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Discovering Thoughts, Inventing Future

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By Ozlem Tonguc Yayintas
Canakkale Onsekiz Mart University, Turkey

Abstract- In this study, the bryophyte flora of the Biga Peninsula (Canakkale province) was investigated. In total 119 taxa were found in this area. According to the grid-square system formed by Henderson (1961), 37 moss taxa for A1 square are new records. Among them *Rhabdoweisia crispata, Schistidium robustum* and *Scorpidium cossonii* are recorded for the first time in Turkey. In addition *Mielichhoferia elongata* (Hoppe & Hornsch. ex Hook.) Hornsch. and *Meesia uliginosa* Hedw. were given as new records from the Thrace region for Turkey. And also all new national records are described and illustrated. Diagnostic characters, a description, detailed illustrations and taxonomic comments on the species are given. It is compared with the related species and the geographic distributions of the new records are given.

Keywords: bryophyte, flora, biga peninsula, thrace region, turkey, rhabdoweisia, schistidium, scorpidium, mielichhoferia, meesia, new national record.

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Abstract- In this study, the bryophyte flora of the Biga Peninsula (Canakkale province) was investigated. In total 119 taxa were found in this area. According to the grid-square system formed by Henderson (1961), 37 moss taxa for A1 square are new records. Among them *Rhabdoweisia crispata, Schistidium robustum* and *Scorpidium cossonii* are recorded for the first time in Turkey. In addition *Mielichhoferia elongata* (Hoppe & Hornsch. ex Hook.) Hornsch. and *Meesia uliginosa* Hedw. were given as new records from the Thrace region for Turkey. And also all new national records are described and illustrated. Diagnostic characters, a description, detailed illustrations and taxonomic comments on the species are given. It is compared with the related species and the geographic distributions of the new records are given.

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I. Introduction

Turkey-in-Europe (Thrace, European Turkey) occupies the south-eastern extension of the Balkan Peninsula, towards Asia, from which it is separated by two canals -the Bosporus and the Dardanelles - and the Sea of Marmara. It covers an area of 23.500 km^2, and surrounded by sea in the northeast, east and south.

Turkey is one of the most floristically rich countries in the world, with very high levels of plant diversity, with 3504 endemic (30%), and 1096 non-endemic (9%) species in the flora (Ekim *et al.* 2000). Kaz Mountain (1796 m), formerly known as Ida Mountain, is the highest peak of the Biga Peninsula, separating the Aegean and Marmara regions (Fig.1). The national park (39°40'N - 26°45'E) consists of many deep valleys. The canyons are situated within the highlands of Kaz Mountain, and continue in a north-south direction towards the vicinity of Edremit. This region supports a diverse and distinct flora and fauna, consisting mainly of fir forests at elevations higher than 1000 m and pine forests at lower elevations. There are about 800 natural plant taxa in Kaz Mountain National Park and 68 of them are endemic to Turkey (Özhatay and Özhatay, 2005). About 30 of the endemic taxa grow only in this park (Satıl *et al*., 2006). For that reason, the area was classified as a European "Important Plant Area" (www.plantlife-ipa.org). Although the climate of the area is similar to the Mediterranean temperate zone, it is in a transition zone between the Mediterranean and Black Sea climates (Uysal, 2010). The combination of geographical isolation, an unusual range of climatic conditions, and the meeting of Mediterranean and Euro–Siberian floristic regions have resulted in exclusive vegetation in this area. The study area on Kaz Mountain is in the Aegean region of Northwest Turkey and includes elements of the Euro-Siberian, Mediterranean and Irano- Turanian floras. Species of trees and bushes coexisting with *Pinus nigra* are as follows: *Fagus orientalis, Castanea sativa, Carpinus betulus, Quercus cerris* var. *cerris, Q, petraea* ssp. *iberica*, *Q. frainetto, Carpinus betulus, Tilia argentea, Populus tremula, Corylus avellana, Sorbus aucuparia, Crataegus monogyna, Prunus divaricata, Juniperus foetidissima, Cornus mas, Acer platanoides,* and *Platanus orientalis*. *Abies nordmanniana* ssp. *equi-trojani* is found together with the following trees and bushes: *Carpinus betulus*, *Acer platanoides*, *A. campestre*, *Quercus cerris* var. *cerris, Q. frainetto, Q. petrea ssp. iberica, Populus tremula*, *Castanea sativa, Fagus orientalis*, and *Crataegus monogyna*. The *Fagus orientalis* is found together with the following trees and bushes; *Abies nordmanniana* ssp. *equi-trojani*, *Pinus nigra* ssp. *pallasiana*, *Castanea sativa, Carpinus betulus, Acer platanoides, Quercus cerris* var. *cerris*, *Q. frainetto, Taxus baccata, Populus tremula, Platanus orientalis,* and *Corylus avellana*. *Carpinus betulus* is commonly found; *Corylus avellana, Taxus baccata, Quercus cerris var. cerris, Cornus mas, Sorbus aucuparia, Malus sylvestris, Prunus divaricata, Castanea sativa, Rosa canina, Pinus brutia, Fagus orientalis.* (Gemici et *al.*, 1998; Öner, 2009; Uysal, 2010).

Another part of the study area, Thrace region, occupies a small portion of Turkey (Fig.2), covering ~23,500 km^2 that lies at the southeastern extremity of Europe, with the Aegean Sea to the west and the Black Sea to the east. It is separated from the rest of Turkey in mainland Asia to the south by the Sea of Marmara and the Canakkale and Bosphorus straits that, respectively; connect to the Aegean and Black seas. In comparison with the rest of Turkey, the topography in Thrace is commonly lower in elevation. The Yıldız Mountains

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(Istranca Mountains) lie in north-eastern Thrace, the highest point being Mahya Mountain (1,035 m). This mountain range borders the Black Sea and represents an extension of Anatolia's northern Black Sea Mountains, extending into southeastern Bulgaria. The range is composed of forest vegetation, the humid northern slopes supporting *Fagus orientalis* forest and *Rhododendron ponticum* scrub (YMBP 2010). Generally, humid oceanic climate is seen in the study area. As known, oceanic climate is characterized without a dry period. Bioclimatically, the climate in the study area is very suitable for growing of the taxa mainly originated in the Euro-Siberian region, including *Corylus avellana* L var. *avellana, Fagus orentalis* Lipsky, *Quercus frainetto* Ten., *Q.infectoria* Oliver subsp. *infectoria*, *Carpinus betulus* L.

Bryophytes tend to be highly specific with regard to particular micro-environmental factors such as temperature, light and water availability, substrate chemistry etc., making them good ecological indicator species. They are ecologically significant in playing a key role in ecosystem dynamics (Vanderpoorten and Goffinet, 2009). In Turkey, bryological studies were mostly performed by Turkish bryologists after 1988. The most recent bryophyte studies focused on the western part of Turkey as follows: Erdag, 2002; Erdağ and Kürschner, 2001, 2002; Erdağ *et al*., 2003; Tonguc Yayintas, 2000, 2009, 2010; Natcheva *et al*., 2008; Kirmaci and Agacagil, 2009; Kirmaci and Erdağ, 2009, 2010; Ursavas *et al.,* 2009. To date, 760 mosses, 171 liverworts and 3 hornworts have been recorded in Turkey (Frey and Kürschner, 2011).

The bryophyte flora of the European part (Turkish Thrace) remains poorly documented with respective to both species diversity and distribution. There are some records dealing with restricted regions (Yayıntaş & Tonguc 1994, 1996; Yayıntaş & al.1996; Tonguc-Yayintas 2010, 2013; Gökler & Öztürk 1996; Papp & Sabovljevic 2003; Natcheva et al.2008). The Turkish Thrace comprises 3 % (23. 764 km^2) of the territory of Turkey. The latest checklist of the species diversity of the Turkish Thrace includes 217 mosses (Sabovljevic & al. 2008) and 27 hepatics (Sabovljevic & Natcheva 2006).

The author made collections as part of bryophyte research studies (2010-2012) in the Biga Peninsula and Thrace region (Fig.2), which is located in northern and northwestern Turkey, in the Kaz Mountain area and Yildiz Mountain (Fig.1). According to the Turkish checklists (Uyar and Cetin, 2004; Kürschner and Erdag, 2005) among these collections, *Rhabdoweisia crispata* (Dicks.) Lindb, *Schistidium robustum* (Nees & Hornsch.) H.H.Blom, and *Scorpidium cossonii* (Schimp.) Hedenäs are reported for the first time from Turkey. In addition to the Biga Peninsula area records, *Mielichhoferia elongata* (Hoppe&Hornsch. ex Hook.) Hornsch. and *Meesia uliginosa* Hedw. were given as new records from the Thrace region for Turkey. New records of taxa are a noteworthy first step towards a flora for Turkey and Southwest Asia. In this regard, the following two new records are a further contribution to reach this ambitious aim.

Collections were made between June 2010 and June 2012 from different localities and habitat types. All collected specimens are kept in the special collection of Ozlem TONGUC YAYINTAS at Canakkale Onsekiz Mart University and also in New York Botanical Garden (NYBD) and Duke University Herbarium (DUKE). Collection numbers for the Tonguc Yayintas are preceded by a T. Specimens were identified by using relevant literature (Casas et al., 2009; Crum and Anderson, 1981; Greven, 2003; Guerra et al., 2006; Guerra and Cros, 2007; Heyn and Herrnstadt, 2004; Nyholm, 1981; Kürschner and Frey 2011; Lewinsky, 1993; Smith, 2004; Pedrotti, 2001; Zander, 1993). The floristic list is arranged according to the system proposed by Goffinet and Shaw (2009). In addition, the new records for A1 grid-square determined by reviewing the related literature (Cetin 1999; Oren *et al.* 2007; Ursavas *et al.*2009; Savaroglu *et al*. 2011). The new records for A1 grid square are indicated with (▲), and new record for Turkish bryophyte flora with (**) in the bryofloristic list presented in the appendix.

II. Results

a) Bryophyta

Sphagnaceae *Dumort.*

1. ▲**Sphagnum fimbriatum** Wilson: Canakkale, Can, Söğütalan village, peat bog Ciğer gölü (Liver Lake), on a wet rocky bank, 650 m, 39°52'37" N 26°55'40" E, June 16, 2010, T. 2684, det. *J. Shaw* (given as a new record from Turkey, in press).

Polytrichaceae *Schwägr.*

2. **Pogonatum aloides** (Hedw.) P.Beauv.: Canakkale, Biga, Abdiağa village, in valley, Abdiağa creek, 45 m, on humus rich soil, N 40^{0}19'73.6", E 027^{0}25'98.4", 10.05.2012, T. 4024; Biga, Arabaalani and Kurşunlutepe, valley on soil, 542 m, N 40^{0}13'61.3" E 027^{0}29'28.3", *Platanus orientalis* forests, 10.06.2012, T. 4050; on soil, 554 m, T. 4051; Biga, between Elmali and Arabaalani villages, 504 m, roadside, on gravel, N 40^{0}13'55.9", E 027^{0}26'26.3",16.06.2012, T. 4065; Biga, Hosaba creek and environs, on soil, 458 m, mixed forest of *Platanus orientalis*, *Quercus* sp. and *Acer platanoides*, 16.06.2010, T. 2621.
3. **Pogonatum nanum** (Hedw.) P.Beauv.: Canakkale, Biga, Armutcuk Hill, N 40^{0}07'41", E027^{0}22'33", 452 m, mixed forest of *Quercus* sp., *Carpinus betulus,* and *Tilia tomentosa*, 16.06.2010, T. 2593, 2594, 2596, 2602; Biga, Armutcuk Hill, 466 m, on soil, 40^{0}07'39.5", E 027^{0}22'20.6", under *Castanea sativa*, 16.06.2010, T. 2688; Biga, between Elmali and

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Arabaalani villages, on roadside, 504 m, near bank, N 40°13'55.9", E 027°26'26.3", 10.06.2012, T.4057, 4063.

4. **Polytrichastrum formosum** (Hedw.) G.L.Smith.: Canakkale, Biga, between Elmali and Arabalani villages, in moorland, 500 m, N 40°13'56.2", E 027°28'24.1",16.06.2012, T. 4064.
5. **Polytrichum commune** Hedw. var. **commune**: Canakkale, Biga, between Elmali and Arabalani villages, 839 m, mixed forest of *Quercus petraea, Carpinus betulus* and *Fagus orientalis,* N 40°13'55.9", E 027°26'26.3", on roadside, on soil, 10.06.2012, T.4066.
6. **Polytrichum juniperinum** Hedw.: Canakkale, Biga, 458 m, on soil, N 40°07'42", E 27°22'33", 458m, *Quercus* sp., *Carpinus* sp.,and *Tilia tomentosa*, 16.06.2010, T. 2597; Canakkale, Biga, between Elmali and Arabalani villages, 542 m, N 40°06'31.6", E 027°21'66.0", humus cliff soil, mixed forest of *Quercus* sp., 10.06.2012, T 4054, 4055; Canakkale, Yenice, between Beyoglu wood store and Yolindi village, 193 m, N 40°06'79.6", E 027°20'32.0", on boulder, 10.06.2012, T. 5009.
7. **Polytrichum piliferum** Schrab.ex Hedw.: Canakkale, Biga, Kirkgecit, valley, on roadside, 71 m, N 40°07'76.8", E 027°13'11.5", mixed forest of *Platanus orientalis*, *Quercus* sp., *Cistus creatiqus, Rubus sp.*, 16.06.2012, T.5047.
8. ▲**Polytrichum strictum** Menzies. ex Brid.: Canakkale, Biga, mixed forest of *Quercus* sp., *Carpinus* sp., *Tilia tomentosa*, N 40°07'42", E 27°22'33", 458 m, in bogs, 16.06.2010, T. 2590.

Timmiaceae Hedw.

9. ▲**Timmia austriaca** Hedw.: Canakkale, Biga, between Elmali and Arabalani villages, Armutcuk hill, *Quercus petrea, Carpinus betulus, Fagus orientalis,* and *Rhododendron flavum* forests, on soil, 839 m, 16.06.2010, T. 2502.

Grimmiaceae Arn.

10. **Grimmia anodon** Bruch & Schimp.: Canakkale, Biga, Kirkgecit thermal spring, roadside, 45 m, N 40°09'52.7", E 027°12'49.4", 16.06.2012, on boulder, T. 5036.
11. **Grimmia pulvinata** (Hedw.) Sm.: Canakkale, Biga, 42 m, forest, on rock, N 40° 01'19.8", E 027° 02'06.1", 16.06.2010, T.2690, 2695; Biga, Abdiağa village, Abdiağa creek, inner valley, forest, on rock, 78 m, N 40°18'07.1", E 027°26'06.1",10.05.2012, T. 4001; Biga, Kirkgecit thermal spring, roadside, on boulder, 45 m, N 40°09'52.7", E 027°12'49.4", 16.06.2012, T. 5037; on slope, on soil, 44 m, N 40°09'51.9", E 027°12'49.1", 16.06.2012, T. 5040.
12. **Schistidium apocarpum** (Hedwig) Bruch & Schimper: Canakkale, Biga, between Kursunlutepe and Arabaalan, on boulder, N 40°13'73.6", E 027°29'72", 10.06.2012, T.4060.
13. ▲**Schistidium atrofuscum** (Schimp.) Limpr.: Canakkale, Biga, Kirkgecit, valley, on boulder, 198 m, N 40°06'02.5", E 027°14'09.2", 16.06.2012, T.5054.
14. ▲**Schistidium dupretii** (Thér.) W.A. Weber.: Canakkale, Yenice, between Beyoglu wood store and Yolindi village, on boulder, forest area,171 m, N 40°06'81.9", E 027°20'01.1", 16.06.2012, T. 5005.
15. ****Schistidium robustum** (Nees & Hornsch.) H.H.Blom: Canakkale, Biga, on calcareous rocks, 870 m, N 40°05'53.3", E 27°22' 33.9", 16.06.2010, T. 2633.

Archidiaceae Schimp.

16. **Archidium alternifolium** (Dickson ex Hedwig) Mitten: Canakkale, Biga, Hosoba Creek and environs, on wet soil, 40°07'41.9", E 027°22'33.7", 452 m, 16.06.2010, 2605.

Fissidentaceae Schimp.

17. **Fissidens adianthoides** Hedw.: Canakkale, Biga, near by the waterfalls, on wet rock faces, 70 m, N 40°11'99", E 027°20'59", 16.06.2010, T. 2663.
18. **Fissidens exilis** Hedw.: Canakkale, Biga, at nearby the river, on soil, 70 m, N 40°11'99", E 027°20'59", 16.06.2010, T. 2655; Canakkale, Biga, Abdiağa village, in valley, nearby Abdiağa creek, 45 m, N 40°19'73.6", E 027°25'98.4", on humus rich soil, 10.05.2012, T. 4007.
19. ▲**Fissidens crispus** Mont.: Canakkale, Yenice, Yolindi village, on humus rich soil, forest area consists of *Acer* sp. and *Juglans regia*, 140 m, N 40°07'90.3", E 027°21'51.4", 16.06.2012, T. 4093.
20. ▲**Fissidens monguillonii** Thér.: Canakkale, Yenice, Yolindi village, 165 m, N 40°07'90.2", E 027°21'50.9", on humus rich soil, forest area consists of *Acer* sp. and *Juglans regia*, 16.06.2012, T. 5002.

Rhabdoweisiaceae Limpr.

21. ▲**Dichodontium pellucidum** (Hedw.) Schimp. var. **flavescens** (Dicks.) Moore: Canakkale, Biga, Kirkgecit, 53 m, valley, on rock wet in the stream, N 40°09'97.6", E 027°12'84.3", *Quercus* sp., 16.06.2012, T. 5053.
22. **Dicranoweisia cirrata** (Hedw.) Lindb.: Canakkale, Biga, 569 m, epiphyte on *Pinus nigra*, N 40°06'05", E 27°21'06" , 16.06.2010, T. 2678.
23. ****Rhabdoweisia crispata** (Dicks.) Lindb. : Canakkale, Biga, between to Arabaalan village and Kurşunlutepe, inner valley, on soil in humid slope, 591 m, N 40°13'73", E 27°29'87", 16.06.2012, T. 4062.

Dicranaceae Schimp.

24. **Dicranella heteromalla** (Hew.) Schimp.: Canakkale, Biga, Arabaalani village and environs, on gravel, 342 m, N 40°15'50.6", E 017°35'72.7", 16.06.2012, T. 4040.

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25. ▲**Dicranum fuscescens** Sm.: Canakkale, Biga, on tree bases, 445 m, N 40°07'39", E 27°22'20", 16.06.2010, T. 2593, 2594, 2595, 2597.
26. ▲**Dicranum leioneuron** Kindb. : Canakkale, Biga, between Arabaalani and Kurşunlutepe villages, mine area, mixed forest *Quercus petraea* ssp. *iberica* and *Q. frainetto*, 600 m, N 40°13'61.3", E 027°29'28.3", 16.06.2012, T. 4062.
27. **Dicranum majus** Sm.: Canakkale, Biga, 458 m, on soil, mixed forest of *Quercus* sp., *Carpinus sp.,* and *Tilia tomentosa*, N 40°07'42", E 27°22'33", 16.06.2010, T. 2592; Biga, epiphyte on *Castanea sativa*, 466 m, N 40°07'39.5", E 027°22'20.6" GPS: 5311364441200, 16.06.2010, T. 2635; Biga, mixed forest of *Castanea sativa*, on soil, 466 m, N 40°07'39.5", E 027°22'20.6", 16.06.2010, T. 2687; Biga, 870 m, epiphytic on *Fagus orientalis*, N 40°05'53.2", E 027°22'33.9", 16.06.2010, T. 2681.
28. ▲**Dicranum polysetum** Sw. ex anon.: Canakkale, Biga, Kirkgecit thermal spring, on slope, on boulder, 77 m, N 40°07'76.5", E 027°13'10.5", 16.06.2012, T. 5042.
29. **Dicranum scoparium** Hedw.: Canakkale, Biga, mixed forests of *Fagus orientalis, Quercus* sp., *Carpinus betulus*, ferns, *Rubus* sp., on soil and tree, 800 m, N 40°06', E 27°21', 16.06.2010, T. 2590, 2591; Biga, between Elmali and Arabalani villages, 504 m, near bank, on soil, N 40°13'55.9", E 027°26'26.3", 16.06.2012, T. 4054.
30. ▲**Dicranum tauricum** Sapjegin: Canakkale, Biga, Kirkgecit, valley, at *Juniperus* sp. bases, 71 m, N 40°07'76.8", E 027°13'11.5", 16.06.2012, T. 5047.

Leucobryaceae *Schimp.*

31. ▲**Dicranodontium uncinatum** (Hedw.) A. Jaeger.: Canakkale, Biga, between Elmali and Arabalani villages, 500 m, on humus cliff, N 40°13'56.2", E 027°28'24.1", 16.06.2012, T. 4056; Yenice, Yolindi village, on humus rich soil, forest area, 165 m, N 40°07'90.2", E 027°21'50.9", 16.06.2012, T. 4098.

Pottiaceae *Schimp.*

32. ▲**Anoectangium sendtnerianum** Bruch & Schimp.: Canakkale, Biga, Kirkgecit thermal spring, on slope, on boulder, 77 m, N 40°07'76.5", E 027°13'10.5", 16.06.2012, T. 5042.
33. **Barbula unguiculata** Hedw.: Canakkale, Biga, Yolindi village and environs, 500 m, UTM 5316344443134, 16.06.2010, T.2641; Yenice, Yolindi village, on humus rich soil, forest area 140 m, N 40°07'96.3", E 027°21'51.4", 16.06.2012, T. 4092; Yenice, Yolindi village, 165 m, *Acer* sp. and *Juglans regia* mixed forest area, on humus rich soil, N 40°07'90.2", E 027°21'50.9", 16.06.2012, T. 5002.
34. ▲**Cinclidotus danubicus** Schiffn. & Baumgartner: Canakkale, Biga, near waterfalls, exposed to wet rock, 70 m, N 40°11'99", E 027°20'59", 16.06.2010, T. 2671.
35. ▲**Cinclidotus fontinaloides** (Hedw.) P. Beauv.: Canakkale, Biga, near river, on submerged rocks, 70 m, N 40°11'99", E 027°20'59", 16.06.2010, T. 2623.
36. ▲**Cinclidotus riparius** (Host ex Brid.) Arn.: Canakkale, Biga, near river, on submerged rocks, 70 m, N 40°11'99", E 027°20'59", 16.06.2010, T. 2626.
37. **Dialytrichia mucronata** (Brid.) Broth.: Canakkale, Biga, Abdiağa village, in valley, Abdiağa creek, on tree root, 78 m, N 40°18'95.1", E 027°26'15.4", 16.06.2012, T. 4032.
38. **Didymodon luridus** Hornsch.: Canakkale, Biga, Yolindi village and environs, 500 m, UTM 5316344443134, 16.06.2010, T.2642; Yenice, between Beyoglu wood store and Yolindi villages, on boulder, 193 m, N 40°06'79.6", E 027°20'32", 16.06.2012, T. 4090.
39. **Didymodon rigidulus** Hedw.: Canakkale, Biga, Abdiağa village, in valley, Abdiağa creek, on humus rich soil, *Platanus orientalis,* 45 m, 40°19'73.1" N, E 027°25'98.4", 16.05.2012, T. 4004.
40. ▲**Didymodon vinealis** (Brid.) R. H. Zander var. **flaccidus** (Bruch & Schimp.) R. H. Zander: Canakkale, Biga, Abdiağa village, in valley, Abdiağa creek, 80 m, *P. orientalis* trunk, N 40°18'94.2", E 027°26'13", 16.05.2012, T. 4013.
41. ▲**Tortella flavovirens** (Bruch) Broth.: Canakkale, Biga, sandy soil, 42 m, N 40°11'98", E 027°20'61", 16.06.2010, T. 2696.
42. **Tortula muralis** Hedw.: Canakkale, Biga, Kirkgecit thermal spring, on slope, on soil, 44 m, N 40°09'51.9", E 027°12'49.1", 16.06.2012, T. 5032.
43. **Tortula obtusifolia** (Schwägr.) Mathieu: Canakkale, Biga, Kalafat village, nearby Nilufer Pond, on soil, 77 m, UTM 5258994451753, 16.06.2012, T. 4081.
44. **Trichostomum brachydontium** Bruch: Canakkale, Biga, on rocks and soil, 445 m, N 40°07' 42.1", E 027°22'33.5", 16.06.2010, T. 2693.
45. **Trichostomum crispulum** Bruch: Canakkale, Biga, Abdiağa village, in valley, nearby Abdiağa creek, on wet boulder, 78 m, N 40°18'95.1", E 027°26'15.4", 16.06.2012, T. 4033.
46. **Syntrichia ruralis** (Hedw.) F. Weber & D. Mohr.: Canakkale, Biga, Kirkgecit thermal spring, on slope, on soil and rock, 45 m, N 40°09'52.8", E 027°12'49.4", 16.06.2012, T. 5035, 5038.

Bryaceae *Schwägr.*

47. ▲**Bryum algovicum** Sendtn. ex Müll. Hal.: Canakkale, Biga, on soil, in mixed forests, 70 m, N 40°11'99", E 27°20'59", 16.06.2010, T. 2631, 2634.
48. **Bryum caespiticium** Hedw.: Canakkale, Biga, *Quercus cerris, Carpinus betulus* and *Tilia tomentosa,* on soil, 452 m, N 40°07'41.9", E 027°22'33.7",16.06.2010, T. 2601.

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49. **Bryum creberrimum** Taylor: Canakkale, Biga, Kirkgecit, inner valley, on boulder, nearby stream, 212 m, N 40^{0}06'02.8", E 027^{0}14'10", 16.06.2012, T. 5050.
50. **Bryum pallescens** Schleich. ex Schwägr.: Canakkale, Biga, *Abies nordmanniana* subsp. *equi-trojana* and *Fagus orientalis* mixed forests, 680 m, N 40^{0}06'31.6", E 027^{0}21'66.1", 16.06.2010, T. 2680; Biga, Kirkgecit, inner valley, on clay, 214 m, N 40^{0}06'02.6", E 027^{0}14'10.2", 16.06.2012, T. 5051.
51. **Bryum pseudotriquetrum** (Hedw.) P. Gaertn., E. Mey. & Scherb. var. **bimum** (Schreb.) Lilj.: Canakkale, Biga, Abdiağa village, inner valley, Abdiağa creek, on root of *Platanus orientalis*, 62 m, N 40^{0}19'53.5", E 027^{0}26'06", 16.05.2012, T. 4023.
52. **Bryum torquescens** Bruch & Schimp.: Canakkale, Biga, Arabaalani village and environs, epiphytic on *Quercus* sp., 350 m, 40^0 15'50.6" N, E 027^{0}35'72.7", 16.05.2012, T. 4044.
53. ▲**Bryum uliginosum** (Brid.) Bruch & Schimp.: Canakkale, Biga, Abdiağa village, inner valley, Abdiağa creek, on humus rich soil, 45 m, N 40^{0}19'73.6", E 027^{0}25'98.4", 16.05.2012, T. 4009.
54. ▲**Plagiobryum zierii** (Hedw.) Lindb.: Canakkale, Biga, Abdiağa village, inner valley, Abdiağa creek, on humus rich soil, *Platanus orientalis* forest, 45 m, 40^{0}19'73.1" N, E 027^{0}25'98.4", 16.05.2012, T. 4004.
55. ▲**Ptychostomum capillare** (Hedw.) D. T. Holyoak & N. Pedersen Canakkale, Biga Kurşunlutepe, mixed forest *Pinus nigra,* and *Abies nordmanniana* ssp. *equi-trojani* , on rocks, 542 m, N 40^{0}13'60.6", E 027^{0}29'46.4", 16.06.2012, T. 4049; Biga, Kirkgecit thermal spring, roadside, on boulder, 44 m, N 40^{0}09'69.9", E 027^{0}12'28.4", 16.06.2012, T. 5039, 5041.

