



## Tortrix Moths (*Lepidoptera: Tortricidae*) Feeding on Wood-Fruit Plants in Eastern Azerbaijan

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### Abstract:

The research has been carried out during 1994-2012 in the Eastern Azerbaijan and 17 species of tortrix moths from 14 genera have been recorded. They belong to Tortricinae (9 species) and Olethreutinae (8 species) subfamilies. From recorded species 5 ones (*Ptycholoma lecheana* (L.), *Cacoecimorpha pronubana* (Hüb), *Eudemis profundana* (Den.et Schiff.), *Epinotia demarniana* (Fisch.), *Hedya salicella* (L.)) are new to Azerbaijan fauna. The widest trophic connection is registered in 3 tortrix moth species: *Archips rosanus*, *Archips xylosteanus*, *Tortrix viridana*. Thus, *Archips rosanus* feeds on 26 plant species, *T.viridana* – 12, *A.xylosteanus* – 12. From tortrix moths new to Azerbaijan fauna *E.profundana* only predominated during research. From food plants *Quercus castaneifolia* suffered more. From recorded species *Archips crataeganus*, *Ptycholoma lecheana*, *Cacoecimorpha pronubana*, *Hedya salicella*, *Spilonota ocellana*, *Epinotia demarniana*, *Notocelia uddmanniana* are not numerous. They are registered in a few samples only. Bioecological abilities, trophic connections, vertical distribution was analyzed. Ecological biodiversity of population was estimated using various ecological indices.

**Key Terms:** Tortricidae, leafroller, trophic links, Azerbaijan

### Introduction:

The Tortricidae is one of the most diverse families in the Microlepidoptera with over 10,300 species described (Gilligan et al. 2012). The family representatives have been recorded in all the continents but South America (Brown 2005).

The number of leafrollers in countries bordering with Azerbaijan differ according to places. So, Tortricidae family contains 469 species in Turkey, 145 species (Kochak and Kemal 2012) in Iran, 139 species (Esartia 1989a, 1989b) in Georgia. The Caucasian leafrollers were studied by Kuznetsov (Kuznetsov 1978) and only 288 species were noted in the Caucasus (Kochak and Kemal 2012). Despite these studies the Tortricidae fauna of the Caucasus is still not sufficiently studied.

The leafroller fauna in Azerbaijan has not been studied yet as a systematic group. There is only fragmentary information on separate species of family, but studies covering the family as a whole have not yet been carried out. The first

information about the species of leafrollers was given in the article by Rekach and Dobretsova in 1935. The authors note three species (*Clepsis pallidana* (Fabr.), *Cochylys posterana* Zell., *Epiblema scutulana* (Den & Schiff)) damaging cotton, peas and alfalfa in Nakhichevan area and Ganja-Gazakh region of Azerbaijan. Bogachev (1951) registered 8 species of leafrollers damaging grapes, fruit and wood plants. From them two species (*Sparganothis pilleriana* (Den & Schiff), *Lobesia botrana* Den.et Schiff.) widely distributed in Absheron and 3 species (*Cydia pomonella* L., *Cydia fagiglandana* (Zell), *Cydia funebrana* (Tr.) in Guba-Khachmaz region. In the works of Akhundova-Tuayeva (1960) information about species composition of 21 species of leafrollers feeding on fruit and ornamental plants is given. In 1968 Danilevsky and others informed about 25 more species of leafrollers spreading in Azerbaijan. Kostyuk (1980) described 13 species of leafrollers collected in the Azerbaijan territory. In eighties Abdullayeva (1988, 1990) added another 53 species to the check list of leafrollers of Azerbaijan. Five more species (*Ptycholoma lecheana* (L.), *Cacoecimorpha*

*pronubana* Hub., *Eudemis profundana* (Den. et Schiff.), *Epinotia demarniana* (Fisch.), *Hedya salicella* L.) were added to the Azerbaijan tortricid fauna as the result of our researches (Maharramova 2011) carried out during 1994-2012. Thus, the total number of leafrollers in the Azerbaijan fauna became 128 species.

