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Can organizational culture influence Innovation? An empirical study on organizational culture characteristics and innovative intensity

Tahseen Arshi. A.

tahseen.arshi@majancollege.edu.om

Director of Studies, Faculty of Business Management

Majan College (University College), Muscat Oman

Abstract

Organizational culture has been associated with promoting innovative culture. However the soft aspects of organizational culture makes it challenging for firms to appropriately prescribe measures that specifically promotes various aspects of organizational innovation particularly innovative scale and frequency. This study identified key determinants of organizational culture that promotes both radical and incremental innovation represented as scale and frequency respectively. Data was collected from 200 sample representing organizations in 5 different sectors in the Omani private sector. The findings indicated that factors those are relevant for exploitation of current culture was found to be associated with incremental innovation, while the cornerstone of culture for radical innovation was associated with departure from existing culture and practices.

Key Words: Organizational culture, entrepreneurial architecture, innovative intensity, radical innovation, incremental innovation

1. Introduction

The research on cultural impact and innovation is diverse and no agreed upon theoretical models have been forwarded that assesses the impact of organizational culture on the entire innovation process. Further this study fills a critical gap in literature by providing clear and prescriptive organizational culture dimensions that promote either incremental or radical innovation. Dunlop-Hinkler, Mudambi and Kotabe (2010) pointed out that there is no dominant theory on innovation and considering new challenges emerging there is an increasing need for more theorizing. Snow (2007) pointed out that the research should seek more information on opportunity seeking and advantage seeking through innovation and culture can be a critical dimension. Leiblein (2007) also agreed that more understanding is required on how innovative opportunities are created within the firm and how these can be assessed. If the innovative dimensions especially for both radical and incremental innovation is understood and analyzed, firms will be in a better position to develop and implement culturally friendly innovative strategies.

Entrepreneurial management differs from corporate management in its strategic orientation, commitment of resources and organizational culture (Hisrich, Peters, and Shepherd 2010). Entrepreneurial culture facilitates creative practices and innovative outputs which is a critical entrepreneurial competency and is essential in the knowledge economy (Basadur and Gelade 2006). Burns (2013), after thorough review of literature proposed an enabling framework to promote entrepreneurial management in large organizations. Burn (2013) explained that the entrepreneurial management in large firms can be enabled through its 'entrepreneurial architecture' and one of the important dimensions of entrepreneurial architecture is organizational culture. This study focuses on the role of organizational culture in enabling innovation in organizations.

Global Hypothesis

Organizational culture has a significant impact on innovation capability of the firms

HO: Specific aspects on organizational culture impact innovation scale and frequency (represented as incremental and radical innovation)

2. Literature Review

Most of the literature on organizational culture is devoted to analyzing organizational culture from the established cultural frameworks. These include Hofstede dimensions, organizational learning frameworks and knowledge management frameworks.

According to Hofstede (1980) culture is the 'collective programming of the mind'. Cornwall and Perlman (1990) explained that organizational culture is about beliefs and values. Denison (1995) asserted that culture is "the deep structure of organizations, which is rooted in the values, beliefs and assumptions held by organizational members" (p. 654). According to Guirdham (1999) values are central to organizational culture. James et al. (2007) also agreed that culture is comprised of normative beliefs (system values) and shared behavioral expectations (system norms). Ahmed and Shepherd (2010) explained that organizational climate and culture are similar, although culture is deeper than climate. According to them climate is more observable as it is the reflection of the culture (Schneider et al. 1996).

Bowman and Faulkner (1997) were of the view that the organizational culture is constructed through organizational process, behaviors and cognitive processes. Organizational processes involve leadership styles, structure, empowerments, controls and rewards, routines,

rituals and symbols. Behaviors are constructed through job titles, slogans, and metaphors. The cognitive processes are constructed through beliefs, ethics, norms, and rules.

Schneider, Gunnarson and Niles-jolly (1996) elaborated the dimensions of climate, which are reflected through interpersonal relationships, nature of work, nature of hierarchy and support and rewards. Ahmed and Shepherd (2010) argued that the strength of the culture depends primarily on two things:

1. Pervasiveness of norms and beliefs in the explicit culture
2. Fit between implicit and explicit aspects of culture

However, the foundation of strong culture and weak culture had been laid by the mammoth study conducted by Hofstede who developed four dimensions of culture on a continuum. These dimensions included individualism versus collectivism, low versus high power distance, low versus high uncertainty avoidance, masculinity versus femininity. Further, short versus long term orientation was added by Hofstede and Bond (1991). Flynn and Chatman (2001) analyzed how strong and weak cultures support or inhibit innovation. Quoting researches done by Sutton and Hargadon (1996), and Flynn and Chatman (2001) they concluded that strength of organizational culture depends on conformity and uniformity of norms. For some organizations individualistic norms may be misconstrued as sign of weak culture, but individualistic norms may be desirable because it promotes individual aspirations and enable employees to confront challenges with fear of reprisal (Triandis 1995). On the other hand collectivism may be desirable for generation and implementation of innovative ideas as pointed out by Wagner (1995). Nemeth (1997) had pointed out that much attention is being paid to dissent and disagreement in creativity and innovation literature. However collectivism was considered as an important norm in promoting culture of innovation (Tushman and Anderson 2004). Similarly research on power establishes the need to use power carefully. Pfeffer (1993) elaborated on the benefits of high and low power distances.

Burns (2013) mapped Hofstede's dimensions with entrepreneurial architecture dimensions. Entrepreneurial management supports high collectivism as it build relationships and networks with stakeholders. Morris et al. (1996) observed that as the organization grows, entrepreneurial organizations tend to move towards collectivism. These aspects of culture promote belongingness and enhance motivation. Entrepreneurial management balances masculinity and femininity as relationships have to be built. Entrepreneurial management has low tolerance for uncertainty avoidance and has tolerance for risk. This is that aspect of culture that promotes creativity and innovation as it understands the value of failure. Finally, low power distance in entrepreneurial management creates open relationships, flat structures and information and knowledge sharing. Hall (2005) also observed that low power distance culture promotes innovation while high power distance hinders creativity and innovation.

Hofstede et al. (1990) also made attempts to differentiate entrepreneurial management form administrative management. Getting insights form the studies of Hofstede Timmons and Peters (1997) argued that entrepreneurial management is distinct through the following characteristics:

- People and empowerment
- Focus
- Commitment and personal responsibility

Schein (1994) placed importance on 'organizational learning and argued that learning organizations provides fertile grounds for innovation. Such as organizational culture, is created through focusing on people rather than systems, empowerment, open communication, team

work, approachable leaders and viewing problems in a holistic way. Culture also has impact on both leadership style and organizational structure. Entrepreneurial management would promote flat and open organizational structure, while leadership style in such cultures would be distributive and transformational.

2.1 Cultural Effectiveness and Innovation

The research on cultural impact and innovation is diverse and no agreed upon theoretical models have been forwarded that assesses the impact of organizational culture on the entire innovation process (Tushman and Anderson 2004). Researchers have devoted efforts to study impact of organizational culture on different aspects of innovation process such as new idea generation, creative inertia, and implementation of innovation processes and outputs. Tushman and Anderson (2004) further pointed out that there is no paradox between strong and weak cultures and innovation as the misconception lies in the content and strength of culture. They pointed out that both these concepts are blurred in innovation literature.

There is quite a substantial body of literature that is devoted in understanding and evaluating cultural effectiveness in the context of innovation. Miron, Erez, and Naheh, (2004) identified that culture is organizations specific and hence they argued that culture can provide an organization with competitive advantage. Researchers such as Peters and Waterman (1982) and Kotter and Hasket (1992) had linked cultural effectiveness and organizational performance. Deshpande et al. (1993) particularly linked cultural type to innovativeness. Inspired by the seminal work of Quinn and Rohrbaugh (1983) Deshpande et al. (1993) developed a typology of culture into four archetypes. McColl-Kennedy and Anderson, (2002) pointed that performance oriented cultures, although focus on efficiency and cost cutting, but they also promote the culture of innovation. Sarros, Cooper and Santora (2008) argued that culture mediates the relationship between transformational leadership and organizational climate for innovation.

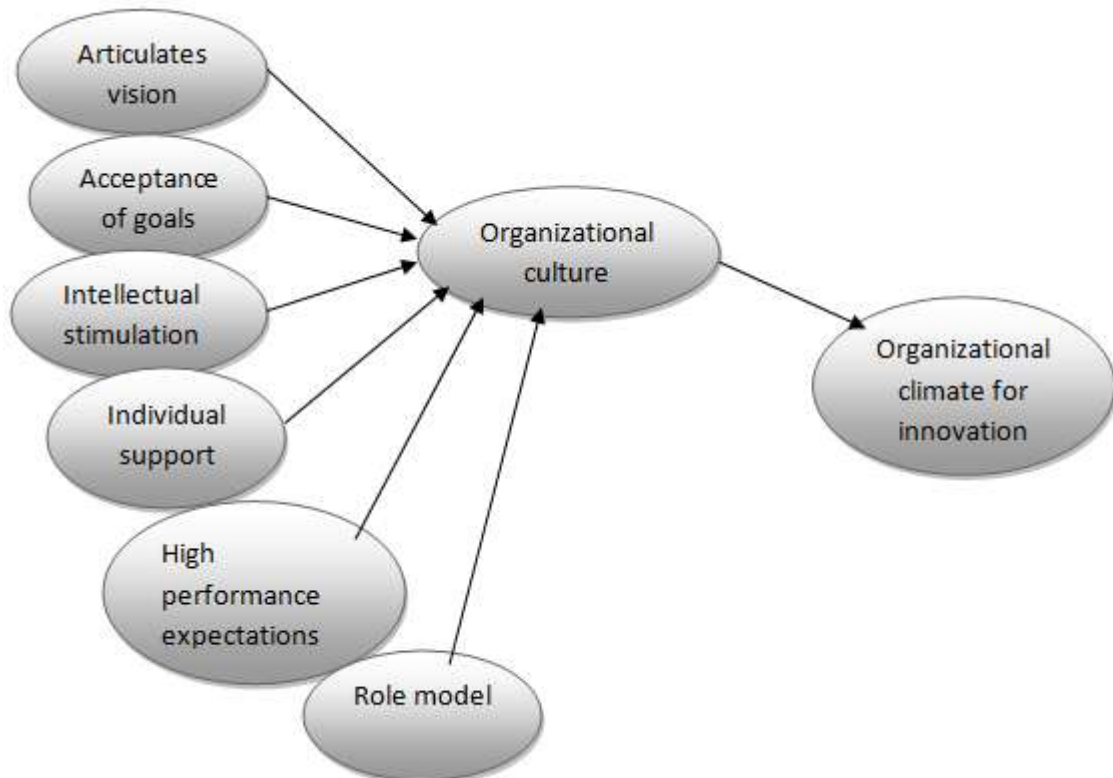


Figure 1: Structural model of relationship between organizational culture, transformational relationship and organizational climate for innovation, Source: Sarros, Cooper and Santora (2008)

Similarly, Denson and Mishra (1995) identified four cultural traits with cultural effectiveness. These four dimensions were involvement, consistency, adaptability long-term vision, and mission. According to Denison and Mishra (1995) these dimensions represent ability for integral change as well as stability. They explained that involvement and consistency focuses on external adaptation, while involvement and adaptability is geared up to meet the challenges of change and innovation. Knox (2002) focused his discussion on how employee commitment and skills were critical in promoting and maintaining organizational innovation. Lau and Ngo (2004) found out that organizational culture mediates the role between human resource (HR) systems and innovation. They argued that HR systems such as training, team development and performance-based reward systems can be used to create an organizational culture that promotes innovation. Maria and Watkins (2003) found the link between learning organizational culture and innovation.

Learning organizational culture continuously creates learning opportunities, promotes inquiry and dialogue, encourages collaboration and team learning, empower people towards collective vision, connect the organization to its environment and leaders model and support learning (Marsick and Watkins 1999). They pointed out that the perception (which aspects of change are important) and action (implementation- where they are) of innovation are integral to organizational culture and must be positively developed. The concluded that organizational culture that promotes team learning, continuous learning and supported by leadership is more effectively tuned towards innovation. Similarly Ismail (2005) measured the organizational creative climate factors (CCQ) (Ekvall 1988) and learning organization (LO) and found that both variables contributed 58.5 per cent to the explanation of observed variance in the innovation construct. He specifically found out that LO factors contributed more than CCQ factors especially dimensions such as “Embedded Systems”, “Systems Connection” and “Continuous Learning” was more important.

Amabile (1999) and Woodman and Schoenfeldt (1990) studied the individual traits that support innovative culture and values. These dimensions were internal focus, curiosity, persistence, energy, ability to deal with uncertainty, self-confidence, intuition, creativity and intellectual honesty. Culture and climate can create innovative orientation and positive behaviors reinforced through sensitive leadership, which is part of entrepreneurial architecture. Bastic and Leskovar-Spacapan (2006) identified three broad constructs of organizational culture that impacts innovativeness. These were entrepreneurial culture, market oriented culture and innovative components of culture. Specifically they identified that the elements of entrepreneurial culture that impacts innovation are tolerance for risk, proactiveness, and receptivity to innovation. They further argued that all these constructs of organizational culture should be developed and should complement each other which can in turn enhance the innovative intensity of the organization.

Youngblood (2007) questioned the validity of mechanistic cultures in the context of present environment where change and innovation is critical to organizational success. He argued that classical cultures with mechanistic process are not suited to the present environment characterized by speed, creativity and responsiveness. He propagated what he called a ‘quantum’ culture that is geared up to meet the challenges of innovation. According to Youngblood (2007) “*in quantum cultures radical innovation is not centralized or senior level activity, but instead is distributed responsibility. Ideas are considered based on merit and not source*” (7). The two views of diagrammatically opposite cultural views are presented through the table below:

Table 1: Comparison of different cultural values, Source: Youngblood, (2005: 6)

	Classic Culture	Quantum Culture
Central Metaphor	Machines	Natural systems
Attitudes toward people	Must be managed, controlled, not trustworthy; must be given incentive and driven to do good work	Capable, trustworthy, creative, and committed to doing great work
Strategy	Centralized, fixed	Emergent, opportunistic, flexible
Structure Hierarchy Network	Leadership Leaders are rare, heroic people who are all-knowing and who are expected to drive the company to achieve results	Leadership is a distributed phenomenon; results are achieved by creating an environment where ingenuity, creativity, and responsibility can thrive
Management	Command and control methods are used to meet planned levels of performance	Employees operate with a high level of autonomy and are coached to produce extraordinary results in surprising ways
Culture	Unimportant; given little or no attention	Vital to success; significant time and energy given to it
Renewal	Focus on extending existing business model by doing more of what's already being done only better	Focus on creating breakthrough innovations that change the rules or create whole new markets
Agility	Slow, inward focused, unresponsive	Fast, extremely focused, very responsive
Vitality	Employee welfare is secondary to financial concerns; motivation through economic benefits	People are treated equal to or above financial concerns; motivation through an inspiring vision and ability of everyone to contribute

Organizational culture is created that supports entrepreneurial organizational design and structures. Organizational culture also supports achievement of innovation strategies because without adequate beliefs that value innovation and change, such strategies would not be feasible. Further, the dependencies between the dimensions of entrepreneurial architecture are demonstrated by the fact that entrepreneurial leaders facilitate all the other dimensions of entrepreneurial architecture. Entrepreneurial leaders create entrepreneurial culture, design

entrepreneurial structures and design entrepreneurial strategies. This may not be possible without the intention, belief, support and intervention of top management and leaders of the organization. Isaksen and Ekvall (2006) developed the Situational Outlook Questionnaire (SOQ) that measures nine dimensions of organizational climate. According to him appropriate organizational climate can enable favorable organizational culture for innovation.

