several ecosystem services such as carbon storage, climate regulation, and biodiversity protection at different spatial scales. Flora is one of the components taking role in fulfilling the important functions of mountainous areas. Flora decreases the hit and flow speed of water and increases the water holding capacity of soil that it grows on it and this process contributes to decrease in erosion risk and supports the continuity of hydrologic circle in the earth (Beniston 2003; Altın 2006).

It is stated that beginning from the 19. century, Earth has entered to a new climate change process, with the effect of global warming which is occurred as a result of human actions in addition to natural change. Some of the important results of global climate change that is connected to global warming are irregular precipitations and weakening of water sources. Irregular precipitations that are stated as a result of climate change and drought which may occur due to this process increase the importance of flora on mountains. Because of the features sensitive to climate change, it is stated that mountainous areas are one of the areas that environmental and socio-economic effects can be seen on. Mountainous areas also unique areas to detect the climate change and assessment of the effects related to climate change. This is because of the fast climate variations in short horizontal distances according to height at high mountains and the reflection of these factors on vegetation and hydrology (Beniston 2003; Pickering 2008).

In the Eastern Anatolia Region especially in areas that oak trees are decreased and mountainous areas on the limit of forest,
Astragalus sp. (liquorices) and similar step plants generate the protection cover of the soil. Arid and semiarid plants liquorices species have deep going tap root and side roots that are spreading like web for adapting to strong winter cold and drought in summer months on the mountains where they commonly exist. By wide deep tillers and umbrella shape petal structure, Astragalus species decrease the moisture loss by protecting the soil from sun and support storage of water which comes by raining. By this process these plants help feeding and accumulating water sources to flow regularly and giving life to their environment. Step plants such as liquorices which are protecting and enhancing the living area where they spread, provide appropriate environment for especially annual plants in their environment and enable to share habitat with various living species in near surrounding (Alp 2013).

In this study, reflection of climate change to climatic features of Başkale Town, within the framework of climate data for long years in Başkale Town (Van) that has the highest altitude in Anatolia and the role of Astragalus species in decreasing of negative effects in this climate change are examined.

Materials and Methods:

The study area that is determined in the scope of research is Başkale Town of the city Van which is in the east of Turkey. The elevation of the town from sea level is 2400 meters and the land area is 2598 km². Başkale is established in a valley between north-south direction high mountain series. On the east of the town Haravil Mountain (Yiğıt Mountain) (3468 m), on the west Ispiriz Mountain (Başkale Mountain) (3688 m), and on the south-west Gökdağ (3604 m) are located. In 2012, the total population of the town is 62,550. Town’s main source of income is livestock breeding; the vegetative production is not developed because of the hardness of climate conditions and shortage of suitable lands for production (Al et al. 2011).

In the terrestrial climate conditions dominated town, the most important water source is Hoşap stream. The source of the stream is Ispiriz Mountains and upland of Norduz and its being fed by many side creeks which are coming from neighbor Mountains. Hoşap stream passes from Gürpınar and Gevaş towns and pours to Lake Van by a shallow and marshy shore which is in the north of Gevaş Town. Besides this stream, the big Zap Water that is one of the most important branches of Dicle River generates from the creeks coming from Haravil Mountain and Mengene Mountain (At et al. 2011). The study area is in the Irano-Turanian region and showing mountain step features according to phytogeographical features. Among these species, there are Festuca sp., Gentiana sp., Thymus sp., Acanthalimon sp. and Astragalus sp. (Altan 1988).

In the scope of this study, meetings were made with local community and field observations done related to usage of liquorices in Başkale town and climatic changes was examined by using the data for between 5, 10 and 30 years of Başkale town meteorology stations which were taken from Directorate of Meteorology. According to the study context, monthly number of snowy days, monthly snow thickness (cm), monthly snowy number of days, monthly maximum average temperature, monthly minimum temperature average (C°), monthly maximum raining average (mm), monthly average temperature (C°), monthly average moisture (%) are examined through the meteorological data.

Results and Discussion:

In the number of snowy days significant decreases was determined between the last 30 and 10 years in Başkale Town. As the number of snowy days is 54 in last 30 years, it was 43 days in last 10 years and 41 days in last 5 years. These decreasing are more distinctive on March in last 30 years period and on April in last 5 years period in number of snowy days (Figure 1). Whereas the rainy days number decrease, depending on this serious decreases have been determined in snow thickness. As the total average snow thickness in last 30 years is 885 cm, it is measured as 375 cm in last 10 years and 269 cm in last 5 years is (Figure 2).
When number of snowy days compared in last 5 and 30 years data, significant decrease has been determined especially on December, January, February and March in the study area. Whereas the average number of snowy days is 117 in last 30 years, it is 97 in last 10 years and it is 85 in last 5 years (Figure 3). By contrast with the decrease in the number of snowy days and snow thickness decrease it is detected that the monthly average temperature increased (Figure 4).
It is observed that the long years average temperature rates show an increase in last 10 years period except November among all of the months in a year in Başkale. It is determined that the increase of monthly average temperature in the last five years is more distinctive than last 10 years.