Mielichhoferiaceae Schimp.

56. **Pohlia nutans** (Hedw.) Lindb.: Canakkale, Biga, Kirkgecit, inner valley, on wet soil, 214 m, N 40^{0}06'02.6 ", E 027^{0}14'10.2", 16.06.2012, T. 5048.

Mniaceae Schwägr.

57. **Mnium hornum** Hedw.: Canakkale, Biga, under *Fagus orientalis* forest, on rock crevices, 870 m, N 40^{o}06' 11.1", E 027^{0}21' 75.1", 16.06.2010, T. 2683.
58. **Plagiomnium affine** (Blandow ex Funck) T.J.Kop.: Canakkale, Biga, Abdiağa village, inner valley, Abdiağa creek, on soil, 78 m, N 40^{0}18'07.1", E 027^{0}26'06.1", 16.05.2012, T. 4027; Yenice, Yolindi village, on humus rich soil, 165 m, N 40^{0}07'90.2", E 027^{0}21'50.9", 16.06.2012, T. 4095.
59. **Plagiomnium elatum** (Bruch & Schimp.) T.J.Kop.: Canakkale, Biga, Kirkgecit thermal spring, roadside, on soil, 39 m, N 40^{0}09'90.3", E 027^{0}12'64.6", 16.06.2012, T. 5028; Biga, Kirkgecit thermal spring, roadside, forest area, on soil, 46 m, N 40^{0}09'90.5", E 027^{0}12'64.7", 16.06.2012, T. 5029.
60. **Plagiomnium ellipticum** (Brid.) T.J.Kop.: Canakkale, Biga, between Arabaalani and Kurşunlutepe villages, under *Carpinus betulus* forests, soil covered rocks, 542 m, N 40^{0}13'61.3", E 027^{0}29'28.3", 16.06.2012, T. 4061; Yenice, Yolindi village, on humus rich soil, 165 m, N 40^{0}07'90.2", E 027^{0}21'50.9", 16.06.2012, T. 4096; Biga, Kirkgecit thermal spring, roadside, forest area, on soil, 46 m, N 40^{0}09'90.5", E 027^{0}12'64.7 ", 16.06.2012, T. 5030.
61. **Plagiomnium medium** (Bruch & Schimp.) T.J. Kop.: Canakkale, Biga, Hosoba Creek and environs, 458 m, on *Quercus* sp., UTM 531722441624, 16.06.2010, T. 2613.
62. ▲**Plagiomnium rostratum** (Schrad.) T.J.Kop.: Canakkale, Biga, near by the waterfalls, on wet rocks, N 40^{0}11'98.8", E 027^{0}20'61", 16.06.2010, T. 2620.
63. **Plagiomnium undulatum** (Hedw.) T.J.Kop.: Canakkale, Biga, Hosoba Creek and environs, , 439 m, UTM 531722441624, 16.06.2010, T. 2603; Biga, Abdiağa village, inner valley, Abdiağa creek, on wet soil near stream bed, 75 m, N 40^{0}19'02.2", E 027^{0}26'04.4", 16.05.2012, T. 4002; Yenice, Yolindi village, on humus rich soil, forest area, 165 m, N 40^{0}07'90.2", E 027^{0}21'50.9", 16.06.2012, T. 4095, 4097, 5003, 5018; Yenice, between Beyoglu wood store and Yolindi village, on boulder, forest area, 171 m, N 40^{0}06'81.9", E 027^{0}20'01.1", 16.06.2012, T. 5008; Biga, Kirkgecit, inner valley, on rock wet in the stream, *Quercus* sp., 53 m, N 40^{0}09'97.6", E 027^{0}12'84.3",16.06.2012, T. 5027.

Orthotrichaceae Arn.

64. ▲**Amphidium mougeotii** (Bruch & Schimp.) Schimp.:Canakkale, Biga, between Arabaalani and Kurşunlutepe villages, mixed forest *Pinus nigra, Abies nordmanniana* ssp. *equi-trojani*, on tree trunk, 542 m, N 40^{0}13'60.6", E 027^{0}29'46.4", 16.05.2012, T. 4048.
65. **Orthotrichum affine** Schrad. ex Brid.: Canakkale, Biga, mixed forest of *Platanus orientalis*, and *Juniperus oxycedrus*, on tree trunk, N 40^{0}07'44.6", E 027^{0}22'41.8", 542 m, 16.06.2010, T. 2676; Yenice, between Asagiinova village and Beyoglu wood store, *Quercus* sp. forest, on tree trunk and rock, 204 m, N 40^{0}06'81.9", E 027^{0}20'01.1", 16.06.2012, T. 4087, 4088; Biga, between Arabaalani and Kurşunlutepe villages, 543 m, on *Platanus orientalis* trunk, N 40^{0}13'61.3", E 027^{0}29'28.3", 16.05.2012, T. 4059.
66. **Orthotrichum anomalum** Hedw.: Canakkale, Biga, on rock, 391 m, N 40^{0}07'90", E 27^{0}22'43", 16.06.2010, T. 2691; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on trunk of *P. orientalis*, 62 m, N 40^{0}19'53.5", E027^{0}26'06", 16.05.2012, T. 4022.

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67. **Orthotrichum diaphanum** Schrad. ex Brid.: Canakkale, Biga, epiphytic on *Carpinus betulus* trunk, 439 m, 16.06.2010, T. 2630; Biga, on *Fagus orientalis* trunk, 391 m, N 40°07'90", E 27°22'43", 16.06.2010, T. 2690.
68. **Orthotrichum laevigatum** E. Zetterst.: Canakkale, Yenice, between Asagiinova village and Beyoglu wood store, forest area, on tree brunch, 224 m, N 40°05'10.9", E 027°17'93.6", 16.06.2012, T. 5013.
69. **Orthotrichum rupestre** Schleich. ex Schwägr.: Canakkale, Biga, Hosoba Creek and environs, on rocks, 452 m, N 40°07'41.9", E 027°22'33.7", 16.06.2010, T. 2614; Biga, between Arabaalani and Kurşunlutepe villages, mixed forest *Pinus nigra, Abies nordmanniana* ssp. *equi-trojani*, on tree trunk, 542 m, N 40°13'60.6", E 027°29'46.4", 16.05.2012, T. 4048; Yenice, between Asagiinova village and Beyoglu wood store, 204 m, *Quercus* sp. forest, on tree trunk, N 40°06'81.9", E 027°20'01.1", 16.06.2012, T. 5004.
70. ▲**Orthotrichum scanicum** Grönv.: Canakkale, Biga, on tree trunk of *Fagus orientalis, Quercus* sp., *Carpinus betulus*, 870 m, N 40°05'53.3", E 027°22'33.9", 16.06.2010, T. 2694.
71. ▲**Orthotrichum sordidum** Sull. et Lesq.: Canakkale, Biga, Hosoba Creek and environs, on *Platanus orientalis* trunk, 452 m, N 40°07'41.9", E 027°22'33.7", 16.06.2010, T. 2611.
72. **Orthotrichum speciosum** Nees: Canakkale, Biga, Arabaalani and Kurşunlutepe, mine area, on tree trunk, *Quercus petraea* ssp. *iberica* and *Q. frainetto*, 600 m, N 40°13'73.6", E 027°29'87.2", 16.06.2012, T. 4058.
73. ▲**Orthotrichum sprucei** Mont.: Canakkale, Biga, Arabaalani and Kurşunlutepe, mixed forest *Quercus petraea* ssp. *iberica* and *Q. frainetto*, on tree trunk, 600 m, N 40°13'73.6", E 027°29'87.2", 16.06.2012, T. 5022.
74. **Orthotrichum striatum** Hedw.: Canakkale, Yenice, between Asagiinova village and Beyoglu wood store, on *Quercus* sp. tree trunk, forest area, 230 m, N 40°05'10.4", E 027°17'93.6", 16.06.2012, T. 5014.
75. ▲**Orthotrichum urnigerum** Myrin: Canakkale, Yenice, between Asagiinova village and Beyoglu wood store, on rock, 198 m, N 40°05'84.6", E 027°18'76.4", 16.06.2012, T. 5023.

Amblystegiaceae Kindb.

76. **Amblystegium serpens** (Hedw.) Schimp.: Canakkale, Biga, mixed forest of *Platanus orientalis*, and *Juniperus oxycedrus*, on tree trunk, 110 m, N 40°11'84.8", E 027°19'76.8", 16.06.2010, T. 2600; Biga, Hosoba Creek and environs, on *Quercus* sp. trunk, 452 m, N 40°07'41.9", E 027°22'33.7", 16.06.2010, T. 2622; Biga, under *Tilia tomentosa*, on tree trunk, 59 m, N 40°11'84.9", E 027°20'40.2", 16.06.2010, T. 2666.
77. ▲**Hygrohypnum luridum** (Hedw.) Jenn.: Canakkale, Biga, between Elmali and Arabalani villages, on *Fagus sylvestris*, 350 m, N 40°13'56.2", E 027°28'24.1", 16.05.2012, T. 4043.
78. **Tomentypnum nitens** (Hedw.) Loeske: Canakkale, Biga, Kalafat village, nearby Nilufer Pond, on log, fen, 77 m, UTM 5258994451753, 16.06.2012, T. 4080.

Campyliaceae

79. **Pseudocalliergon turgescens** (T. Jensen) Loeske: Canakkale, Biga, mixed forest of *Fagus orientalis, Quercus* sp., *Carpinus betulus*, ferns, and *Rubus* sp., 700-800m, 40°06'N - 27°21'E, 16.06.2010, T. 2679.
80. ****Scorpidium cossonii** (Schimp.) Hedenäs: Canakkale, Can, Söğütalan village, nearby peat bog Ciğer gölü (Liver Lake), mixed forest of *Quercus* sp., *Pinus nigra* and *Abies nordmanniana* subsp. *equi-trojan*, *Equisetum* sp., and *Carex* sp., on a wet rocky bank, 650 m, 39°52'37" N, 26°55'40" E, June 16, 2012, T. 4086

Leskeaceae Schimp.

81. **Pseudoleskea incurvata** (Hedw.) Loeske var. **incurvata** (Hedw.) Loeske: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, *Platanus orientalis*, on humus rich soil, 45 m, N 40°19'73.1", E 027°25'98.4", 16.05.2012, T. 4007.

Brachytheciaceae Schimp.

82. **Brachytheciastrum velutinum** (Hedw.) Ignatov & Hutten: Canakkale, Biga, Hosoba Creek and environs, mixed forest of *Quercus cerris, Carpinus betulus* and *Tilia tomentosa*, on boulders, 452 m, N 40°07'41.9", E 027°22'33.7", 16.06.2010, T. 2604.
83. **Brachythecium albicans** (Hedw.) Schimp.: Canakkale, Biga, at nearby the river, on soil, 70 m, N 40°11'99", E 027°20'59", 16.06.2010, T. 2628.
84. **Brachythecium erythrorrhizon** Schimp.: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on *Platanus orientalis* root, 50 m, N 40°19'71.4", E 027°25'97.7", 16.05.2012, T. 4010; Biga, Arabaalani village and environs, trunk on the *Tilia tomentosa*, 350 m, N 40°15'48.2", E 027°30'76.4",16.05.2012, T. 4041; Biga, Arabaalani and Kurşunlutepe village and environs, *Pinus nigra* forest, on soil, 350 m, N 40°15'54.8", E 027°30'81.0", 16.05.2012, T. 4046.
85. **Brachythecium rutabulum** (Hedw.) Schimp.: Canakkale, Biga, *Abies nordmanniana* subsp. *equi-trojana* and *Fagus orientalis* mixed forests, N 40°06'11.1", E 027°21'75.1", 16.06.2010, T. 2621; Yenice, between Asagiinova village and Beyoglu wood store, frequently *Quercus* sp forest, on soil, 198 m, N 40°05'84.6", E 027°18'76.4", 16.06.2012, T. 4089.

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86. **Cirriphyllum crassinervium** (Taylor) Loeske & M. Fleisch.: Canakkale, Biga, Hosoba Creek and environs, mixed forest of *Quercus cerris, Carpinus betulus* and *Tilia tomentosa*, on rock, 452 m, N 40^{0}07'41.9", E 027^{0}22'33.7",16.06.2010,T. 2619; Biga, on rock, 42 m, N 40^{0}11'98", E 027^{0}20'61", 16.06.2010, T. 2625; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on boulder , 75 m, N 40^{0}19'02.2", E 027^{0}26'04.4", 16.05.2012, T. 4003.
87. **Eurhynchiastrum pulchellum** (Hedw.) Ignatov. var. **diversifolium** Ochyra & Zarnowiec: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, *Platanus orientalis*, on humus rich soil, 45 m, N 40^{0}19'73.1", E 027^{0}25'98.4", 16.05.2012, T. 4019; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on soil,78 m, N 40^{0}18'07.1", E 027^{0}26'06.1", 16.05.2012, T. 4026.
88. **Homalothecium sericeum** (Hedw.) Schimp.: Canakkale, Biga, Arabaalani village and environs, trunk on the *Tilia tomentosa*, 350 m, N 40^{0}15'48.2", E 027^{0}30'76.4", 16.05.2012, T. 4039; Yenice, between Asagiinova village and Beyoglu wood store, on tree trunk, forest area, 230 m, N 40^{0}05'10.4", E 027^{0}17'93.6", 16.06.2012, T. 5021; Biga, Kirkgecit thermal spring, roadside, on boulder, 48 m, N 40^{0}09'70.5", E 027^{0}12'28.6", 16.06.2012, T. 5033; Biga, Kirkgecit thermal spring, on tree trunk, 40 m, N 40^{0}09'96.5", E 027^{0}12'83.5", 16.06.2012, T. 5043, 5044.
89. **Kindbergia praelonga** (Hedw.) Ochyra: Canakkale, Biga, Kalafat village, Nilufer Pond, on rotten, 125 m, UTM 5258994451753, 16.06.2012, T. 4083.
90. **Oxyrrhynchium hians** (Hedw.) Loeske: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on soil, 76 m, N 40^{0}18'07.1", E 027^{0}26'06.1", 16.05.2012, T. 4038.
91. **Oxyrrhynchium schleicheri** (R.Hedw.) Röll.: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on boulder, 75 m, N 40^{0}19'02.2", E 027^{0}26'04.4",16.05.2012, T. 4018; Yenice, Yolindi village, on humus rich soil, forest area, 165 m, N 40^{0}07'90.2", E 27^{0}21'50.9",16.06.2012, T. 5001.
92. **Platyhypnidium riparioides** (Hedw.) Dixon: Canakkale, Biga, on soil, 569 m, N 40^{0}06'05.8", E 027^{0}21'06.6",16.06.2010, T.2673, 2674; Biga, near by the waterfalls, on wet rocks, 350 m, N 40^{0}11'99", E 027^{0}20'59, 16.06.2010,T. 2607, 2608; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, under *Platanus orientalis*, on soil, 45 m, N 40^{0}19'73.1", E 027^{0}25'98.4", 16.05.2012, T. 4005; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on boulder,75 m, N 40^{0}19'02.2", E 027^{0}26'04.4", 16.05.2012, T. 4018; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, *Platanus orientalis* forest, 45 m, on rocks, N 40^{0}19'73.1", E027^{0}25'98.4", 16.05.2012, T. 4031; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on rock and on tree root, 78 m, N 40^{0}18'95.1", E 027^{0}26'15.4", 16.05.2012, T. 4033, 4037; Biga, between Arabaalan and Kurşunlutepe villages, *Platanus orientalis* forests, on tree roots, 554 m, N 40^{0}13'61.3", E 027^{0}29'28.3", 16.05.2012, T. 4051; Yenice, Yolindi village, forest area, upper surface of rock, 165 m, N 40^{0}07'90.2", E 027^{0}21'50.9", 16.06.2012, T. 4099; Yenice, between Beyoglu wood store and Yolindi village, on boulder, forest area, 171 m, N 40^{0}06'81.9", E 027^{0}20'01.1", 16.06.2012, T. 5008; Biga, Kirkgecit, valley, on boulder, nearby stream, 212 m, N 40^{0}06'02.8", E 027^{0}14'10.0", 16.06.2012, T. 5050.
93. **Pseudoscleropodium purum** (Hedw.) M. Fleisch.: Canakkale, Biga, Hosoba Creek and environs, mixed forest of *Quercus cerris, Carpinus betulus* and *Tilia tomentosa*, on boulders, 452 m, N 40^{0}07'41.9", E 027^{0}22'33.7", 16.06.2010, T. 2603; Yenice, Yolindi village, on humus rich soil, forest area,165 m, N 40^{0}07'90.2", E 027^{0}21'50.9", 16.06.2012, T. 4096.
94. **Rhynchostegium confertum** (Dicks.) Schimp.: Canakkale, Biga, Arabaalani village and environs, trunk on the *Tilia tomentosa*, 350 m, N 40^{0}15'48.2", E 027^{0}30'76.4",16.05.2012, T. 4041; Canakkale, Yenice, Yolindi village, forest area, on humus rich soil, 140 m, N 40^{0}07'90.3", E 027^{0}21'51.4", 16.06.2012, T. 5002; Biga, Kirkgecit thermal spring, on slope, on boulder, 77 m, N 40^{0}07'76.5", E 027^{0}13'10.5", 16.06.2012, T. 5055.
95. **Rhynchostegium megapolitanum** (F. Weber & D.Mohr) Schimp.: Canakkale, Biga, at nearby the river, humus rich soil, 70 m, N 40^{0}11'99", E 027^{0}20'59", 16.06.2010, T. 2627, 2667; Biga, Kurşunlutepe village, mixed forest *Pinus nigra, Abies nordmanniana* ssp. *equi-trojani*, on soil banks, 542 m, N 40^{0}13'60.6", E 027^{0}29'46.4", 16.05.2012, T. 4053, 4061; Yenice, Yolindi village, on humus rich soil, forest area,165 m, N 40^{0}07'90.2", E 027^{0}21'50.9", 16.06.2012, T. 4094.
96. **Rhynchostegium murale** (Hedw.) Schimp.: Canakkale, Biga, near by the waterfalls, on rocks, 350 m, N 40^{0}11'99", E 027^{0}20'59, 16.06.2010, T. 2610; Biga, Yolindi village and environs, nearby creek and covered by diatoms, 391 m, N 40^{0}07'90", E 27^{0}22'43.4",16.06.2010, T. 2643; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on rock, 78 m, N 40^{0}18'95.1", E 027^{0}26'15.4", 16.05.2012, T. 4027, 4034; Yenice, Yolindi village, on humus rich soil, forest area consists of *Acer* sp. and *Juglans regia*, 165 m, N 40^{0}07'90.2", E 027^{0}21'50.9", 16.06.2012, T. 5018.
97. ▲**Rhynchostegiella curviseta** (Brid.) Limpr.: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on damp soil, 78 m, N 40^{0}18'07.1", E 027^{0}26'06.1", 16.05.2012, T. 4027.

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98. **Sciuro-hypnum populeum** (Hedw.) Ignatov & Huttunen: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on humus rich soil, 75 m, N 40^{0}19'53.5", E 027^{0}26'06", 16.05.2012, T. 4021.
99. **Sciuro-hypnum reflexum** (Starke) Ignatov & Huttunen: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on tree root, 76 m, N 40^{0}18'07.1", E 027^{0}26'06.1", 16.05.2012, T. 4023; Biga, Kalafat village, nearby Nilufer Pond, on log, 125 m, UTM 5258994451753, 16.06.2012, T. 4082.
100. **Scleropodium caespitans** (Müll. Hal.) L. F. Koch.: Canakkale, Biga, on rocks, 569 m, N 40^{0}06'05.8", E 027^{0}21'06.6",16.06.2010, T. 2640; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on boulders, 75 m, N 40^{0}19'02.2", E 027^{0}26'04.4", 16.05.2012, T. 4036.
101. **Scleropodium touretii** (Brid.) L.F.Koch.: Canakkale, Biga, Hosoba Creek and environs, on rock, 210 m, N 40^{0}08'26.9", E 027^{0}22'27.9", 16.06.2010; T. 2618; Biga, Kirkgecit thermal spring, roadside, on boulder, 44 m, N 40^{0}09'69.9, E 027^{0}12'28.4", 16.06.2012, T. 5031; Biga, Kirkgecit thermal spring, roadside, on soil, 39 m, N 40^{0}09'90.3", E 027^{0}12'64.6", 16.06.2012, T. 5046.
102. **Scorpiurium circinatum** (Bruch) M. Fleisch. & Loeske: Canakkale, Biga, *Quercus sp., Fraxinus sp., Arbutus* sp.,*Rubus* sp. and *Tilia tomentosa*, at nearby the river, humus rich soil, 70 m, N 40^{0}11'99", E 027^{0}20'59", 16.06.2010, T. 2664, 2667, 2669.

Hypnaceae Schimp.

103. ▲**Hypnum andoi** A. J. E. Smith: Canakkale, Biga, Kalafat village, nearby Nilufer Pond, on tree trunks, 125 m, UTM 5258994451753, 16.06.2012, T. 4082.
104. **Hypnum callichroum** Brid.: Canakkale, Biga, Kalafat village, nearby Nilufer Pond, on rotten, 125 m, UTM 5258994451753, 16.06.2012, T. 4083.
105. **Hypnum cupressiforme** Hedw.var. **cupressiforme**: Canakkale, Biga, Abdiağa village, inner valley, nearby Abdiağa creek, *Platanus orientalis* trunk, 80 m, N 40^{0}18'94.2", E 027^{0}26'13.0", 16.05.2012, T. 4008; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, mixed forest *Carpinus betulus, Cornus mas* and *Fraxinus angustifolia*, on boulder, 542 m, N 40^{0}18'95.1", E 027^{0}26'15.3", 16.05.2012, T. 4028, 4029; Biga, Kalafat village, Nilufer Pond, on log, fallen, 75 m, UTM 5258994451753, 16.06.2012, T. 4080; Yenice, between Asagiinova village and Beyoglu wood store, *Quercus* sp. forest, on tree trunk, 204 m, N 40^{0}06'81.9", E 027^{0}20'01.1", 16.06.2012, T. 5011; Biga, Kirkgecit thermal spring, roadside, on tree trunk, 53 m, N 40^{0}09'92.6", E 027^{0}12'84.3", 16.06.2012, T. 5052.
106. **Hypnum cupressiforme** Hedw.var. **lacunosum** Brid.: Canakkale, Biga, *Laurus nobilis*, *Fraxinus* sp. and ferns area, 439 m, N 40^{0}07'44", E 027^{0}22'40", 16.06.2010, T. 2633, 2668; Biga, mixed forests of *Abies nordmanniana* subsp. *equi-trojana* and *Fagus orientalis*, on tree trunk, 730 m, N 40^{0}05'66.1, E 027^{0}21'77.5", 16.06.2010, T. 2681; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on boulder ,75 m, N 40^{0}19'02.2", E 027^{0}26'04.4",16.05.2012, T. 4017.
107. **Hypnum cupressiforme** Hedw.var. **resupinatum** (Taylor) Schimp.: Canakkale, Biga, between Arabaalani and Kurşunlutepe villages, on *Pinus nigra* trunk, 350 m, N 40^{0}15'54.8", E 027^{0}30'81.0", 16.05.2012, T. 4042; Biga , Kurşunlutepe, mixed forest *Pinus nigra, Abies nordmanniana* ssp. *equi-trojani*, on tree trunk, 542 m, N 40^{0}13'60.6", E 027^{0}29'46.4", 16.05.2012, T. 4045.
108. **Hypnum imponens** Hedw.: Canakkale, Biga, Kalafat village, Nilufer Pond, on log, on tree root, 125 m, UTM 5258994451753, 16.06.2012, T. 4084.
109. **Hypnum jutlandicum** Holmen & E. Warncke: Canakkale, Yenice, between Asagiinova village and Beyoglu wood store, forest area, on tree brunch, 224 m, N 40^{0}05'10.9", E 027^{0}17'93.6", 16.06.2012, T. 5012; Yenice, between Asagiinova village and Beyoglu wood store, 199m, epiphytic on *Quercus* sp., N 40^{0}05'84.6", E 027^{0}18'76.7", 16.06.2012, T. 5016.
110. ▲**Hypnum revolutum** (Mitt.) Lindb.: Canakkale, Biga, on rock, 42 m, N 40^{0}11'98", E 027^{0}20'61", 16.06.2010, T. 2625.

Leucodontaceae Schimp.

111. **Antitrichia curtipendula** (Hedw.) Brid.: Canakkale, Biga, Armutcuk Hill, *Pinus nigra* and *Castanea sativa* forest, on tree trunks, 676 m, N 40^{0}06'07.4", E 027^{0}21'70.7", 16.06.2010, T. 2600; Biga, *Abies nordmanniana* ssp. *equi-trojana* and *Fagus orientalis* forest, 870 m, N 40^{0}05'66.1", E 027^{0}21'77.5", 16.06.2010, T. 2680, 2682.
112. ▲**Leucodon sciuroides** (Hedw.) Schwägr. var. **morensis** (Schwägr.) De Not: Canakkale, Biga, mixed forest of *Platanus orientalis* and *Juniperus oxycedrus*, 731 m, N 40^{0}05'66.2", E 027^{0}21'75.9", 16.06.2010, T. 2598; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, on trunk of *P. orientalis*, 62 m, N 40^{0}19'53.5", E 027^{0}26'06", 16.05.2012, T. 4011, 4012; Biga, Kurşunlutepe, mixed forest *Pinus nigra, Abies nordmanniana* ssp. *equi-trojani*, on tree trunk, 542 m, N 40^{0}13'60.6", E 027^{0}29'46.4", 16.05.2012, T. 4045; Yenice, between Asagiinova village and Beyoglu wood store, 198 m, epiphytic on *Quercus* sp., N 40^{0}05'11.2", E 027^{0}17'93.2", 16.06.2012, T. 5015.

Neckeraceae Schimp.