2.2 Incremental and radical innovation

These innovation types based on scale and frequency are interchangeably termed as innovation intensity and more comprehensively as entrepreneurial intensity (Morris and Kuratko 2002). The researcher wishes to use the term 'entrepreneurial innovative intensity' as it represents the true spirit of innovation in the context of entrepreneurial orientation. Bessant and Tidd (2011) argued that innovation varies on the degree of their novelty and innovations may range from minor improvements- termed as incremental innovation to radical changes- termed as radical innovation. The further argued that the former is usually characterized by changes in components and later as changes in systems- an explanation that is found in some of innovation models. Both radical innovation and incremental innovation have different competitive consequences and requires different organizational capabilities. Tidd and Bessant (2009) have enumerated the benefits of both types of innovation in delivering competitive advantage. Kanter (2010) argued that organizations must have capabilities for incremental innovation before they can acquire new capabilities for radical innovation. On the other hand Christensen and Overdorf (2005) cautioned that organizations with incremental innovation capabilities fail to handle revolutionary changes and hence their ability to meet the challenges of disruptive innovation becomes restricted. Prahalad and Mashelkar (2010) pointed out radical innovations are disruptive and changes industry dynamics thus providing substantial level of competitive advantage.

3. Methodology

An abstract construct like culture qualifies to be epistemologically grounded in interpretivist philosophy. However, this research acknowledging its limitations in terms of measurement adopted a realist approach. Since the objective was to identify and measure the dimensions of organizational culture validity was critical (Fisher 2004). Positing the research into realist philosophy meant that quantitative strategies became dominant and hence a cross-sectional research design was adopted. Quantitative methods provided a framework for the study and statistical persuasion became critical to validity. Quantitative strategies allowed measurement with greater control and as recommended by Saunders (2012) allowed greater amount of reliability and generalisability.

3.1 Operationalization of Constructs

The primary research tool that was adopted was questionnaire survey using five point Likert scale. A 40-item questionnaire was constructed and 20 items were allocated to both types of innovation through two sets of questionnaires. The dimensions were also validated through qualitative interviewing. Data was collected from 200 employees working in different private sector organization in Oman. The sectors that were included in this study were telecommunications, banking, retail, tourism, airlines, and financial services.

3.2 Reliability and Validity

A total of 40 items (all scale data) were subjected to alpha test too ensure reliability. The reliability test of the interval scaled data showed a high internal consistency as the Cronbach Alpha value was 0.712 which is by all means highly desirable as suggested by

Saunders et al. (2006). Homoscedasticity was checked using Tabachnik and Fidell's (2007) and Pallant's (2005) recommendations. The Leven's test (.623 and .712) and multi-collinearity and variation inflationary factor (VIF) showed desirable scores (tolerance less than 10 and VIF greater than 2.5) was achieved. There was no auto-correlation detected in the data as was indicated through the Durbin Watson Test (1.809 and 1.810). These tests indicated that there were no violations of the assumptions of regression equations. Validity was very important as the items in the questionnaires were being tested for the first time and no other standards scales were available. Face validity and content validity was established through extensive survey of the extant literature on both innovation and organizational culture. The factors were regressed to establish convergent validity and verimax rotation scores which were higher than .6 were retained in the regression model, which meant that the dimensions had high convergent validity. It meant that each of the 20 items (organizational culture dimensions) was qualified to measure both types of innovation constructs.

4. Findings and Data Presentation

The 30 items used in questionnaire was subjected to Pearson Product moment correlation test. Out of the 40 items that were subjected to testing 21 items showed strong correlation values ($P > .05$) as shown in table 1 below. Table 1 show that out of these 21 items, 11 items showed strong correlation values between incremental innovation and organizational culture and 9 items between radical innovation and organizational culture.

Table 2: Pearson Product moment correlation test (DV incremental and radical innovation)

organizational culture Dimensions	Innovation Type	
	Radical innovation	Incremental Innovation
acceptance of uncertain outcomes	.760**	
risk acceptance culture	.728**	
degree of freedom	.742**	
Organizational climate		.670**
degree of organizational involvement	.498**	
feedback from stakeholders		.809 **
Balance between exploitation And exploration		.498*
Structural and cultural support through rewards		.616**
Employees perceived expectations		.750**
Organizational climate supporting creativity		.899**
Training for change		.512*
Innovation Champions	.740**	
Value in Failure	.812**	
Harnessing Knowledge		.510*
Risk acceptance culture	.823**	
Programmed deviations	.520*	
Ability to manage toxic side effects		.491*
Changing process dramatically	.597*	
Well known paths		.582*
Nature of work	.489*	
Habitualized actions and behaviors		.545*

The findings indicated that the respondents could identify organizational culture dimensions that lead to either incremental or radical innovation. Further, to evaluate the collective impact of all dimensions on these types of innovation multiple regression tests were conducted and the results are presented in tables 3 and 4.

Table 3: Regression on dimensions for organizational culture and radical innovation construct (DV) P>.05

Model Summary: Radical Innovation Culture

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.699(a)	.634	.601	.68677	1.809

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
.623	4	195	.692

Model		Un-standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.408	.266		1.538	.126
	acceptance of uncertain outcomes	.406	.086	.499	4.729	.000
	risk acceptance culture	.123	.075	.411	1.645	.001
	degree of freedom	.015	.072	.399	.211	.012
	degree of organizational involvement	.512	.069	.411	1.785	.000
	value in failure	.577	.048	.379	1.987	.001

Table 4: Regression on dimensions for organizational culture and incremental innovation construct (DV) P>.05

Model Summary: Incremental Innovation Culture

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.840	.712	.701	.61213	1.810

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
.712	4	195	.719

Model		Un-standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.408	.266		1.538	.107
	Perception of risk	.406	.086	.374	4.729	.001
	Organizational climate supporting creativity	.123	.075	.398	1.645	.000
	feedback from stakeholders	.213	.072	.374	1.711	.000
	Harnessing Knowledge	.169	.075	.159	2.263	.025
	Structural and cultural support through rewards	.370	.072	.380	1.229	.001
	Balance between exploitation and exploration	.343	.087	.039	1.645	.003
	Training for change	.123	.056	.119	2.200	.029

The findings indicate that there is a strong and positive relationship between dimensions of organizational culture and innovation construct. Further dimensions of organizational culture and innovation types were also found to be correlated. Dimensions of organizational culture and incremental and radical innovation showed significant correlation values. Most prominent relationships that are reported between radical innovations and organizational culture include, acceptance of uncertain outcomes (.000), risk acceptance culture (.001), degree of freedom (.012), degree of organizational involvement (.000) and value in failure (.001)

The presentation of the multiple regression models (table 3) explains 60% (adjusted R square) of the relationship between dependent (incremental innovation) and independent variables (dimensions of organizational culture) in this model. Acceptance of uncertain outcomes with the highest beta score of .499 (p value .000) contributes maximum towards radical innovation outputs followed by degree of freedom with a beta score of .399 lead to opportunities for radical innovation. The presentation of the multiple regression models (table 4) explains 70 % (adjusted R square) of the relationship between dependent (incremental innovation) and independent variables (dimensions of organizational culture) in this model. Organizational climate with a beta score of .398 (p value .000) contributes maximum towards incremental innovation outputs followed by feedback from stakeholders with a beta score of .374 (p value .000) lead to opportunities for incremental innovation. Based on these findings the global hypothesis that organizational culture dimensions influence organizational innovation is accepted. Further, null hypothesis that organizational culture dimensions impact the scale and frequency of innovation is also accepted as the dimensions in this study are clearly demarcated.

5. Discussion

The discussion on organization structure and strategies revolve around more tangible aspects of organizational design. The organization structure supports hard innovative practices such as innovation stage-gate methodologies, goals, reward systems, procedures, resources and infrastructures. The discussion on culture revolves around soft innovation practices. Like the studies done by Maria and Watkins (2003) who found the link between learning organizational culture and innovation, this study also found significant relationship between organizational culture and innovation. The soft aspect focuses on promoting innovation through culture and

climate. Amabile (1999) and Isaksen (2006) have discussed in detail how organizational climate that facilitate creation both creativity and innovation. Degree of freedom, nature of work, rewards and dedication of resources contribute towards creation of favorable organizational climate for innovation. Incremental innovation revolves around continuous improvements and listening to various stakeholders for improvements. These factors are more associated towards promoting incremental innovation as the current culture and practices are promoted and favorable organizational climate is created. The findings on culture and radical innovation revolved around departure from existing cultural and practices. When organizations are willing to develop a culture that promotes radical innovation, it requires greater commitment than incremental innovation and creation of quantum culture (Youngblood 2007). In this culture risks have to be part of work environment and failure should be a learning point. The top management of the organization should involve itself in innovation processes and should be accept uncertain outcomes. Shalley and Gilson (2004) argued that whether leaders do it on purpose they play an important role on creating the right climate for innovation Merx-Chermin and Nijhof (2005) also found positive relationship between organizational architecture dimensions and radical innovation. They argued that knowledge sharing culture and trust has to be built in the organizations that can facilitate radical innovation.

6. Conclusions

The cultural dimensions were found to be influencing the level of innovation intensity. The culture of incremental innovation is quite different from culture for radical innovation and both require different levels of commitment and involvement. Organizations which are more focused on incremental innovation should exploit current cultural strengths, promote continuous improvement culture and listen to various stakeholders for areas of improvement. Organizational climate that promote creativity is critical in creating culture that promotes incremental innovation. The top management should focus on balancing between exploitation and exploration. On the other hand, the culture for radical innovation is denoted by significant departure from existing culture and practices. It requires courage, commitment and dedication of resources form the top management of the organization to create such an organizational culture. This study like few other studies have established that culture can influence innovation in a significant way along with other dimensions of entrepreneurial architecture comprising of strategies, structure and leadership. This study also filled a critical gap in literature by identifying dimensions of organizational culture which are suited for either incremental or radical innovation. It provides scope for further research which can be done to operationalize each dimensions of incremental and radical innovation and validate in similar or other research settings. This was also a primary limitation f the study that the data was collected from a research setting that is not known for innovation particularly radical innovation. The generalisability of the findings needs further validation.

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Qur'anic Therapy: A Probe into The Efficacy of Verses of Exorcism ('Ayatu 'R- Ruqyah)

Dr. Shaykh Luqman Jimoh

*Department of Religions and Peace Studies,
Lagos State University, Ojo, Lagos, Nigeria
jimluq@yahoo.co.uk*

Abstract

A recent World Health Organization report has it that more than 450 million people world-wide suffers from one brand of mental disorder or the other. Research has shown that demonic possession is one of the factors responsible for the increase in the rate of mental disorder; and that all over the Muslim world, there are Muslim exorcists who attend to this brand of mental disorder using some extraction from the Qur'an labeled 'Ayatu 'r-Ruqyah (Verses of Exorcism). This study therefore looks at the therapeutic use of the Qur'an with special reference to 'Ayatu' r- Ruqyah (verses of exorcism). The claim of Muslim exorcists that 'Ayatu' r- Ruqyah is efficacious in treating mental derangement of demonic origin is equally examined. The study however concludes that the efficacy of verses of exorcism largely depends on some other factors which include the spiritual strength of both the possessed and the exorcist; and that in the absence of those factors, the recitation of verses of exorcism only may not produce the desired result.

Key words: Demon, Demonic Possession, Exorcism, Exorcist, Mental Disorder, Prophetic Tradition, Music Therapy, Incantation.

1. Introduction

The Qur'an, Muslims believe, is the Divine Book revealed by the Almighty Allah to Prophet Muhammad both in letters and spirit, through the agency of the arch Angel Jibril (Gabriel). Muslims also believe that the Qur'an was revealed to serve as guidance to mankind in general and Muslims in particular.

Apart from serving the purpose of guidance, the Qur'an also serves many other purposes to the Muslims, one of which is healing. References for this assertion in the Qur'an include Q.17:82 and Q. 41:44 both of which read thus: "We have revealed in the Qur'an that which is a cure and a mercy for those who believe..." and "Say: it is a guide and a healing to those who believe". Qur'anic exegetes such as As-Sawi (2004), Al Baghdadi (1995), Ar-Razi (n.d) and a host of others have all interpreted these verses to mean that the Qur'an could also be used in treating ailments which may be physical or spiritual. To evince their submission, reference is made to the statement of Prophet Muhammad when he said to one of his companions who, by the means of recitation of Chapter One of the Qur'an (*Suratu 'l-Fatihah*), successfully exorcised a king who was bitten by a scorpion: "Who taught you that *Fatihah* could be used for exorcism (*ruqyah*)?" (Imam Bukhari, 1998). Commenting on the above cited Qur'anic verses, the exegetes submit that the Qur'an has healing qualities which cover not just a part of the Qur'an but the whole of it. They conclude therefore that the Qur'an is a healing for both spiritual and physical ailments.

In the Muslim world today, using the Qur'an for exorcism purposes is fast spreading like palm oil on hot yam. Across various Muslim countries, Muslim exorcists who claim to treat different ailments by the means of the Qur'an are found. One common ailment that such exorcists claim to treat is demonic-possession using verses of exorcism extracted from the Qur'an and labeled '*Ayatu 'r-Ruqyah*'. Through this endeavor, the Muslim exorcists have sought to contribute in no small measure to the reduction of mental-related illnesses which is now a global challenge. Since the Muslim exorcists' claim is that the verses of exorcism is efficacious in treating victims of demonic attack back to normalcy, this study seeks to examine the veracity of this claim by looking critically at the argument advanced by the Muslim exorcists.

2. The Qur'an and its Healing Qualities

In view of the Qur'anic verse where Allah declares that He has revealed in the Qur'an that which is a cure and a mercy for believers (Q.17:82), solutions to all problems-spiritual, physical and psychological-are therefore mostly sought for by the Muslims, using verses of the Qur'an. This is borne out of their belief and conviction that the Qur'an contains highly potent healing qualities. On the healing qualities of the Qur'an, Dr. Aziz Ahmed Quadri (n.d) has the following remarks:

I did not find any area covered in a standard text book of psychiatry that is not guided by the Holy Qur'an and Sunnah of Prophet Mohammed (PBUH). Over time I started counseling my patients in the light of religious knowledge I have acquired in my life so far, through the Holy Qur'an. And I must say it has rewarded me. This therapy has worked wonders in certain cases. Through this book I have made a humble effort to share my experience in treating patients through religious psychotherapy.

Quite a good number of studies have been carried out by Muslim scholars on the healing qualities of the Qur'an. While some of such efforts concentrate on the merits and virtue

of Qur'anic chapters and verses, some others squarely focus on the healing qualities. As-Suyuti's *Hama'ilu 'z-Zahri fi Fada'ili 's-Suwar* is one popular work that discusses in details the benefits and merits of reciting various Chapters and verses of the Qur'an. Another endeavor of As-Suyuti in this regard are two sections in his *al-'Itqan* under the heading *Fada'ilu 'l-Qur'an* and *Khawwasu 'l-Qur'an*. One of the earliest studies on the healing qualities of the Qur'an and its therapeutic uses is *khawwasu 'l-Qur'an* by Al Hakim al-Tamimi in the ninth century (9thC.E). Commenting on the merit of this work, Fazlur Rahman (1987) writes:

The "miraculous properties" of practically each passage of the Qur'an are discussed, including their curative properties for various diseases. Indeed each chapter of the Qur'an is represented as having different benefits when read in different manner.