### **Materials and Methods:**

*Research area.* The research was carried out during 1994-2012 in the Eastern Azerbaijan including Qonagkand physical-geographical region in the north-east, Absheron-Gobustan physical-geographical region in the east and Lankaran physical-geographical region in the south-east.

The plant cover of the stationary areas selected for observation is characterized by mixed plants. In the south-east and north-east areas it is consisted of natural cenosis, in eastern areas mainly of agrocenosis. Ornamental plants introduced from different continents and countries for greenery are predominated here.

*Methods.* Larvae, pupae and adults of leafrollers were collected in nature according to the standard entomological methods (Fasulati 1971). Leaf roller caterpillars and pupae collected in nature were to be kept in the laboratory until adult emerging.

To characterize biodiversity of leafrollers population the frequency of occurrence was calculated according to Zalepukhin's method (2003). Ecological indices of Simpson, Shannon, Pielou, Margaleff and Faunistic similarity were calculated by BioDiversity Pro-2 programme.

### **Results and Discussion:**

The representatives of the Tortricidae family of the order Lepidoptera are mainly polyphagous and oligophagous species. Adults are small sized moth. The number of annual generations varies from one to two or more (tropical and subtropical species) according to the species. They are also called "Leafroller moths" because in many species the larva rolls up leaves into a tube and tie them with silk and feed on them from within.

Larvae of all leafrollers lead hidden life. They

find protection (especially from birds) while they feed on the foliage. The larva are very active and roll the leaves in different forms depending on their species. The leafrollers spend pupa stage between rolled or wrapped leaves.

The eggs of the leafrollers are deposited singly, in masses or in small clusters of two to three eggs depending on their subfamilies. Thus species of subfamily Sparganotinae lay eggs in masses and cover them with fat. It is typical for some species of Tortricinae subfamily. Some representatives of Tortricinae subfamily deposit eggs single. But species of Archipinae subfamily deposit eggs in two forms (single, and in masses) (Razowsky 1976).

### **Order Lepidoptera**

#### **Superfamily Tortricoidea**

#### **Family Tortricidae**

Tortricidae family includes three subfamilies: Tortricinae, Olethreutinae, Chlidanotinae. Species of Olethreutinae subfamily having narrow host areal, many species of Tortricinae subfamily are polyphagous. But trophic connections of species of Chlidanotinae subfamily has been studied poorly (Brown, et al. 2008).

In research areas 17 species of Tortricidae belonging to 2 subfamilies (Tortricinae - 9 species and Olethreutinae - 8 species) and 14 genera had been recorded (table 1). From recorded species 5 ones (*Ptycholoma lecheana* (L.), *Cacoecimorpha pronubana* Hubn., *Eudemis profundana* (Den. et Schiff.), *Epinotia demarniana* (Fisch.), *Hedya salicella* L.) are new to Azerbaijan fauna (Maharramova 2011).

The recorded species of tortricids belong to 5 tribes – Archipini (6 species), Tortricini (3 species), Olethreutini (3 species), Eucosmini (4 species) and Grapholitini (1 species). Tribes Archipini and Tortricini belong to Tortricinae subfamily, but Olethreutini, Eucosmini and Grapholitini belong to Olethreutinae subfamily. Archipini (6 species) and Eucosmini (4 species) differ in species richness, and the poorness tribe to be Grapholitini (with one species only).

**Conclusions:**

*Trophic links.* The reason why they call these moths “leafrollers” is the moth larvae of this type roll leaves and bind them together in a protective leafy tube with webbing.

Some larvae differ greatly from others typical leafrollers exhibiting different eating activities (Horak et al. 1998).