113. ▲**Homalia trichomanoides** (Hedw.) Brid.: Canakkale, Biga, Hosoba Creek and environs, mixed forest of *Quercus cerris, Carpinus betulus* and *Tilia tomentosa*, on boulders, 452 m, N 40^{0}07'41.9", E 027^{0}22'33.7",16.06.2010,T. 2619.

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114. **Leptodon smithii** (Hedw.) F. Weber & D. Mohr.: Canakkale, Biga, Armutcuk hill, 870 m, epiphytic on *Carpinus betulus*, N 40°05'53.3", E 027°22' 33.9", 16.06.2010, 2609, 2629; Canakkale, Biga, mixed forest of *Fagus orientalis, Quercus* sp., *Carpinus betulus*, ferns, *Rubus* sp., on tree trunk, 724 m, N 40°06' 67.2", E 027°21'79.8", 16.06.2010, T. 2670.
115. **Neckera complanata** (Hedw.) Huebener: Canakkale, Yenice, between Beyoglu wood store and Yolindi village, on boulder, 193 m, N 40°06'79.6", E 027°20'32.0",16.06.2012, T. 4092.
116. ▲**Neckera pennata** Hedw.: Canakkale, Yenice, between Asagiinova village and Beyoglu wood store, 198 m, epiphytic on *Quercus* sp., N 40°05'11.2", E 027°17'93.2", 16.06.2012, T. 5025 (Second record)
117. **Thamnobryum alopecurum** (Hedw.) Gangulee: Canakkale, Biga, near by the waterfalls, on wet rocks, 350 m, N 40°11'99", E 027°20'59, 16.06.2010, T. 2605, 2606; Biga, Abdiağa village, inner valley, nearby Abdiağa creek, *Platanus orientalis* forest area, on humus rich soil, 45 m, N 40°19'73.1", E 027°25'98.4", 16.05.2012, T. 4007; Yenice, Yolindi village, on humus rich soil, mixed forest *Acer* sp. and *Juglans regia*, 165 m, N 40°07'90.2", E 027°21'50.9", 16.06.2012, T. 5000.

Lembophyllaceae *Broth*.

118. **Isothecium alopecuroides** (Lam. ex Dubois) Isov.: Canakkale, Biga, on *Fagus orientalis* trunk, 731 m, N 40°06'66.2", E 027°21'75.9", 16.06.2010, T. 2636.

Anomodontaceae *Kindb.*

119. **Anomodon viticulosus** (Hedw.) Hook. & Taylor: Canakkale, Biga, Arabaalani and Kurşunlutepe, *Platanus orientalis* forests, on tree trunk, 543 m, N 40°13'61.3", E 027°29'28.3", 16.06.2012, T. 4052; Yenice, between Beyoglu wood store and Yolindi village, on boulder, 193 m, N 40°06'79.6", E027°20'32.0", 16.06.2012, T. 4091, 4092; Yenice, between Beyoglu wood store and Yolindi village, river side and forest area, on tree root, 171 m, N 40°06'81.9", E 027°20'01.1", 16.06.2012, T. 5006, 5007, 5019; Yenice, between Beyoglu wood store and Yolindi village, on roadside, on boulder,193 m, N 40°06'72.7 ", E 027°19'91.3", 16.06.2012, T. 5010.

b) New National Records from Biga Peninsula, Canakkale.

Rhabdoweisia crispata *(Dicks.) Lindb.(Fig.3 A-H).*

TURKEY: Canakkale, Biga, between to Arabaalan village and Kurşunlutepe, inner valley, on soil in humid slope, 591 m, N 40°13'73", E 27°29'87", 16.06.2012, T. 4062.

Rhabdoweisia was treated in the family Rhabdoweisiaceae by Magill and Schelpe (1979) but most authors place the genus in the Dicranaceae (Rooy 1991). *Rhabdoweisia crispata* has the small size and bears resemblance to the genus *Weissia*. Plants form bright yellowish- green to green tufts or cushions up to 1.5 cm tall. Stems are erect, forked by innovations, red-brown, without central strand, with smooth rhizoids at base of stem. Leaves are oblong-lanceolate to narrowly lanceolate, obtuse to acute, keeled, strongly divergent when moist, and crisped when dry, leaf margin irregularly denticulate at the apex, costa ending below apex, mid leaf cells towards to upper cells rounded quadrate to quadrate hexagonal, 7.5-12.5 *μ*m wide; basal cells rectangular. Capsule ovoid, and peristome teeth linear to linear-lanceolate. *Rhabdoweisia crispata* was growing in humid shaded rock crevices. This species is rare and difficult to identify in the field and requires a qualified expert to make a positive identification.

According to checklists of the moss flora of Turkey (Uyar and Cetin 2004; Kürschner and Erdağ 2005), the present report is the first for *Rhabdoweisia crispata* in Turkey. At present, the species is known from Lebanon and Southwest Asia (Frey and Kürschner 2011). *Rhabdoweisia crispata* is known from throughout Europe, the Faroes, Greenland, North and South America, Juan Fernandez, Hawaii, Java, Japan, and eastern Asia, Kazakhstan and Africa (Nyholm 1965; O'Shea 1999; Smith 2004; Sabovljevic et al. 2008).

c) Grimmiaceae

Schistidium robustum *(Nees et Hornsch.) H. H. Blom (Fig. 4. A-G).*

TURKEY: Canakkale, Biga, Armutcuk hill, on calcareous rocks, 870 m, N 40°05'53.3", E 27°22'33.9", 16.06.2010, T. 2633; Biga, Kirkgecit, inner valley, on boulder, 214 m, N 40°06'02.6" , 027°14'10.2" E, 16.06.2012, T. 5045.

Schistidium Bruch & Schimp. is a large genus with about 120 species (Crosby *et al*. 2000) distributed throughout the world. The taxonomy of *Schistidium* is at present extremely unsettled. Bremer (1980a, 1980b, 1981) in a world revision of the genus reduced *Schistidium* to 12 species. In contrast, Blom (1996) in a revision of the *Schistidium apocarpum* (Hedw.) Bruch & Schimp. complex in Norway and Sweden recognized 31 species. Nearly all moss taxonomists agree that the genus is extremely complex and contains many more species than recognized by Bremer. Indeed, a recent molecular study (Goryunov *et al*. 2007) of eight *Schistidium* species from Russia and northwest Europe found strong support for the narrower species concepts of Blom. For many regions of the world, however, the number of *Schistidium* species present and the names associated with them remains an open question. The genus is perhaps best known in Europe where Hill *et al*. (2006) reported 42 species of *Schistidium* in Europe and Macaronesia. Blom (1998) and Smith (2004) divided European *Schistidium* into the following 5 groups and 3 subgroups: *Apocarpum* group (*Rivulare* subgroup,

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Aporcarpum subgroup, and *Strictum* subgroup), *Robustum* group, *Confertum* group, *Atrofuscum* group, and *Umbrosum* group. Kürschner & Erdağ (2005) reported 13 species of the genus *Schistidium* in Turkey. Townsend (2005) tentatively identified another species (*Schistidium submuticum* Zickendr.ex Blom) in the country and Yayintas (2009) was given new report of *S. agassizii* Sull. & Lesq. from Turkey. The following report of *S. robustum* (Nees et Hornsch.) H. H. Blom from Turkey increases the total number of species in that country to 16. Until know, this plant was only known from Europe, North America, Russia, and West Caucasus; this new record in Turkey fills both the bryological and distributional gap (Smith 2004; Ignatov *et al.* 2006; Lüth 2007).

Plants medium-sized to large, forming small group, characteristically noticeably hoary tufts. Central strand distinct, mostly broad. Hair-point coarse, mostly long and noticeable, 0.4–0.8 (–1.1) mm, rigid and straight, decurrent, densely spinulose and sharp. Costa and margins smooth. Lamina smooth, unistratose or less frequently with bistratose spots. Lamina cells mostly elongated and becoming shorter towards apex, 9–10(–11) µm wide in upper, 8–11 µm wide in central and lower parts of leaf, sinuose to strongly sinuose with incrassate walls. K+ red. Sporophytes common, and immersed; peristome patent to squarrose, sometimes twisted, 300-430 *µ*m, red or orange-red, densely papillose, entire or weakly perforated. Spores 8-11 *µ*m, smooth.

d) Amblystegiaceae

Scorpidium cossonii *(Schimp.) Hedenäs (Fig. A-E)*

TURKEY: Canakkale, Can, Söğütalan village, nearby peat bog Ciğer gölü (Liver Lake), mixed forest of *Quercus* sp., *Pinus nigra* and *Abies nordmanniana* subsp.*equi-trojan*, *Equisetum* sp., and *Carex* sp., on a wet rocky bank, 650 m, 39°52'37" N, 26°55'40" E, 16.06. 2012, T. 4086 (CNH, DUKE Herbarium).

Scorpidium cossonii grows in mineral-rich and often calcareous habitats in fens, springs, and periodically water-filled depressions, or sometimes on shores. It is widespread and often common in temperate to sub-polar areas of the northern and southern hemispheres, and in the Andes (Š t e c h o v á *et al*, 2008). According to some authors (Wynne, 1944; Mårtensson, 1956; Smith, 1978; Steere, 1978), *S. cossonii* and *S. revolvens* are so similar at a superficial examination that especially many earlier authors recognized only one or one species with two varieties (Nyholm, 1965; Crum & Anderson, 1981; Frey *et al*., 1995). Hedenäs & Eldenäs, according to their study in 2008, showed that the molecular data strongly support a clade including *S. cossonii* and *S. scorpioides* with *S. revolvens* as sister to this clade. According to checklists of the moss flora of Turkey (Kürschner & Erdağ, 2005; Uyar & Cetin, 2004), the present report is the first for *Scorpidium cossonii* in Turkey. At present, the species is known from Lebanon from Southwest Asia (Frey & Kürschner, 2011). According to the Ha´jkova´ and Ha´jek (2006) in central Europe, *S. cossonii* is more common than *S. revolvens*, which is restricted to relic stands in the mountains (Kučera and Va´nˇa, 2003). *Scorpidium cossonii* is known from throughout Europe, North and South America, Canada, Eurasia, Kazakhstan,Bosnia-Herzegovina, Bulgaria, Montenegro, Romania and Slovenia and (Nyholm, 1965; Smith, 2004; Sabovljevic *et al*. 2008).

The collecting area is placed on Can (Canakkale) (Fig.1) and the combination of geographical isolation, an unusual range of climatic conditions, and the meeting of Mediterranean and Euro–Siberian floristic regions have resulted in unique vegetation in this area. Depending on the elevation and slope-aspect, two vegetation types are common. At lower elevations and on south-facing slopes, Mediterranean vegetation is most prevalent and at higher elevations and on north-facing slopes the Black Sea vegetation type is abundant.

Scorpidium cossonii shows similar appearance to *S. revolvens* such as dark green to red colors, upright and abundant short branches, slender to robust patches, and upland plants. But *S. cossonii* is dioicous, the mid-leaf cells shorter in the stem leaves and the ends of these cells are square to shortly fusiform-narrowed in the first species whereas they are shortly to long fusiform-narrowed in *S. revolvens* (Smith, 2004; BFNA/bfnamenu). *Scorpidium cossonii* was gathered with *Fissidens adianthoides*, *Bryum pseudotriquetrum* and *Sphagnum fimbriatum*.

e) Additional New National Records from Thrace Region, Kirklareli.

i. *Mniaceae*

Mielichhoferia elongata *(Hoppe & Hornsch. ex Hook.) Hornsch. (Fig. 5. A-H).*

Turkey, Kirklareli, between Derekoy and Sukrupasa forest, *Fagus orientalis* and *Quercus petraea* forests, on soil, 453 m, 41°93'91.6" N, 027°51'38.8" E, 08.09.2011, T. 3468, *Conf.* J. Shaw.

Plant slender, forming yellow-green patches, and brown below, up to 1.5 cm high. Individual stems are slender and very delicate, with small, erect, and overlapping leaves that are 0.4–1.1 mm long, finely and toothed above and have an acute tip, leaf margin plane; nerve thin and ending below apex; upper leaf cells wide, elongate rhomboid, median cells 10 x 40.5 *µ*m and thin walled, basal cells 10 x 38 *µ*m and rectangular. Seta cygneous; capsule pyriform, spores 16 *µ*m.

The moss *Mielichhoferia elongata* belongs to a small group of specialists occurring on substrates with high copper concentrations. It has been termed a “copper moss” (Martensson & Berggren, 1954;

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Shacklette, 1967) and used as a geobotanical indicator plant to mineralization (Url, 1956; Brooks, 1971; Sassmann *et al*. 2010). As stated by Shaw (2000), the family Mielichhoferiaceae includes species that were traditionally classified in the Bryaceae, but are phylogenetically closer to the Mniaceae and molecular evidence showed that multiple loci suggest that the Mielichhoferiaceae may form early diverging lineages within the broader Mniaceae clade and the family may therefore be paraphyletic. The three genera of Mielichhoferiaceae were commonly classified in the Bryaceae till Cox and Hedderson (2003) published their phylogenetic study in which they showed that these genera are more closely related to Mniaceae than Bryaceae (BFNA/bfnamenu.htm).

According to checklists of the moss flora of Turkey (Uyar & Cetin, 2004; Kürschner & Erdağ, 2005; Kürschner & Frey, 2011), the present report is the first for *Mielichhoferia elongata* in Turkey. *Mielichhoferia elongata* is known from throughout west and central Europe, Spain, Pyrenees, Italy, Yugoslavia, North and South America, New Zealand, Australia, Caucasus, Russia, Asia, and east Africa (Ignatov *et al*. 2011; Nyholm, 1993; Smith, 2004).

Mielichhoferia and *Pohlia* grow in similar habitats. When saw this *Mielichhoferia* species are gametophytically similar to small species of *Pohlia*, but they can be distinguished by a characteristic whitish color and very small size. The main differences between the two genera are gametangia borne style; on short lateral shoots are seen in Mielichhoferia and terminal shoots are observed in *Pohlia.* Secondly differences are occurred the perichaetial leaves which are as long as or longer than vegetative leaves in *Pohlia* but are smaller, with more lax cells and shorter costa in *Mielichhoferia. Mielichhoferia elongata* differs from the *M. mielichhoreriana* in rather thin-walled laminal cells; less sharply acute leaves, and smooth scattered papillose rhizoids.

f) Meesiaceae

Meesia uliginosa *Hedw. (Fig. A-K).*

Turkey, Kirklareli, Demirköy, Yıldız Mountain, below Mahya hill, *Fagus orientalis* associated with *Quercus petraea* subsp. *iberica, Q. cerris*, and *Carpinus betulus*, 857 m, on damp soil, 41°78'33.3" N - 027°60'00" E, 09.09.2011, T 3688. *Conf.* J. Shaw.

The peak is Mahya Mountain (1,031 m), which is located between Demirköy and Kırklareli. Mahya Mountain and its surroundings annually receive 1500 mm precipitation, reflecting altitude and humid Black Sea influences.

Plants 0.1 – 2.5 cm long, blackish-green to dark green above, light brown to brownish-green below, branched, and rhizoids highly papillose. Leaves not in distinct rows, linear-ligulate to linear-lanceolate, non-decurrent or shortly decurrent, 1.5-4.0 mm long, 0.3-0.7 mm wide near leaf base, erect or erect-spreading when wet; apex obtuse or rounded; margin entire, strongly revolute at least in lower half; upper cells sub-quadrate to shortly rectangular, 13 x 5 μm, mid-leaf cells narrowly rectangular and smooth, 19 x 7 μm, basal cells rectangular, thin-walled, longer than mid-leaf cells; costa strong, usually more than 0.4 the width of leaf at base, 80 μm wide at base, usually ending below the apex; setae 0.6-5.0 cm long. Capsules pale brown and darker when old, asymmetrical and pyriform.

At first sight you can take it as a *Pohlia* or *Bryum* species. The ligulate leaves and strongly revolute leaf margins are distinctive structures of *Meesia uliginosa.* Among the most abundant moss species found in these fens are *Aulacomnium palustre*, *Bryum pseudotriquetrum, Drepanocladus aduncus,* and *Leptobryum pyriforme*.

Meesia uliginosa has a continuous circumpolar boreal distribution. Twelve species are distributed in North, Central, and South America; Europe; Asia; Africa; Australia; Pacific Islands (New Zealand). *Meesia* occurred on calcareous soil banks, on wet soil or peaty humus and in rich fens in boreal, alpine, and Arctic circumstances (Smith, 2004). According to checklists of the moss flora of Turkey (Uyar & Cetin, 2004; Kürschner & Erdağ, 2005; Kürschner & Frey, 2011), the present report is the first for *Meesia uliginosa* in Turkey. *Meesia uliginosa* is known from throughout Europe, Spain, Pyrenees, North America, Caucasus, Russia, Siberia, China, Kazakhstan, Mongolia, Greenland (Nyholm, 1993; Ochyra and Smith, 1999; Smith, 2004; Casas et al., 2006).

III. Discussion

As a result of the study 119 moss taxa belonging to 23 families and 60 genera have been found in the area. Among them, according to the grid-square of Henderson (1961) (Fig.1) 37 moss taxa are new records for the A1 grid-square. These are as follows: *Sphagnum fimbriatum, Polytrichum strictum, Timmia austiaca, Schistidium atrofuscum, S. dupretii, Fissidens crispus, F. monguilloni, Dichodontium pellucidum* var. *flavescens, Dicranum fuscescens, D. leioneuron, D. polysetum, D. tauricum, Dicranodontium uncinatum, Anoectangium sendtnerianum, Cinclidotus danubicus, C. fontinaloides, C. riparius, Tortella flavovirens, Bryum algovicum, B. uliginosum, Plagiobryum zierii, Plagiomnium rostratum, Amphidium mougetii, Orthotrichum laevigatum, O. scanicum, O. sordidum, O. sprucei, O. urnigerum, Hygrohypnum luridum, Rhynchostegiella curviseta, Hypnum andoi, H. revolutum, Leucodon sciuroides* var. *morensis, Homalia trichomanoides, Pseudocalliergon turgescens, Scorpidium cossonii* and *Neckera pennata*. Three new moss taxa (*Rhabdoweisia crispata, Schistidium robustum* and *Scorpidium cossonii*) are also reported as

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new records for Turkey. Moreover *Rhabdoweisia* is a new genus record for the moss flora of Turkey. Although the climate of the area is similar to the Mediterranean temperate zone, it is in a transition zone between the Mediterranean and Black Sea climates, so acrocarpous mosses contribute 60.5% and pleurocarpous mosses contribute 39.5% to total bryoflora.

The abundance of families in terms of moss species in the study area is as follows; Brachytheciaceae (21 taxa) and Pottiaceae (15 taxa), Orthotrichaceae (12 taxa), Bryaceae (9 taxa), Hypnaceae (8 taxa), Dicranaceae (7 taxa), Mniaceae (7 taxa), Polytrichaceae (7 taxa), Grimmiaceae (6 taxa), Neckeraceae (5 taxa) (Table 1). However, five families are represented monotypically in the area. Almost all pleurocarpous families have mesophytic or hygrophytic groups, especially Brachytheciaceae, Amblystegiaceae and Neckeraceae. Brachytheciaceae family is higher in our area because of forest vegetation is dominant in the north and northwest Biga peninsula, transition climatic conditions, in habitat having abundant water and many creeks and these contribute to the humidity.

The most species-rich genera are as follows: *Orthotrichum* (11 taxa), *Hypnum* (8 taxa), *Bryum* (8 taxa), *Plagiomnium* (6 taxa), *Dicranum* (6 taxa), *Polytrichum* (4 taxa), *Brachythecium* (4 taxa), *Schistidium* (4 taxa), *Fissidens* (4 taxa), *Cinclidotus* (3 taxa), *Didymodon,* (3 taxa) and *Rhynchostegium* (3 taxa) (Table 2). Other genera are represented by fewer than 3 taxa in the study area. This is the second record for *Neckera pennata* from Turkey. The first record was given from Kayseri - Yahyali, Hacer Forest (in press) and also *Sphagnum fimbriatum* is given as a new record from Turkey (in press).

In the north parts of the study area covered by *Platanus orientalis* forest, there occur *Pogonatum aloides, Didymodon rigidulus, D. vinealis* var. *flaccidus, Bryum pseudotriquetrum* var. *bimum, Plagiobryum zierii, Orthotrichum sordidum, Pseudoleskea incurvata, Brachythecium erythrorrhizon, Eurhynchiastrum pulchellum* var. *diversifolium, Platyhypnidium riparioides, Hypnum cupressiforme, Anomodon viticulosus.* Likewise in the north side of the study area covered by *Platanus orientalis, Quercus* sp., *Juglans regia* and *Acer platanoides* forest there occur *Pogonatum aloides, Fissidens crispus, F. monguillonii, Barbula unguiculata, Orthotrichum affine, Orthotrichum anomalum, Rhynchostegium murale* and *Thamnobryum alopecurum* on tree trunks and soil.

In the *Quercus* sp., *Carpinus betulus, Castanea sativa* and *Tilia tomentosa* forest area *Pogonatum nanum, Polytrichum juniperinum, P. strictum, Dicranum majus, D. fuscescens, Bryum caespiticium, Amblystegium serpens, Brachyheciastrum velutinum, B. erythrorrhizon, Cirriphyllum crassinervium, Homalothecium sericeum, Psedoscleropodium purum, Rhynchostegium confertum, Scorpiurium circinatum, Homalia trichomonaides* occur.

North side of study area covered by *Quercus petraea, Carpinus betulus, Fagus orientalis, Rubus* sp. and ferns mixed forest there occur *Polytrichum commune* var. *commune, P. piliferum, Dicranum scoparium, D. majus* and *Orthotrichum diaphanum* epiphytic on *Fagus orientalis*, *Timmia austriaca, Mnium hornum, Plagiomnium ellipticum, Hygrohypnum luridum, Orthotrichum diaphanum, O. scanicum, Oxyrrhynchium schleicheri, Hypnum jutlandicum, Hypnum cupressiforme* var. *cupressiforme, Leptodon smithii, Isothecium alopecuroides, Thamnobryum alopecurum, Neckera pennata* and epiphytic *on Quercus petraea* var. *iberica* and *Q. frainetto*.; *Dichodontium pellucidum, Dicranum leioneuron, Bryum torquescens, Plagiomnium undulatum, Orthotrichum affine, O. rupestre, O. spruce, O. striatum, Brachythecium rutabulum*; epiphytic on *Pinus nigra*: *Dicranoweisia cirrata*.

Towards to southern part of the study area covered by *Pinus nigra, Fagus orientalis* and *Abies nordmanniana* ssp. *equi-trojani* mixed forest area there occur *Bryum capillare, B. pallescens, Amphidium mougeotii, Orthotrichum rupestre, Brachythecium rutabulum, Rhynchostegium megapolitanum, Leucodon sciuroides* var. *morensis*, *Hypnum cupressiforme* var. *lacunosum, H. cupressiforme* var. *resupinatum* and *Antitrichia curtipendula*; covered by *Platanus orientalis* and *Juniperus oxycedrus* mixed forest area there occur *Dicranum tauricum*, *Orthotrichum affine*, and *Leucodon sciuroides* var. *morensis*.

The following bryophyte species were found to be abundant on rocks near stream beds and submerged or wet rock and soil: *Archidium alternifolium, Fissidens exilis, Dichodontium pellucidum var. flavescens, Cinclidotus danubicus, C. fontinaloides, C. riparius, Dialytrichia mucronata, Bryum creberrimum, Pohlia nutans, Plagiomnium rostratum, P. undulatum, Platyhypnidium riparioides, Rhynchostegium murale, Oxyrrhynchium hians* and *Sphagnum fimbriatum, Polytrichum strictum, Tomentypnum nitens, Kindbergia praelonga, Sciuro-hypnum reflexum, Hypnum andoi,* and *H. callichroum* were found near pond and bogs.

Our research shows that the northwest Anatolia is relatively rich in moss flora, when it is compared to other regions of Turkey respectively in Table 3 and Table 4, Kaz Dag (Erdag and Yayintas, 1999), Uludag (Cetin, 1999), Erdek-Bandirma (Oren *et al*., 2007), and Osmaneli district (Savaroglu *et al.*, 2011).

It is hoped that further study will contribute more species to the knowledge of moss flora in Turkey and that this study will be useful as a guide for future research.

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Table 1 : The distribution and percentage of the taxa according to the families.

Families	Number of Species	Rate (%)
Brachytheciaceae	21	17.64
Pottiaceae	15	12.60
Orthotrichaceae	12	10.08
Bryaceae	9	7.56

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Hypnaceae	8	6.72
Polytrichaceae	7	5.88
Mniaceae	7	5.88
Dicranaceae	7	5.88
Grimmiaceae	6	5.04
Neckeraceae	5	4.20
Fissidentaceae	4	3.36
Rhabdoweisiaceae	3	2.52
Amblystegiaceae	3	2.52
Leucodontaceae	2	1.68
Campyliaceae	2	1.68
Sphagnaceae	1	0.84
Timmiaceae	1	0.84
Leskeaceae	1	0.84
Lembophyllaceae	1	0.84
Anomodontaceae	1	0.84
Archidiaceae	1	0.84
Leucobryaceae	1	0.84
Melichhoferiaceae	1	0.84
Total: 23	119	100

Table 2 : The distribution and percentages of the taxa according to the genera.

Genera	No. of taxa	Rate (%)
Orthotrichum	11	9.24
Hypnum	8	6.72
Bryum	8	6.72
Plagiomnium	6	5.04
Dicranum	6	5.04
Polytrichum	4	3.36
Schistidium	4	3.36
Fissidens	4	3.36
Rhynchostegium	3	2.52
Didymodon	3	2.52
Brachythecium	3	2.52
Pogonatum	2	1.60
Grimmia	2	1.60
Tortula	2	1.60
Trichostomum	2	1.60
Oxyrrhynchium	2	1.60
Scleropodium	2	1.60
Sciuro-hypnum	2	1.60
Neckera	2	1.60
Sphagnum	1	0.84
Polytrichastrum	1	0.84
Dichodontium	1	0.84
Dicranoweisia	1	0.84
Rhabdoweisia	1	0.84
Archidium	1	0.84
Timmia	1	0.84
Dicranella	1	0.84
Dicranodontium	1	0.84
Anoectangium	1	0.84
Barbula	1	0.84
Dialytrichia	1	0.84
Tortella	1	0.84
Syntrichia	1	0.84
Plagiobryum	1	0.84
Pohlia	1	0.84
Mnium	1	0.84
Amphidium	1	0.84

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Amblystegium	1	0.84
Hygrohypnum	1	0.84
Pseudoleskea	1	0.84
Brachytheciastrum	1	0.84
Cirriphyllum	1	0.84
Homalothecium	1	0.84
Eurhynchiastrum	1	0.84
Kindbergia	1	0.84
Platyhypnidium	1	0.84
Pseudoscleropodium	1	0.84
Rhynchostegiella	1	0.84
Scorpiurium	1	0.84
Tomentypnum	1	0.84
Antitrichia	1	0.84
Leucodon	1	0.84
Homalia	1	0.84
Leptodon	1	0.84
Thamnobryum	1	0.84
Isothecium	1	0.84
Anomodon	1	0.84
Scorpidium	1	0.84
Pseudocalliergon	1	0.84
Total: 60	119	100

Table 3 : Comparison of the largest families in the study area and neighboring areas (taxa count and distribution percentage).