Some other notable authoritative works that Muslims rely on in sourcing information about the various therapeutic uses of Qur'anic verses and chapters include *'Ismullahi 'l-'A'zam* of At- Tukhi (n.d), *Shamsu 'l-Ma'arifi 'l-Kubra* and *Manba' 'Usulu 'l-Hikmah*, both of Al-Buni (1970,1985), *Ar-Rahmat fi 't-Tibbi wa 'l-Hikmah* of As-Suyuti(n.d) etc. The information contained in these works are, according to the authors, obtained from two sources. The first is Prophetic Traditions and the second one is personal exertion and successful experiments.

In the various collections of Prophetic Traditions, there are sections dealing with the therapeutic uses of the Qur'an. A good example is the tradition cited earlier about the use of Chapter One of the Qur'an to cure scorpion or snake bite. Another one is the collection of Qur'anic Chapters and verses used for exorcism purposes referred to as *'Ayatu 'r-Ruqyah*.

On personal exertion and experiment, Muslim scholars have submitted that this is based on circumstances surrounding the revelation of Qur'anic verses and their contents. The Qur'an contains Chapters and verses that relate to different issues. The content of the verses and the issues discussed in them are considered when suggesting them for therapeutic uses. For instance, *Suratu 'l-jinn* (Ch.72) and all other verses in the Qur'an where there are discussions on spirits and demons are suggested for use in warding off demonic attack. *Suratu 'l-Falaq* and *Nas* (Q113 and 114) because of their content and the circumstances surrounding their revelation are recommended for general protection. Verse 5 of *Suratu 'l-'Alaq*(Q.96), verse 6 of *Suratu 'l-'A'la* (Q.87), the tail end of verse 114 of *Surat Taha* (Q.20) and the tail end of verse 113 of *Suratu 'n-Nisa'* (Q.4) are all recommended for use as brain tonic because their contents have to do with knowledge. For easy delivery, verse 20 of *Surat 'Abas* (Q.80) is recommended for pregnant women.

A careful study of the content of most works dealing with liturgical and therapeutic use of the Qur'an reveals the above trend whereby Qur'anic Chapters and verses are recommended for use for a particular purpose based on the content of the Qur'anic portions and the circumstances surrounding their revelation which should have some bearings with the situation on ground. In addition, these authorities would have used the verses and Chapters of the Qur'an for the said purposes and found them to be efficacious.

3. Demonic Possession in the Light of Islam

Information about the world of spirits and demons in Islam are derived mainly from the Qur'an, sayings of Prophet Muhammad and experiences of Muslims as chronicled in their writings some of which include a section of *Majmu' Fatawa* of Ibn Taymiyyah (1995) captioned *'Idahu Dilalah fi 'Umumi 'r-Risalat; Zadu 'l - Mi'ad* of Ibn Qayyim (1994) and *Ghara'ib wa 'Aja'ibu'l-Jinn wa 'sh-Shayatin* of Ash-Shibli (1992) etc.

Spirits and demons, according to Muslim writers, are spiritual creatures imbued with certain powers one of which is the ability to penetrate and take control of human beings, animals and objects such as trees, stones etc. This fit, in the opinion of Yusuf (1983), becomes possible due to the demons' attribute of grosslessness since their initial creation was from fire free of smoke and smoke is the grosser accompaniment of fire. When this happens, it is commonly referred to in Islamic theological parlance as *Mass* (i.e spirit-possession or demonic possession).

One who is possessed by a demon is robbed of his personality. The demon takes partial or total control of his speeches, movements and actions. The victim loses his consciousness. One major manifestation of demonic-possession is "insanity". The victim behaves as one who is mentally deranged. He is emotionally imbalanced and as such behaves irrationally.

Orthodox Muslims, relying on Qur'anic text, sayings of the Prophet, confirmation of Muslim writers and some renown medical doctors as well as experiences of people, have confirmed the reality of spirit – possession (Jimoh 2012). The portion of the Qur'an cited by most Muslim writers to establish the reality of demonic possession is verse 275 of Chapter 2 of the Qur'an which reads thus: "Those who devour usury will not stand except as stand the one Satan by his touch has driven to insanity...." Almost all Qur'anic commentators are agreed that this Qur'anic statement is a direct reference and confirmation of the reality of demonic possession.

The word '*Mass*' used in the verse according to Al-'Alusi (1978) and Al-Khazin (n.d) is mental disorder deriving from demonic attack. Qurtubi (1954) submits that the interpretation of this verse shows the weakness in the position of those who deny mental disorder deriving from demonic attack; and that the demon cannot enter into man's body and possess him. Another authority, Ibn Kathir (1993) cited Ibn 'Abbas as saying that one who devours usury will be raised up on the Resurrection Day a mad man attacked by a demon. Most Qur'anic exegetes therefore are of the opinion that it is possible for the demon to enter into man's body; take full control of his senses and activities and render him insane.

In the collections of the sayings of the Prophet, there are quite a number of references to insanity deriving from demonic possession. An example is the one contained in the commentary of Al Bana (n.d) on the collection of Ahmad that a woman came with a son of hers to the Messenger of Allah and said; "O Allah's Messenger, he (the boy) is certainly insane. He is seized by fits whenever we want to eat and as such spoils our meal". Allah's Messenger then rubbed his chest and prayed for him. The boy then vomited and a black puppy came out of his mouth, which ran away.

A narrative cited by Ash-Shibli (1992) also shows how a Muslim scholar, 'Ahmad bin Hanbal expelled a demon from the body of an insane maiden in the house of al-Mutawakkil, a 'Abbasid caliph, only by sending his shoe. The content of the narrative is a testimony to 'Ahmad's confirmation of insanity stemming from demonic-attack.

Confirming the reality of demonic possession, Ibn Taymiyyah (1995) writes *inter-alia*:

The possessing demon speaks on the tongue of the possessed who does not, at all, realize that he is being touched and possessed by a demon who is speaking on his tongue. And, indeed, when he recovers, he does not have any idea of all he had spoken (while in the state). Also, when a possessed man is beaten with blows capable of killing or making a man sick, such blows do not have the least effect on the possessed who after recovery also informs the people that he does not feel anything. That is simply because all the beatings fall on the possessing demon only.

Another Muslim scholar, Ibn Qayyim (1994) also confirmed the reality of spirit-possession. He writes:

Only ignorant doctors and the pseudo-intellectuals who consider heresy a virtue deny spirit-possession and do not believe that they have effects on the body of the possessed. They have no basis (for this denial) except their ignorance of its occurrence, as there is nothing in the field of Medicine, which rejects it, while the senses and experiences (of people) confirm its reality...

Some other Muslim writers who have confirmed the possibility and reality of demonic possession in their various writings include Al Qarni (1990), Abu Ameenah (1989) etc.

4. Muslim Exorcists

All over the Muslim world, Muslim exorcists who derive from the Qur'an sorts of metaphysical cures are found. Acting in the capacity of consultants on spiritual matters, they attend to people's problems of all sorts such as ill-luck, barrenness, sickness of all kinds, disturbances from witches, evil eyes, sorcerers and evil spirits, inability to get a suitor, dull business, mental derangement etc.

The methods employed by the Muslim exorcists vary from one locality to the other. In some localities, solving the problems identified above requires that prayer sessions should be organized during which certain Chapters of the Qur'an are recited repeatedly for a number of times. Chapters 18, 36, 48, 56 and 67 are favorites in this regard. Indeed, quite a good number of the exorcists have, due to frequent repetition, memorized them. They are the Chapters usually put on tape by the reciters. Chapter 36 is believed to be multi-purpose while chapter 18 is for general protection. Chapter 48, 56 and 67 are for prosperity. At times, the client, according to Opeloye and Jimoh (2004) may also be directed to read or repeat certain verses and chapters of the Qur'an in the morning and or at night.

It should be noted however that some exorcists have given the uses of the Qur'an wider dimensions. The exorcism is not limited to only recitation of the Qur'an; some, in the view of Muslih (1982), recite it in adulterated form, yet some introduce some other features into it such as intermittent incantation. To determine the Qur'anic Chapter and verses to be read and the number of times they should be repeated, some take to divination. Opeloye and Jimoh (2004) write that in some other instances, the Qur'anic Chapters or verses may be written on wooden black slate with ink and washed with water for the client to drink possibly with honey or some other ingredients. The Qur'anic verses may also be written on a piece of paper in the form of talismans or amulets with some ingredients. It should be mentioned however that these uses as described above are not universally recognized. Many of them are known and are practicable only in those areas where they had been introduced.

There are, however, orthodox Muslim exorcists who attend to victims of demonic assault using Qur'anic chapters and verses believed to be recommended by Prophet Muhammad. The Prophet himself had on occasions treated victims of demonic assault. A thorough analysis of the Prophetic methods according to Jimoh (2012) reveals three different ways and manners of exorcism. The first identifiable manner of prophetic exorcism of victims of demonic possession is use of prayer only. There are instances when the Prophet only prayed for victims of demonic possession and instantly, they were delivered. Sometimes, before saying the prayer, he would rub the victim's chest. Another manner was by issuing out some words of command, once, twice or thrice to the possessing demon and immediately the demon would flee while the patient would regain consciousness. Such words of command include: "In the Name of Allah, I am Allah's servant, go away, O enemy of Allah" and "Get out enemy of

Allah, I am Allah's Apostle" etc. Another way is backing up the words of command with some actions such as holding the victim's nostrils; or opening his mouth and spitting into it, three times; or beating his chest. He also, at times, used to beat the victim's back with his garment and then washed his face with water after he might have regained consciousness. Sometimes, he combined between all the three ways identified above.

5. Treatment of Demonic Possession with verses of Exorcism ('Ayatu 'r Ruqyah)

Ruqyah which literally translates in English as incantation in a technical sense refer to exorcism. Exorcism is defined by Thayer (1979) as adjuration addressed to evil spirits to force them to abandon an object, place or person. In Islamic theology however *Ruqyah* (exorcism) is deliverance of a victim of demonic assault. Exorcism may be by the means of recitation of certain portions of the Qur'an. The Qur'anic Chapters and verses that are used for this purpose are called 'Ayatu 'r Ruqyah. It is true that the Prophet himself did not use the Qur'anic extraction ('Ayatu 'r Ruqyah) for exorcism, but a narrative in a Prophetic tradition contains the extraction which include Qur'an Chapter 1, 2:1-4, 2:163-164; 2:255; 2:284-286; 3:18; 7:54; 23:117; 37:1-10; 59:21-24; 72:3; 109; 112; 113 and 114.

It should however be mentioned that the Prophetic tradition containing this extraction has been graded weak by scholars. Ash Shahawi (1993) says the reason why the tradition is graded weak is that one 'Abu Janab al-Kalbi who has been adjudged weak, renounced and a forger by scholars is in the chain of the tradition. However, since the tradition is considered weak only on account of the presence of 'Abu Janab only while the other men in the chain are considered sound and trustworthy; and more so that the chapters and verses mentioned therein are, in some other authentic traditions, recommended for exorcism, most Muslim exorcists see nothing wrong in using its collection of chapters and verses for the purpose of exorcism which may be seen as only a meritorious deed.

Muslim exorcists have always claimed that the verses of exorcism are efficacious and that they definitely have effects on the possessing demons. Their position according to Jimoh (2012) is informed by the reactions they get from the possessing demon that may feature some signs of uneasiness, transmissible through the possessed. The demon might even speak on the tongue of the possessed, answering questions posed to it by the exorcist.

Some scholars have submitted that the above claim should not be taken on its face value to be true. They argue based on the instances given above about the Prophet who successfully exorcised victims of demonic possessing only by adjuration. They further support their position with the instance of Ahmad bin Hanbal who healed a victim of demonic possession only by sending verbal message to the possessing demon. Based on this argument, they therefore reason that successful exorcism is a function of many other factors that interplay with the recitation of 'Ayatu 'r Ruqyah to produce the desired result. After all, not all instances of recitation yield success. Bali (1989) has mentioned sound creed, piety, obedience to God, sincerity of intention, knowledge about the nature of *jinn*s etc. as some of the factors that boost the efficacy of the recitation of verses of exorcism by exorcists. Ibn Qayyim (1994) has identified the spiritual strength of both the possessed and the exorcist as the main factor upon which the success of any exorcism operation largely depend. The conclusion therefore is that in the absence of all the above stated factors, the recitation of verses of exorcism only may not produce the desired result.

The above however does not raise doubt about the efficacy of 'Ayatu 'r- Ruqyah. Muslim scholars have advanced various reasons the recitation of 'Ayatu 'r- Ruqyah should not be doubted as effective means of exorcism.

In the first place, there is the belief that there is inherent power in the Divine Words of God. The Qur'an which Muslims believe is the exact Words of Allah and an expression of His Power and Might possess qualities that would serve both religious and secular purposes. According to Muslih (1982), words of the Qur'an possess special powers which are capable of performing wonders because the ever-existing power of Allah could be effectively invoked through those words if they are properly used. To buttress this argument, the Qur'anic verses: "Had We sent down this Qur'an on a mountain, you would have seen it (the mountain) humble itself and cleave asunder for fear of Allah..." (Q.59:21); and "If there were a Qur'an with which mountains were moved, or earth were cloven asunder, or the dead were made to speak (this would have been the one!) (Q.13:31) are cited.

There is also the general belief that there is power in word absolutely. That is the reason why prayers, curses and incantations have effects. Muslih (1982) submits that philosophers have confirmed that the recitation of incantations which sometimes contain unknown and meaningless words have effects either in warding off evil or causing it to happen. People pray, request for prayers and say 'Amen' during prayer sessions because they believe in its efficacy. Conversely, people dread being cursed because they believe curses produces negative effects. If this is true about incantation, prayers and curses, it is not strange therefore, that verses of exorcism in the Qur'an which are read like adjuration to the possessing demon have therapeutic effects.

Another argument advanced to show the efficacy of Qur'anic therapy has to do with music therapy. Music therapy is the use of music to bring about healing. Quite a number of researches have revealed the efficacy of music therapy in promoting health. Research has shown that music has profound effects on the mind, psyche and body of the listeners and that it is beneficial in treating varying ailments such as cancer, chronic stress, pain, depression etc. In the opinion of Elizabeth Scott, music with a strong beat can stimulate brain waves, with faster beat brings sharper concentration and more alert thinking while slower tempo promote a calm and meditative state.

Demonic possession, it has been submitted, also affects the brain in most cases. One major reason why this is so according to Bali (1989) is that immediately the possessing *jinn* gains entrance into the body of the possessed through any part of his body, it goes straight to the brain; and from there, it causes serious disorder of the mind and takes control over all activities of the bodily organs. A confirmation of this submission is the discovery made in modern medicine that there is usually a strange but stable vibration noticeable in the brain of any victim of demonic possession. The Qur'an of course is not music and any attempt to liken it to it is out-rightly rejected (Q.36:69). Though the rendition of Qur'an is not accompanied with any beat but its mystery lies in its sound effect which apart from being divine is also rendered with ecstasy; this combined with its message leaves profound and lasting effects not only on the possessed but also on the possessing demon as well as the exorcist. If the above submission on music is anything to go by in terms of therapy, then the Qur'an especially when rendered in slow, rhythmic form has more profound curing effects. However, for the Qur'an to have therapeutic effect, two factors are vital: conscientious rendition in a way that the heart and the tongue are in harmony; and absolute belief in its curative power.