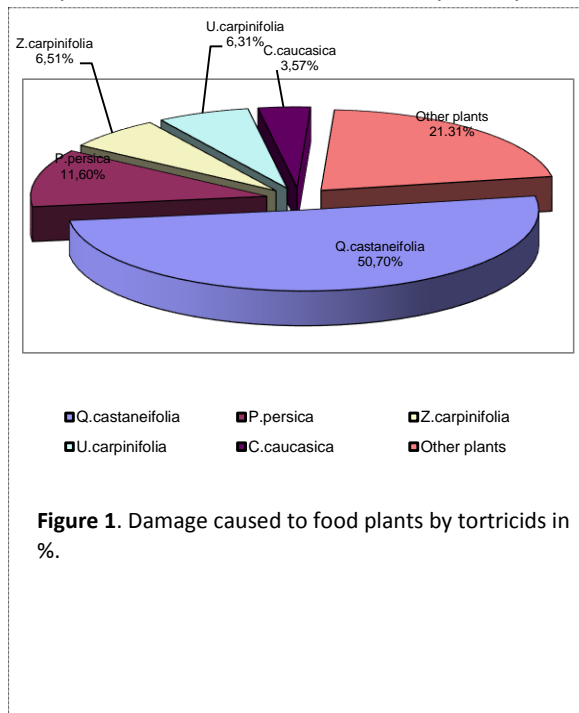
Though leafrollers are known as pests of agriculture, woods and ornamental plants some species of leafrollers are used as biological agent against invasive weeds, some species of leafrollers are known as potential pest for weeds using them as food (Brown, et al. 2008).

In spite of the amount of food plant pests

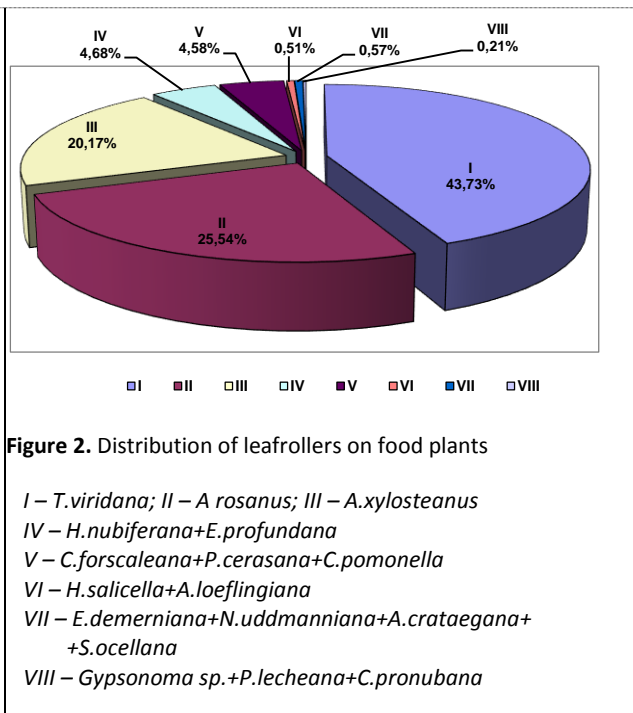
prefer one of these plants to the others and they damage mainly the same food plant.

The analyses of trophic links of the noted leafrollers show that they more frequently feed on *Q.castaneifolia*, *P.persica*, *Z.carpinifolia*, *U.campestris*, *S.kuznetsovii* and etc. (Maharramova 2009). Most species of leafrollers (7 species) prefer *Q.castaneifolia* and therefore it suffers more than other trees (50,7%) (Figure 1).

As table 1 shows *A.rosanus* holds a leading position among the leaf rollers according to the number of host plants (n=26). However it does not harm food plants as much as *T.viridana*. Thus, harm done to plants is estimated as follows: *T.viridana* - 43,7%, *A.rosanus* -25,5% and *A.xylosteanus* - 20,1% (Figure 2).