Largest families	Biga Peninsula (Biga, Yenice)	Kaz Dagi (Balikesir)	Uludag (Bursa)	Bandirma-Erdek (Balikesir)	Osmaneli (Bilecik)
Brachytheciaceae	21 (17.64)	27 (19.2)	10 (11.8)	23 (17.2)	15 (16.66)
Pottiaceae	15 (12.60)	25 (17.9)	10 (11.8)	20 (14.9)	21(23.33)
Orthotrichaceae	12 (10.08)	6 (4.3)	5 (5.9)	7 (5.2)	5 (5.55)
Bryaceae	9 (7.56)	9 (6.4)	8 (9.5)	7 (5.2)	6 (6.66)
Hypnaceae	8 (6.72)	6 (4.3)	2 (2.4)	6 (4.5)	7 (7.77)
Polytrichaceae	7 (5.88)	4 (2.8)	8 (9.5)	4 (3.0)	-
Mniaceae	7 (5.88)	7 (5.0)	4 (4.7)	3 (2.2)	5 (5.55)
Dicranaceae	7 (5.88)	3 (2.1)	4 (4.7)	2 (1.5)	1 (1.11)
Grimmiaceae	6 (5.04)	15 (10.7)	11 (12.9)	8 (6.0)	10 (11.11)
Neckeraceae	5 (4.20)	4 (2.8)	-	2 (1.5)	4 (4.44)

Table 4 : Comparison of the largest genera in the study area and neighboring areas (taxa count and distribution percentage).

Largest genera	Biga Peninsula (Biga, Yenice, Can)	Kaz Dagi (Balikesir)	Uludag (Bursa)	Bandirma-Erdek (Balikesir)	Osmaneli (Bilecik)
Orthotrichum	11	5	5	6	5
Hypnum	8	5	2	4	6
Bryum	8	7	7	7	6
Plagiomnium	6	4	1	3	5
Dicranum	6	1	2	1	1
Polytrichum	4	1	5	2	-
Schistidium	4	2	2	2	3
Fissidens	4	4	-	6	-
Cinclidotus	3	1	-	-	-
Rhynchostegium	3	2	1	2	1
Didymodon	3	-	1	4	3
Brachythecium	3	7	7	4	4

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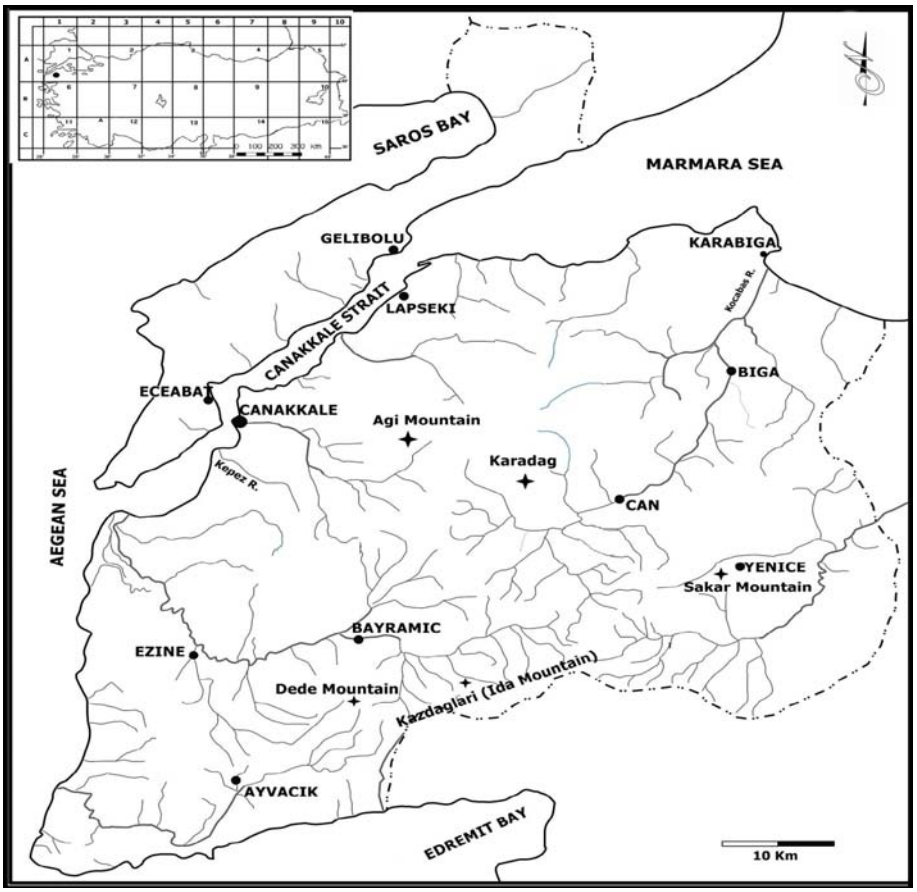

Figure 1 : Henderson grid system and study area – Biga Peninsula map.

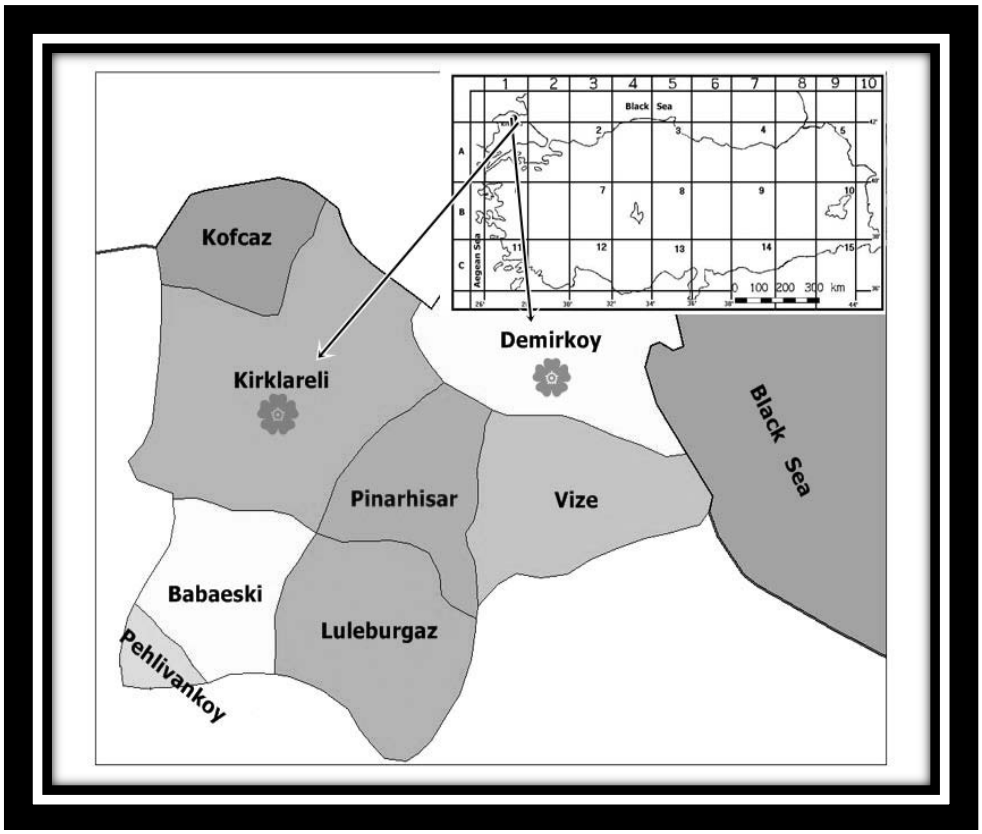

Figure 2 : Henderson grid system and study area – Thrace Region map.

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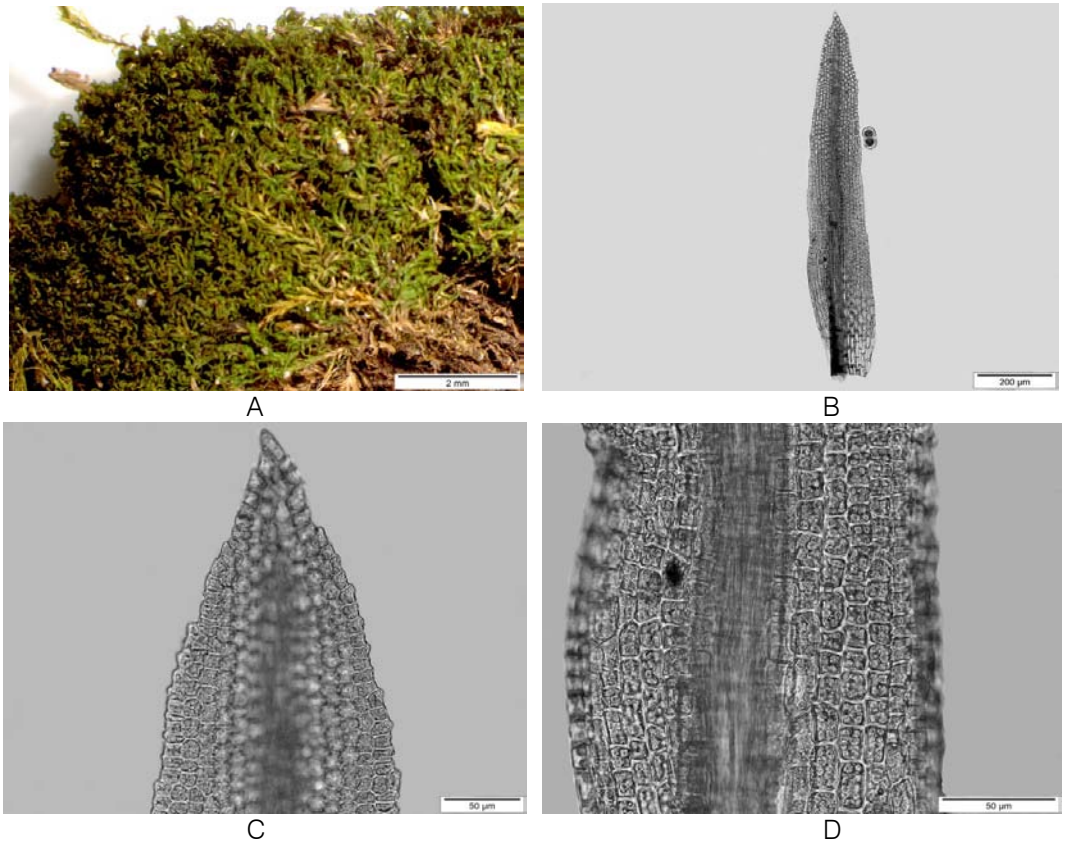

Figure 3 : *Rhabdoweisia crispata* (Dicks.) Lindb (A) Habitat; (B) whole leaf; (C) upper leaf cells; (D) mid-leaf cells.

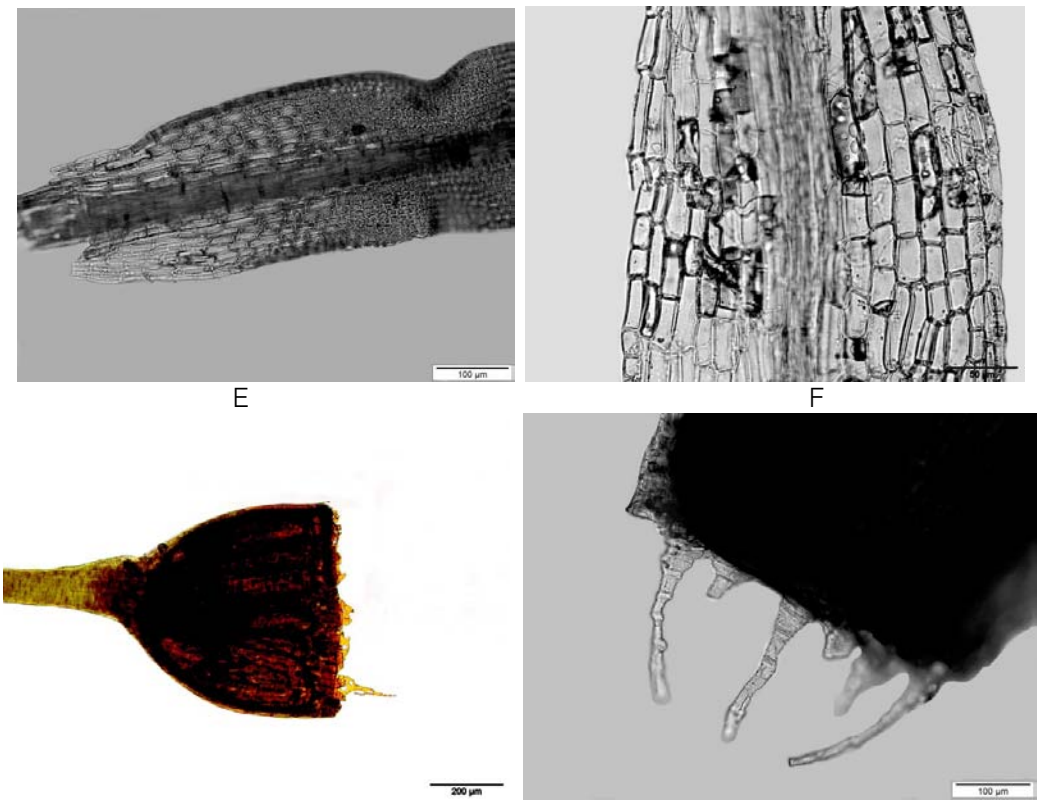

Figure 3 : *Rhabdoweisia crispata* (Dicks.) Lindb (E-F) leaf base cells; (G) sporophyte; (H) peristome teeth.

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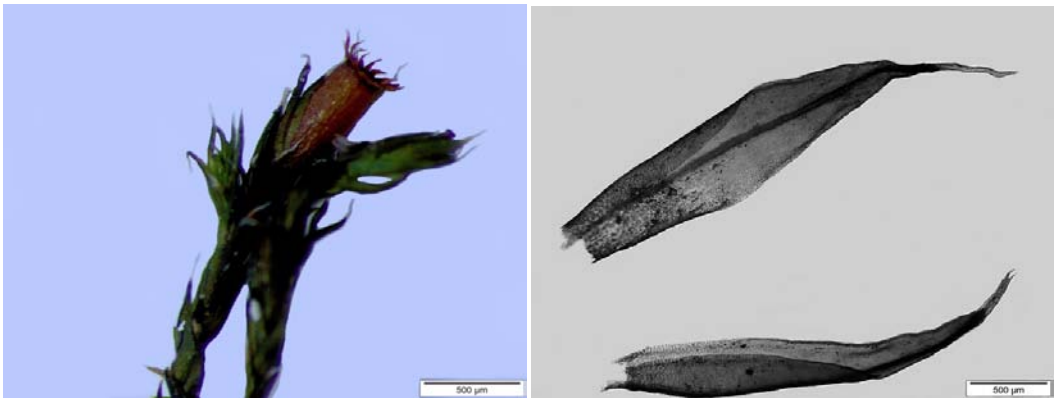


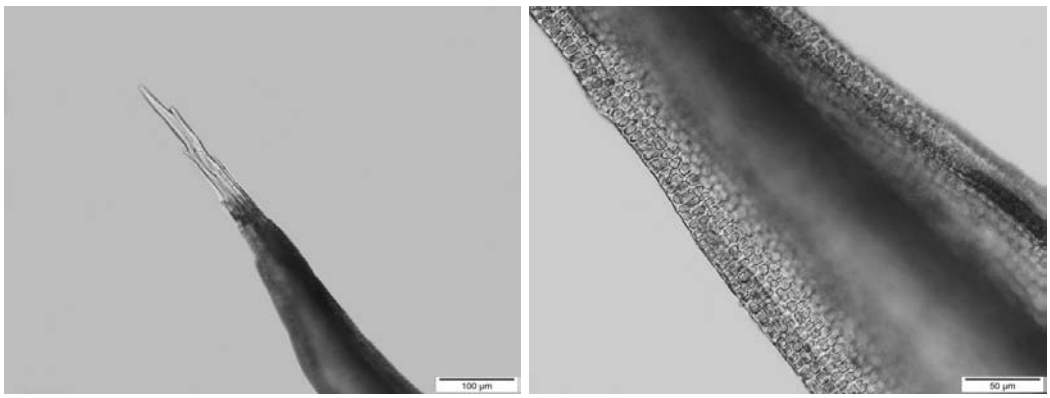
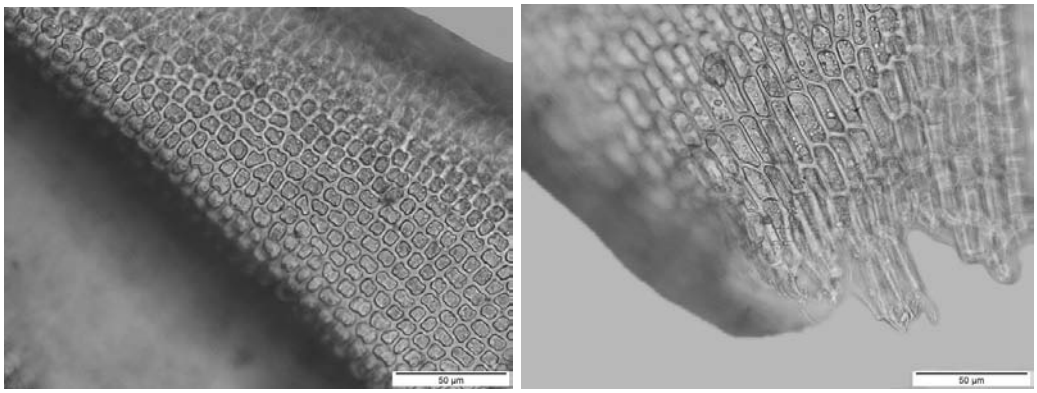


Figure 4 : *Schistidium robustum* (Nees et Hornsch.) H. H. Blom (A) General view; (B) leaves; (C) toothed hair point; (D) upper leaf cells.



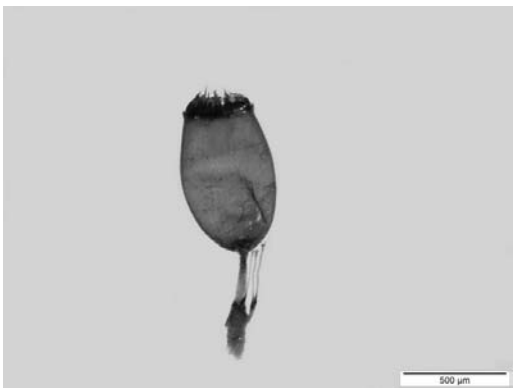


Figure 4 : *Schistidium robustum* (Nees et Hornsch.) H. H. Blom (E) mid-leaf cells; (F) leaf base cells; (G) sporophyte.

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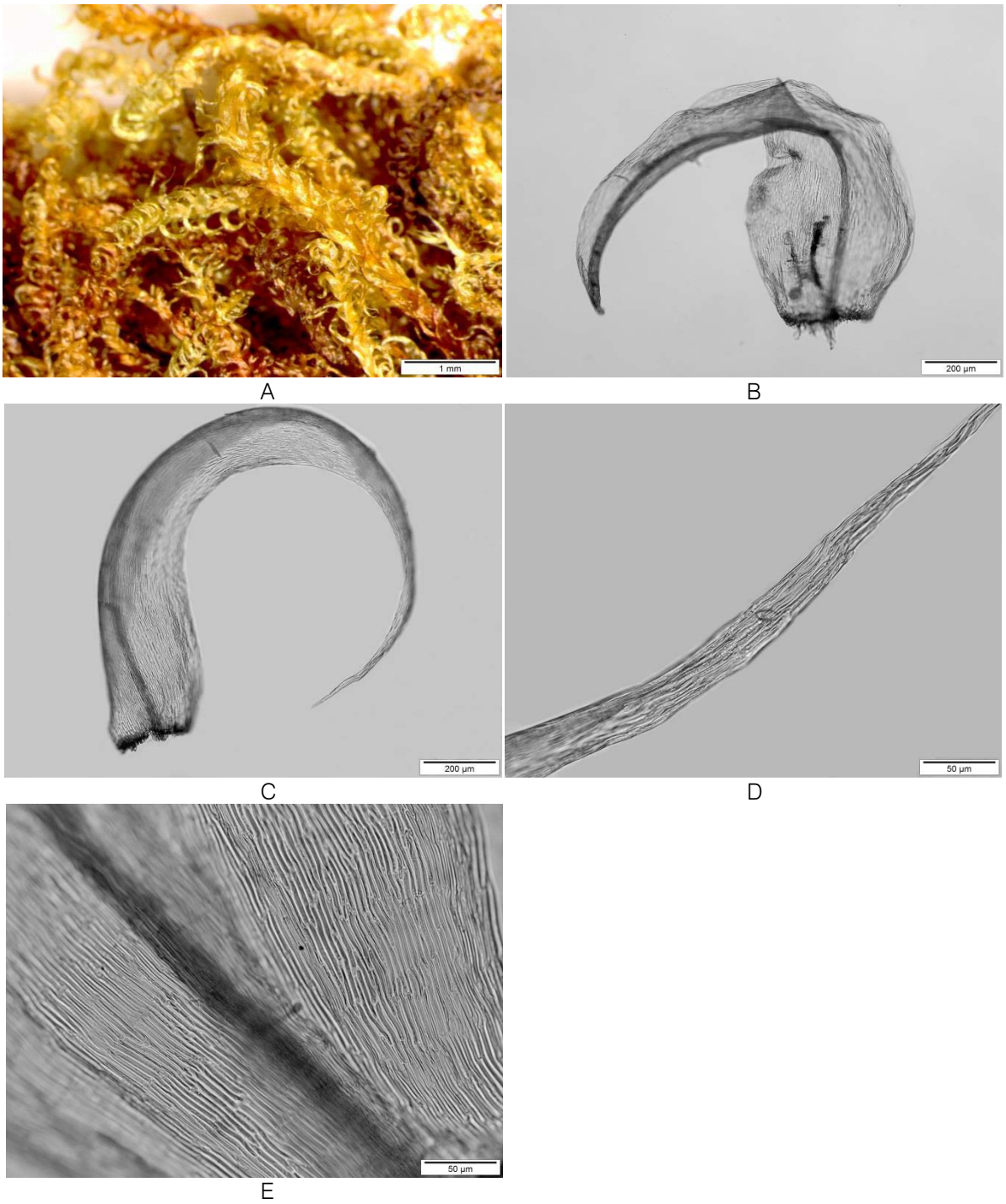

Figure 5 : *Scorpidium cossonii* (Schimp.) Hedenäs (A) Whole plant; (B-C) leaves; (D) long leaf tip; (E) nearby mid leaf and basal cells.

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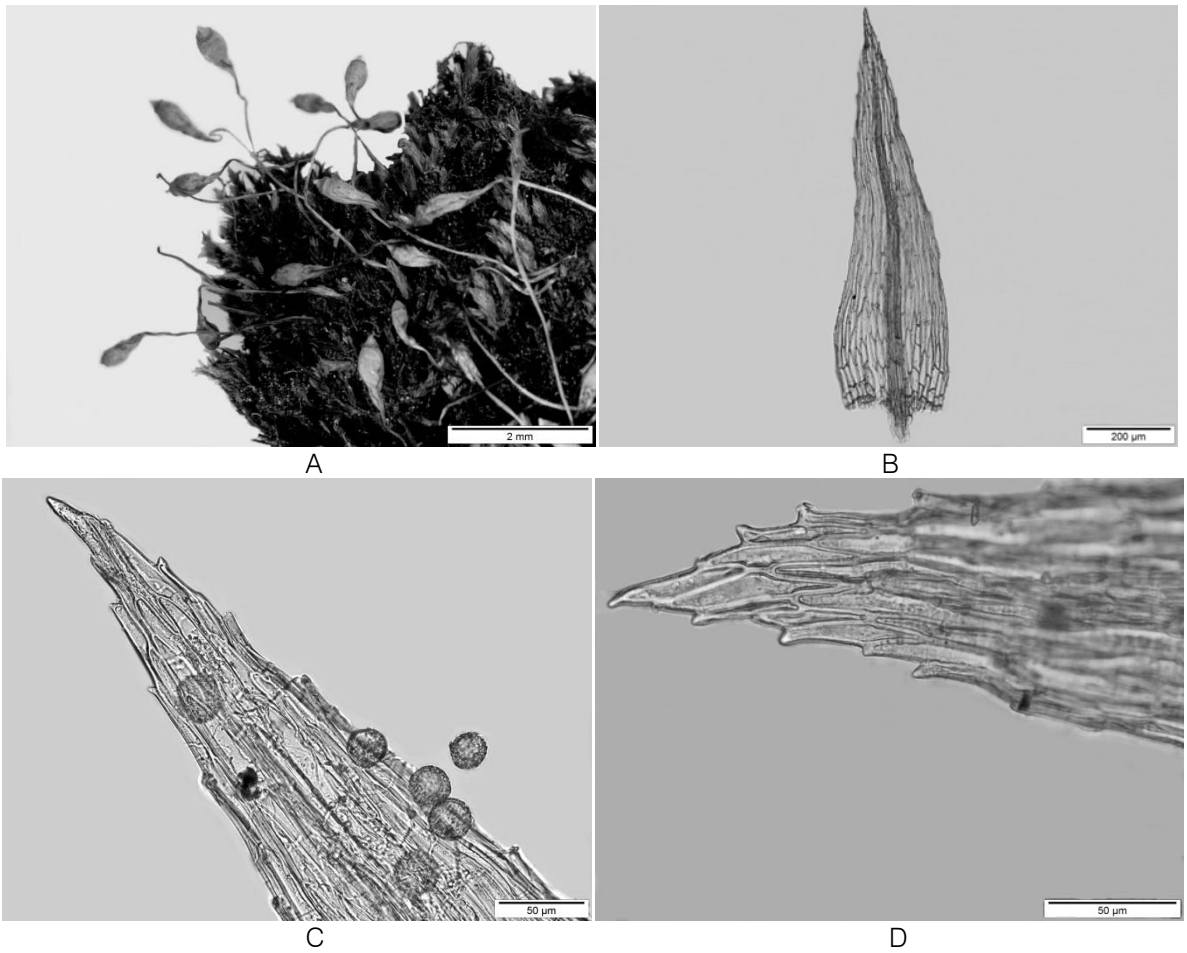
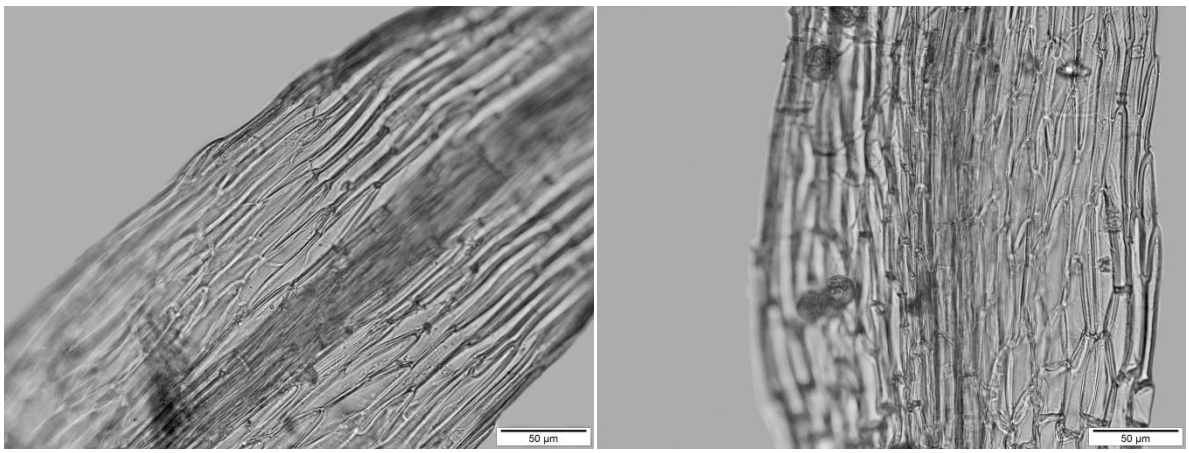


Figure 6 : Mielichhoferia elongata (Hoppe & Hornsch. ex Hook.) Hornsch. (A) Whole plant; (B) leaf; (C) leaf tip; (D) upper leaf cells.