6. Conclusion

From the foregoing discussion, we have been able to demonstrate that the Qur'an has some healing qualities which are often tapped by most Muslim exorcists during exorcism. The discussion has also shown that demonic possession is one fount responsible for mental disorder and that Muslim exorcists use extractions from the Qur'an called '*Ayatu'r- Ruqyah* in

delivering victims of demonic possession. While arguments of Muslim scholars proving the efficacy of verse of exorcism are advanced in the study, there is equally a discussion on some other factors that aid the efficacy of the verses of exorcism. The conclusion however is that the efficacy is a function of the level of faith and conviction of both the exorcist who renders the verse of exorcism and the patient upon whom the exorcism operation is being administered in the Power of God to effect a cure through His Divine Words.

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Conflict Management Styles implemented by the administrators in the public sector universities of Punjab, Pakistan

Muhammad Tahir Khan Farooqi

*Department of Education, University of Education, Lahore (Okara Campus), Pakistan.
e.mail: drtahirfarooqi@ue.edu.pk*

Mahr Muhammad Saeed Akhtar

*Institute of Education and Research, University of the Punjab, Lahore (Pakistan).
e.mail: mahrsaeed1@yahoo.com*

Mubin Ul Islam

*Govt. High School, 38 GD, Okara (Pakistan).
e.mail: dr200411@gmail.com*

Asif Iqbal

*Department of Education, Govt. College University, Faisalabad (Pakistan).
e.mail: asifphd@hotmail.com*

Abstract

Conflict is a natural element of an organization which prevails because of human interaction, difference of opinion, views and ideas. In educational organization, the conflict occurred amongst faculty members, between the administrative and faculty staff and vice versa. The prevailing conflict management styles were Integrating, Obliging, Dominating, Avoiding, and Compromising styles. The survey technique was used and the data were collected through questionnaire. The MANOVA was run to compare the styles of conflict management used by the administrators. Results of the study inferred that most of the administrators used the same conflict management styles irrespective of gender, qualification, teaching and administrative experience. However, in new universities avoiding style was widely applied by the administrators. Further studies may be conducted to explore the performance of administrators under respective styles.

Key Words: Educational organization, Conflict management styles, Administrators and Faculty Staff.

Introduction

The idea of conflict is as old as the history of human beings. It is natural and unavoidable phenomenon relating to human organisation (Cetin & Hacifazlioglu, 2004; Miklas & Kleiner, 2003). According to Lussier, (2002) it is natural element prevailing in organisation. Due to human interaction it creates an internal misunderstanding. Personal interest and ideas create differences of opinion among workers in the organization (Burnside, 2008). Thus, it is not viable to wipe out the conflicts; but their horizon can be narrowed by effective management. According to Marquis and Huston (2000); Rahim, Margner, and Shapiro (2000), conflict emerges from the incompatibility in opinion, principles and approaches among the members of the organization. It is common fact in all public and private work places; so it is an inescapable part of human activity (Brahnam, Margavio, Hignite, Barrier, & Chin, 2005). Conflict among workers and managers have various implications due to mutual relationships because it directly affects worker's performance (Ang, 2005; Frymier & Houser, 2000; Gillespie, 2004). As Grean, Lesile, and Marks (2001) stated that organisations depend on faction as the basic source of work now a day. Thus, these factions utilise the organisational resources and by whom conflict is created. The classical school opined that it creates inefficiency which is to be eluded (Esquivel, 1997). The conflict with the appearance of "Modern Social and Open System Theory" is considered as a positive sign of well-defined organisational environment.

Lack of openness and oblique expectations, communication problems, contradiction with social norms, managerial issues, poor performance, and violation of rules and organisational policies are some of the reasons of conflict in organization (Adrian-Taylor, 2007; Osinchuk, 1995). Managing conflict is an essential part in all organisations irrespective of its negative or positive results (Lussier, 2004; Park & Antonioni, 2007). University is the highest level of educational organisation and academic gathering of multiple disciplines. Thus, the presence of conflict is understandable. The Conflict between faculty and management has a positive as well as negative results (Kaushal & Kwantes, 2006). The negative results comprise feeble interpersonal relations, elevated pressure, and increase in absenteeism (Guneri & Coban, 2004; Morris-Rothschild & Brass, 2006; Sava, 2002; Tantleff-Dunn, Dunn & Gokeem, 2002), while positive results produce innovation, creativity, higher quality, and mutual understanding (Longaretti & Wilson, 2000; Mamchur & Myrick, 2003; Rahim, Magner, & Shapiro., 2000). The effective management of conflict can reduce negative impacts on the organisational environment (Kaushal & Kwantes, 2006). Sometimes people think of conflict as a fighting activity. Conflict, however can be beneficial. Its occurrence in every organisation is deniable but management is a thorough task.

Review of Related Literature

Since the 21st century, various behaviour styles have been introduced in different institutions to deal with conflict. From such styles, writers and experts have reorganized the styles of conflict management which are being widely used through out the world, i.e. integrating, obliging, dominating, avoiding and compromising (Nelson & Quick, 2000; Robbins, 2001). The complete description of these styles is mentioned below.

Integrating style

It is connected with problem solving method. This style is used for honesty, communication, searching for options, and examination of differences to reach solution, constructive to both parties. Complex problems were solved (Kinicki & Kreitner, 2008). This style is beneficial in managing workers' performance and social rivalries in an organisation (Lawrence & Lorsch, 1967; Pruitt & Carnevale, 1993). Similarly, Su'udy (2009) reported in

his study that among the Indonesian and American youth the most effective conflict management styles were compromising and integrating. Moreover, Copley (2008) described that hospital supervisors prefer to use integrating style in resolving subordinate's conflicts. This style is suitable in dealing with the organisational vision, mission, goals and long-range planning.

Obliging style

It is linked with endeavour to reduce the enmities and using the common ideas. The style is suitable when one group is ignorant with the issues causing conflict and the problem is extremely significant. According to Ozkalp, Sungur, and Ozdemir (2009), obliging style creates harmony and social attraction but reduces creativity and novelty. Moreover, Britta, Brassard, and Rothschild (2006) stated that obliging style creates harmony by fulfilling the students' needs. This style is unsuitable when one party thinks that it is right and ethical while the other is wrong or unethical (Kinicki & Kreitner, 2008; Rahim, 2002).

Dominating style

It is associated with assertive behaviour. One party tries its best to achieve objectives ignoring the interest of the other party. It is used in such conditions when one party thinks that unfavourable decision may be harmful to its survival (Rahim, 2002). The manager can utilize this style when hasty decisions are needed. The subordinates have no expertise in making technical decision or to deal with unpopular course of action. This style is used to take abrupt decision and the decision of equally powerful parties (Kinicki & Kreitner, 2008).

Avoiding style

It is related with removal and keeps away from situations. The avoiding person neither succeeds to satisfy one self nor the others. It is also unsuitable to make prompt and abrupt decisions through this style especially when the groups are not ready to wait (Rahim, 2002). According to Cingöz-Ulu and Lalonde (2007), Turkish people mostly used refraining style of conflict management which is also preferred by Chinese people (Chung, 2009).

Compromising style

It is engaged in give-and-take situation from both the parties which are ready to make mutual decisions. The style at hand is beneficial when both the parties want to reach conclusion through negotiation. In fact it is a temporary solution of the complex problem. It is unsuitable to deal with complex problems permanently through this style. But unfortunate situation is that most of the managers use this problem to solve the complex matters and devise the efficient alternatives of these matters (Burnside, 2008; Kinicki & Kreitner, 2008; Rahim, 2002).

The above-mentioned styles of conflict management are almost prevailed in the organisations throughout the world. The following description is the testimonial evidence of the situation. According to Boonsathorn (2007), the workers prefer different conflict management styles with respect to their areas. In Thailand, the people give importance to avoiding and obliging style of conflict management as compared to American who prefer dominating.

Similarly, Cai, and Fink (2002) stated that individualists give preference to avoiding as compared to collectivist who choose dominating style. Moreover, Ekhouly and Buda (1996), deduced from their study that the managers of Middle East prefer integrating and avoiding while the managers of United States used obliging, dominating and compromising styles. The prior cited literature motivated the researcher to discover the conflict management styles in higher educational institutions with special reference to Punjab as less research work has been carried out in this crucial issue.

Rational of the Study

Conflict prevails in educational organization by dint of employees mutual differences. It is the managers who use different styles to manage the conflicts for the smooth functioning of the organizations. Universities of Pakistan have well established organizational structure, so that managers apply different styles to manage the conflict between the employees. Unfortunately, in Pakistan the literature regarding the area of conflict management styles is still not being explored. So, it was the need of the time to search out the conflict management styles applied in managing employees' conflict.

Significance of the Study

Conflict is indispensable part of organization. It is the result of cultural, ethnic and gender differences among the employees. Thus, it is need of the hour to study the prevailing conflict management styles in the universities of the Punjab. This study is helpful to identify the applied styles of conflict management in the universities of the Punjab. It will also be useful to understand the current interaction and relation of the employees in the organizational structure. The study will also create new horizons about human relations in educational organization. This study will also be beneficial to manage conflicts between academia and administration.

Design and Procedure of the Study

The study was designed to explore the conflict management styles used by the administrators of the public sector universities in Punjab. For this purpose four public sector universities (two newly established and two old established) were selected as the sample of the study by using purposive sampling technique. Ten similar departments were randomly selected from each university. When the departments were randomly selected, it was found that botany department was not present in The Islamia University of Bahawalpur while the administrator of Physics department of Govt college University Faisalabad refused to share the information. So the number of departments remained 38 from the selected sample. Table 1 represents the true picture of the selected sample along with the designation of administrators.

Table: 1

<i>Designation wise University Administrator Selected Sample</i>						
Selected University	Chairman/ Chairperson	Professor	Associate Professor	Assistant Professor	Lecturer	Total
The University of the Punjab	10	9	1	0	0	10
The Islamia University of Bahawalpur	9	7	2			9
University of Sargodha	10	5	2	3	0	10
GC University Faisalabad	10	1	4	3	1	9
Total	39	22	9	6	1	38

As the study was descriptive in nature, survey technique was used to collect the data from the departmental heads of the selected universities. The questionnaire developed by V. Jonson, (permission was taken in oral communication) the retired professor of university of

Arizona was adapted for the study after permission. To make this instrument compatible to local situation, this instrument was pilot tested upon ten departmental heads of Bahauddin Zikria University Multan. The Reliability coefficient was 0.74. The analysis of the collected data was also carried out using SPSS. For this purpose Multivariate Analysis of Variance MANOVA was applied. The following hypotheses were formulated to conduct the study.

Ho₁: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan.

Ho₂: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of administrative experiences.

Ho₃: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of their academic qualifications.

Ho₄: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of gender

Ho₅: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on department basis of the administrators.

Ho₆: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of designation of the administrators.

Hypotheses Testing

Ho₁: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan.

Table: 2

Univariate / multivariate analysis of variances for the differences of conflict management styles used by administrators of public sector universities in Punjab, Pakistan.

Multivariate Analysis of Variance

Wilk's Lambda	F-value	Hypothesis df	Error df	Significance
0.450	1.863	15.00	83.22	0.039

Univariate Analysis of Variance

	Item mean				S.D.				F-value	P-value
	PU	IUB	US	GCU F	PU	IUB	US	GCU F		
Integrating style	15.50	15.33	16.00	16.22	2.46	2.12	0.94	2.95	0.33	0.808
Obliging style	16.00	15.89	14.20	16.22	2.40	1.69	2.44	1.85	1.84	0.158
Dominating style	14.20	12.56	12.00	14.22	1.22	3.04	1.26	2.92	2.60	0.068
Avoiding style	9.90	11.11	12.50	12.44	2.38	1.17	1.71	2.60	3.58*	0.024
Compromising style	14.40	14.55	13.10	14.33	2.12	1.42	2.08	2.06	1.16	0.340

N=38

Punjab University=10

Islamia University Bahawalpur=9

University of Sargodha=10

Govt. College University Faisalabad=9

*p<0.05, **p<0.01

Multivariate Analysis of Variances given in table 2 reflects that the F- value (F= 15,83) = 1.863, p= 0.039 < = 0.05, Wilk's Lambda= 0.450 is significant. Hence, the null hypothesis that, "there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan". It is therefore, concluded that there is significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan. Univariate Analysis of Variance revealed that administrators of public sector universities in Punjab differ significantly on avoiding style whereas rest of the styles are being used all administrators in other universities. Fig. 1 depicts the picture of used styles.

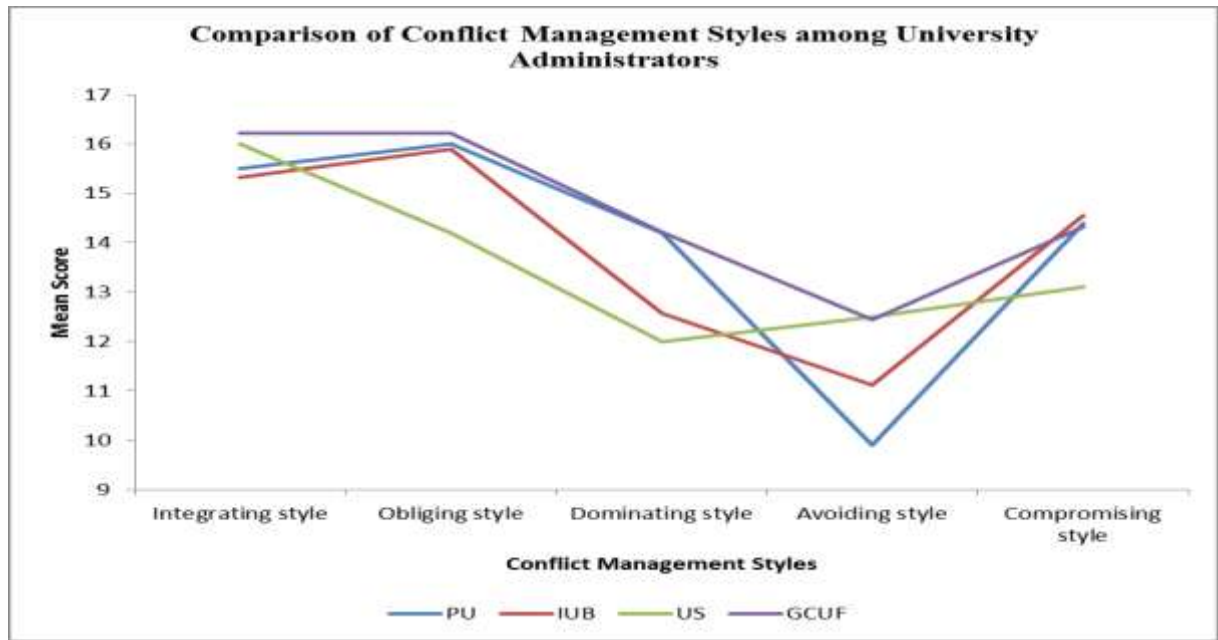


Fig. 1 Graphical representation of conflict management styles among university administrators

Administrative Experience

H₀₂: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of administrative experiences.

Table: 3

Univariate / multivariate analysis of variances for the differences of conflict management styles used by administrators of public sector universities in Punjab, Pakistan on the basis of administrative experiences

Multivariate Analysis of Variance				
Wilk's Lambda	F-value	Hypothesis df	Error df	Significance
0.742	2.228	5	32	0.076

Multivariate Analysis of Variance given in Table 3 reflects that the F- value (F =5,32) = 2.228, P = 0.076 > 0.05, Wilk's Lambda = 0.742) is not significant. Hence, the null hypothesis that “there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of administrative experiences” is accepted. Hence it is concluded that there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of administrative experiences.

H₀₃: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of their academic qualifications.