**Figure 1.** Damage caused to food plants by tortricids in %.



**Figure 2.** Distribution of leafrollers on food plants

- I – *T.viridana*; II – *A.rosanus*; III – *A.xylosteanus*
- IV – *H.nubiferana*+*E.profundana*
- V – *C.forscaleana*+*P.cerasana*+*C.pomonella*
- VI – *H.salicella*+*A.loeflingiana*
- VII – *E.demerniana*+*N.uddmanniana*+*A.crataegana*+*S.ocellana*
- VIII – *Gypsonoma sp.*+*P.lecheana*+*C.pronubana*

The following five tortricid species are not of major economic importance on deciduous wood-fruit tree crops in Azerbaijan: *A.crataegana*, *C.pronubana*, *N.uddmanniana*, *Gypsonoma sp.* These species were registered on one host plant only (Table 1).

*Distribution according to research areas.* 14 species of leafrollers had been noted in the south-east, and 9 species in the each of east and north-east areas. Five species were registered in each of 3 regions. Faunistic similarity index is 44,6% (Figure 3).

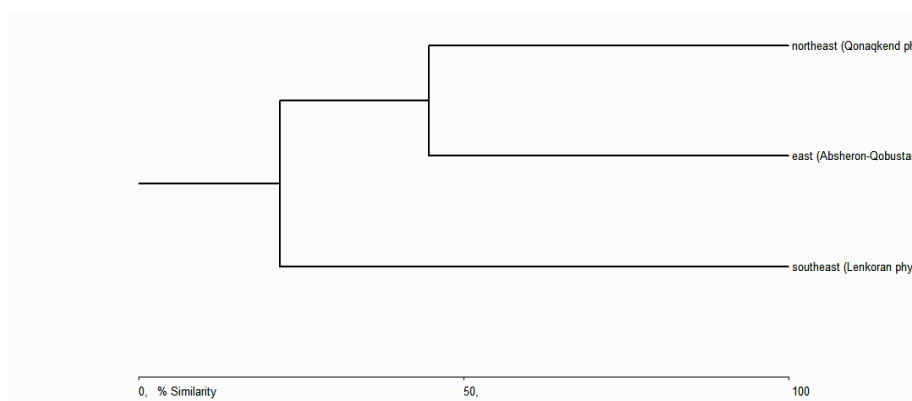


Figure 3. Faunistic similarity of tortricids in research areas

One of species of leafrollers (*H.salicella*) was noted only in the north-east, 2 species (*P.lecheana*, *Gypsonoma sp.*) were met only in

the east and 4 species (*P.cerasana*, *E.demardiana*, *N.uddmanniana*, *A.crataegana*) were met in the south-east region.