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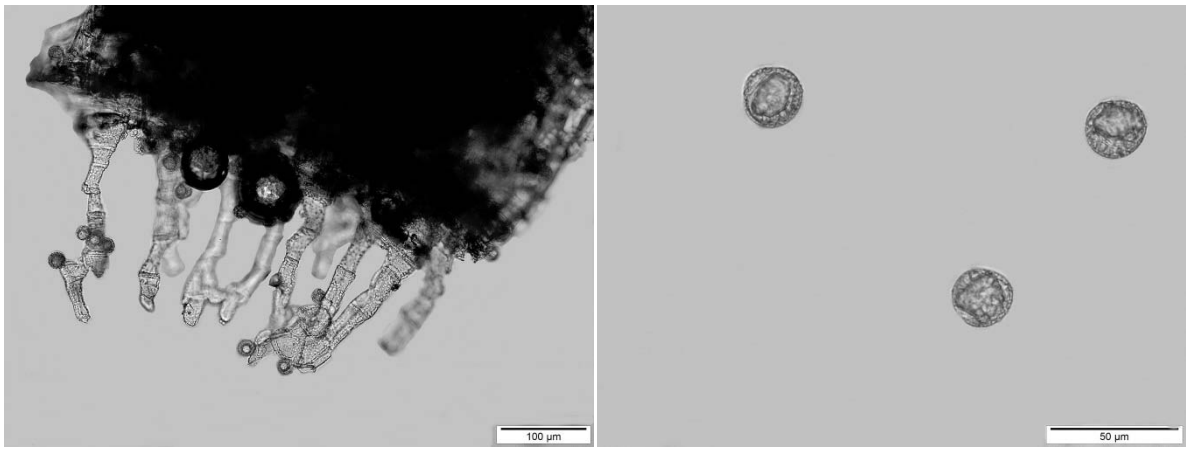

G H

Figure 6 : Mielichhoferia elongata (Hoppe & Hornsch. ex Hook.) Hornsch. (E) mid-leaf cells (F) leaf base cells; (G) peristome teeth; (H) spores.

A B

C D

Figure 7 : Meesia uliginosa Hedw. (A) Leaf; (B) leaf tip; (C) upper leaf cells; (D) mid-leaf cells

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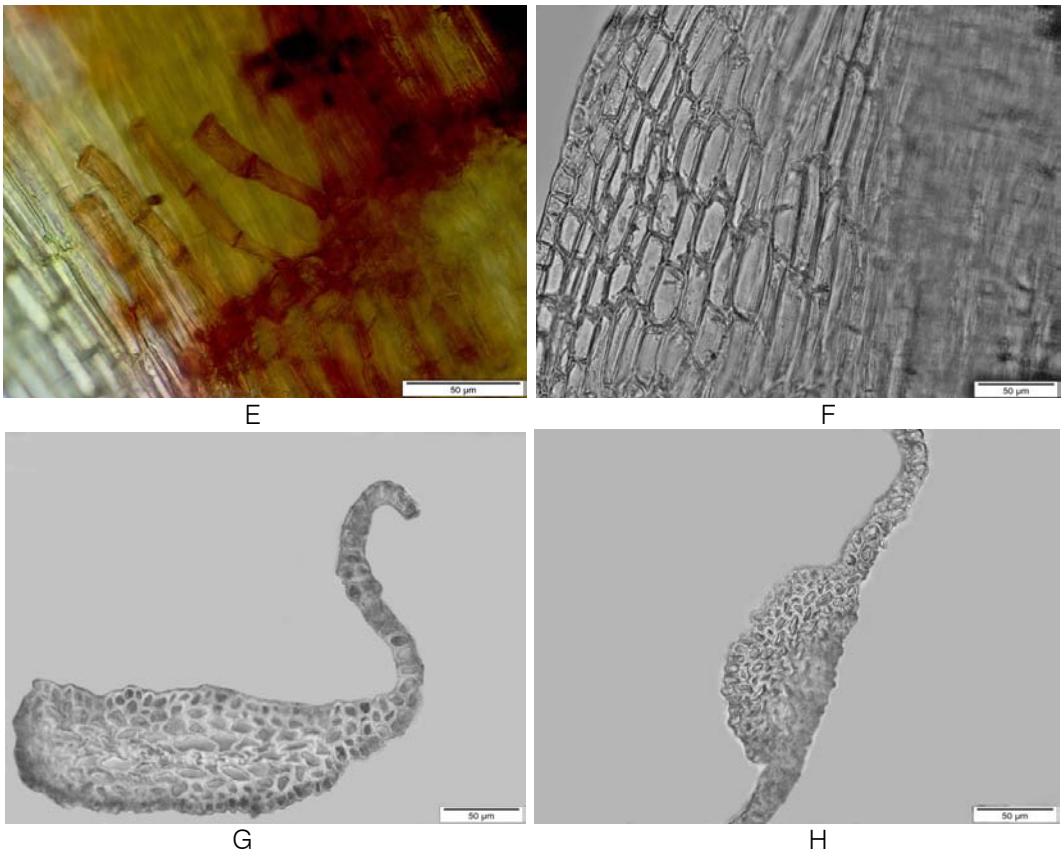

Figure 7 : *Meesia uliginosa* Hedw. (E) leaf base cells with rhizoids; (F) leaf base cells; (G-H) cross section of leaves.

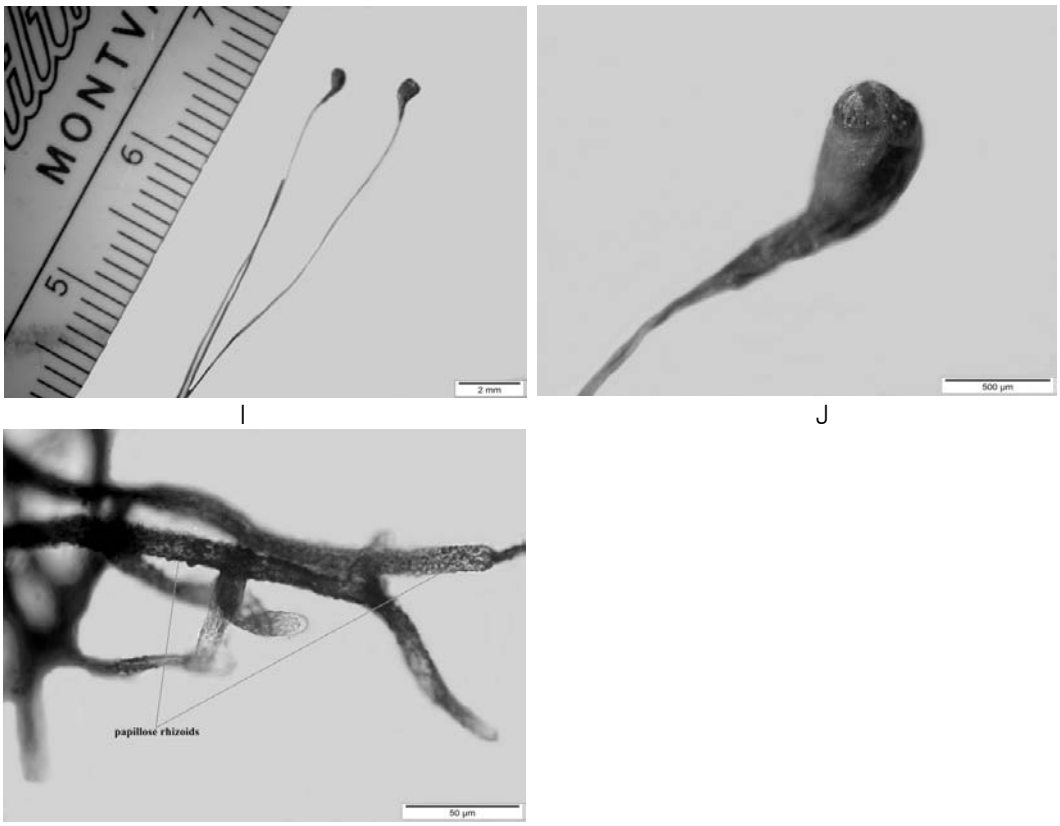

Figure 7 : *Meesia uliginosa* Hedw. (I-J) sporophytes; (K) papillose rhizoids.

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Scleractinian Corals of Loha Barrack Crocodile Sanctuary, Andaman and Nicobar Islands

By Tamal Mondal, C. Raghunatha & K. Venkataraman
Zoological Survey of India, India

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Keywords: *Scleractinian corals, Bay of Bengal, Loha Barrack Crocodile Sanctuary, Andaman and Nicobar Islands.*

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Scleractinian Corals of Loha Barrack Crocodile Sanctuary, Andaman and Nicobar Islands

Tamal Mondal [α], C. Raghunathan [σ] & K. Venkataraman [ρ]

Abstract- Loha Barrack Crocodile Sanctuary is the only protected area out of 96 for conserving crocodiles in its natural habitat at the western side of South Andaman region of Andaman and Nicobar Islands which is surrounded by Bay of Bengal. More than 91% of the sanctuary is covered by marine ecosystem. A total of 146 species of scleractinian corals under 49 genera and 14 families were reported during the present study. The maximum number of 34 species was found under the family Fungiidae which is the nucleus of scleractinian corals reef ecosystem. On the basis of then present study, more conservatory measures can be drawn on scleractinian corals in this sanctuary along with the target animal i.e. crocodile.

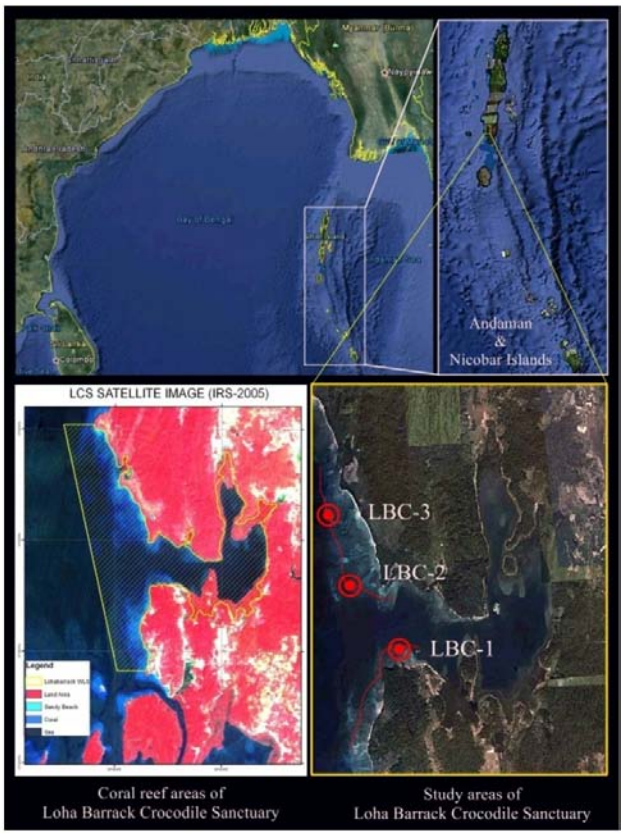
Keywords: Scleractinian corals, Bay of Bengal, Loha Barrack Crocodile Sanctuary, Andaman and Nicobar Islands.

I. Introduction

Loha Barrack Crocodile Sanctuary is the only sanctuary of Andaman and Nicobar Islands which was designated in 1983 primarily to conserve the salt water crocodile and its habitat [1]. The sanctuary is spread across about an area of 22.80 sq. km. where 20.80 sq.km areas are covered by marine ecosystems. The three sides of the sanctuary are surrounded by seashore whereas the Bay of Bengal surrounds the western side. Marine biodiversity is the most important aspect, basically sustain on the scleractinian corals, are known as the founder species of tropical marine ecosystem [2]. These hard corals are the crucial organisms of marine ecosystem by providing settlement cues [3-5], suitable place of living [6-8], reducing mortality rate [9-11], and several sustainable work towards the successful development of a great deal of faunal communities [12]. The present paper dealt with the scleractinian corals of Loha Barrack Crocodile Sanctuary for taking proper conservation plan along with the target species of this sanctuary.

II. Material and Methods

The extensive surveys were conducted at 3 stations such as LBC-1 (Lat. 11°38.035'N and Long. 92°38.722'E), LBC-2 (Lat. 11°38.765'N and Long. 92°35.837'E) and LBC-3 (Lat. 11°39.693'N and Long 92°35.520'E) of Loha Barrack Crocodile Sanctuary during the month of May, 2011 to explore the faunal communities by employing Self Contained Underwater Breathing Apparatus (SCUBA) diving, snorkeling (Map 1). At first, observations were made by Manta tow study method [13, 14]. Underwater digital photography of individual species was made by underwater camera (Sony-Cyber Shot, Model-T900, marine pack, 12.1 megapixels). The recorded scleractinian species of corals were identified following Veron and Pichon [15-17], Veron *et al.* [18] Veron and Wallace [19], Veron [20] and Wallace [21].



Map 1 : Study areas of Loha Barrack Crocodile Sanctuary

III. Results and Discussion

The study revealed out 146 species of scleractinian corals under 49 genera and 14 families from Loha Barrack Crocodile Sanctuary (Table 1). The maximum number of 34 species was seen under the family Fungiidae followed by family Faviidae (31 species) and family Acroporidae (23), whereas the

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minimum of only one species was recorded from family Astrocoeniidae and Dendrophylliidae each (Fig 1). A maximum number of 11 genera were recorded under the family Faviidae whereas the minimum of only one genus was recorded under four families such as Oculinidae, Astrocoeniidae, Siderastreaidae and Dendrophylliidae (Fig 2).

Table 1 : Scleractinian corals of Loha Barrack Crocodile Sanctuary

Sl. No.	Scientific Names
	Family: ACROPORIDAE Verrill, 1902
	Genus: *Acropora* Oken, 1815
1.	*Acropora cuneata* (Dana, 1846)
2.	*Acropora palifera* (Dana, 1846)
3.	*Acropora tenuis* (Dana, 1846)
4.	*Acropora hyacinthus* (Dana, 1846)
5.	*Acropora cerealis* (Dana, 1846)
6.	*Acropora austera* (Dana, 1846)
7.	*Acropora robusta* (Dana, 1846)
8.	*Acropora subglabra* (Brook, 1891)
9.	*Acropora spicifera* (Dana, 1846)
10.	*Acropora nobilis* (Dana, 1846)
11.	*Acropora aspera* (Dana, 1846)
12.	*Acropora robusta* (Dana, 1846)
13.	*Acropora forskali* (Ehrenberg, 1834)
14.	*Acropora gemmifera* (Brook, 1892)
15.	*Acropora formosa* (Dana, 1846)
16.	*Acropora latistella* (Brook, 1891)
17.	*Acropora florida* (Dana, 1846)
18.	*Acropora microphthalma* (Verrill, 1859)
	Genus: *Montipora* de Blainville, 1830
19.	*Montipora verrucosa* (Lamarck, 1816)
20.	*Montipora aequituberculata* Bernard, 1897
21.	*Montipora danae* (MED and H, 1851)
	Genus: *Astreopora* de Blainville, 1830
22.	*Astreopora myriphthalma* (Lamarck, 1816)
23.	*Astreopora listeri* Bernard, 1896
	Family: OCULINIDAE Gray,1847
	Genus: *Galaxea* Oken, 1815
24.	*Galaxea astreata* (Lamarck, 1816)
25.	*Galaxea fascicularis* (Linnaeus, 1767)
	Family: POCILLOPORIDAE Gray, 1842
	Genus: *Pocillopora* Lamarck, 1816
26.	*Pocillopora damicornis* (Linnaeus,1758)
27.	*Pocillopora ankeli* Scheer and Pillai, 1974
	Genus: *Stylophora* Lamarck, 1816
28.	*Stylopora pistillata* Esper, 1797
	Genus: *Seriatopora* Schweigger, 1819
29.	*Seriatopora stellata* Quelch, 1886
30.	*Seriatopora hystrix* Dana, 1846
	Family: ASTROCOENIIDAE Koby, 1890

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Genus: *Stylocoeniella* Yabe and Sugiyama, 1935

31. *Stylocoeniella armata* (Ehrenberg, 1834)

Family: SIDERASTREIDAE Vaughan and Wells, 1943

Genus: *Psammocora* Dana, 1846

32. *Psammocora digitata* MED and H, 1851
33. *Psammocora contigua* (Esper, 1797)
34. *Psammocora obtusangula* (Lamarck, 1816)

Family: AGARICIIDAE Gray, 1847

Genus: *Pachyseris* Milne Edwards and Haime, 1849

35. *Pachyseris speciosa* (Klunzinger, 1879)
36. *Pachyseris foliosa* Veron, 1990
37. *Pachyseris rugosa* (Lamarck,1801)
38. *Pachyseris gemmae* Nemenzo, 1955

Genus: *Pavona* Lamarck,1801

39. *Pavona venosa* (Ehrenberg, 1834)
40. *Pavona varians* Verrill, 1864
41. *Pavona duerdeni* Vaughan, 1970
42. *Pavona maldivensis* (Gardiner, 1905)

Genus: *Leptoseris* Milne Edwards and Haime,1849

43. *Leptoseris mycetoseroides* Wells, 1954

Genus: *Gardineroseris* Scheer and Pillai, 1974

44. *Gardineroseris planulata* (Dana, 1846)

Family: FUNGIIDAE Dana,1846

Genus: *Cycloseris* Milne Edwards and Haime,1849

45. *Cycloseris somervillei* (Gardiner, 1909)
46. *Cycloseris erora* (Doderlein, 1901)
47. *Cycloseris costulata* (Ortmann, 1889)
48. *Cycloseris colini* Veron, 2002
49. *Cycloseris sinensis* MED and H, 1849
50. *Cycloseris cyclolites* (Lamarck, 1801)
51. *Cycloseris vaughani* (Boschma, 1923)
52. *Cycloseris patelliformis* (Boschma, 1923)
53. *Cycloseris curvata* (Hoeksema, 1989)

Genus: *Diaseris* Edwards and Haime ,1849

54. *Diaseris distorta* (Michelin, 1843)

Genus: *Ctenactis* Verrill, 1864

55. *Ctenactis ecninata* (Pallas, 1766)
56. *Ctenactis crassa* (Dana, 1846)

Genus: *Herpolitha* Eschscholtz, 1825

57. *Herpolitha limax* (Houttuyn, 1772)
58. *Herpolitha weberi* Horst,1921

Genus: *Fungia* Lamarck,1801

59. *Fungia concinna* Verrill, 1864
60. *Fungia corona* Doderlein, 1901
61. *Fungia danai* MED and H,1851
62. *Fungia fralinae* Nemenzo,1955
63. *Fungia fungites* (Linnaeus,1758)

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64. *Fungia granulosa* Klunzinger, 1879
65. *Fungia horrida* Dana, 1846
66. *Fungia klunzingeri* Doderlein, 1901
67. *Fungia moluccensis* Horst, 1919
68. *Fungia paumotensis* Stutchbury, 1833
69. *Fungia puishani* Veron and De Vantier, 2000
70. *Fungia repanda* Dana, 1846
71. *Fungia scutaria* Lamarck,1801
72. *Fungia scabra* (Doderlein,1901)

Genus: *Podabacia* Milne Edwards and Haime,1849

73. *Podabacia crustacea* (Pallas, 1766)
74. *Podabacia lankaeneis* Veron, 2002

Genus: *Lithophyllon* Rehberg, 1892

75. *Lithophyllon lobata (*Horst, 1921)
76. *Lithophyllon undulatum* Rehberg, 1892

Genus: *Polyphyllia* Quoy and Gaimard,1833

77. *Polyphyllia talpina* (Lamarck, 1801)

Genus: *Sandalolitha* Quelch, 1884

78. *Sandalolitha robusta* Quelch, 1886

Family: FAVIIDAE Gregory, 1900

Genus: *Diploastrea* Matthai, 1914

79. *Diploastrea heliopora* (Lamarck, 1816)

Genus: *Leptoria* Milne Edwards and Haime,1848

80. *Leptoria phrygia* (Ellis and Solander, 1786)

Genus: *Cyphastrea* Milne Edwards and Haime, 1848

81. *Cyphastrea chalcidicum* (Forskal, 1775)
82. *Cyphastrea microphthalma* (Lamarck, 1816)
83. *Cyphastrea japonica* Yabe and Sugiyama, 1932

Genus: *Caulastrea* Dana, 1846

84. *Caulastrea furcata* Dana, 1846
85. *Caulastrea connata* (Ortmann, 1892)

Genus: *Goniastrea* Milne Edwards and Haime ,1848

86. *Goniastrea minuta* Veron, 2002
87. *Goniastrea retiformis* (Lamarck, 1816)
88. *Goniastrea edwardsi* Chevalier,1971

Genus: *Favia* Oken, 1815

89. *Favia pallida* (Dana, 1846)
90. *Favia matthaii* Vaughan, 1918
91. *Favia rotumana* (Gardiner, 1899)
92. *Favia danae* Verrill, 1872

Genus: *Platygyra* Ehrenberg, 1834

93. *Platygyra pini* Chevalier, 1975
94. *Platygyra sinensis* (MED and H, 1849)
95. *Platygyra acuta* Veron, 2002
96. *Platygyra verweyi* Wijsman-Best 1976

Genus: *Favites* Link, 1807

97. *Favites spinosa* (Klunzinger, 1879)

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98. *Favites pentagona* (Esper, 1794)
99. *Favites russelli* (Wells, 1954)
100. *Favites complanata* (Ehrenberg, 1834)
101. *Favites vasta* (Klunzinger, 1879)

Genus: *Montastrea* de Blainville, 1830

102. *Montastrea colemani* Veron, 2002
103. *Montastrea salebrosa* (Nemenzo, 1959)
104. *Montastrea valenciennesi* (MED and H, 1848)

Genus: *Echinopora* Lamarck, 1816

105. *Echinopora lamellosa* (Esper, 1795)
106. *Echinopora horrida* Dana, 1846
107. *Echinopora pacificus* Veron, 1990

Genus: *Leptastrea* Milne Edwards and Haime, 1848

108. *Leptastrea purpurea* (Dana, 1846)
109. *Leptastrea aequalis* Veron, 2002

Family: PORITIDAE Gray, 1842

Genus: *Porites* Link, 1807

110. *Porites lobata* Dana, 1846
111. *Porites monticulosa* Dana, 1846
112. *Porites murrayensis* Vaughan, 1918
113. *Porites cylindrica* Dana, 1846
114. *Porites rus* (Forskal, 1775)
115. *Porites solida* (Forskal, 1775)

Genus: *Goniopora* de Blainville, 1830

116. *Goniopora columna* Dana, 1846
117. *Goniophora lobata* MED and H, 1860
118. *Goniopora stokesi* Milne Edwards and Haime, 1851
119. *Goniopora minor* Crossland, 1952

Family: MUSSIDAE Ortmann, 1890

Genus: *Symphyllia* Milne Edwards and Haime, 1848

120. *Symphyllia radians* MED and H,1849
121. *Symphyllia recta* (Dana,1846)
122. *Symphyllia valenciennesii* Milne Edwards and Haime, 1849
123. *Symphyllia agaricia* MED and H, 1849

Genus: *Lobophyllia* de Blainville, 1830

124. *Lobophyllia corymbosa* (Forskal,1775)
125. *Lobophyllia hemprichii* (Ehrenberg, 1834)

Genus: *Cynarina* Bruggemann , 1877

126. *Cyanarina lacrymalis* (MED and H, 1848)

Family: PECTINIDAE Vaughan and Wells, 1943

Genus: *Pectinia* Oken, 1815

127. *Pectinia paeonia* (Dana, 1846)
128. *Pectinia alcicornis* (Saville-Kent,1871)
129. *Pectinia lactuca* (Pallas, 1766)

Genus: *Echinophyllia* Klunzinger,1879

130. *Echinophyllia orpheensis* Veron and Pichon, 1980
131. *Echinophyllia echinoporoides* Veron and Pichon, 1980

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132. *Echinophyllia aspera* (Ellis and Solander, 1788)
133. *Euphyllia ancora* Veron and Pichon, 1980

Genus: *Mycedium* Oken,1815

134. *Mycedium elephantotus* (Pallas, 1766)

Genus: *Oxypora* Saville Kent,1871

135. *Oxypora crassispinosa* Nemenzo, 1979
136. *Oxypora lacera* (Verrill, 1864)

Family: MERULINIDAE Verrill,1866

Genus: *Merulina* Ehrenberg, 1834

137. *Merulina ampliata* (Ellis and Solander, 1786)
138. *Merulina scabricula* Dana, 1846

Genus: *Hydnophora* Fischer de Waldheim,1807

139. *Hydnophora exesa* (Pallas,1766)
140. *Hydnophora microconos* (Lamarck, 1816)
141. *Hydnophora rigida* (Dana, 1846)

Genus: *Scapophyllia* Milne Edwards and Haime, 1848

142. *Scapophyllia cylindrica* MED and H, 1848

Family: EUPHYLLIDAE Veron, 2000

Genus: *Euphyllia* Dana, 1846

143. *Euphyllia glabrescens* (Chamisso and Eysenhardt, 1821)

Genus: *Plerogyra* Milne Edwards and Haime, 1848

144. *Plerogyra sinuosa* (Dana, 1846)