Table: 4

Univariate / multivariate analysis of variances for the differences of conflict management styles used by administrators of public sector universities in Punjab, Pakistan on the basis of their academic qualification

<i>Multivariate Analysis of Variance</i>				
Wilk's Lambda	F-value	Hypothesis df	Error df	Significance
0.670	1.377	10	62	0.212

Multivariate Analysis of Variance given in Table 4 reflects that the F- value ($F = 10,62$) = 1.377, $P = 0.212 > 0.05$, Wilk's Lambda = 0.670) is not significant. Hence, the null hypothesis that "there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of their academic qualifications" is accepted. Hence it is concluded that there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of their academic qualifications.

Ho₄: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of gender.

Table: 5

Univariate / multivariate analysis of variances for the differences of conflict management styles used by administrators of public sector universities in Punjab, Pakistan on the basis of gender

<i>Multivariate Analysis of Variance</i>				
Wilk's Lambda	F-value	Hypothesis df	Error df	Significance
0.865	1.003	5	32	0.432

Multivariate Analysis of Variance given in Table 5 reflects that the F- value ($F = 5,32$) = 1.007, $P = 0.432 > 0.05$, Wilk's Lambda = 0.865) is not significant. Hence, the null hypothesis that "there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of gender" is accepted. Hence it is concluded that there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of gender.

Ho₅: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on department basis of the administrators.

Table: 6

Univariate / multivariate analysis of variances for the differences of conflict management styles used by administrators of public sector universities in Punjab, Pakistan on department basis of the administrators

<i>Multivariate Analysis of Variance</i>				
Wilk's Lambda	F-value	Hypothesis df	Error df	Significance
0.257	0.872	45	110	0.693

Multivariate Analysis of Variance given in Table 6 reflects that the F- value ($F = 45,110$) = 0.872, $P = 0.693 > 0.05$, Wilk's Lambda = 0.257) is not significant. Hence, the null hypothesis that "there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on department basis of the administrators" is accepted. Hence it is concluded that there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on department basis of the administrators.

Ho6: There is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of designation of the administrators.

Table: 7

Univariate / multivariate analysis of variances for the differences of conflict management styles used by administrators of public sector universities in Punjab, Pakistan on the basis of designation of the administrators

<i>Multivariate Analysis of Variance</i>				
Wilk's Lambda	F-value	Hypothesis df	Error df	Significance
0.576	1.227	15	83	0.269

Multivariate Analysis of Variance given in Table 7 reflects that the F- value ($F = 15,83$) = 1.227, $P = 0.269 > 0.05$, Wilk's Lambda = 0.576) is not significant. Hence, the null hypothesis that "there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of designation of the administrators" is accepted. Hence it is concluded that there is no significant difference of conflict management styles used by the administrators of public sector universities in Punjab, Pakistan on the basis of designation of the administrators.

Results and Discussion

The administrators of the universities in Punjab use integrating, obliging and dominating style. The difference only lies in the use of avoiding style which is widely used by the administrators of new established universities. However, there was no significant difference found about the use of conflict management styles on the basis of academic qualifications, gender, teaching experiences, designation and administrative experience. Demographic information has no effect upon their styles of conflict management. The only difference was found in the use of avoiding style. In the new established universities, administrators use mostly avoiding style because of lack of administrative experience. They show the neutral attitude and maintain positive relations with the subordinate. It was inferred from the data that the administrators have no interference in conflicting matters. The conflict management style of such administrators was seemed as avoiding style is ineffective and inappropriate (Gross & Guerrero, 2000). However, the results of the studies conducted in Turkey and China also support the results of the study in hand (Cingöz-Ulu and Lalonde (2007); Chung, 2009).

The study also concluded that male and female administrators have used same kind of conflict management style. The researcher inferred that both gender administrators used same style because of their same cultural, social and organizational background. Same is true with their academic qualification, teaching and administrative experiences and their designation. Such characteristics have no impact upon the conflict handling styles of the administrators. The rationale is that environmental influence modifies the habits of the administrators, so they deal every kind of situation in the same fashion. In Pakistan same kind of organizational

environment is prevailing in every university. So they unanimously used integrating, obliging and dominating styles of conflict management in their respective departments. Mostly commonly used styles are cooperative style and sometimes assertive style. Chan, Huang and Ng, (2007) stated that integrating styles produce positive results. Likewise, Morita, (2003) concluded that integrating and the compromising styles were widely used by the American and Japanese administrators. As overall these integrating, obliging and dominating styles of conflict management are the mouth piece of administrators in Punjab.

From the study in hand, the administrators of new established universities maintain friendly relationships with the subordinates, provide them different facilities, and oblige them. It is due to inexperience of administrators and wants to remain away from the conflict like situation. It is deduced from the data that no difference was found in the conflict like situation on the base of gender, qualification, teaching experience, administrative experience and designation.

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Content Evaluation of Physical Education Teacher Preparation Peograms for Women at Sultan Qaboos University in Oman

Yousra AL-Sinani

YJS

yousra@squ.edu.om

Sultan Qaboos University

Abstract

This paper details an interview-based study carried out at the Sultan Qaboos University to determine the effectiveness of the PEITTFW conducted by the University. This study is the first to attempt to evaluate the initial teacher training programs for women in physical education in the Sultanate of Oman. This study utilized the method of interviews in order to gather data for the perception of the PEITTFW program by the key personnel involved in the program, such as lecturers, teachers, inspectors, and the students. The study found that there was a general consensus that the number and allocation of the credit hours was acceptable. All the courses were adjudged to be mostly effective as well, except for the University requirements imposed on the students. There was also a general consensus on the necessity of both educational and specialist courses in the PEITTFW, although this support was far from unanimous. Interviewees stated that there were significant deficiencies in the component of applied studies, which required a complete overhaul, with respect to frequency and duration. In addition, the interviewees also identified the lack of necessary resources and facilities at the SQU as a major issue facing the PEITTFW.

Keywords: Initial teacher training, Oman, physical education, Interview.

Introduction:

Oman is a Middle East country, located on the Tropic of Cancer in the “far south east of the Arab peninsula and is surrounded by the Hormuz Strait from the north, Republic of Yemen from the south, Gulf of Oman and Arabian Sea from the east, and by the Kingdom of Saudi Arabia and United Arab Emirates from the west” (Ministry of Information, 1993; Vine P, 1995). It is the second largest country in the Arab Peninsula, covering a total area of 309,500 square kilometers.

Oman is an Islamic country, predominantly Arab and tribal in organization. Although Arabic is the chief language, English is taught in schools and some teaching programmes in higher education are delivered in English. Oman is a religiously diverse country with majority of the population being Muslims (86%), followed by Hindus and Christians. Oman has a developing mixed economy, and the production and export of petroleum is its largest sector. (Al-Sinani and Benn 2010)

Until 1970 Omani society was closed to the outside world, and people led very simple lives. His Majesty Sultan Qaboos assumed power in 1970 and since then much has changed. He received his traditional education in Oman and modern higher education in the United Kingdom. Sultan Qaboos has led the country through a social transformation, an ongoing modernization process that is changing Oman on many fronts. This has not been a smooth process because of a range of factors have dominated the transformation process, for example, Islamic values, norms, behaviors, widespread illiteracy and deeply rooted traditional Omani customs. Such factors have slowed the pace of modernization and are reflected in developments for programs for teacher education. (Al-Sinani and Benn 2010)

The challenges of initial teacher training in physical education for Muslim women have been researched highly in Western societies, for example, in England through the work of Benn (1994, 1996a, 1996b, 2000, 2002), as compared to Muslim countries. (Benn and AL Sinani 2013). There are three studies of physical education initial teacher training conducted, one in Saudi Arabia (Al-Ghamdi 1992), one in Bahrain (Mulla-Abdullah 1998) and one in Qatar (El-Emadi 2002), all from the male perspective, and indicating that there are issues to be addressed in Arab countries if improvements in teacher training practice are to be achieved. This study is therefore original as it is the first formal attempt to evaluate the initial teacher training programme for women in the Sultanate of Oman, and the first to focus on professional training for Muslim women teacher trainers in an Arab country, consequently impacting on issues of equity in both vocational training and the provision for physical education for Muslim girls in schools.

The aim of the study is to evaluate the effectiveness of the physical education initial Teacher Training programme for Women (PEITTFW) in Oman. In order to streamline its scope and direction, the study will be guided by the key research question: What are the perceptions of the effectiveness of the Sultan Qaboos University (SQU) PEITTFW by key stakeholders: the PE lecturers; final year students, PE teachers, PE inspectors?

Evaluation Research:

Different definitions of evaluation research have been defined and Patton (1986:67) considered that “different definitions of evaluation reveal important differences in what various educators emphasise in their work”.

According to Ross and Freeman (1993:54) “Evaluation research is the systematic application of social research methods to the assessment of social intervention programs. It draws upon the techniques and concepts of several disciplines and is useful at every stage in the conceptualization, design, planning, and implementation of programs”.

Evaluation Research in Arab World:

A series of studies in education evaluation were carried out during the period 1978-1995 on a regional level within the Arab world.

Al Ahmed (1978) used questionnaires to evaluate the quality of ITTPs at Kuwait University, as perceived by 221 graduates. . He recommended that professional courses in education be evaluated in terms of whether they were actually providing prospective teachers with the skills they needed to allow them to be employed effectively in schools.

Another study based on Kuwait University was conducted by Badran and Deeb (1980) to evaluate the ITT programme in the Department of Education. These researchers devised two questionnaires for graduates, and another questionnaire for supervisors, and principal. The researchers concluded their research by mentioning that the Department of Education at Kuwait University was considered to be very effective according to the graduates’, supervisors’ and principals’ perceptions.

Razik (1981) evaluated the Faculty of Education at Qatar University through examining the effectiveness and weaknesses of its ITT programme, by the use of a questionnaire and interview exercise. The findings revealed that the programme was not effective. Respondents believed that more time should have been devoted to professional courses and there should have been more communication and interaction between the various departments of the Education Faculty.

Al Rabani (1995) conducted a study intended to evaluate the Social Studies Teacher Training Programme at the Faculty of Education in Sultan Qaboos University (SQU) from the perspective of the graduates, to identify its strengths and weaknesses. The study recommended that the Social Studies Teacher Training programme should be developed to bring it up to a higher academic level.

There have been no ITT evaluations at SQU since the start of the course for the PE ITTP, even though other subjects have been evaluation.

While there have been many international studies focussing on initial teacher training programme evaluation, they have been largely neglected in the Arab World and this partly explains the many challenges faced by the graduates of educational programmes. Educational evaluation is important in order to provide policy-makers and stakeholders with sufficient knowledge upon which to base their judgements and take a specific course of action in developing educational programmes. Many ITT review studies such as those of Clark (1971), and Al Ghamdi (1992) indicate that more teaching practice is required during the training in order to equip the student teachers with better pedagogical skills. Most studies performed by El Emadi (2002) Al Ghamdi (1992) involved students, graduates (teachers), and supervisors in the evaluation, in order to be as comprehensive as possible by gaining a perspective of the training from all the different populations involved. The aim was to reach large numbers of respondents, and it was through questionnaires that these opinions and views could be gathered, and categorised. To be critical, questionnaire-dependent research can miss the in-depth views of

those involved, can encourage superficial answers, lack cross-referencing for tests of validity and have limited use in terms of providing sound information on which judgements and decisions for future direction can be made. Hence, in this study interviews were conducted in order to gain understanding of the effectiveness of training for the reality of the vocation in schools.

Methodology:

To achieve this aim, research method employed in this study was interview and used both qualitative and quantitative analyses in order to capture breadth and depth of perceptions on the effectiveness of the PEITTPFW. Cresswell (2003) and Teddlie and Tashakkori (2003) have recently advocated greater use of mixed methods in social science research.

Interviews:

Interviews were held since it allowed the gathering of more in-depth interpretive data reflecting individual's experiences, beliefs, and social reality. Rubin and Rubin (1995: 19) note that "qualitative interviewing encompasses a variety of ways of questioning", and Cohen et al (2001:267) observed that an interview is an interchange of views between two or more people on a topic of mutual interest, that sees the centrality of human interaction for knowledge production, and emphasizes the social-situation of research data.

Also in this study, consideration has been given to the three guiding themes mentioned in Rubin and Rubin (1995: 19) which firstly states that an understanding of culture is necessary, and in a society like the Omani society where cultural questions seem to permeate everyday life very strongly, it is crucial to appreciate this in order to accommodate what is being said. Secondly, "interviewers are participants in an interviewing relationship" and this acknowledgement requires interviewers to accept that their personal feelings and interactions affect the interview. Thirdly, they note the need to "hear and understand and give the interviewees public voice".

In structuring the interviews similar topics and lines of questioning were explored mainly for two reasons. Firstly, this process helped in triangulation, and secondly, some people found it easier to be interviewed than to respond in written form to a questionnaire. The type of interview employed was semi-structured, which allowed for a schedule of questions to be delivered and at the same time permitted the interviewees to expand on their responses as they felt appropriate.

Interviews were used to collect data relating to the evaluation of the PEITTPFW from 39 volunteers in total from all four respondent groups: students (5), teachers (25), Lecturers (4) and Inspectors (5). The interviews were held in Arabic. According to Gay and Airasian (2000), a sample of 10% of the whole population is the minimum required for an interview. My samples for this study constituted at least 10% of the whole population from each group.

The basic interview schedule had seven questions: most of these remained the same or similar across the four respondent groups but question seven was adapted to best explore possible differences in their responses.

The questions were addressed with regard to:

- Structure and Resourcing of the Courses
- Content of the Course
- Applied Studies
- Resources and Structures

For the interviews, appointments were arranged, and time and space was set aside to make the experience as comfortable as possible. An hour was requested for each interview. The interviews were tape recorded where this was not possible notes were taken and written up immediately after the event. Interviews were transcribed and coded. All interview data was used during analysis process in which transcripts were reviewed for emergent themes, patterns of consensus, points of difference, and finally cross-referenced with other data sources.

Results:

Structure and Resourcing of the Courses:

Suitability of the credit hours required for the preparation of the PE teachers:

The number of hours students are required to complete in order to graduate is 132. Respondents were asked their opinion as to whether the total number of hours should be increased, remain the same or be reduced. The interviews which also explored this question confirmed the general view of the total number of hours allocated to the course being appropriate. This consensus indicated a high level of knowledge concerning the requirements of the training course.

The balance of time allocated to the different areas of study:

The time allocated to the different areas of study is 54% for specialist subjects, 33% for education subjects and 13% for university requirements. (University requirements are Arabic, English and Computer skills).

According to the interview session held, it was substantiated that credit hours were satisfactory but division between physical education department / education and University requirements need to be changed. Teachers, lecturers and students suggested the factual, rote learning in the education system in Oman and GCC countries could be dropped in favor of a wider variety of National Curriculum skills.

Effectiveness of the areas of study in the programme:

The following shows the above areas of study (Specialist subject, Education studies, and University requirements) in terms of the considered effectiveness of each.

During interviews the respondents confirmed the specialist subject division of the course is considered the most effective followed by Education Studies. The interviewers in general did not find University Requirements helping in our preparation as physical education teachers, especially the Arabic language and Oman history taken in the first year. Since, it had already been covered in secondary school, it was inappropriate to repeat that work and instead use the hours in physical education specialist subject work. The respondents believed that credit hours were satisfactory but divisions between physical education department, Education Studies and University Requirements needed to be changed. The Specialist Subjects should be increased and University Requirements reduced.

Content of the Course:

Educational Subjects:

A list of educational subjects included in the program and an indication as to their perceived benefit with regard to the preparation of physical education teachers was shown and interviews were conducted.