Table 1. Bioecological characteristics of tortricids in Eastern Azerbaijan

Leaf rollers	Samples	Date of sampling	Place of sampling	Trophic links in Eastern Azerbaijan		Generations and overwinter stages
				1	2	
Subfamily Tortricinae		1994-1998				
Tribe Archipini						
Genus <i>Pandemis</i> HUBNER, 1825	150	2002-2005	south-east		<i>Malus L., Crataegus caucasica</i> K.Koch.	bivoltine larva stage
<i>Pandemis cerasana</i> (Hubner, 1786)		2010, 2012				
Genus <i>Archips</i> HUBNER, 1822						
<i>Archips rosanus</i> (Linnaeus, 1758)	2640	1994-2012	south-east east north-east		<i>Quercus castaneifolia</i> C.A.Mey, <i>Malus L., Armeniaca vulgaris</i> Lamarck, <i>Parrotia persica</i> (DC.) C.A. Mey., <i>Rubus L., Amorpha fruticosa L., Carpinus caucasica</i> A.Grossh., <i>Fraxinus sp., Zelkova carpiniifolia</i> (Pall.) Dipp., <i>Mespilus germanica Z., Crataegus caucasica, Alnus barbata</i> C.A. Mey., <i>Acer hyrcanum</i> Fisch. & Mey., <i>Robinia pseudoacacia L., Gleditsia caspia</i> Desf., <i>Platanus digitifolia</i> Palib., <i>Ligustrum sp., Salix kusnetzowii</i> Laksch., <i>Colutea sp., Tilia begoniifolia</i> Stev., <i>Maclura aurantiaca</i> Nutt., <i>Punica granatum L., Cydonia oblonga</i> Miller, <i>Prunus domestica L., Ulmus carpiniifolia</i> Rupp. ex Suckov	monovoltine egg stage
<i>Archips crataeganus</i> (HUBNER, 1799)	14	2001, 2011	south-east		<i>Rubus L.</i>	Monovoltine
<i>Archips xylosteanus</i> (Linnaeus, 1758)	2085	1994-2012	south-east east north-east		<i>Quercus castaneifolia, Parrotia persica, Carpinus caucasica, Populus hyrcana</i> A.Grossh., <i>Zelkova carpiniifolia, Mespilus germanica, Malus L., Rubus L., Armeniaca vulgaris, Alnus subcordata</i> C.A.Mey.	Monovoltine egg stage
Genus <i>Ptycholoma</i> STEPHENS, 1929						
<i>Ptycholoma lecheana</i> (Linnaeus, 1758)*	8	2001	east		<i>Malus L., Quercus castaneifolia</i>	Monovoltine II-III larva stage

<b>Genus Cacoecimorpha</b> OBRAZTSOV, 1954 <i>Cacoecimorpha pronubana</i> HÖBNER, 1800* Tribe Tortricini	5	2003	south-east north-east	<i>Ligustrum sp.</i>	Larva stage
<b>Genus Aleimma</b> HUBNER, [1825] <i>Aleimma loeflingiana</i> (LINNAEUS, 1758)	26	1998, 2001, 2008, 2011	South-east north-east	<i>Quercus sp., Ulmus carpinifolia, Salix Kusnetzowii</i> Zaksch., <i>Carpinus caucasica</i>	Monovoltine egg stage
Genus <i>Tortrix</i> LINNAEUS, 1758 <i>Tortrix viridana</i> Linnaeus, 1758	4520	1994-2012	east south-east	<i>Quercus sp., Q.castaneifolia, Tilia begoniifolia, Zelkova carpinifolia, Mespilus germanica, Ulmus carpinifolia, Parrotia persica, Cydonia oblonga, Crataegus caucasica., Carpinus caucasica, Populus hyrcana</i> A.Grossh., <i>Alnus barbata</i>	Monovoltine egg stage
Genus <i>Croesia</i> HUBNER, [1825] <i>Croesia forskaleana</i> (Linnaeus, 1758)	186	1995-2000-2001-2005-2012	south-east north-east	<i>Acer hyrcanum</i>	Larva stage
Subfamily Olethreutinae Tribe Olethreutini Genus <i>Eudemis</i> HUBNER, [1825] <i>Eudemis profundana</i> ([Denis and Schiffermuller], 1775)*	224	1995-1999-2003-2005-2012	south-east north-east	<i>Quercus sp., Ulmus carpinifolia, Salix kusnetzowii., Crataegus caucasica, Cydonia oblonga</i>	Unknown
Genus <i>Hedya</i> HUBNER, [1825] <i>Hedya nubiferana</i> Haworth, [1811]	260	1994-2002-2005-2012	south-east east north-east	<i>Cydonia oblonga, Malus L., Armeniaca vulgaris, Prunus domestica, Quercus sp.</i> (Maharramova 2010)	Monovoltine larva stage
<i>Hedya salicella</i> (Linnaeus 1758)*	27	2005, 2007-2010, 2012	north-east	<i>Salix kuznetsovii, Populus hyrcana</i>	Unknown
Tribe Eucosmini Genus <i>Spilonota</i> STEPHENS, 1829 <i>Spilonota ocellana</i> (Denis and Shiffermüller, 1775)	13	1995-1996-2003-2007	south-east east north-east	<i>Malus L.</i>	Larva stage
<i>Epinotia</i> Hubner, 1825 <i>Epinotia demarniana</i> (Fischer von Röslerstamm, 1840)*	18	1995-2000-2001-2006, 2011	north-east	<i>Alnus barbata</i> <i>Ulmus carpinifolia</i>	Unknown
Genus <i>Gypsonoma</i> MYRICK, 1895 <i>Gypsonoma sp.</i>	9	1996	east	<i>Populus sp.</i>	Unknown
Genus <i>Notocelia</i> HUBNER, [1825] <i>Notocelia uddmanniana</i> (Linnaeus, 1758)	14	2001, 2010	south-east	<i>Rubus L.</i>	Unknown
Tribe Grapholitini Genus <i>Cydia</i> HUBNER, [1825] <i>Cydia pomonella</i> (Linnaeus, 1758)	137	1995-1997-2001-2002-2005-2012	south-east east north-east	<i>Crataegus caucasica, Cydonia oblonga, Malus L.</i>	Bivoltine Larva stage
<b>Ecological indices</b>					
<b>Species diversity by Shannon</b>				<b>0,59</b>	
<b>Species abundance by Margaleff</b>				<b>2,98</b>	
<b>Dominancy by Simpson (1/D)</b>				<b>3,45</b>	
<b>Evenness by Pielou</b>				<b>0,47</b>	
<b>Faunistic similarity</b>				<b>44,6%</b>	