Genus: *Physogyra* Quelch, 1884

145. *Physogyra lichtensteini* MED and H, 1851

Family: DENDROPHYLLIIDAE Gray, 1847

Genus: *Turbinaria* Oken, 1815

146. *Turbinaria peltata* (Esper, 1794)

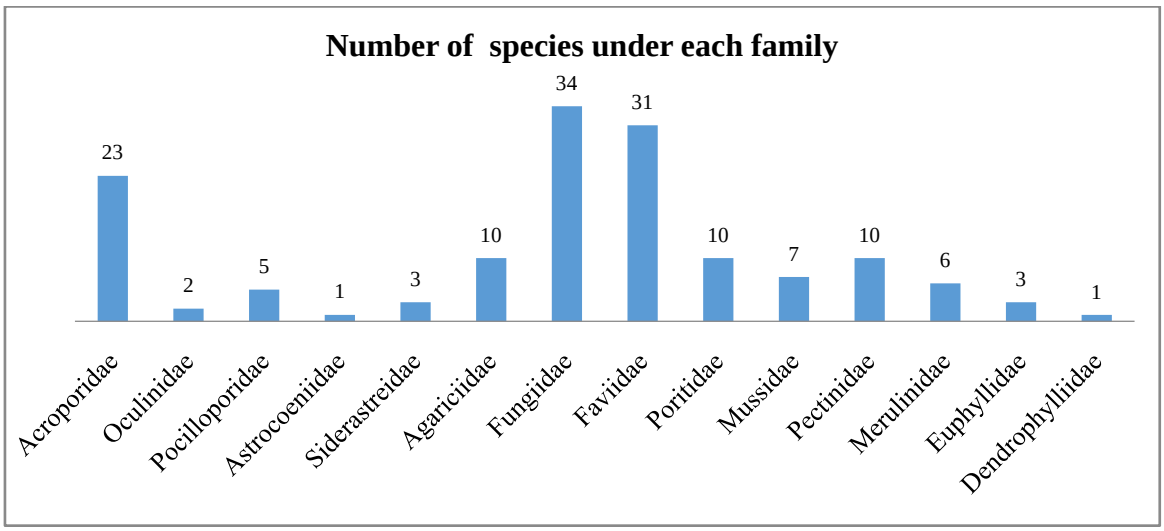

Figure 1 : Number of species present under each family at Loha Barrack Crocodile Sanctuary

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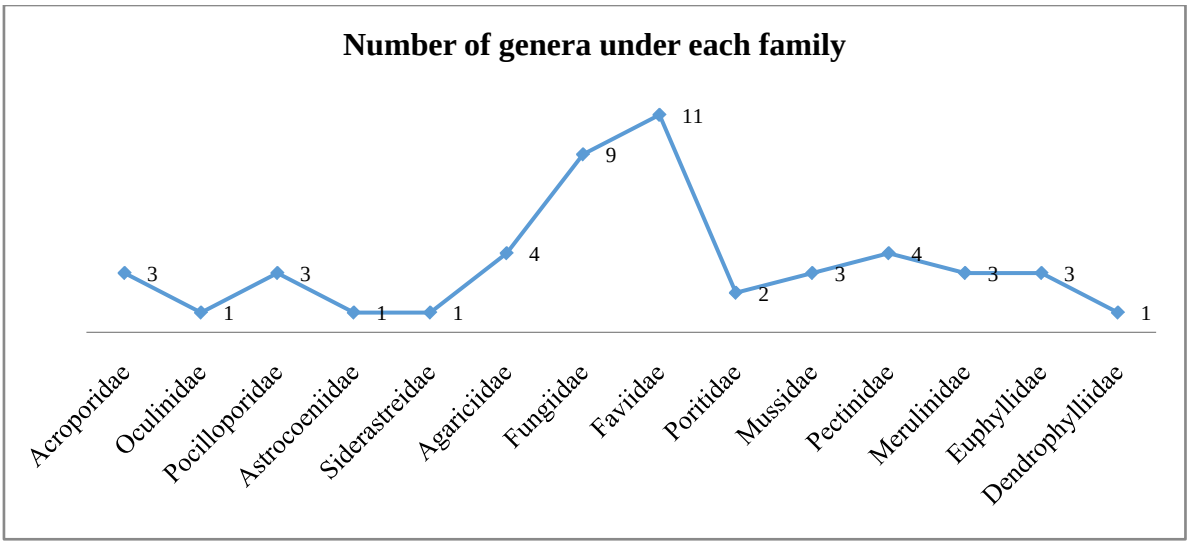

Figure 2 : Number of genera present under each family at Loha Barrack Crocodile Sanctuary

Coral are the most productive ecosystem in marine environment. Out of 34 described phyla, 32 are recorded from the coral reef ecosystem [22]. Andaman and Nicobar Islands are the place with fringing type of coral reef mostly in the eastern part and the barrier type reefs can be seen in the western part of these groups of islands [23]. The present study was carried out at the western continental shelf of Andaman and Nicobar Island, but the immediate western continental shelf of the islands also showed fringing type reef in and around Loha Barrack Crocodile Sanctuary area. The studies on scleractinian corals of the said sanctuary were not made earlier though the reports are available on other parts of the Andaman and Nicobar Islands. In 2003, the gross exploration of the scleractinian lives of Andaman and Nicobar Islands stated 208 species of corals [23]. Later on in 2010, Ramakrishna *et al.* enlisted a total number of 418 hard corals from different areas of Andaman and Nicobar Islands [24]. Later on 2012, Tamal Mondal *et al.* listed 479 species of corals under 17 families from these groups of islands through the data collected by Zoological Survey of India [25]. Development and growth of scleractinian corals are highest in an oligotrophic environmental condition [26]. The presence of 30.48% of total species and 82.35% of total genera content of Andaman and Nicobar Islands reported from Loha Barrack Crocodile Sanctuary denotes the favorable ecological attributes of that area for their sustainable progression. The reports of present study will be helpful to conserve the coral reefs of the Loha Barrack Crocodile Sanctuary besides Crocodiles.

IV. Conclusion

Loha Barrack Crocodile Sanctuary is the only sanctuary for the crocodiles among the 96 of Andaman and Nicobar Islands. Due to the presence of this target animal i.e. crocodile, it is quite difficult to make underwater studies on scleractinian corals. But extensive SCUBA diving was made at the LBC Sanctuary to record the scleractinian corals to make proper conservatory measures along with the crocodile. A total of 146 species of hard corals were documented from the study areas which signifies the enriched biogenic marine habitat of this sanctuary.

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Effect of Coconut Milk and Benzyl Amino Purine on the Vegetative Growth, Nutritional and Chemical Constituent of *Amaranthus Hybridus* Linnaeus seedlings

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Abstract- Studies were carried out to investigate the effects of 10%, 15% coconut milk and 50mg/L, 100mg/L Benzyl amino purine on the vegetative growth, nutritional and photochemical constituents of *Amaranthus hybridus* Linnaeus seedlings. Plants sprayed with water were the controls. All the treatments resulted in significantly increased leaf number, stem girth, plant height, shoot/root ratio, leaf area ratio and chlorophyll content of the vegetable with highest values recorded in treatments with 15% coconut milk at 14 weeks after planting. Treatments with 15% coconut milk also resulted in greater mineral elements contents at 14 weeks after planting of the vegetable. Alkaloids (3.55), saponins (1.66), phenols (0.36) and flavonoids levels (0.85) were higher in 15% coconut milk treated plants, whereas phytic acid (1.26) and hydrocyanic acids levels (15.30) were greater in 100mg/L Benzyl amino purine and 10% coconut milk respectively at 14 weeks after planting.

Keywords: amaranthus hybridus, coconut milk, benzyl amino purine, chlorophyll content, nutritional contents, phytochemical constituents.

GJSFR-C Classification : FOR Code: 060799

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Effect of Coconut Milk and Benzyl Amino Purine on the Vegetative Growth, Nutritional and Chemical Constituent of *Amaranthus Hybridus* Linnaeus seedlings

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Abstract- Studies were carried out to investigate the effects of 10%, 15% coconut milk and 50mg/L, 100mg/L Benzyl amino purine on the vegetative growth, nutritional and photochemical constituents of *Amaranthus hybridus* Linnaeus seedlings. Plants sprayed with water were the controls. All the treatments resulted in significantly increased leaf number, stem girth, plant height, shoot/root ratio, leaf area ratio and chlorophyll content of the vegetable with highest values recorded in treatments with 15% coconut milk at 14 weeks after planting. Treatments with 15% coconut milk also resulted in greater mineral elements contents at 14 weeks after planting of the vegetable. Alkaloids (3.55), saponins (1.66), phenols (0.36) and flavonoids levels (0.85) were higher in 15% coconut milk treated plants, whereas phytic acid (1.26) and hydrocyanic acids levels (15.30) were greater in 100mg/L Benzyl amino purine and 10% coconut milk respectively at 14 weeks after planting. The study shows that 15% coconut milk persistently had the greater potentials to increase vegetative growth, nutritional and phytochemical constituents of *Amaranthus hybridus* leading to its significance in nutrients requirements of man and usefulness in medicinal industries.

Keywords: amaranthus hybridus, coconut milk, benzyl amino purine, chlorophyll content, nutritional contents, phytochemical constituents.

I. Introduction

Vegetables are essential in the diet as they provide plant fibre, mineral elements, vitamins, carbohydrates and proteins (Hollingsworth, 1981). In Nigeria, as in most other tropical countries of Africa where the daily diet is dominated by starchy staple foods, vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acid (Okafor, 1983). Many of the local vegetable materials are under-exploited because of inadequate scientific knowledge of their nutritional potentials. Though several works reporting compositional evaluation and functional properties of various types of edible wild plants in use in the developing countries abound in literature, much still need to be done. Many workers (Lockeett *et al.,* 2000; Akindahunsi and Salawu, 2005; Edeoga *et al.,* 2006; Hassan and Umar, 2006; Ekop, 2007) have reported the compositional evaluation and functional properties of various types of edible wild plants in use in the developing countries. In Nigeria, *Amaranthus hybridus* L, popularly called 'efo tete', 'tete oyinbo' or 'tete-nla' in Yoruba land (Gbile, 2002), is an annual herbaceous plant of 1- 6 feet high. The leaves are alternate petioled, 3 – 6 inches long, dull green, and rough, hairy, ovate or rhombic with wavy margins. The flowers are small, with greenish or red terminal panicles. Taproot is long, fleshy red or pink. The seeds are small and lenticellular in shape; with each seed averaging 1 – 1.5 mm in diameter and 1000 seeds weighing 0.6 – 1.2 g. It is rather a common species in waste places, cultivated fields and barnyards. In Nigeria, *Amaranthus hybridus* leaves combined with condiments are used to prepare soup (Oke, 1983; Mepha *et al.*, 2007). In Congo, their leaves are eaten as spinach or green vegetables (Dhellot *et al.*, 2006). The growth regulators influence plant growth and development at very low concentrations while they inhibit at high concentrations (*Jules et al.*, 1981). Monthly foliar spraying of geranium (Pelergonium graveolens) resulted in increased plant height and herb production (Mohammed *et al.,* 1983). Spraying of datura plant, *Datura innoxia* planted in different salinity concentrations with chlormequat, ethephon or kinetin was found to enhance plant growth, alkaloidal and soluble sugar contents of leaves and reduce the harmful effect of salinity on the plant (Abdul-Rahman and Abdel-Aziz, 1983). Application of gibberellic acid, 4-chloroindole and 6-benzyl amino purine on to the standard petal and calyx of Vicia faba var. major was found to significantly enhance pod set (Rylott and Smith, 1990). Currently, there is no information on the effects of coconut milk (CM) (a crude

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source of cytokinin) and benzyl amino purine (BAP) on the growth, nutritional and chemical composition of *Amaranthus hybridus.* This study was therefore designed to evaluate the vegetative growth, nutritional and phytochemical chemical composition of *Amaranthus hybridus* in responses to coconut milk and benzyl amino purine treatments and to determine the optimum concentrations of the hormones that can be recommended for spraying on the vegetable for enhanced growth and quality.

II. Materials and Methods

a) Seed Collection and Planting

Seeds of *Amaranthus hybridus* was obtained from the Institute of Agricultural Research and Training (IAR&T) Ibadan, Oyo State, Nigeria ((7° 23'N and 3° 51'E). Seedlings were raised from seeds planted on sandy loam nursery seed bed (5m x 5m) at the forestry nursery unit of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria (7° 11'N and 3° 21'E), in the rainforest belt with an annual rainforest of 963.3mm (Fadimu *et al.,* 2012). Five nursery seed beds in three replicates were made. Each nursery seed bed formed a plot. Water was added to the nursery bed when necessary to keep it moist. Seedlings were thinned to 100 seedlings per bed 2 weeks after planting (WAP) putting uniformity of height into consideration and were considered matured enough to be subjected to treatments.

b) Coconut milk (CM) and Benzyl amino purine (BAP) Treatments on the Amaranthus Hybridus Seedlings

The seedlings of *Amaranthus hybridus* were sprayed foliarly in this experiment with coconut milk (CM) and benzyl amino purine (BAP). Different concentrations of the coconut milk treatments were 10% and 15% while 50mg/L and 100mg/L for benzyl amino purine. 500ml of the various concentrations of the coconut milk and benzyl amino purine were applied on the seedlings of the *Amaranthus hybridus* by foliar spraying until the leaf surfaces were properly wet and dripping at 3 weeks intervals, starting from 2 weeks after planting (WAP) while seedlings of *Amaranthus hybridus* sprayed with 500ml distilled served as the control. The treated and control vegetables were harvested for all the analyses at 14 weeks after planting (WAP). The method of Akubugwo *et al.* (2007) was used for processing the leaves of *Amaranthus hybridus* in preparation for various analyses after harvesting. The collected sample was thoroughly mixed, had their stalks removed, rinsed with de-ionized water and the residual moisture evaporated at room temperature before sun-drying for 2 - 3 days on a clean paper with constant turning over to avert fungal growth. The sun-dried sample was ground into fine powder using pestle and mortar, and sieved through a 2.0 mm mesh sieve to obtain a dried powdered sample that was used for all the analyses.

c) Vegetative Growth, Nutritional Chemical Constituent of the seedlings of Amaranthus Hybridus

Treated and control seedlings of *Amaranthus hybridus* were sampled at 14 weeks after planting. The vegetative growth (leaf number, plant height, stem girth, shoot-root ratio and leaf area ratio) were measured according to the method of Mukhtar (2008) while the chlorophyll contents of the leaves were determined using the method of Witham *et al.* (1971).

The mineral elements, comprising sodium, calcium, potassium, magnesium, iron, zinc and phosphorus were determined according to the method of Shahidi *et al.* (1999) and Nahapetian and Bassiri (1975) with some modifications. Exactly 2.0 g of each of the processed samples were weighed and subjected to dry ashing in a well-cleaned porcelain crucible at 550°C in a muffle furnace. The resultant ash was dissolved in 5.0 ml of $HNO_3/HCl/H_2O$ (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining material in each crucible, 5.0 ml of de-ionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into a 100 ml volumetric flask by filtration through whatman No.42 filter paper and the volume was made to the mark with de-ionized water. This solution was used for elemental analysis by atomic absorption spectrophotometer. A 10 cm long cell was used and concentration of each element in the sample was calculated on percentage (%) of dry matter that is mg/100 g sample. Phosphorus content of the digest was determined calorimetrically according to the method described by Nahapetian and Bassiri (1975).

Flavonoids were estimated by the method of Bohm and Kocipal (1974). Alkaloids, phenols and saponins were determined by the method of Harborne (1973) as detailed by Obadoni and Ochuko (2001). Tannin determination was determined according to Van-Burden and Robinson (1981) and determination of Hydrocyanic acid was quantified by the method of Bradbury *et al.* (1991) while Determination of Phytic acid was by the method of Wheeler and Ferrell (1971).

d) Statistical Analysis

The experimental layout was a randomized complete block design containing three replications (Steel and Torrie, 1982). Each replication contained five treatments and every treatments consisted of 100 seedling plants (5 treatments × 3 replications ×100 seedling plants = 1500 seedling plants). Data were subjected to analysis of variance (ANOVA) using Duncan Multiple Range Test (DMRT) for mean separation (Sokahl and Rholf, 1969).

III. Results and Discussion

In this study, significant ($P \leq 0.05$) increases in all the vegetative growth parameters (leaf number, stem girth, plant height, shoot/root ratio, leaf area ratio) were

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observed in the *Amaranthus hybridus* seedlings treated with different concentration of coconut milk (CM) and benzyl amino purine (BAP) at 14 weeks after planting in comparison with the control. 15% Coconut milk treatment recorded the highest number of leaf number (144cm), stem girth (3.98cm), plant height (167cm), shoot/root ratio (2.14), leaf area ratio (365.5) and chlorophyll content (3.01mg/100g) (Table 1). **Ebofin *et al.* (2004)** similarly recorded enhancement in leaf number and plant height in *Prosopis africana* and *Albizia lebbeck.* Spraying of kinetin on *Datura innoxia* plant at 1mg/L, 5mg/L and 10mg/L was found to cause increased vegetative growth **(Abdel-Rahman and Abdel-Aziz, 1983).** An increase in stem circumference was likewise observed according to **Kadiri (1991)** personal communication in his studies with *Abelmoschus esculentus* and *Lycopersicum esculentus* treated with various concentration of GA_3 and 2, 4-D. Furthermore, similar results were observed by **Mukhtar (2008)** where chlorophyll content (1.08mg/g) at 9 weeks was obtained in *Hibiscus sabdariffa* treated with 15% coconut milk, followed by 100ppm GA_3 (0.93mg/g). The production of high shoot-root ratio in *Amaranthus hybridus plants* raised with hormones in this study suggests that the rate of absorption of available nutrients might have significantly been enhanced. **Akhtar *et al.* (2008)** explained that increases in shoot-root ratio by hormone treatments are due to the fact that they enhance the stem elongation plants. In addition, cytokinins such as those contained in coconut water, benzyl amino purine (BAP) also facilitate cell division and sprouting **(Pan, 2001).** GA_3 and IAA had regulatory effect to enhance the plant height, number of branches, numbers as compared to other plant growth regulators and control **(Sarkar *et al.,* 2002).** GA_3 and IAA treated plants exhibited higher values of dry weight and chlorophylls content than the control **(Abdel-Lateef, 2003; Afroz *et al.,* 2005; Abou Al-Hamd, 2007).** Enhanced germination and seedling growth by plant growth regulators may be mediated through changes in the activities of carbohydrate metabolism enzymes **(Kaur *et al.,* 2000).**

Mineral composition (Potassium, sodium, calcium, magnesium, zinc, iron and phosphorus) recorded in mg/100g in all the various treatments of coconut milk (CM) and benzyl amino purine (BAP) applied on *Amaranthus hybridus* showed significant differences in comparison with the control. Treatment of 15% CM produced the maximum K (53.70), Na (7.21), Ca (43.01), Mg (229.30), Zn (3.12), Fe (13.30) and P (34.22) (Table 2). The ratio of sodium to potassium (Na/K) and calcium to phosphorus (Ca/P) were also shown in Table 2. Magnesium content (229.30 mg /100 g) and Iron content (13.30 mg/100g) of the leaves are within the range reported in some green vegetables **(Ladan *et al.*, 1996; Ibrahim *et al.*, 2001; Antia *et al.*, 2006; Hassan and Umar, 2006).** Magnesium is a component of chlorophyll **(Akwaowo *et al.*, 2000)** while **McDonald et al., (1995)** highlighted magnesium for efficient metabolism of carbohydrates and lipids, involved in cellular respiration and general cellular biochemistry and function. It is also an important mineral element in connection with ischemic heart disease and calcium metabolism in bones according to **Ishida *et al.*, (2000).** Iron is an essential trace element for haemoglobin formation, normal functioning of the central nervous system and in the oxidation of carbohydrates, protein and fats **(Adeyeye and Otokiti, 1999).** The Zinc content (3.12 mg/100 g) compares favourably to most values reported for green leafy vegetables in literatures **(Ibrahim *et al.*, 2001; Hassan and Umar, 2006).** Zinc is involved in normal function of immune system **(Akubugwo et al., 2007)**. Also, zinc stabilizes the molecular structure of cellular components and membranes and contributes in this way to the maintenance of cell and organ integrity **(Emebu and Anyika, 2011).** The Na/K ratio in the body is of great concern for prevention of high blood pressure **(Akubugwo et al., 2007).** Na/K ratio less than one is recommended **(FND, 2002).** Therefore, high blood pressure diseases would be minimized due to constant intake of *Amaranthus hybridus* because Na/K composition is lower than one. For good Ca to P intestinal absorption, Ca/P ratio should also be close to unity **(Gull-Guerrero *et al.*, 1998)** and the ratio in this study supports this requirement, hence provides evidence of good Ca to P intestinal absorption.

Table 3 contains full details of the effects of different concentrations of coconut milk (CM) and benzyl amino purine (BAP) at 14 weeks after planting (WAP) on the phytochemical composition of the leaves of *Amaranthus hybridus* in mg/100g (DW). The result indicates that alkaloid (3.55mg/100g), saponin (1.66mg/100g), phenol (0.36mg/100g) and flavonoids (0.85mg/100g) recorded highest values from 15% Coconut milk treatment at 14 weeks after planting while 10% coconut milk treatment at 14 weeks after planting favoured highest values of tannin (0.45mg/100g) and hydrocyanic acids (15.30mg/100g). 100mg/L benzyl amino purine treatment recorded 1.26mg/100g of phytic acids at 14 weeks after planting. Result also shows that at 14 weeks after planting, all the hormonal treatments showed no significant ($P < 0.05$) differences with the controls in all the phytochemical compositions except 15% coconut milk (Table 3). This present result of the alkaloid content of 3.55mg/100g by 15% coconut milk treatment disagreed with results obtained by **Edeoga *et al.*, (2005); Okwu and Josiah, (2006); Akubugwo *et al.*, (2007)** based on the fact that it is higher than the values reported for the leafy vegetables of *Aspilia Africana*, *Bryophyllum pinnatum*, *Cleome rutidosperma* and *Emilia coccinea and Amaranthus hybridus* consumed in Nigeria. The tannin contents (0.45mg/100g) agrees with those of **Edeoga *et al.,* (2005) and Okwu and Josiah (2006).** The flavonoid content of the leaves (0.85 mg/100

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g) and saponin (1.66 mg/100 g) also agreed with the result obtained for *Amaranthus hybridus* in Nigeria but was lower than values reported for *O. gratissiumum* and *Hsypits sauvelens* (Akubugwo *et al.,* 2007). The Hydrocyanic acid content (15.30mg/100 g) and phytic acid content (1.26mg/100 g) of the leaves were lower than the values reported for *A. hybridus and I. batatas* (Akubugwo *et al.*, 2007; Antia *et al.,* 2006). Phytochemical composition of *Amaranthus hybridus* shows that it may not only be useful due to its dietetic value but also medicinally and pharmacologically (Akubugwo *et al.,* 2007). Alkaloids are known to play some developmental control in living system, metabolic role and have a protective role in animals (Edeoga *et al.,* 2006; Edeoga and Eriata, 2001). The anti-nutrients, for example hydrocyanic acid have been suggested in cerebral damage and lethargy in man and animals. Tannins are capable of reducing available protein by antagonistic competition and can therefore cause protein deficiency syndrome, kwashiorkor while phytic acid has complex effect in human system including indigestion of food and flatulence (Maynard, 1997). According to Ekop *et al.* (2004), Eka and Osagie (1998) and Ekop and Eddy (2005) the anti-nutrients present in this plant is within the tolerant levels and can easily be rendered harmless by soaking, boiling or frying. The results from this research work showed that 10%, 15% coconut milk and 100mg/L benzyl amino purine treatments at 14 weeks after planting increases the vegetative growth, nutritional and phytochemical constituents of *Amaranthus hybridus.* This therefore added to its suitability as edible vegetable, nutritional and therapeutic values. These treatments could therefore be used to promote the growth and quality of *Amaranthus hybridus*.

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Table 1 : Effect of different concentrations of Coconut milk (CM) and Benzyl amino purine (BAP) at 14 weeks after planting on leaf number, stem girth (cm), plant height (cm), shoot / root ratio, leaf area ratio and chlorophyll content (mg/g) of *Amaranthus hybridus* seedlings.

	Treatments				
Parameters	10% CM	15% CM	BAP (50 mg/L)	BAP (100 mg/L)	Control
Leaf number	128^{b}	144^{a}	103^{c}	125^{b}	87^{d}
Stem girth (cm)	3.30^{b}	3.98^{a}	2.87^{c}	3.03^{bc}	1.74^{d}
Plant height (cm)	132^{b}	167^{a}	134^{b}	151^{a}	94^{c}
Shoot/root ratio	1.78^{b}	2.14^{a}	0.98^{d}	1.32^{c}	0.76^{e}
Leaf area ratio	283.1^{ab}	365.5^{a}	264.0^{bc}	228.4^{c}	171.6^{d}
Chlorophyll (mg/g)	2.63^{b}	3.01^{a}	2.60^{b}	2.62^{b}	2.27^{c}

Values followed by different letters in the same row differ significantly (P=0.05) according to Duncan's multiple comparison.

Table 2 : Effect of different concentrations of Coconut milk (CM) and Benzyl amino purine (BAP) at 14 weeks after planting (WAP) on the mineral element contents of *Amaranthus hybridus* seedlings.

	Treatments				
Composition (mg/100g)	10% CM	15% CM	BAP (50 mg/L)	BAP (100 mg/L)	Control
Potassium (K)	50.30^{ab}	53.70^{a}	48.00^{b}	48.80^{ab}	42.50^{c}
Sodium (Na)	7.01^{ab}	7.21^{a}	6.24^{c}	6.33^{bc}	5.50^{d}
Calcium (Ca)	40.30^{ab}	43.01^{a}	33.50^{c}	38.70^{b}	28.80^{d}
Magnesium (Mg)	201.40^{b}	229.30^{a}	173.80^{c}	198.30^{b}	146.40^{d}
Zinc (Zn)	2.78^{b}	3.12^{a}	2.31^{c}	2.44^{c}	1.89^{d}
Iron (Fe)	10.90^{b}	13.30^{a}	6.27^{d}	8.49^{c}	4.90^{e}
Phosphorus (P)	32.29^{a}	34.22^{a}	26.80^{b}	31.00^{a}	23.10^{c}
Na/K	0.14^{a}	0.13^{a}	0.13^{a}	0.13^{a}	0.13^{a}
Ca/P	1.25^{a}	1.26^{a}	1.25^{a}	1.25^{a}	1.25^{a}

Values followed by different letters in the same row differ significantly (P=0.05) according to Duncan's multiple comparison.

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Table 3 : Effect of different concentrations of Coconut milk (CM) and Benzyl amino purine (BAP) at 14 weeks after planting (WAP) on the constituents of alkaloids, saponin, tannins, phenols, flavonoid, phytic acid and hydrocyanic acids (mg / 100g dry weight) of *Amaranthus hybridus* seedlings.