The findings showed that the majority of the interviewees considered Education Studies to be useful although there was not total support. The respondents believed that Education Studies were quite effective but there was repetition in many of them and needed to be combined. They found the information to be extensive, with a lot of theory and out of date, resulting in no benefit to students. It was learnt from one of the interviewees that the Ministry physical education lesson plan was different to the one used at SQU. However, a few respondents believed it was very important for physical education students to go through this programme, knowing aspects of child development and teaching method and styles since, the outcome from the physical education department grows out of their knowledge gained in education studies.

Specialist Subjects:

On the basis of specialist physical education elements included in the programme and an indication as to their perceived benefit with regard to the preparation of physical education teachers, interviews were conducted.

The interviews conducted generally confirmed that the students did not rank the practical subjects as the highest, whilst the teachers and lecturers did. The respondents agreed that specialist Subject Practical courses were much more beneficial than the theory specialist ones, for example basketball and volleyball and essential is to the physical education students at SQU. They believed the physical education Department organized this specialism well to provide qualified teachers of the subject. Some of the sports taught were found not to be included in the national curriculum but the respondents believed that as a physical education teacher they should have an overview of different types of sport, not necessarily limited to the ones in the national curriculum. The physical education specialist knowledge in the PEITTP was learnt to be very useful and important to qualify physical education teacher to teach. From the respondents answers it can be noted that there was an overall satisfaction with the Specialized Subject courses.

Applied Studies:

There are two methods by which teaching studies are applied. Firstly, each student “teaches” a lesson to her peers and a lecturer and a feedback is given on her performance. However, each student has just one opportunity during a semester to undertake this exercise. Secondly, small groups of students (6-8) accompany a lecturer to a school where they each in turn teach a lesson to a class of children. Over one semester an individual student would typically teach 10 to 12 lessons. The respondents evaluated the aspects of applied studies and micro-teaching.

The interviews, which also explored this question, confirmed the general view that unlike inspectors, students, teachers and lecturers do not consider the applied studies day to be a particularly stressful experience. They believed that one lesson on practice teaching a week in the fourth year was not enough. It was learnt that as compared to Muscat, in the interiors, the present applied studies was protected and there was an increase in difficulties for physical education teachers. A few respondents recommended that the physical education and method

teaching departments started a more continuous applied studies programme for one semester rather than once a week. The present period was found not to be useful for producing an idea of the reality of physical education in Omani schools.

Interviews indicated greater clarity, suggesting it was the placing and frequency of Applied Studies that needed improving rather than just "more time".

In an open ended question, the respondents were asked to give their views as to the strengths and weaknesses of the PEITTP at SQU. The need for more time to be spent on Applied Studies recurred for all groups. Students, and to a lesser extent teachers, commented on the lack of feedback, although this was (unsurprisingly) not mentioned by lecturers. Both students and teachers felt that there was a lack of communication between the departments that delivered the course. Whilst not really a weakness of the course at SQU, teachers and students, having spent their time in schools during their training considered that the job of the specialist physical education teacher was pressurized due to their isolation and high workload in individual schools.

Resource and Structure:

Evaluating university resources is important in order to ensure an effective teaching programme. The availability of particular facilities and material resources in the physical education department at Sultan Qaboos University was identified as a possible issue.

One of the respondents used the opportunity to explain the gender separation of the resources and stated the sports facilities for the women are on the other side of the campus from the men's facilities and situated in the girls' accommodation where there is no mixing of the sexes. They do work together for theory of the subject but that is how all other departments in the University work.

Discussion:

The interviews focused on various elements of the programme including time distributions, content, facilities and resources, teaching and assessment. A critical aspect of the analysis was that of the responses concerning the time distribution across Subject studies, Education Studies and University requirements. There was a general consensus that the balance needed to be changed in favour of Subject studies and Applied studies.

It is heartening to have the students indicate such a high level of commitment to their future careers in teaching physical education, considering that the reason given by over half the students for "choosing" physical education as their specialism was the relatively low entry requirement rather than a desire to teach physical education. Yet there is much to be improved and comments asking for more continuity of experience, greater diversity of schools and more contact with the real situation are all helpful in this study.

With regard to University requirements (Arabic, English Language, Oman History and Islamic Civilization, introduction to computing), it appears that over half of the respondents in interviews claimed that these were "not effective" elements of the ITTPEPFW, which might be explained by respondents' perceptions that these were not essential in the preparation of physical education teachers. This appears to reflect an instrumentalist view of the degree programme, which fails to acknowledge the role of education in broadening knowledge, skills and understanding and recognition of the significance of the Omani context, particularly given its rapid process of modernization and challenges for the people (Al Ghabshi 2002). References to 'boring' sessions and the necessity for factual rote learning of easily forgettable dates, indicates the problem may be more closely related to selected content and teaching method.

Students were highly critical in interviews, reinforcing the principle that more in-depth knowledge can be gained through the interview process (Rubin and Rubin 1995, Cohen et al 2001). Students were open about their views on relative values of different courses, different teaching method, finding didactic theory sessions (focusing only on memory and recall, rather than understanding and application of knowledge), uninteresting. Practical studies, where theory was applied to practice in situation, were most popular. In interviews students were critical of other aspects such as receiving little or no feedback and assessment. Often they did not understand where grades came from or how they were arrived at, therefore concluding that they were unjust. In the same way teachers' viewed inspectors' gradings of their annual assessments as unjust because they were not prepared for, and did not understand, the criteria on which they had been judged and did not appreciate the lack of feedback or support in relation to grades given. All of this reflects the need for more discussion between groups, for example amongst lecturers in the University about planning, delivery and assessment; between lecturers and students, sharing aims and explaining processes related to the learning and teaching process, clarifying assessment expectations and offering quality feedback to help the student to learn from his or her efforts. Similarly, some dialogue between inspectors and students / teachers would be helpful in sharing expectations and procedures, rationale and criteria for grading.

The following recommendations may be put forth to the key personnel involved in the administration and management of the ITTPEPFW:

An improvement in the library facilities including journals, books, and online resources was the largest area of concern as identified using the questionnaires. Encouragement should be provided for women to join and participate in various research and conference networks at both national and international levels, as this will imbue the program with a global outlook and character. A critical thinking approach to social science research should be promoted, within the local Islamic context. A course to prepare students for the unique socio-cultural challenges they may face in their career with respect to this context as well.

Regular reviews and audits of the ITTPEPFW are absolute requirements in order to maintain quality and to ensure a progressive outlook.

Staffing levels need to be maintained proportionately to the student intake, in order to prevent understaffing. In addition, entry-grade levels should be proportionately raised over time to ensure only sufficiently motivated students pursue this course.

This course should be recognized as providing a unique opportunity for women and the Ministry of Education should take the initiative to work in collaboration with the SQU to develop the expertise and the facilities at the SQU to allow the ITTPEPFW to mature into a world-renowned initial teacher training program.

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Errors in Error Analyses

Abdulmoneim Mahmoud

Department of English, College of Arts

Sultan Qaboos University

Muscat, Oman

amahmoud@squ.edu.om

Abstract

Acknowledging the indispensable role of error analysis in language learning and teaching, this paper presents a critical review of a random sample of recently conducted error analyses. It discusses some of the drawbacks which might preclude teachers from making use of the findings of these studies in remedial as well initial teaching. Some of these problems are indiscriminately carried over from classical error analyses. They include (1) inconsistencies in the terminology use to describe and explain learners' deviations, (2) confusing, conflicting and incomplete explanations and (3) and redundant classifications. These are to be considered only as examples of drawbacks that some analyses of errors might suffer from. Further review of other analyses might reveal more problems. Some suggestions are offered to make these analyses pedagogically useful.

Key words: Errors – Error Analysis – Interlingual errors – Intralingual errors

Introduction

Error analysis (EA) is an everlasting endeavor for the simple reason that first, second or foreign language learners, by definition, will continue to commit errors. As Mahmoud (2011, p. 29) says, "Nobody goes from zero competence to full competence in one leap." In the same vein, James (1998, p. 63) states that "as long as there is incompleteness or failure to attain full NS-like knowledge of the TL, there will be EA." Committing errors is a fact of life, so is learning from them. EA is indispensable in language teaching and it is assuming more importance as an index of language learning and communication strategies. Thus, in addition to its traditional product-oriented role in error correction and remedial instruction, EA has now assumed a process-oriented role as a means of exploring learning and communication strategies, (see also Erdogan, 2005; Xie and Jiang, 2007).

In classroom language teaching, provision of corrective feedback and remedial teaching based on EA are a pedagogical duty undertaken in the hope of accelerating the learning process by helping learners modify their incorrect hypotheses. With the tendency towards a learner-centered approach to language teaching, process-oriented EA has a new role to play. The teaching techniques can be brought closer to the learning strategies through what EA has so far revealed about these strategies. Informed by the findings of EA, language teachers can use techniques that are in line with the learners' psycho-cognitive strategies. They can make use L1-based and L2-based association strategies that learners naturally engage in when they embark on the task of language learning, (for more information see Mahmoud, 2011). Teachers need both product-oriented and process-oriented EA for remedial as well as initial teaching. In response to this growing need, EA of different scales are being conducted around the world, (e.g. Abu-Jarad, 2008; El-Tayeb; 2006; Moretimer, 2001; Olasehinde, 2002; Xie and Jiang, 2007).

However, some of the analyses of errors suffer from inherent drawbacks that might preclude classroom teachers from making use of them. In addition, the teachers might get confused by conflicting views and findings of different analysts. Most of the problems in the analyses I reviewed for the purpose of this study center around the terminology used to describe learners' deviations and their possible causes. The purpose of this study is to draw the second and foreign language teachers' attention to some of these drawbacks so that they guard against them when conducting their own analyses or when relying on the findings of other analysts. I will also offer some suggestions regarding error classifications and explanations that teachers may find practicable. Needless to say, problems related to data collection methods are beyond the scope of this study. The focus is on data analysis, not on data collection. A random sample of 25 analyses of errors made by learners of English as a foreign language (EFL) conducted in the late 1990s and in the 2000s was scrutinized for the purpose of this study. Some of them adopted classical error taxonomies such as those proposed by Corder (1974), Richards (1974) and Selinker (1972). Other analysts added a few more categories to the traditional ones. Most of the problems detected in these error analyses were related to the possible causes of errors. Some inconsistencies were also observed regarding the use of the terms 'slips', 'mistakes', and 'errors' to describe the incorrectly produced forms and structures. These are only a few problems found in a small sample. A critical review of a larger sample might reveal more problems.

Slips, Mistakes and Errors

'Deviation' is used here as a neutral term referring to any linguistic form or structure incorrectly produced by a native or non-native speaker of a language. Error analysts usually use 'slips/lapses', 'mistakes' and 'errors' to distinguish between different types of deviations on the

basis of noticeability and self-correction. The deviations that can be corrected by their producers are indicative of performance problems whereas those that cannot be self-corrected are viewed as signs of incomplete learning (i.e. lack of competence). In his classical study, Corder (1971) labeled the former as 'mistakes' and the latter as 'errors'. According to the noticeability criteria, performance deviations are divided into two types: 'slips or lapses' which their producers can notice and correct by themselves and 'mistakes' which the speakers or writers may not notice but can correct if their attention is drawn to them, (see also James, 1998). Slips and mistakes are made by both native and non-native speakers of a language whereas errors (i.e. competence deviations) are made by first, second and foreign language learners. Although it is not always easy to distinguish between these types of deviations, this three-way classification appears to be pedagogically useful.

Our review of the analyses revealed a clear lack of consistency among the researchers in the use of these three terms which could be a source of confusion for the teachers. For example, Vahdolinejad (2008) has only two categories: lapses and errors. To him, 'lapses' and 'mistakes' are the same. Karaliauskiene (2003) uses 'errors' and 'mistakes' interchangeably. Kharma and Hajjaj (1997) use 'error' in the title of their book but use 'mistake' in the rest of it. Edge (1989) has 'slips' and 'errors' and adds another category labeled 'attempts'. From his definition and examples, it is difficult to differentiate 'errors' from 'attempts'. A self-explanatory quotation from Khammash and Roos (2002, p. 51) reads, "Mistakes or performance errors are slips of the tongue." James (1998, p. 83) classifies deviations into 'slips/lapses', 'mistakes', 'errors' and 'solecisms'. This last category refers to the "breaches of rules of correctness as laid down by purists and usually taught in schools." From a pedagogical perspective, then, this last category is redundant since, as James (ibid, p. 83) himself says, "FL learners taught in formal classrooms ... get heavy exposure to correctness-based instruction."

For pedagogical purposes, the three-way classification (slips, mistakes, errors) seems to be the most appropriate one. Language teachers need to provide corrective feedback with these three types of deviation in mind because each type requires a different response. Needless to say, learners can take care of the slips if they are given the opportunity to do so. They can also correct the mistakes if they are indicated to them. In case of errors, learners need more help ranging from mere indication of the error to the provision of the correct form directly depending on the learner's proficiency level in the language. Thus, the teacher's intervention varies with the type of deviation. Involvement of the learners in the correction process is in line with the learner-centered approach to language teaching, (Mahmoud, 2011).

Transfer and Interference

James (1998, p. 175) echoes what Newmark and Reibel (1968) said over four decades ago when he says "the ultimate cause of error is ... ignorance." As I said in the previous section, errors are due to incomplete learning; they indicate gaps in the learner's competence. When their linguistic means falls short of achieving their communicative goals, language learners resort to various strategies. The most widely used compensatory strategy is linguistic transfer (i.e. reliance on previous linguistic knowledge), that is, intralingual (L2-based) transfer and, in case of second or foreign language learning, interlingual (L1-based) transfer. These two types of strategies rank at the top of the causes of errors in traditional (e.g. Corder, 1974; Seliner, 1974) and recent (e.g. James, 1998; Harmer, 2001) error taxonomies.

However, some error analysts (e.g. Erdogan, 2005; Karaliauskiene, 2003) label the intralingual (L2-based) errors as 'developmental' as opposed to the interlingual (L1-based) ones. These analysts seem to be still embracing the out-dated behaviorist view of the role of the first language as one of hindrance. From a cognitive perspective and in light of the findings of

research on language learning and communication strategies, interlingual transfer is viewed as a compensatory strategy. It is an additional source of hypothesis formation available to second and foreign language learners and users. Reliance on the first language can lead to the formation of correct hypotheses as well as incorrect ones. Like intralingual errors, interlingual errors decrease as the learner's level of proficiency increases, (Mahmoud, 2005). This negative correlation between interlingual errors and proficiency level urges us to view such errors as transitional. If the intralingual errors are described as 'developmental' because they decrease with increased proficiency, the interlingual ones are also 'developmental' as opposed to 'fossilized' errors. Hence, both interlingual and intralingual errors are developmental as long as they are ironed out when the learner moves forward along the interlanguage continuum.

Another problem related to the influence of the first language is that many error analysts refer to it as 'interference' (see e.g. Erdogan, 2005; Harmer, 2001; Hasyim, 2002; Karaliauskiene, 2003). Some others (e.g. Abisamra, 2003; Al-Ajlouni, 2007; Al-Khresheh, 2010) use 'transfer' and 'interference' interchangeably. As I said earlier, interlingual transfer is a cognitive compensatory strategy that the second and foreign language learner falls back on to facilitate the task of learning and using the target language. Hence, "the mental effort exerted by the learner to make use of the native language ... cannot simply be referred to as 'interference' when the transformed form does not conform to the target form," (Mahmoud, 2005, p.16). The term 'interference' implies that the first language is an 'intruder'. In fact it is the learner who 'invites' it as a welcome guest to assist in learning and using the target language. Al-Mounla (2002, p. 123) goes even further to refer to this assisting role as "interlingual disturbance". Existence of negative interlingual transfer implies that there is positive transfer. However, this facilitative effect of the first language is not easy to detect since the correctly produced forms and structures can be attributed to other processes such as subconscious acquisition and memorization of prefabricated patterns and chunks. Viewing the effect of the first language as 'interference' and 'disturbance' may be motivated by the behaviorist theory where second or foreign language learning was believed to be hampered by the 'habits' of the first language.