**Note:** \*New to Azerbaijan fauna

Species composition and number of leafrollers differed in each of studied areas. They were linked with different number of food plants depending on vegetable cover of habitats. So, trophic links of leafrollers with 11 species of plants in the north-east Azerbaijan, 18 species of plants in the east and 21 species of food plants in the south-east were registered (table 1). The most damage in the research area was done by leafrollers near highways.

Approximately once in 9-10 years *T.viridana* forms joint center of outbreak together with such pests as *A.rosanus*, *A.xylosteanus* and *Lymantria dispar*.

*Distribution by years.* During research years (1994-2012) leafrollers were most diverse (14 species) in 2001 (table 1). From recorded species 10 ones (*A.rosanus*, *A.crataegana*, *A.xylosteanus*, *T.viridana*, *C.forskaleana*, *H.nubiferana*, *S.ocellana*, *E.demarniana*, *N.uddmanniana*, *C.pomonella*) were found in the south-east. Obviously, the range of average annual temperature in 2001 was optimum that promoted the development and increase in number of tortricids (Maharramova 2006).

According to species diversity 1995, 2005 and 2011 years are in the second place (10 species in each year). The poorest species diversity was registered in 1996, 2006 (5 species in each year). *A.rosanus*, *A.xylosteanus* and *T.viridana* were noted almost in all research years.

*Vertical distribution of leafrollers (in comparison with sea level).* Thermophilic and heliophilic species of leafrollers (*T.viridana* and others) have wider areas in the open part of woods and in protective belts, the area of these species become smaller in the lower mountain belts. Therefore in the areas below sea level (-21,4 b.s.l) unfavorable environmental condition characterized by the high level of humidity, low temperature and lack of light prevents distribution of leafrollers in such areas. Leafrollers are widely distributed in the areas covering the territories at a sea level and 200 m above sea level. At the height of 250-300 m above sea level the areas of leafrollers begin to decrease. In the territories

350-400 m above sea level and approximately 6-7 km in the depth of woods there was no any leafroller recorded on food plants.

*Estimation of ecological diversity.* Structure of biocenosis includes both a few dominant species and a lot of small numbered species. As a result of decrease in number of common species the density of separate species sharply increases. The species won the competition has an opportunity freely to breed. Favourable environmental condition leads to sharply increase in number of separate species and formation of poor biodiversity (Zalepukhin, 2003). Current diversity of leafrollers in the studied areas was characterised with the help of ecological indices.