It is detected that the increase on monthly average temperature is especially more distinctive in January, February, April, July, October, November and December in the last 5 years (Figure 7). The average temperature of January which is the coldest month is measured as -6.6 °C in the last 30 years, -6.4 °C in the last 10 years and -6.2 °C in last 5 years. The average temperatures of August which is the hottest month measured as 19.7 °C in last 30 years, 20.0 °C in last 10 years and 20.1 °C in last 5 years. It also determined that there is an increase in monthly minimum average temperatures in the last 5 years except May and October and in the monthly minimum average temperatures of February, March, April, October, November and December in the last 10 years (Figure 5). These findings show that monthly average temperatures in Başkale Town have an increasing trend in the area and this trend may have effects on the minimum and maximum monthly average temperatures in the area. Besides, it is detected that raining in spring, summer and winter seasons is decreased (Figure 6).

Monthly proportional moisture rate is inversely correlated to the temperature distribution in a year in Başkale Town. By the increase of average temperature, the proportional moisture rate has a decrease trend in the area. As in August which is the month that the average temperature increases the proportional moisture rate is 40.2% in the last 30 years, it is measured as 39.2% in the last 10 years and 35.5% in last 5 years. With the decrease in raining during the summer months when the temperatures increase, decrease in proportional moisture causes increase in vaporization on plant leaves and surface soil. During this process, the amount of water that the plants need is increasing while the water retention of soil is decreasing.

During the observations in the study area and meetings with the local community, it is detected that the liquorices species are being used intensely as fuel and animal food. Low income level of the local community in the study area and obtaining these plants for free from the nature are effective in the usage of Astragalus species in daily life as well as in livestock breeding activities. In addition to these, the limited area of rangelands detected as another factor that increases the pressure of livestock breeding activities on Astragalus species and contributes to decline in Astragalus sp. population.

Conclusion:

Along the history in the Eastern Anatolia where the people use the natural sources intensely and environmental damage the mountain ecosystem and one of the important components of this system the forest flora has been substantially damaged. Today, a new balance exists based to steppe plants in mountainous areas of the region. However, in the last 50 years while the population of region continuing in a certain cruise, as a result of enhancement in the life standards and decline in mortality, the growth of population

Figure 7. Monthly average temperature for long years (°C) in Başkale Town

Figure 8. Monthly average proportional moisture in long years (%) in Başkale Town
fastened; the pressure on natural sources increased. This pressure has affected *Astragalus* species in various ways such as loss of habitat, habitat degradation or serious decreases in the population of the plant. Because of these anthropogenic effects, the condition of ecological balance which has established by *Astragalus* sp. and similar steppe plant species in mountainous areas for long periods has damaged.

Research findings show that the global climate change affects the climatic features in Başkale Town of city of Van. Increase in average temperature and decrease in snowing, intense local raining in transition seasons are some of the negative results of this effect. Beside these changes, over dismantling of Asparagus species in the town has made the existing ecosystem more sensitive to corruption and increased the possibility of big disasters by insignificant or events in daily nature. Due to the weakness of flora and high slope, velocity of rain and snow waters flow increase which cause insufficient storage in groundwater resources. Furthermore some other possible consequences of this process are decline of water amount in creeks and wells, erosion and drought.

The study area is taking place in Fırat Basin, one of the five points that the most intense discussions being held on water in the world. It’s predicted that the population in Fırat Basin will increase between 32-71% until 2025. In this water ever decreasing Basin, as long as the population increases, it’s predicted that there will be hard competitions between the Basin countries (Postel, 2000). Lack of rain water storage in natural cycle, subsequent drought and other related problems seem to result more complicated conditions for water and related lives in the Fırat Basin.

Against these developments which are threading existence and sustainability of water resources, *Astragalus* sp. and similar species those have protecting features for soil cover can take important roles in rain water storage. Protecting *Astragalus* species in mountainous areas will make significant contributions to decrease negative effects of climate change in the area and region by helping to sustainability of water resources and mountain ecosystems.

Considering the possible consequences of climate change in the area and in Eastern Anatolia, the necessity of efforts for adaptation to new life conditions and to formulate solutions against the problems and threats related to water resources-flora relation become a current issue. In this scope, adaptation of life styles to the new climate features and related conditions, usage of renewable energy sources and landscape protection and restoration efforts, are among the primary precautions against to the damaging practices on *Astragalus* species and populations and for the protection of these species in nature. During the landscape protection and restoration efforts in Başkale Town and similar landscapes, the cyclic character of ecological systems and the possibility of wide range effects of little changes and incidental affects of extensive changes shouldn’t be ignored. In the landscape restoration projects that will be prepared in this scope, usage of horizontalis, spreading and round formed, succulent structured and compact textured *Astragalus* sp. and similar species as pioneers and supporters in plantations will provide the feedback and balance in the ecosystem of the region. Restoration and rehabilitation of damaged area by dismantling of *Astragalus* sp. and similar plants will produce unexpected results on the groundwater storage in the region.

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