The term 'interference' should be spared for cases of the unwelcome intrusion of both the first and the second/foreign language; cases where the learner knows the target second/foreign language form but cannot produce it correctly due to the gravitational pull of the first language. An example from Mahmoud (2005, p. 12) is the substitution of /s/ and /z/ for /θ/ and /ð/ respectively by some Arab learners of English. The phonemes /θ/ and /ð/ exist in standard Arabic and some non-standard varieties (e.g. Gulf countries). Arabs whose non-standard varieties do not have these phonemes commit this substitution mistake not only in English but also in standard Arabic. Likewise, the term 'interference' can be used to the uninvited intrusion of second or foreign language forms. For instance, the phoneme /p/ does not exist in Arabic, yet some Arab learners of English habitually substitute it for /b/. Another example is the involuntary over-use of certain words or expressions out of context to the extent that the word or expression becomes a nickname for its user. Thus, 'interference' can be used to refer to cases of unwelcome intrusion of the first as well as the second/foreign language and 'transfer' can be used to refer to cases of compensation. The difference between the two processes is that 'interference' – whether it is interlingual or intralingual – invariably results in mistakes or unacceptable utterances whereas 'transfer' can be either positive or negative. Accordingly, error analysts can distinguish between 'interlingual transfer' and 'interlingual interference', and between 'intralingual transfer' and 'intralingual interference'. This four-way classification can resolve the confusion that arises when some error analysts use 'interference'

and 'transfer' interchangeably, others use them in different senses and still others coin their own terms such as 'interlingual disturbance'.

Some error analysts (e.g. Khammash and Roos, 2002) believe that the second/foreign interlanguage continuum starts from the first language. This means the second/foreign language learners have to break away from the grip of their first language as they build up competence in the target language. In reality, the interlanguage continuum starts from zero competence in the target language and the first language constitutes of the sources of linguistic knowledge at the learners' disposal to develop their second/foreign language. Thus, the interlanguage continuum of second/foreign language learners is not different from that of the first language learners who start from zero knowledge.

Our review of error analyses revealed some other sources of confusion. Hasyim (2002, p. 45), for example, lists reasons of errors under a sub-heading that reads "Sources or Causes of Errors." The 'sources' include 'prefabricated patterns' such as '*How much does it cost?*', '*I don't speak English*'. As we can see from his examples, such patterns are a source of correct production. He also lists 'appeal to authorities' as a 'source' of error. This is, in fact, a strategy that learners employ to avoid errors. Learners refer to sources of knowledge in case of ignorance or lack of confidence. 'Language switch', which is an interlingual strategy is listed under the 'sources' whereas the other interlingual strategies (e.g. translation) are listed under the 'causes'. Thanasoulas (2000, n.p.) discusses the learners' cognitive strategies and adds to them "question for clarification" which is a social strategy. He lists 'translation' and 'transfer' as two different interlingual strategies. According to him, the former is used for comprehension and/or production and the latter is used only for comprehension. However, since both are used for comprehension, it is nowhere near possible to tell which of them is being used at a particular time. 'Transfer' is a super-ordinate term for both interlingual and intralingual strategies and 'translation' is only one of three interlingual transfer strategies: translation, language switch and foreignization. Hence, the difference between 'sources' and 'causes' is not clear. Khammash and Roos (2002) list 'description' (i.e. circumlocution) which is an intralingual strategy under 'cross-linguistic influence' which is, by definition, interlingual. Hasyim (2002) mixes 'carelessness' - which is related to performance - with the interlingual processes related to the lack of competence.

Some error analysts confuse the linguistic description of an error with the explanation of its underlying cause, (see also Johnson and Johnson, 1998). Bataineh (2005), for instance, believes that the addition of the indefinite article in **English is spoken by a people of every nation* is due either to hypercorrection or to "the learners' tendency to ... use the article in places where it is not required," (n.p.). Abisamra (2003) lists the types of intralingual errors from Richards (1974) – over-generalization, ignorance of rule restrictions, etc. – and adds 'semantic errors' which is a linguistic description, not an explanation. Al-Faqara (2010, p. 55) classifies the negation errors made by Jordanian learners of English into (1) Transfer errors, (2) Double negation, and (3) Wrong use of auxiliaries. The first category is a cause whereas the other two are descriptions. In some cases, the language of the analysis can be confusing. Thomas (2011, n.p.) classifies the deviations into (1) "Those caused by lack of understanding" and (2) "Performative errors." He then asks "But what causes these errors?" and explains "1. Errors caused by lack of understanding: Some possible causes". I believe the quotation is self-explanatory: What causes the errors that are caused by lack of understanding? There are some possible causes!!! We have to understand Thomas' language and his explanation of the causes and understand what he means by 'lack of understanding'! What is it that the learners do not understand? Since Thomas' second category is related to performance deviations, the first

category should be the errors that are caused by the lack of 'competence' in the language rather than by the lack of 'understanding'

Conflicting, Incomplete and Redundant Analyses

Some relatively recent studies (e.g. Brown, 2000) echo classical classifications (Richards, 1974; Selinker, 1972) by listing learning and communication strategies as two more 'reasons' of errors together with interlingual and intralingual transfer. However, these two more reasons are redundant since interlingual and intralingual transfer are learning and communication strategies. James (1998, p. 179) adds communication strategies to the three categories of interlingual, intralingual and induced errors. Unlike Brown (2000), he lists learning strategies under the intralingual errors. Thus, James (*ibid*) has four main types of errors: interlingual, intralingual, communication strategy-based and induced errors. Abisamra (2003) seems to have misread James' classification as three categories. She listed his communication strategy-based errors under intralingual errors together with the learning strategy-based errors. However, both James and Abisamra seem to view interlingual transfer as if it is not a learning and communication strategy whereas in fact it is. James (*ibid*, p. 188) himself confirms this by listing two interlingual strategies – language switch and translation – under communication strategy-based errors. Needless to say, communication strategies can lead to learning through feedback, (see e.g. Mahmoud, 2011).

Abisamra (2003) also gives the same two well-known types of linguistic transfer and adds five more 'reasons': (1) sociolinguistic situation (i.e. motivation – learning setting) (2) age (3) modality (4) succession of approximative systems (5) universal hierarchy of difficulty. She does not explain with examples how these can cause errors. These are, in fact, factors that can affect the rate, route and end result of learning. Thomas (2011, n.p.) enumerates performance factors such as forgetfulness and tiredness. He, then, says that the former is "not necessarily a problem" and the latter leads to forgetting. If tiredness leads to forgetting and forgetting is 'not a problem', then there was no need to list both of them. Al-Faqara (2010, p. 55) attributes the negation errors of the Jordanian learners of English to "the wrong teaching methods and lack of knowledge on the use of negatives and their agreement with the subject and the time reference." However, he does not explain how teaching methods lead to those errors. It is not clear why he selected the teaching methods from a number of other learner-external causes such as the teaching materials, exercises, hypercorrection and faulty language input. The same can be said about Thomas (2011) who confines induced errors to only one factor: the non-native English teachers who he describes as 'bad models'. Regarding Al-Faqara's second reason 'the lack of knowledge', as we said earlier, all errors are due to incomplete learning (i.e. the lack of competence in the language – ignorance). Hence, a more precise possible reason (or reasons) should have been sought.

Khammash and Roos (2002, p. 51) believe that the annexation of the indefinite article to the noun in * *ahouse* by Arab learners of English is due to negative interlingual transfer. However, transfer from Arabic usually leads to the omission of the indefinite article because there is no "distinct marker of indefiniteness" in Arabic, (Bataneh, 2005, n.p.). Some error analysts (e.g. Thomas, 2011) believe that the omission of the third person singular present verb 's' is due to fossilization whereas some others (e.g. Khammash and Roos, 2002) see it as a case of language simplification. However, none of these two are 'causes' of error as we shall see later. To sum up, the most widely documented causes of error are (1) interlingual transfer (2) intralingual transfer and (3) the teaching and learning context (i.e. induced errors). In light of my 30 years of teaching English as a foreign language in both general and higher education institutions in the Arab world, most of the interlingual errors are due to translation followed by

language switch. Cases of foreignization are relatively rare. Most of the intralingual errors are due to over-generalization including the lack of knowledge of rule restrictions followed by circumlocution. Errors of word-coinage are relatively rare. Induced errors are difficult to detect since they are the same as or similar to those caused by learner-internal factors.

It is axiomatic that no error analyst can be definite about the cause of some deviations in the learners' language. Therefore, error analysts need to leave room for ambiguity when identifying, describing and explaining errors, especially if they do not know the first language of the learners whose errors they analyze. They have to bear in mind the fact that their analyses will be seen by language teachers with different linguistic backgrounds around the world. Harmer (2001, p. 100), for example, classifies the error in * *She is more nicer than him* as intralingual. Such an error, however, can also be interlingual when it is committed by Arab learners of English since 'akthar' in Arabic is equivalent to the comparative 'more' and the intensifier 'much' in English. Thomas (2011) rules out translation as a reason for the difficulty facing students in using the past perfect tense. Here again, the Arabic past tense can be used in cases where English uses the present and past perfect and the simple past tense, which can lead to the confusion of these tenses in English or to the avoidance of the complicated ones (i.e. the perfect tenses). Instead of such confusing, incomplete and redundant lists of causes of deviations, error analysts can adhere to the three basic categories of error (i.e. interlingual, intralingual and induced errors) and indicate cases of possible ambiguity. Categories such as 'ambiguous errors' and 'compound errors' appear only in studies intended to lay down the principles and steps of error analysis but rarely in actual analyses.

From a pedagogical perspective, indication of cases of ambiguity can relieve the teachers of the confusion resulting from conflicting analyses where each analyst gives a different reason for the same error without even hinting at any other possible reason (or reasons). Second/foreign language teachers who choose to provide corrective feedback by giving linguistic explanations need to refer to all possible learner-internal causes of the same error, (see Mahmoud, 2011). In this way, the teacher can cater to the individual differences between the learners, since one and the same error can be committed by more than one learner for different reasons. For instance, in Harmer's (2001, p. 100) example discussed earlier, (**She is more nicer ...*), the teacher can explain the error to Arab learners intralingually as a case of over-generalization and interlingually as we explained earlier. More than three of my Arabic-speaking learners of English used 'Arabic' in stead of 'Arab' in * *Arabic countries*. My consultation with them revealed that for some of them it was due to intralingual transfer (e.g. *The Arabic language*). For others it was the result of transfer from Arabic where one word is used for *Arab*, *Arabic* and *Arabian*; the students thought the three English words were interchangeable. Thus, since ambiguous errors require a two-way treatment, classroom-oriented error analysis should list and explain all of the plausible causes of an error.

Fossilization and Simplification

Fossilization and simplification are given by some researchers as causes of errors (see e.g. Al-Mounla, 2002; Bataineh, 2005; Khammash and Roos, 2002; Thomas, 2011). Fossilization is quite simply a state, not a cause. It is the persistence of an error after it is committed for any learner-internal or learner-external reason. After listing fossilization as a "reason for committing errors", Al-Mounla (2002, p. 123) adds "erroneous forms fossilize, too." The second statement clearly negates the first, hence we have to look elsewhere for the reason that leads to the production of the 'erroneous forms' in the first place. Simplification was first introduced as a cause of errors by Selinker (1972) who, three years later (Selinker et al, 1975), adopted a more reasonable view by relating it to both interlingual and intralingual

transfer, (for more information see Mahmoud, 2005). The term 'simplification' is usually used to refer to the missing linguistic elements in the learner's language. However, as I said earlier, errors are due to the learners' use of various cognitive strategies to fill in the gaps in their developing language. Simplification is not listed as one of these strategies in any taxonomy. It is not a learning or communication strategy; it is one of the manifestations of the use these strategies. The term itself is a misnomer since it implies intentionality on the part of the learners and that they are in possession of what can be simplified. The learner's language is different from the intentionally simplified languages such as caretaker speech, baby talk, foreigner talk, teacher talk, electronic text messages and emails. In their attempt to facilitate the task of learning and using the language, learners resort to their previous linguistic knowledge (i.e. interlingual and intralingual transfer) as a compensatory strategy resulting in positive as well as negative transfer. Negative transfer is manifested in omission, addition, substitution and misordering of linguistic elements. Thus, the learner's errors of omission cannot be equated with purposeful simplification of language by competent users.

In case of first language acquisition, telegraphic utterances reflect the child's developing competence and his inability to grasp and incorporate linguistic details at a particular stage of learning. Al-Tweissi (2007, p. 144) defines simplification as "modifications that make sentences or utterances easier to perceive, understand or produce." To exemplify, he lists child language with foreigner talk, teacher talk and baby talk thereby mixing intentionally simplified registers with the learner's developing language. His definition applies to purposeful linguistic modification intended to facilitate comprehension and production. The language of the foreigners, babies and second/foreign language students may sometimes be difficult to understand because of the missing linguistic elements. I believe the term 'interlanguage' which was introduced by Selinker (1972) over four decades ago can best describe the learner's developing language with all its inherent signs of incomplete learning reflected in addition, omission, substitution and misordering. 'Simplification' should be spared for intentional modifications aimed at facilitation of communication or economy of expression. Once again, we need to look for the strategies underlying the second/foreign language errors of omission. For example, omission of the third person singular present verb 's' which Khammash and Roos (2002, p. 52) see as due to simplification could be a substitution error resulting from over-generalization. A learner might have used the verb form without 's' instead of the form with 's' based on other cases such as *I go, We go, You go, They go, He must go, Let Sami go*. Such an explanation may be more useful for the teacher in providing corrective feedback. In a nutshell, the so-called simplification in error analysis is a description, not an explanation.

Avoidance and Ignorance

A criticism leveled at EA by researchers past and present (Darus and Subramanian, 2009; Ellis, 1996; Schachter, 1974) is that it cannot account for avoidance. Schachter (ibid, p. 105) considered it as "an error in error analysis". Second/foreign language learners are believed to avoid the forms and structures that they do not have in their first language as well as those they perceive difficult in the target language. In other words, avoidance is attributed to the influence of the first language and the complexity of the target language. Some error analysts (e.g. Al-Mounla, 2002, Khammash and Roos, 2002; Hasyim, 2002) give avoidance as a cause of errors. However, Laufer and Eliasson (1993, p. 36) believe that "avoidance does not necessarily, or even normally, result in error." Regarding the assumption that EA does not account for avoidance, it is through EA that we get to know the language areas that pose problems to the learners. As Laufer and Eliasson (ibid, p. 36) put it, "Determining what items

or structures are avoided has practical value for it identifies areas that present learning difficulties."