In order to differ the dominant species among leafrollers in the studied areas the species were divided into 3 categories by the Zalepukhin's method according to frequency of occurrence:

1. Constant or background species making the majority of species (PF>50%)
2. Secondary or additional species presented by small quantity (PF – 25-50%).
3. Random species (PF<25%)

The figure 4 shows the above mentioned groups in all studied areas.

As the figure 4 shows random species predominated in all studied areas. Secondary species are represented by 1 or 2 species. *T.viridana* registered to be a constant or background species in the south east only. It is explained by outbreak of *T.viridana* in the mentioned region.

The value (3,45) of the Simpson's index (1/D) indicate that dominancy is not high in the studied area. The value of Margaleff index is high (2,98). It testifies that there is no any dominant species in the studied areas. So index of species diversity is high. The exception was made by *T.viridana* only which outbreaked in Lenkoran only and during certain years.



The value of the Index of Pielou (0,47) shows that the distribution of species in this biocenosis

is almost uniform.

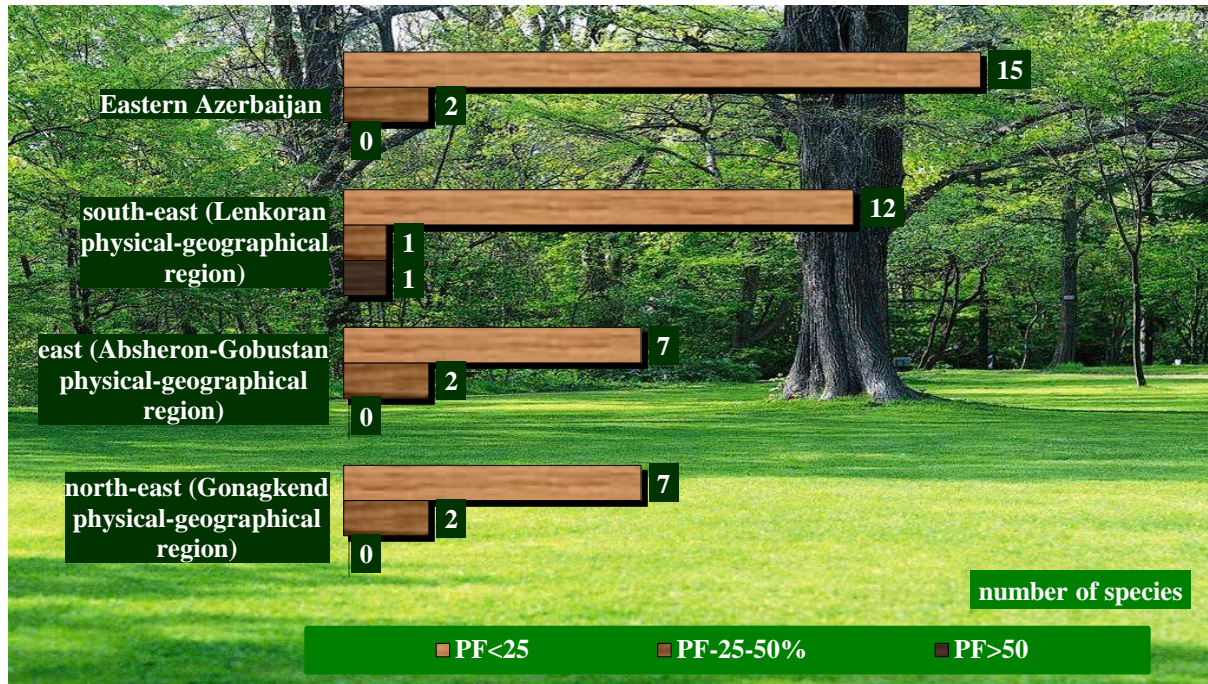


Figure 4. Frequency of occurrence of tortricids in the Eastern of Azerbaijan

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