	Treatments				
Phytochemicals	10% CM	15% CM	BAP (50 mg/L)	BAP (100 mg/L)	Control
Alkaloids	3.53[ab]	3.55[a]	3.51[b]	3.50[b]	3.50[b]
Saponin	1.64[a]	1.66[a]	1.64[a]	1.63[a]	1.65[a]
Tannins	0.45[a]	0.44[a]	0.44[a]	0.44[a]	0.41[a]
Phenols	0.35[a]	0.36[a]	0.34[a]	0.35[a]	0.33[a]
Flavonoid	0.84[a]	0.85[a]	0.78[a]	0.82[a]	0.80[a]
Phytic acid	1.24[a]	1.25[a]	1.24[a]	1.26[a]	1.13[a]
Hydrocyanic acids	15.30[a]	15.20[a]	14.40[a]	15.10[a]	14.10[a]

Values followed by different letters in the same row differ significantly (P=0.05) according to Duncan's multiple comparison.

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Studies on Vegetational Analysis and Regeneration status of Pinus Roxburghii, Roxb. and Quercus Leucotrichophora Forests of Nainital Forest Division

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Abstract- The present study was carried out on two dominant forest types were identified along and elevational gradient in Nainital Forest Division. The dominant tree species were *Quercus leucotrichophora* and *Pinus roxburghii Roxb*. Followed by *Acer oblongum, Rhododendron arboreum, Quercus floribunda, Cedrus deodara, Myrica esculenta, Ficus nerifolia, Cupressus torulosa and Prunus cerasoides*.Tree and sapling species richness, density and diversity were high in *Quercus leucotrichophora* dominated forest and total basal area and concentration of dominance were maximum in *Pinus roxburghii* dominated forest. Seedling species richness was maximum in *Pinus roxburghii* dominated forest and density, diversity and concentration of dominance were maximum in *Quercus leucotrichophora* dominated forest.

Keywords: *vegetation, regeneration, Q. leucotrichop- hora, P. roxburghii, forest.*

GJSFR-C Classification : *FOR Code: 070599*

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Studies on Vegetational Analysis and Regeneration status of Pinus Roxburghii, Roxb. and Quercus Leucotrichophora Forests of Nainital Forest Division

Nandan Singh [α], Kamini Tamta [σ], Ashish Tewari [ρ] & Jeet Ram [ω]

Abstract- The present study was carried out on two dominant forest types were identified along and elevational gradient in Nainital Forest Division. The dominant tree species were *Quercus leucotrichophora* and *Pinus roxburghii Roxb*. Followed by *Acer oblongum, Rhododendron arboreum, Quercus floribunda, Cedrus deodara, Myrica esculenta, Ficus nerifolia, Cupressus torulosa and Prunus cerasoides*.Tree and sapling species richness, density and diversity were high in *Quercus leucotrichophora* dominated forest and total basal area and concentration of dominance were maximum in *Pinus roxburghii* dominated forest. Seedling species richness was maximum in *Pinus roxburghii* dominated forest and density, diversity and concentration of dominance were maximum in *Quercus leucotrichophora* dominated forest.

Keywords: vegetation, regeneration, Q. leucotrichophora, P. roxburghii, forest.

I. Introduction

The Himalayan Mountain is the tallest, most complex and the youngest among the major mountain systems of the world extending for about 2500 km from east to west. The Himalayan forests are rich in biodiversity and distributed over a large extent from lower to higher elevation. The tree vegetation is the dominant components of these forests. Himalayan forests are crucial not only for the people for the living in the Himalaya but also for many more living in the adjoining plains. Various aspect of biodiversity of these forests has been studied by (Dhar et al. 1997, Silori 2001, Kumar 2000 and Khera et al. 2001). If biodiversity is to be used as a resource for sustainable development of local communities, one has to deal with problem related to in identification to potential economic species and their ecology and biology, land use, market demand and supply trends (Tewari and Singh, 1981). Disturbance is a key component of all ecosystems. It affected every level of biological organization and spans a board range of spatial and temporal scales with origins that can be either natural or anthropogenic, and either endogenous or exogenous, disturbances are inherently diverse (White 1979 and White and Jentsch 2001). Anthropogenic disturbances play an important role to change, loss recent phenomenon of climatic change, loss or maintenance of plant biodiversity and more recent phenomenon of climate change will also responsible for the change in species composition and other ecosystem activities (Ram et al. 2005). In the Himalayan region the biotic disturbance occur in the chronic form in which people remove only at a given time. The problem with the chronic form of forest gets time to recover adequately because human onslaught never stops (Singh 1998). Bormann et al. (1970) revealed that along an altitudinal gradient, the total basal area per tree, density and species diversity increased.

Oak (Quercus spp.) occupy most of the area from 1000 to 3000 m altitude in the central and western Nepal, Uttarakhand and HimanchalPardsesh (Singh et al. 2000). Banj oak (*Quercus leucotrichophora*) is the most common broadleaf tree in the mid - elevation central Himalaya in India. These forests have been under a tremendous biotic stress as they provided fuel, fodder and leaf fodder. Concentration of human settlements in the oak forest areas, lopping and felling and occasional fire spreading from pine forest, have reduce the area under oak forest (Champion and Seth 1968). Banj oak forms the matrix species of forest in this zone (Singh and Singh 1986), and is used by the villagers mainly for fuel, fodder, leaf litter and timber. Therefore, one of the immediate ecological problem is this region is revival of the oak forests, which is turn involves vegetational study, evaluation of regeneration status and subsequently the factor influencing the regeneration.

Chir – pine (*Pinus roxburghii* Roxb.)the dominant species from low to mid elevation and it is a frequent reproducer not only in its own forests but also in other forests where it has intruded following disturbance and creation of open canopy. The pine forests have witnessed severe anthropogenic disturbances. The disturbances were mainly in the form of deforestation, animal grazing, lopping, surface burning and litter removal. These continued disturbances are affecting the stability of the ecosystem and retarding the succession

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process. Both natural and anthropogenic caused disturbance are considered since vegetation response do not distinguish between natural and human activities (Oliver and Larson 1990).Other species is occurring in Chir – pine forests usually fail to regeneration (Singh and Singh 1987).). It is important to note that the regeneration mode of tree species in gap may be changeable, however, in warm – temperate forest, it has been suggested that the regeneration mode of tree species in gaps is not an unchangeable property, but becomes a changeable one in relation to the presence or absence of other species such as key dominant species (Yamamoto 1994).

The Himalayan vegetation range from tropical dry deciduous forest in the foothill to alpine meadow above tree line (Singh and Singh 1992 and Ram et al. 2004). Vegetation in the mountain area is affected by several factors of which altitude, aspect, slope and soil depth are predominant as they modify regimes of moisture and exposure to sun. Vegetation within forest is greatly affected by differences in the microclimate, aspect and altitude (Pande et al. (1996). The lesser Himalayan region is colonized by subtropical broad leaved forest is dominated by Chir - pine (*Pinus roxburghii*) and Oak (*Quercus*) species. Various ecological aspects of biodiversity of this forest have been studied by various workers. The vegetation of lesser Himalaya to alpine zone is led by vast exploitation of natural plant diversity or flora due to increasing anthropological pressures.

Regeneration is the process of Sylvigenesis (=Forest building) by which trees and forest survive over time (Halle et al. 1978). Successful regeneration of tree species might be considered to a function of three major components: (i) ability to initiate new seedlings, (ii) ability of seedlings and saplings to survive and (iii) ability of seedlings and saplings to grow (Good and Good, 1972). The future composition of forests depends on potential regeneration status of tree species within a forest stand in space and time (Ayyaapass and Parthasarathy, 1999 and Henle et al. 2004). Regeneration status of a species is one of the most important phenomena for maintaining the forest cover. Regeneration status of a forest community can be indicated by computing the age (or size) structure of individual species. Regeneration is an important phenomenon of development process, which indicates its composition, structure, stand distribution and future crop.

II. Material and Method

The study area is located between 29° 20' and 29° 30' N latitude and 79° 23' and 79° 42' E longitude between 1650 – 1950m elevations in Nainital district of Kumaun Himalaya. The forest were thoroughly surveyed and identified as Banj - oak *(Quercus leucotrichophora*) forestand *Pinus roxburghii* Roxb. (Chir -pine) dominated forest. These forests were selected between 1650 – 1950m elevations and further categorized as low elevation (1650 – 1750m) and high elevation (1850 – 1950m). *Quercus leucotrichophora* is mixed with *Pinus roxburghii* at both the elevation. In each forest two replicated sites were selected. After thoroughly reconnaissance, tree, sapling and seedling species were listed from all the forests. Species richness was determined as the number of species per unit area (Whittaker 1972 and 1975).10 plots of 10x10m were randomly established in each forest for determination of species richness and other vegetation parameters. Three vegetation layers that are trees, saplings and seedlings were analyzed for species richness, density, diversity and concentration of dominance of tree species in different forest. Tree layer were analyzed in 10x10m, sapling in 5x5m (Curtis and Mc Intosh 1950 and Phillips 1959) and seedling were analyzed in 10, 1x1m within each plot. Circumference at breast height (cbh) was taken for the determination of tree basal area and calculated as πr^2, where r is the radius. Tree basal area of a species was the multiple of mean of tree basal area and while total cover of a sapling and seedling species was multiple of mean cover and density. Total basal area/cover was the sum of basal area/cover of all species present in the forest. Density and basal area were converted to per hectare (ha), sapling and seedling cover were given as percent for vegetational parameter. Tree basal area was used to determine the relative dominance of a species while cover was used for saplings and seedlings. Importance Value Index (IVI) was the sum of relative density, relative frequency and relative dominance (Phillips 1959). Species diversity was calculated using Shannon – Wiener information index (Shannon and Weaver 1963) as:

$$H = - \sum (Ni/N) \log 2 (Ni/N)$$

Where, Ni is the number of individual of a species and N is the total number of individual of all species in that stand.

Concentration of dominance was measured by Simpson's index (Simpson 1949).

$$C D = \sum (Ni/N)$$

Where, Ni is the number of individual of a species and N is the total number of individual of all species.

III. Result

a) Species richness, species diversity and concentration of dominance

A total 10 trees, 8 saplings and 6 seedlings species were recorded from study area. Total species richness was greater in oak dominated forest at 1650m

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elevation. Greater number of tree and sapling species was present in oak dominated forest at 1650m elevation, in contrast to this seedling in pine dominated forest (Table 1).

Table 1 : Species richness indifferent elevations

Species	Oak dominated forest		Pine dominated forest	
Trees	1650m	1750m	1850m	1950m
Acer oblongum	+	-	-	-
Cedrus deodara	+	+	-	-
Cupressus torulosa	-	+	-	-
Ficus nerifolia	+	-	-	-
Myrica esculenta	+	-	+	+
Pinus roxburghii	+	+	+	+
Prunus cerasoides	+	+	-	-
Quercus floribunda	-	-	-	+
Quercus leucotrichophora	+	+	+	+
Rhododendron arboreum	+	-	+	+
Total (10)	8	5	4	5
Sapling				
Acer oblongum	+	-	-	-
Cupressus torulosa	-	+	-	-
Ficus nerifolia	+	+	-	-
Pinus roxburghii	-	+	+	+
Prunus cerasoides	+	-	-	-
Quercus floribunda	-	-	+	+
Quercus leucotrichophora	+	+	+	+
Rhododendron arboreum	+	-	-	-
Total (8)	5	4	3	3
Seedling				
Acer oblongum	-	+	-	-
Cupressus torulosa	-	+	-	-
Pinus roxburghii	+	+	+	+
Quercus floribunda	-	-	-	+
Quercus leucotrichophora	+	-	+	+
Rhododendron arboreum	-	-	+	-
Total (6)	2	3	3	3

Total tree diversity ranged from 0.66 – 2.69 and sapling diversity from 1.25 – 1.84. It was maximum in oak dominated forest at 1650m elevation, similarly seedling diversity ranged from 0.87 – 1.50. It was also maximum in oak dominated forest in 1750m elevation compared to pine dominated forest. Total tree concentration of dominance ranged from 0.44 – 0.76 and sapling concentration of dominance from 0.32 – 0.74. It was maximum in pine dominated forest at 1950m elevation compared to oak dominated forest. Seedling concentration of dominance ranged from 0.46 – 0.65. It was maximum in oak dominated forest at 1650m elevation compared to pine dominated forest (Table 2).

IV. Community Structure

Total tree density varied from 510 – 1250 tree/ha. It was maximum at 1650m elevation and minimum at 1750m elevation in oak dominated forest. Total basal area 33.88 – 70.90 m^2/ha, it was maximum in pine dominated forest at 1850m elevation and minimum in oak dominated forest at 1650m elevation. In sapling, total density ranged between 275 and 950 sapling/ha. It was maximum in oak dominated forest at 1650m elevation and minimum in pine dominated forest at 1950m elevation. Total coverranged between 5.86 and 11.96%. It was maximum at pine dominated forest at 1850m elevation compare to oak dominated forest at 1650m elevation. In seedling, total seedling density varied from 405 – 660 seedling/ha. It was maximum in oak dominated forest at 1650m elevation and minimum in pine dominated forest at 1950m elevation. Total cover varied from 8.44 – 12.89%. It was maximum in pine dominated forest at 1950m elevation and minimum in oak dominated forest at 1650m elevation (Table 2).

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Table 2 : Diversity, concentration of dominance and Important vegetational parameters of different forest.

Parameter	Oak dominated forest		Pine dominated forest	
	1650m	1750m	1850m	1950m
Tree				
Density (tree/ha)	1250	510	935	540
T.B.A. (m^2/ha)	33.88	62.6	70.90	49.32
Diversity	2.69	1.31	1.10	0.66
Concentration of dominance	0.51	0.44	0.49	0.76
Richness	8	5	4	5
Sapling				
Density (sapling/ha)	950	500	280	275
Total cover (%)	5.86	11.22	11.96	10.98
Diversity	1.84	1.78	1.25	1.26
Concentration of dominance	0.32	0.34	0.42	0.74
Richness	5	4	3	3
Seedling				
Density (seedling/ha)	660	610	465	405
Total cover (%)	8.44	9.19	12.02	12.89
Diversity	0.87	1.50	1.17	1.16
Concentration of dominance	0.65	0.47	0.51	0.46
Richness	2	3	3	3

V. Discussion

The Himalaya is one of the largest mountain systems of the world and is considered as the great repository of biological and culture diversity. However, a wide variation in species richness across sites with similar tree crown cover may indicate that several other factors, such as history of disturbance, leaf chemistry of canopy and spatial arrangement of individuals can verify diversity (Kumar 2000). The Himalaya embodies a diverse and characteristics vegetation distribution over a wide range of topographical variations (Dhaulkhandi et al. 2008). The vegetation characteristics show dominance of one or more species in the area. Disturbance promotes undergrowth species diversity possibly by allowing several species to maintain their population in open condition. More penetration of light in open canopy forest may enable each species to develop large population, and large population may be less vulnerable to local extinction. In the present study, plant biodiversity is assessed by quantitative analysis of forest vegetation in different forest including anthropogenic and natural disturbance do not provide time for the ecosystem recovery and widen the forest gap and fragmentation of the land in the region.

The oak dominated forest showed highest species richness followed by chir–pine dominated forest. The chir-pine dominated forest was characterized by low species richness. Oak dominated forest showed greater variation in all three layers tree, sapling and seedling species richness. The decrease in species richness may be due to change in climatic condition, un-matured seed fall, increase biotic pressure and close of the tree canopy which arrest the regeneration of the some tree species. The opening of canopy increase the number of sapling species in the high disturbed forest. The different studies on the temperate forest oak and oak mixed forest indicate that the tree richness ranged between 3 and 43 species (Tewari and Singh 1982, Baduni and Sharma 1997, Rekhari et al. 1997, Ghildiyal et al. 1998 and Kharakwal 2005. Ram et al. 2004 have the tree richness at 1800 – 2000m (11 species). Burns (1995) and Austin et al. (1996) have analyzed association between species richness and climate, slope position and soil nutrient status. Both studies found that total species richness was greater at low elevation, warm site with moderate canopy, moderate rainfall and intermediate to high nutrient level.

Total tree density varied from 510 – 1250 tree/ha. Singh et al. (1994) have reported density value ranging from 250 – 2070 tree/ha for different Central Himalayan forests. Semwal (2006) has reported 640 tree/ha to 1146.69 tree/ha in forest of Kumaun Central Himalaya. Earlier tree density reported from 320 – 1670 ind/ha and 360 – 1787.5 ind/ha from low to high altitude forests of western Himalaya (Saxena and Singh 1982; Ralhan et al. 1982;Tewari 1982; Kalakoti et al. 1986; Chandra et al. 1989; Rawal et al. 1994 and Samant et al. 2002). The sapling density was observed between 275 – 950 sapling/ha and seedling density ranged between 405 – 660 seedling/ha. Greater variation in tree density was in oak dominated forest compare to chir-pine dominated forest. Similarly, sapling and seedling density varied in oak dominated forest. The oak dominated forest may favour the growth and of herbaceous vegetation with decreasing richness and density of the other woody vegetations.

In the present study, the value of total basal area of different forest and elevation was 33.88 - 70.90 m^2/ha. The tree basal area for several Central Himalayan

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forest was reported in the ranged of 16.6 – 69.5 m^2/ha (Sexana and Singh 1982, Tewari 1982). Singh et al. (1994) have reported that total tree basal area for *P. roxburghii* forest (17 – 47 m^2/ha), *Q. leucotrichophora* forest (12 – 74 m^2/ha). The sapling cover of the forest ranged between 5.86 – 11.96%, whereas, the seedling cover was observed between 8.44 – 12.89%.

Shannon-weiner index tree diversity ranged between 0.66 and 2.69 in different forests and elevations. The sapling diversity ranged between 1.25 and 1.84, while the seedling layer diversity ranged between 0.87 and 1.50. The tree diversity index analyzed reported for most of the low elevation Central Himalayan forest (0.33 - 2.95) by Saxena and Singh (1982), Ralhan et al. (1982), Upreti et al.(1985), Bargali et al. (1987) Tripathi et al. (1987) and Rikhari et al. (1989). Tripathi et al. (1991) have reported tree diversity values 2.69 - 3.82 from low to high elevation. Giri et al. (2008) have reported tree diversity between 0.88 and 2.11 Monk (1967) and Risser and Rice (1971) obtained 2 - 3 as the highest values for diversity index of temperate forest. The diversity was lowest for the pine dominated forest and highest for oak dominated forest. The increased disturbance intensity may favour the invasion of seedling while moderate disturbance in oak forest favour the sapling. Anthropogenic disturbance first decrease the tree diversity with increasing intensity of disturbance decreased trees and sapling diversity and increased seedling diversity. The diversity of disturbance decreased the overall richness and diversity of the ecosystem.

Simpson's index tree concentration of dominance ranged between 0.44 and 0.76in different forests. The sapling concentration of dominance ranged between 0.32 and 0.74, while the seedling concentration of dominance ranged between 0.46 and 0.65. Whittaler (1965) and Risser and Rice (1971) reported concentration of dominance for tree layer in the range of 0.10 – 0.99 for temperate forests. Sexena and Singh (1982) and Ralhan et al. (1982) have reported similar value in the range of 0.25 – 1.00. The species richness and species diversity was greater in oak dominated forest at low elevation and moderate canopy sites. It is apparent from the current study that moderate disturbance is helpful in the regeneration of *Q. leucotrichophora* dominated sites.

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Phytochemical and Nutritional Constituents of Some Common Vegetables in South-West, Nigeria

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Abstract- Several vegetable species abound in Nigeria and most West African countries where they are used partly as condiments or spices in human diets or as supplementary feeds to livestock. There were ten samples of vegetable used in this study and were analyzed for a major source of ascorbic acid and the mean values ranged from 170 – 425 mg/100 g, *Celosia argentea* "Soko" (425 mg/100 g) and *Amaranthus hydridus* "tete" (408 mg/100 g) both having the highest ascorbic acid while *Corchorous olitorius* "ewedu" (170 mg/100 g) had the least ascorbic acid. *Amaranthus hydridus* and *Talinum triangulare* had the highest mineral contents. Carbohydrate contents ranged from 3.9 – 48.2 g/100 g, *Ocimum gratissium* "efirin" having 3.9 g/100 g while *Vernonia amygdalina* "ewuro" had 48.2 g/100 g. Protein content ranged from 5 –28.2 g/100 g.

Keywords: *vegetables; phytochemical constituents; nutritional values.*

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Phytochemical and Nutritional Constituents of Some Common Vegetables in South-West, Nigeria

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Abstract- Several vegetable species abound in Nigeria and most West African countries where they are used partly as condiments or spices in human diets or as supplementary feeds to livestock. There were ten samples of vegetable used in this study and were analyzed for a major source of ascorbic acid and the mean values ranged from 170 – 425 mg/100 g, *Celosia argentea* "Soko" (425 mg/100 g) and *Amaranthus hydridus* "tete" (408 mg/100 g) both having the highest ascorbic acid while *Corchorous olitorius* "ewedu" (170 mg/100 g) had the least ascorbic acid. *Amaranthus hydridus* and *Talinum triangulare* had the highest mineral contents. Carbohydrate contents ranged from 3.9 – 48.2 g/100 g, *Ocimum gratissium* "efirin" having 3.9 g/100 g while *Vernonia amygdalina* "ewuro" had 48.2 g/100 g. Protein content ranged from 5 –28.2 g/100 g. *Talinum triangulare* "gbure" had the lowest while *Corchorous olitorius* had the highest protein content. Fiber content ranged from 1.0 – 11.5 g/100 g *Vernonia amygdalina* had the lowest fiber content while *Senecio biafrae* had the highest. The analysis of the samples also showed the presence of flavonoids, alkaloids, saponins, inulins and tannins, this indicates that the vegetables studied contain an appreciable amount of bioactive compounds. This research analyzed the phytochemical and nutritional values of these vegetables with a view to ascertain their nutritional composition for appropriate recommendation if need arises.

Keywords: vegetables; phytochemical constituents; nutritional values.

I. Introduction

The amounts of the nutrient constituents in the commonly used leaf vegetable species in Nigeria have been studied to some extent, the lesser known regional and local species remain virtually neglected (Kola, 2004). Lack of information on the specific nutrients and phytochemicals in a large number of the native vegetables species with which Nigeria is richly endowed is partly responsible for their under exploitation especially in areas beyond the traditional localities where they are found and consumed. Among the leafy vegetables in which their phytochemicals and nutrients have not been extensively studies are leaves of water leaf among others (Ezekwe et al., 2001).

Vegetables contain various medicinal and therapeutic agents. There are large arrays of laxatives, sedatives and soporifics or sleep inducing components in the vegetable kingdom. Vegetables like onions act as tonic and are excellent for the nerves. Certain vegetables are highly beneficial in the treatment of various diseases. Spinach is beneficial in the treatment of kidney troubles. Lettuce can be used as a food remedy for insomnia. Water leaf has been also implicated medically in the management of cardiovascular diseases like stroke, obesity, and so on (Adewunmi and Sofowora, 1980). The "Efirin" (scented leaf) serves as a decongestant for head, colds, bronchitis and sinusitis. Also, the leaf is chewed traditionally for all tooth and gum disorders.

This study was carried out to evaluate the phytochemical and the nutritional composition of common vegetables so as to put into literature the significance of eating these common vegetables in southwest Nigeria. Further research may wish to concentrate on the anti-microbial properties of these valuable vegetables commonly found in the south western Nigeria.

II. Materials and Methods

a) Collection of Samples

Samples of vegetables were randomly selected from popular local markets in Osogbo. All samples were randomly collected aseptically in a sterile foil paper and a sterilized container which are tied and labelled appropriately in readiness for phytochemical and nutritional analysis.

b) Preparation of Extracts

The analysis determined the biologically active compounds that contribute to the flavour, colour and other characteristics of vegetables. Hundred gram of each vegetable sample was washed with deionised water to remove dust particles, the leaves were sun dried for 3 - 4 days. The leaves were later milled to obtain the powder using an electric blender, the powder were soaked in 360ml of sterile distilled methanol and 240ml of sterile distilled water in ratio 3 : 2 for four days at 30°C – 32 ° C. The extracts were filtered through a

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Millipore filter (0.25µm). The resulting filtrates were concentrated under reduced pressure at 50°C and then transferred into a well labelled sterile bottle (Kumar et al. 2009).

c) Test for Alkaloids

About 1% HCl and 6 drops of Mayer's reagent and Dragendroff"s reagent was added to the extract. The organic precipitate indicates the presence of alkaloids (Kumar *et al*. 2009).

d) Test for Flavonoids

About 5ml of dilute ammonia solution was added to the extract of each samples, followed by addition of con. H_2SO_4. A yellow coloration confirms the presence of flavonoids which disappeared immediately (*Ayoola et al.* 2008)

e) Test for Saponins

Exactly 20ml of distilled water was measured in a graduated cylinder for 15 minutes, formation of foam (about 1cm layer of foam) indicated the presence of saponins (Kumar *et al.* 2009).

f) Test for Tannins

Few drops of lead acetate were added to about 5ml of the extract, the formation of a yellow precipitate indicated the presence of tannin (Edeoga *et al.* 2005).

g) Test for Carbohydrate

About 2 drops of Molisch's the extract was added to 2ml of the sample extract in a test tube and mixed thoroughly, while the 2ml of con.H_2SO4 was added. A reddish violet color appeared immediately which indicated the presence of carbohydrates.

h) Test for Protein

Two ml of protein solution and 40% NaOH solution and 1 to 2 drops of 1% $CuSO_4$ solution was added. A violet color indicated the presence of peptide linkage of the molecule.

i) Test for Ascorbic acid

To the extract, 10 drops starch solution was added with the aid of a pipette and it was stirred using a toothpick, iodine solution was added in drops until a color that persisted longer than 20 seconds which is the endpoint. The color change indicated the presence of Vitamin C (Omaha 2011).

j) Determination of Moisture content

The wet weight of the fresh vegetable leaves (samples) was recorded before placing them in a hot air oven at 1000° C for an hour for the complete evaporation of water. The sample was taken out, cooled and weighed to obtain the dry weight. The dry weight was subtracted from the wet weight to get the moisture content.

k) Determination of Mineral content

Milled samples (5 g) were dry-ashed in a furnace at 550° for 24 hours. The resulting ash was cooled in a desiccator weighed. Two ml of concentrated HCl, were added to dissolve the ash and a few drops of concentrated HNO_3 were added. The solution was placed in a boiling water bath and evaporated almost to dryness. The contents were then transferred to 100 mL volumetric flask and diluted to volume with deionized water and appropriate dilutions were made for each samples before analysis. Calcium, magnesium and iron contents were quantified using atomic absorption spectrophotometer while Sodium and potassium were determined with a flame photometer or Gallenkamp (AOAC, 1990).

III. Results

The studies revealed that the *Ocimum gratissimum* had 189g/100gDM of Ascobic acid compared to *Corchorous olitorus* that had about 170 g/100g DM. The carbohydrate content of the samples was discovered to be 3.9 g/100g DM in *Ocimum gratissimum* while 27.1 g/100g DM was obtained for *Corchorous olitorus*. The protein constituent was estimated to be 5.4 g/100g DM in *Ocimum gratissimum* while 28.2 was observed for *Corchorous olitorus*. The moisture content of the vegetable samples was discovered to be 32.2 g/100g DM in *Ocimum gratissimum* while 27.5 g/100g DM was obtained for *Corchorous olitorus*. The fiber content of the vegetable was discovered to be 11.5 g/100g DM in *Ocimum gratissimum* and 9.2 g/100g DM was obtained for *Corchorous olitorus*.

The ascorbic content of *Solanum macrocarpon* 340 g/100g DM was less than that of *Vernonia amygdalina* 348 g/100g DM, the carbohydrate content was 48.2 g/100g DM and 6.4 g/100g DM respectively for *Vernonia amygdalina* and *Solanum macrocarpon*.The protein constituents of *Vernonia amygdalina* and *Solanum macrocarpon* were 14.9 g/100g DM and 4.6 g/100g DM respectively while the moisture contents were estimated to be 21.9 g/100g DM and 85 g/100g DM for *Vernonia amygdalina* and *Solanum macrocarpon* espectively. The fibre content was estimated for 1.0 g/100g DM and 1.6 g/100g DM for *Vernonia amygdalina* and *Solanum macrocarpon* respectively. The *Senecio biafrae* had the least ascorbic acid when compared with *Celosia argentea*, *Amaranthus hybrides*, *Talinum triangulare*, *Hisbiscus esculenta* and ugu. Whereas the *Senecio biafrae* (30.0 g/100g DM) showed the highest carbohydrate constituents when compared with *Celosia argentea*, (4.0 g/100g DM), *Amaranthus hybrides* (7.0 g/100g DM) *Talinum triangulare* (4.8 g/100g DM) *Hisbiscus esculenta* (10.6 g/100g DM) and *Telfaria occidentalis* (6.9 g/100g DM). The *Senecio biafrae* is highly proteinous by showing up to 12.3 g/100g DM being the highest when compared with the protein contents of *Celosia argentea* (6.2 g/100g DM), *Amaranthus hybrides* (4.6 g/100g DM), *Talinum triangulare* (5.0 g/100g DM) , *Hisbiscus esculenta* (5.2

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g/100g DM) and *Telfaria occidentalis* (4.7 g/100g DM). The *Talinum triangulare* had the highest moisture content(93 g/100g DM) when compared with all other vegetable samples.The fibre content was highest in *Senecio biafrae* (11.8 g/100g DM) as shown in the table 1.

About four mineral elements were established in the analysis. These elements include: Calcium (Ca), Potassium (K), Magnesium (Mg), Sodium (Na) and Iron (Fe). The *Senecio biafrae* had the highest Ca (2.67 mg/100 g) content among other vegetables sampled while the least content was found in *Ocimum gratissimum* (1.23 mg/100 g).The potassium content was maximum in *Talinum triangulare* when compared with other vegetables. However, the minimum potassium content was found in *Ocimum gratissimum* (2.35 mg/100 g).The magnesium content of the vegetables was found to be maximum in "tete" (2.54 mg/100 g) while the least magnesium content was discovered in *Ocimum gratissimum* (0.44 mg/100 g).The sodium content of the vegetable samples was maximum in *Amaranthus hybridus* (6.85 mg/100 g) while the least sodium content was found in *Vernonia amygdalina* (0.04 mg/100 g).The iron content of the vegetables was maximum in *Amaranthus hybrids* (0.13 mg/100 g).However the minimum iron content was found in *Vernonia amygdalina* (0.03 mg/100 g).

The *Ocimum gratissimum* and *Corchorous olitorus* showed the presence of all the constituents while *Vernonia amygdalina* showed the presence of all the constituent that is alkanoid, flavonoid,saponoid inulin except saponin. *Solanum* and *Senecio biafrae* did not exhibit the presence of inulin whereas all other phytochemical constituent were exhibited.*Celosia* showed the presence of all the phytochemical constituents except saponin. However, the *Amaranthus hybrides* exhibited all the phytochemical constituents including saponin.Inulin was absent in *Talinum triangulare*, *Hibiscus esculenta* and *Telfaria occidentalis* while other phytochemical constituent were present. However, *Telfaria occidentalis* did not exhibits the presence of saponin.

IV. Discussion

Nutrients are necessary for life and good health; these may be found in a number of different foods. The general function of nutrients includes energy, building materials for body structures and regulations and control of body processes. The proximate analysis showed that the studied vegetables are good sources of carbohydrate and protein; especially *Vernonia amygdalina* and *Corchorus olitorius*. The carbohydrates and proteins present in these vegetables may be a conglomerate of bioactive sugars, glycoproteins or proteins which gives most of the vegetables their medicinal potency against certain diseases.

Some plants are known to contain certain sugars which are biologically active against some diseases (Srivastava et al., 1989). The elements such as calcium, magnesium, potassium, iron and sodium found in small amount in the leaves are nutritionally and biochemically important for proper body function. For instance, calcium is known to play a significant role in muscle contraction, bone and teeth formation and blood clotting (Ahmed and Chaudhary, 2009; Heaney, 2009).

Some of these minerals such as magnesium are needed as cofactor in enzyme catalysis in the body (Ahmed and Chaudhary, 2009). Sodium and potassium which are present in the intracellular and extracellular fluid helps to maintain electrolyte balance and membrane fluidity. Iron is known to be a component of some metalloenzymes, myoglobin and heamoglobin (Ahmed and Chaudhary, 2009), which is needed in the transport of oxygen and carbon dioxide during respiration or cellular metabolism. This heamoglobin (containing iron) also serve as buffer to regulate changes in blood pH (Kamshilov and Zaprudnova, 2009). It is known that inorganic mineral elements such as potassium, calcium play important roles in the maintenance of normal glucose-tolerance and in the release of insulin from beta cells of islets of Langerhans (Choudhary and Bandyopadhyan, 1999). Iron is an essential trace element for haemoglobin formation and normal functioning of the central nervous system (Adeyeye and Otokiti, 1999).

The study also shows that vegetables contain small amount of fiber, this could be beneficial when consumed. Dietary fibre is important for lowering blood cholesterol and blood sugar. It is known to reduce the risk of diseases such as obesity, diabetes, breast cancer, hypertension and gastrointestinal disorder (Saldanha, 1995).

The presence of secondary metabolites such as alkaloids, saponins, tannins, flavonoid and Inulin in the vegetables may contribute to its medicinal value. Some of these compounds are well documented to exhibit hypoglyceamic activity in animals (Akhtar et al., 1981). Saponins inhibit Na^+ efflux leading to higher Na^+ concentration in cells, thereby activating a Na^{+-} Ca^{2+} antiport (Schneider and Wolfing, 2004). This effect produces elevated cytosolic Ca^{2+} which strengthens the contraction of the heart muscle and thereby reducing congestive heart failure (Schneider and Wolfing, 2004). Traditional leafy vegetables have proven nutritive value in terms of having more protein, minerals and carbohydrate than some exotic vegetables.

V. Conclusion

The vegetables sampled for analysis exhibited some forms of nutritional values which enable the plant to be known for having therapeutic traces. It is to be noted that vegetables contain some certain nutritional

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elements which will make the plants to be source nourishment for the body. It will also promote good health and proper functional mechanism in the body.

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Table 1 : Nutritional values of some the vegetable samples.

Nutritional value of some Vegetable samples (g/100 g DM)					
Samples	Ascorbic acid	Carbohydrate	Protein	Moisture	Fiber
Ocimum gratissimum	189	3.9	5.4	32.2	11.5
Corchorous olitorus	170	27.1	28.2	27.5	9.2
Vernonia amygdalina	348	48.2	14.9	21.9	1.0
Solanum macrocarpon	340	6.4	4.6	85.6	1.6
Senecio biafrae	203	30	12.3	28	11.8
Celosia argentea	425	4.0	6.2	84	1.1
Amaranthus hybrids	408	7.0	4.6	86	1.8
Talinum triangulare	284	4.8	5	93	1.4
Hisbiscus esculenta	221	10.6	5.2	26.5	2.9
Telfaria occidentalis	345	6.9	4.7	92	2.7

Table 2 : Mineral contents of some the Vegetable samples.

Mineral contents of the samples (mg/100g)					
Samples	Ca	K	Mg	Na	Fe
Ocimum gratissimum	1.23	2.35	0.44	0.76	0.04
Corchorous olitorus	1.27	3.84	0.60	0.34	0.05
Vernonia amygdalina	2.26	3.76	0.46	0.04	0.03

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Solanum macrocarpon	2.43	5.67	1.93	4.56	0.07
Senecio biafrae	2.47	3.74	1,32	4.85	0.05
Celosia argentea	2.67	3.94	1.42	5.23	0.06
Amaranthus hybrids	2.06	4.83	2.54	6.85	0.13
Talinum triangulare	2.45	6.11	2.23	0.29	0.44
Hisbiscus esculenta	2.48	4.75	1.83	0.35	0.07
Telfaria occidentalis	1.74	2.46	0.66	1.18	0.04

Table 3 : Phytochemical Screening of some of the vegetable samples.

Samples	Alkaloid	Flavonoid	Saponin	Tannin	Inulin
Ocimum gratissimum	+	+	+	+	+
Corchorous olitorius	+	+	+	+	+
Vernonia amygdalina	+	+	+	-	+
Solanum macrocarpon	+	+	+	+	-
Senecio biafrae	+	+	+	+	-
Celosia argentea	+	+	-	+	+
Amaranthus hybrides	+	+	+	+	+
Talinum triangulare	+	+	+	+	-
Hisbiscus esculenta	+	+	+	+	-
Telfaria occidentalis	+	+	-	+	-

(+) = positive; (-) = negative

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Viral Latency, Molecular Pathogenesis and Malignancy

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Abstract- Viruses are a major component of the biosphere, entering cells and genomes to insert their own genetic material. Herpesvirus lies hidden for years in the cells of the nervous system before emerging to cause herpes vesicles at the body surface. In the 'virosphere' there are the retroviruses, whose RNA genome can be converted to DNA by the reverse transcriptase enzyme carried in their viral particles, integrating their genes into the host cell genome and becoming one with it. When, for any of a number of reasons, the host immune system undergoes degrees of immunosoppression, the virus can reactivate, replicate, and cause disease. Even when this does not occur, oncogenic virus latency can induce malignancy in host cells.

Keywords: latency, herpesvirus, oncogenic viruses, t antigens, papillomavirus.

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Viral Latency, Molecular Pathogenesis and Malignancy

Giulio Tarro

Abstract- **Viruses are a major component of the biosphere, entering cells and genomes to insert their own genetic material. Herpesvirus lies hidden for years in the cells of the nervous system before emerging to cause herpes vesicles at the body surface. In the 'virosphere' there are the retroviruses, whose RNA genome can be converted to DNA by the reverse transcriptase enzyme carried in their viral particles, integrating their genes into the host cell genome and becoming one with it. When, for any of a number of reasons, the host immune system undergoes degrees of immunosoppression, the virus can reactivate, replicate, and cause disease. Even when this does not occur, oncogenic virus latency can induce malignancy in host cells.**

Keywords: latency, herpesvirus, oncogenic viruses, T antigens, papillomavirus.

I. Latent and Persistent Infection

It is common knowledge that a virus penetrates into the host cell through a specific receptor in an interaction that can be analogized as a 'lock and key'. The infection may be productive for the virus and lytic for the cell (an acute infection), or the virus may remain latent in the living cell and occasionally replicate over time (Roizman et al 2012). In the latter case the infection may be persistent, and can be characterized either by periodic cycles of viral replication, or continual virus production as part of a chronic infection (Held and Derfuss 2012).

The *Herpesviridae* family is the typical example of a group of viruses that can give rise to a latent infection in animals (Cohrs and Gilden 2012). These viruses are very diffuse in humans, and after entering the body may establish a relationship that lasts until the death of the host. After the initial infection Herpesviruses localize to a specific compartment of the host, according to their tropism, and remain there extended periods. For example, the varicella zoster virus (causative agent of chickenpox) remains in nerve cells for the life of the host, or until a lack of the host immune defense let it reactivate, migrate to the body periphery and form herpes zoster vesicles (shingles) (Cohrs and Gilden 2012, Zerboni and Arvin 2011, Chen and Gershon 2011, Kinchington and Goins 2011). The clinical manifestations can be more or less severe according to the virus strain and the body immunity (St. Leger and Hendricks 2012, Sawtell et al 2011, Thompson and Sawtell 2011), and recently some viral genes have been identified as being responsible for the molecular mechanisms that allow the viral genome to exit latency; the 'pacemaker' triggering virus reproduction and the lysis of infected cells (Bowles and Blaho 2011).

Every subfamily of herpesviruses occupies a different compartment in latency, but they mostly remain in immune-privileged areas of the host. Therefore this human–virus interaction can last for extended periods: the virus is protected from humoral antibodies and lymphocyte attack, but the immune system isolates the virus, limiting its harmfulness even if it cannot be eradicated from the body.

Herpes simples virus (HSV) types 1 and 2 cause infection of epithelial cells and then lie hidden in the neurons: HSV 1 yields oropharyngeal lesions (cold sore) that can recur and, rarely, cause encephalitis, whereas HSV2 infection begins at the genital mucosa.

II. Molecular Pathogenesis and Malignancy

The *Polyomaviridae* family includes JC Virus (JCV), BK Virus (BKV) and SV40. As with the *Herpesviridae* family, these viruses are capable of establishing latent infection in the human host, and often initially infect children without causing clinical symptoms. JCV is mostly found in the kidney, but can be found also in lymphocytes, bone marrow, lung, intestine and brain. The host immune system plays an important role in the reactivation of the virus from the latent stage, which can occur as a consequence of immunosuppression, allowing JCV to replicate and cause disease.

Before being associated with colon cancer (Boland et al 2010) and brain tumors (Reiss et al 2010), JCV provided information that allowed a better understanding of the relationship between human immunosuppression and the molecular origins of tumor immunology (Finn 2008). JCV can be reactivated in the nervous system, causing encephalopathy (Ellis et al 2012) or potentially progressive multifocal leucoencephalopathy (PML), a fatal demelinating

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disease of the central nervous system observed in immunosuppressed individuals.

BKV is pathogenic in humans with haemorrhagic cystitis, nephropathy and has been recently associated with prostate cancer (Imperiale and Das 2010).

III. The Oncogenic Viruses

The correlation between virus and tumors goes back to the beginning of the last century when, in 1911, the American researcher Peyton Rous observed the role of viruses in causing sarcoma in chickens (Zur Hausen 2008). It is worth noting that this research was treated with some skepticism and even derision by the academic world for many years, such that it was only in 1966, at 87 years of age, that he was honored with the Nobel Prize for Medicine. Today, epidemiological investigations and research have allowed the identification of numerous viruses as causes of tumors in man (Table 1) (Zur Hausen 2008). For example, the hepatitis viruses B and C are particularly involved with hepatocellular carcinoma (Block and Mehta 2010, Sir and Ou 2010). Altogether, over the 50% of all the tumors of the liver in the world are attributable to a hepatitis B infection, for which an effective preventative is available (Table 2) (Chang and Chen 2010). At least 300.000 cases of liver cancer could be prevented per year, for which mortality is nearly 100%. HCV, aside from its role in liver cancer, is also involved in the development of some malignant lymphomas (Sir and Ou 2010).

HPV infection has been correlated with carcinoma of the cervix of the uterus, particularly genotypes 16 and 18, and is considered to be carcinogenic in humans (Katrenellenbogen and Galloway 2010). The prevalence of this infection is very high among sexually active adults, and increases with the number of sexual partners. Insofar as persistent infection is important in the carcinogenesis(. Baldwin and Munger 2010), this is therefore a cancer type that is 'transmitted by sex'. HPV is responsible for 80% of the carcinomas of the cervix and uterus that occur in the industrialized countries, and 90% of those in the developing world (Zur Hausen 2007), 70.000 and 260.000 new cases annually, respectively. HPV can also cause squamous carcinomas of the vulva, penis and anus. One can calculate that these viruses cause almost 30.000 cases of carcinoma of the vulva per year worldwide. Other tumors are also potentially associated with HPV, particularly cancers of the head and neck, of the esophagus and of the skin, although these associations remain to be confirmed ((Katrenellenbogen and Galloway 2010).

There is then the AIDS-associated virus, HIV, that is indirectly associated with two cancer types, Kaposi's sarcoma and non-Hodgkin lymphoma (De Falco et al 2010), as the immunodeficiency that it causes allows these conditions to develop (Finn 2008). In the patients with HIV over the sarcoma of Kaposi and the non-Hodgkin lymphomas, also . Hodgkin lymphoma frequency is significantly increased in HIV-seropositive individuals from an epidemiological point of view, as are other types of cancer, such as head and neck, testicular, anal and melanomas, based on cohort studies. Other oncogenic viruses include: human herpes virus type 8 (HHV8) (Minhas and Wood 2010, Hayward et al 2010), which is considered to be the cause of Kaposi's sarcoma when enabled by HIV (that is, the so-called 'classical Kaposi'). It is furthermore associated with various other cancer types, such as the body-cavity-based lymphomas, and Castleman's lymphadenopathy. The Epstein Barr virus (EBV) is considered a carcinogenic herpetic virus with conclusive evidence of its association with Burkitt's lymphoma, which often appears in immunosuppressed patients; in Hodgkin T-lumphoma; and in nasopharyngeal carcinoma (Pagano 2010, Dar and Sugden 2010). HTLV1 is considered carcinogenic as it causes acute T-cell leukemia (Matsuoka 2010, Marriott 2010).

IV. Virally-Induced Tumor Antigens

Some antigens have been very well-studied, especially in cell lines and in the newborn hamster model, particularly SV40 (Butel 2010) and the polyoma virus (Figure 1), (Sabin and Koch), in which it has been possible not only to show the presence of the normal antigens (enzymes) of the early viral replication, but also the so-called non-structural antigens, not present in the viral particle, but present in the cells infected and transformed by that virus (Rathi and Pipas 2010). Much has been contributed on this topic by the studies of the American groups lead by Huebner (NCI) and Green (Saint Louis) for the adenoviruses, by Sabin and Tarro (Cincinnati) for some herpes- and pox-viruses, by Melnick (Houston) for other herpesvirus (VZV) and by Rapp (Hershey, Pennsylvania) for the rest of the herpetic family (CMV). The epidemiological risk factors for the papilloma viruses are now well established in the literature. The proteins E6 and E7 are of particular interest because they are able to inactivate oncosuppressors during the process of malignant transformation (Thomas et al 2010). Therefore in the interpretation of the various stages of the cervical cancerogenesis it is important to establish that exist at least two mechanisms: the first tied up to the effect of papilloma viruses, agents of sexually transmissible diseases, and then that tied up to papilloma virus that has the DNA responsible of dictating a code of malignancy as the types 16, 1 8, 31 and others (Zur Hausen 2007). The passages from a stage to the other of the cell proliferation, can be triggered by other factors, such as HSV-2, hormones, contraceptives etc.. Following a publication from the Carbone group in

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Chicago, SV40 has been implicated not only in CNS glioma, but also in mesothelioma, a cancer of the pleura (Baranova et al 2010), however this was not confirmed recently. In June 2006 the Food and Drug Administration (FDA) approved the release of the first vaccine against HPV, targeting two oncogenic (16 and 18) and two non-oncogenic (6 and 11) genotypes (Table 2).

V. Conclusions

At this point I would like to take the HCV (hepatitis C virus) from the Flaviviridae family as model of virus that causes primary infection mostly by infected blood. HCV is eliminated by the host in about 15% of cases whereas its infection remains in the body in about 85% of cases. In the latter event the outcome might be quite different going from mild hepatitis and stable infection with different degrees of seventy till liver cirrhosis and also hepatocellular carcinoma 10-30 years later (Feitelson 2010).

Although the human being develops a strong immunoresponse to the virus, HCV yields a defense based overall on genetic variation that allowes viral strains to survive. The viral strategy explains therefore the increased chronic infections, the reinfection with different genotypes, the unsatisfactory therapy and the chimerical project of producing a vaccine in short times.

The influenza virus of the *Orthomixoviridae* family possesses a very high rate of genetic variation (Tarro and Esposito 2011). During its replication, one virus can experience genetic mutation equal to 2% of its total genome in 5 days' time; compared with this, a similar proportion of evolution from monkey to man took eight million years. Of course, this process is much faster in viruses with a simpler, more mutation-prone RNA genome. Haemagglutinin (HA) and neuraminidase (NA) are critical virulence determinants for influenza virus type A (Esposito et al 2012), and these viruses circulate in animals and humans with 16 subtypes of HA, 9 subtypes of NA, and 144 identified combinations in total. The previously-mentioned tendency towards mutation of the viral particle and its genome in general allows influenza A to undergo antigenic drift into minor changes – resulting in sporadic or small outbreaks of flu – or to undergo antigenic shift, resulting in major changes, new subtypes, and often large epidemics and pandemics (Chowell et al 2009, Lister et al 2009, Dawood et al 2009, Zimmer and Burke 2009, Morens et al 2009, Enserink and Cohen 2009).

Current and upcoming methodologies for extracting viral and non viral antigens (Tarro 2009), and techniques of cancer vaccine development (Vergati 2010) will allow further progress in understanding the role of viruses and the strategies of the immune system to produce humoral and cellular antibodies against them (Stix 2007). These tools have helped immunology to become a science, and are not simply a means to push sophisticated laboratory setups on to higher targets. Along these lines, non-invasive tumor monitoring (Schiller 2008) as well as mass spectrometry-based proteomics (Indovina et al 2012) may be a path to biomarker discovery. Peptide search in the tumor liberated protein (Tarro et al 2005) and cancer proteomics (Indovina et al 2011) represent the most advanced discovery in anticancer peptide vaccines (Perez 2010) Finally it is noteworthy to mention the emerging role of cytomegalovirus in malignant glioma (Cobbs 2012). Against this background, antiviral developments may well usher in a new era in anticancer strategies.

The author declares no conflict of interests

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Table 1 - Cancer AssociatedViruses of Man

- **Proven**

Certain strains of papillomavirus (Papovaviridae)
Epstein-Barr virus (Herpesviridae)
Hepatitis B virus (Hepadnaviridae)
HTLV-I and –II (Retroviridae)
Human herpes virus-8 (Herpesviridae)
Merkel cell polyomavirus (MCV)

- **Suspect**

Hepatitis C virus (Flaviviridae)
Herpes simplex virus (cofactor) (Herpesviridae)
HIV-1 and -2 (Retroviridae)
Polyomavirus (BKV, JCV) (Papovaviridae)

- **Possible**

Adenovirus (Adenoviridae)

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Table 2 - Examples of Licensed and Experimental Vaccines against Established or Putative Virus Cancers of Man

- Licensed

Hepatitis B (plasma-derived and recombinant)
Adenovirus (live and killed)
Papillomavirus

- Experimental-Investigative

Retrovirus	
HIV-1 and -2	AIDS
HTLV-1 and HTLV-2	Leukemia
Epstein-Barr virus	
Hepatitis C	

Source: Modified from annals N.Y. Academy of Science

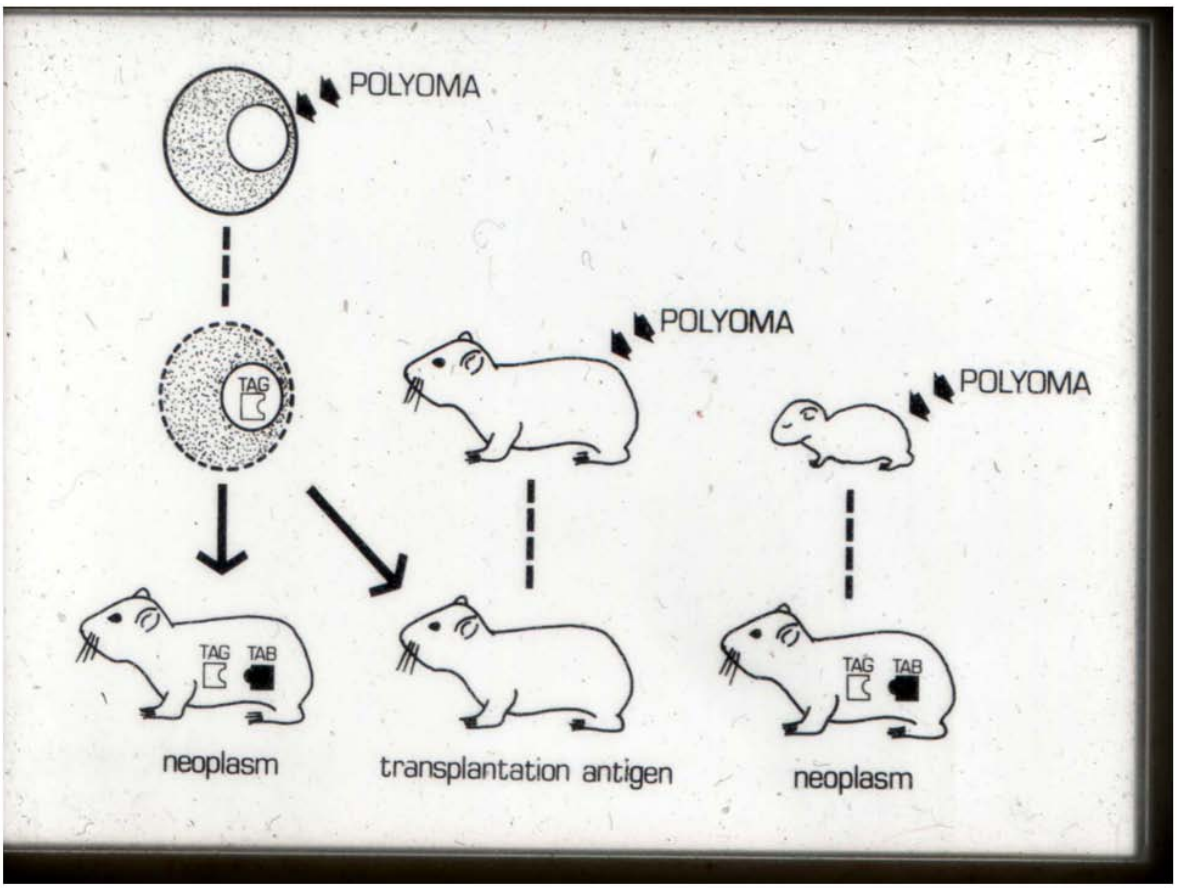

Figure 1 : The polyoma virus inoculated in tissue culture (left) transforms the cells that injected into adult hamster cause cancer with production of a transplantation antigen that protects the adult animals preinoculated by the virus (middle). In newborn hamsters the polyomavirus yields straight tumors (right)

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Content

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Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
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