The Longman Dictionary of Contemporary English (1995, p. 75) defines the word 'avoid' as "deliberately not do something, especially because it is dangerous, unpleasant, etc." Thus, 'avoidance' implies a choice. In language learning, the learner can 'avoid' a form or structure and use another one, (see also Hulstijn and Marchena, 1989). For instance, second/foreign language learners of English may avoid phrasal verbs and use single verbs for an interlingual or intralingual reason. They may use active sentences instead of the passive ones. In such cases, avoidance may not result in error but it reveals problem areas. The term 'avoidance' is a misnomer in cases where learners do not use certain linguistic elements due to ignorance (i.e. the lack of knowledge). A learner may not produce a required form due to a memory lapse or because it sounds like a taboo form in the first language. Thus, avoidance is only one reason for the nonuse of certain language items. To sum up, the nonuse of a form or structure can be due to (1) the lack of knowledge (ignorance), (2) the lack of confidence (avoidance), or (3) a memory lapse (performance). Hasyim (2002, p. 46) maintains that "When a learner... cannot say *I lost my way*, he might avoid the word *way* and say *I lost my road*." However, this is a hypothetical example and the nonuse can be due to of avoidance only if the learner knows the word '*way*' but does not produce it for some reason.

In addition to indication of problematic areas, nonuse of some language forms can reveal other concomitant errors. For example, one of my students of English resorted to circumlocution to refer to the 'intermediate' school. He defined it as * *the school in it the people learning the English for first time*. I thought he did not know the word 'intermediate' (i.e. due to ignorance) but it turned out to be avoidance; he was not sure of the spelling. If it were not for avoidance, we would not discover these problem areas. No doubt, there are cases where the reverse is true; what we think is avoidance can be ignorance. Needless to say, one learner's avoidance is another learner's ignorance and yet another learner's memory lapse. Therefore, the nonuse of some linguistic forms and structures should be interpreted carefully. The need for further research on the phenomenon of nonuse cannot be over-emphasized. In depth studies on nonuse are needed to shed more light on (1) the reasons (ignorance - avoidance), (2) the underlying strategies (interlingual – intralingual influence), and (3) the result (error – non-error). The findings of such studies can reveal more about the language acquisition process and, hence, pave the way for more rigorous error analyses which can, in turn, make for more efficient teaching and correction techniques. Meanwhile, an inclusive term such as 'nonuse' can be used instead of 'avoidance'. 'Avoidance' inculcates deliberateness into the teachers which is a one-sided view of the phenomenon. Since not everything that is taught is learned by all students all the time, there is a possibility of ignorance and, hence, nonuse.

Conclusion

As long as people continue to learn a first, second or foreign language, they will commit errors at all linguistic levels and error analysis will remain an ongoing area of research. Learners' errors will have to be analyzed as a means of gaining an insight into the language learning process. From a pedagogical perspective, error analysis still plays its traditional role of assisting teachers in providing corrective feedback. With the proliferation of research in language learning and communication strategies, error analysis has gained ground as an index to these strategies. What has been revealed so far about the learners' strategies, in turn, can help in bridging the gap between language learning and teaching. Teaching techniques can be brought closer to the learning process by approximating the learner's natural hypothesis formation process. In light of this learner-centered approach to language teaching, error

analysis plays an important role. However, a critical review of some recently conducted error analyses reveals that there are some inherent drawbacks that might render them useless. The purpose of this study was to enumerate some of these drawbacks followed by some suggestions. The main problems in the scrutinized error analyses were: (1) inconsistencies in the terminology used to label and explain learners' deviations, (2) confusing, conflicting and incomplete explanations, and (3) redundant classifications of causes of error. For pedagogical purposes, the types of deviations can be confined to slips, mistakes and errors. Based on language learning and communication strategies, errors can be reduced to only two types: interlingual and intralingual errors. The former include translation errors, language switch and foreignization and the latter include over-generalization errors, circumlocution and word coinage. The terms 'transfer', 'interference' and 'developmental' apply to both interlingual and intralingual errors. Error analysts need to indicate ambiguity by leaving room for all possible descriptions and explanations of an error. Fossilization is not a cause of error; it is the state of persistence of an error after it is made. Simplification is a misnomer; it refers to intentional linguistic modifications made by competent language users. The cases of omission, addition, substitution and misordering in the learner's language are the result of employing various learning and communication strategies. The term 'avoidance' which is widely used in the error analysis literature refers to only one reason for the nonuse of certain forms and structures. A more inclusive term such as 'nonuse' is needed to account for both avoidance and ignorance.

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The Global Financial Crisis and Bank Lending to SMEs in Nigeria

Chukwuma Ukoha

MSc Management, University of Derby, United Kingdom

chuqz_online@yahoo.co.uk

Abstract

This paper examined the impact of the global financial crisis on the Nigerian banking industry, in order to establish whether the financial crisis reduced the volume of bank loans to SMEs. This study is a survey carried out *ex post facto*. The population of the study includes all the commercial banks in Nigeria. The study relied on secondary data, obtained from the Central Bank of Nigeria, which showed the volume of banks' loans to the private sector, from 2005-2011. The figures were adjusted for inflation and expressed in 2011 price level, and categorised into the following periods: before the financial crisis (2005-2006), during the financial crisis (2007-2009), and after the financial crisis (2010-2011). Line graphs were used to visually summarize the results. The major finding of the study is that the global financial crisis did not cause a reduction in the volume of bank loans given to the private sector. However, the inflation adjusted figures showed that the real value of loans declined slightly between 2009 and 2011, as a result of inflation. The study recommends that the Central Bank of Nigeria (CBN) should take active steps towards reducing the rate of inflation to the barest minimum, in order to address the problem of inflation induced decline in the real value of money.

Key Words: Banks, Finance, Global Financial Crisis, Lending, SMEs

Introduction

Small and Medium Enterprises (SMEs) in Nigeria require bank loans to grow their businesses. If Nigeria is to experience any significant economic growth, SMEs will be central to the process given the significance of SMEs in the Nigerian economy. SMEs contribute more to the Nigerian Gross Domestic Product (GDP) than oil and gas. SMEs contribute more than 70% of the GDP (Capaldo, 2008), while oil and gas accounted for only 14.27% of the GDP in 2011 (Nwachukwu, 2011). Sadly though, most SMEs die within five years of their establishment, a smaller fraction die between their sixth and tenth year, and only between 5% and 10% of new SMEs grow to maturity (Onugu, 2005). One major reason for this situation is insufficient capital (Onugu, 2005).

Nigeria is one of the most developed economies in Africa, with the petroleum industry providing 95% of foreign trade earnings and about 80% of budget revenues (Trading Economics, 2010). However, many experts believe that the SMEs have underachieved, in terms of their contribution to the economic growth of the country (Onugu, 2005). SMEs represent a significant proportion of the Nigerian economy and 60% of the Nigerian workforce is employed by them (Capaldo, 2008). About 95% of all industrial establishments in Nigeria are SMEs (Eriki and Inegbenebor, 2009) and they contribute 76% of Nigeria's GDP (Capaldo, 2008). SMEs are expected to play a major role, in terms of creating employment opportunities, enhancing of the per capita income, speeding up industrialization and technological development in the country (Ogujiuba et al, 2004). SMEs are increasingly recognized as the principal means of achieving equitable and sustainable industrial diversification and dispersal, and in most countries, account for well over half of the total share of employment, sales and value added (Udechukwu, 2003). Developing economies, like, Nigeria, rely on micro, small and medium businesses, to improve the living standards of the citizenry and also to contribute to capital formation (Adejuyigbe and Dahunsi, 2010). For these reasons the development of SMEs is of utmost importance to the Nigerian economy.

SMEs often find it difficult to obtain external financing (Ayadi, 2009). According to Berger et al, (2000) it is more difficult for small businesses to obtain credit than big ones. This situation seems to have been worsened by the global financial crisis which brought about a drop in the prices of assets. Many financial institutions saw their capital corrode because of the drop in asset prices, and this made them tighten lending standards and margins (Brunnermeier, 2009). Both effects caused panic-sales, pushed down prices and tightened funding even further. Access to bank loans became extremely limited because banks were uncertain about their future access to capital markets, and they started to hoard funds, even though the credit worthiness of borrowers did not change (Brunnermeier, 2009). The chances of small businesses getting credit from financial institutions became slimmer.

Financial Prospects of SMEs

The financial prospect of SMEs has been the focus of several research studies. Kauffman (2005) in his study of the challenges SMEs face in Africa, identified the lack of funds as a major constraint. Ayadi (2008) examined the possible effect of the Capital Requirements Directives and the Basel II, on SME financing in Europe, and observed that it could raise the cost of managing credit portfolio and also lead to the unfavourable re-evaluation of the risk rating of SMEs. Kremp and Philpon (2008) identified a significant change in the ownership structure of SMEs over the last decade, and suggested that credit constraints influence small firms to join larger groups. Bernet and Westerfeld (2008) suggested that internal rating models used by banks to evaluate SMEs' credit worthiness differ significantly,

in terms of underlying rating philosophy, the rating system architecture and rating model calibration.

SMEs depend on banks for funding. According to Ogujiuba *et al* (2004), the prevailing credit facilities available to SMEs in Nigeria are overdraft, and asset based short-term loans. SMEs in Nigeria, just like those in other countries, use overdraft facilities to manage their way through business cycles (CGAP, 2006). Banks prefer to offer overdrafts and short term loans because they are easily rolled-over, attract almost market interest rates and are fully collateralized (Idowu, 2011). Even access to overdrafts and short-term loans are very limited (ECA, 2001). A survey carried out in Nigeria by the USAID (2005) showed that about 70% of respondents utilizing commercial banks' overdraft facilities with lower interest rates, were required to pledge collateral in form the of Land (48%), building (31%), fixed asset, such as machinery (35%) and (8%) for other assets (Idowu, 2011).

Financing in Africa is usually rated to be more risky than in other regions, and financing SMEs is universally rated as being more risky than financing large organisations, and the provision of credit to SMEs in Africa unfortunately, brings together these two high risk characteristics (Peria and Soledad, 2009). The ratio of credit to non-government sector to GDP is low. In most sub-Saharan African countries, the ratio of bank credit to the private sector was below 20% in 2007 (Sacerdoti, 2009). These low ratios of credit to GDP could be an indication of underdeveloped banking sectors, or it could be an indication of a lack of funding capacity (Cunningham, 2012).

High risk and high transaction costs in lending to SMEs in Africa have been major impediments to SMEs access to loans (Peria and Soledad, 2009). A study of borrowing in six African countries showed that SMEs had worse chances of accessing credit than large organisations (Bigsten *et al*, 2003). African banks do not appear to be in a hurry to develop the business of lending to SMEs, because they operate profitably via the role of lending to large organisations and by holding high yielding government debt (Peria and Soledad, 2009). This interest rate differential might be a reflection of a risk premium and not just high cost of administering small loans (RPED/World Bank, 2002) The higher risk of lending to SMEs in the region might be the reason behind the higher interest rates observed in Africa, which in turn might be a reflection of the high inflation rate in most Sub-Saharan Africa countries (Saibu and Olayungbo, 2011), since financial liberalization requires that nominal interest rate be kept higher than inflation, to ensure positive real interest rates (Harvey, 1998).

The Global Financial Crisis

The global economic crisis had its origin in the bursting of the housing bubble in the United States (U.S) in 2007 (Veric and Islam, 2010). The crisis started with the indiscriminate extension of credit to sub-prime-borrowers, whose capacity to pay back was doubtful. The replacement of the orthodox banking system in which banks hold loans until they are returned, with off-balance sheet banking that involved packaging loans together and reselling them as securities, was the catalyst to the boom in housing prices, because it encouraged the inflow of capital from other countries. However, this new system compromised lending standards and ultimately caused the global financial crisis (Brunnermeier, 2009). According to Soludo (2009) the crisis manifested strongly in the sub-prime mortgages, with borrowers unable to make higher payments on adjusted mortgages. Hence, there was a loss of retail confidence (Dickie, 2009). The combination of factors such as- loose monetary policy, global imbalances, misjudgement of risk and lax financial regulations, created the conditions that ushered in the crisis (Veric and Islam, 2010). The balance sheets of banks deteriorated, as the effects of the aforementioned factors became increasingly evident.

The crisis quickly spread to Europe and soon became a global problem. The interconnectedness of the global banking system ensured that the U.S subprime mortgage crisis spread to other economies around the world (Nitschka, 2012). Financial institutions found it increasingly difficult to lend and even had to recall credit lines, to improve their liquidity (Aluko, 2009). In response to the situation, financial institutions resorted to the use of credit contraction to tighten lending standards (Komolafe, 2008). This led to the introduction of stricter lending requirements by banks and financial institutions (Soludo, 2009).

Africa and the Global Financial Crisis

Several studies assert that the inability of SMEs to obtain adequate funds is the major hindrance to their growth (Kauffman, 2005; Ayadi, 2008; Kremp and Philpon, 2008). They rely mainly on financial institutions for funds, and this over reliance on only one source for funding makes them vulnerable to external factors that might affect the banks' ability to lend (Ogujiuba et al, 2004). Beger and Udell (2001) have noted that negative changes to the economic environment, where the banks and SMEs operate can negatively affect the willingness and ability of banks to lend to them. According to World Bank estimates, the global economy contracted by 2.1 % in 2009, the economy of the OECD area contracted by 4.7 % between the first quarter of 2008 and the second quarter of 2009, and government debt, within the area, rose to about 100% of the GDP (Sedej and Justinek, 2012). The rise in debt was because Governments borrowed more as a result of the crisis, to stimulate the economy. In most countries, the financial system and the stock market were significantly affected by the crisis. Banks were particularly affected, especially those with off-shore credit lines (Ashamu and Abiola, 2012). Between 2007 and 2008 the world witnessed a financial crisis comparable to the Great Depression of the 20th century.

Since SMEs rely on financial institutions for funds, they were therefore, vulnerable to the impact of the downturn in the global economy, given that access to loans became increasingly stringent (Sedej and Justinek, 2012). In a conference organised by the OECD working party on SMEs and entrepreneurship, to discuss the impact of the global credit crunch on SMEs, government officials, representatives of SMEs, financial institutions and stakeholders presented evidence, which showed that there was a severe shortage of loans to SMEs, and the situation was exacerbated by the comparatively high interest rates charged them (OECD, 2009). Though the timing and seriousness of the financial crisis varied from country to country, credit tightening was severe and interest rate spreads continued to rise, despite the easing of monetary conditions by central banks (OECD, 2009).

The global recession presented grave challenges for many African countries. It came at a time the region was witnessing a steady economic growth (Ashamu and Abiola, 2012). It not only clipped African growth, but probably squeezed the finance for small firms more drastically (Collier, 2009). The financial sector in Africa, to a large extent, avoided the first round of the financial crisis, but second-round repercussions were difficult to evade. Many banks in Africa are foreign-owned, and in response to the crisis, they reallocated liquidity to the home economy, to the detriment of the African economy (Collier, 2009). Peria and Soledad (2009) noted that during the period of economic boom, investors took higher risks to make profit. As the boom collapsed, so did the appetite for risk, leaving African SMEs with slimmer chances of obtaining funding. This was exacerbated by the rapid fiscal degeneration of many African governments, caused by the fall in revenues from exports. Governments needed to borrow, but with the collapse of the international appetite for risk, their options were probably limited to selling debt to their domestic market. Public borrowing from banks limits private borrowing. Consequently banks tended to lend less to SMEs.

The Global Financial Crisis and the Nigerian Economy

The Nigerian economy was not totally insulated from the effects of the global financial crises, because to some extent, it is integrated with that of other countries (Adamu, 2009). The continuous deregulation and liberalisation of the global economy has encouraged globalisation and the integration of markets, and ensures that crisis in any economy is felt by others.

As a result of the global financial crisis, many western banks reduced their financial investment in Nigeria in order to aid the parent organisations (Adamu, 2009), and international hedge funds and credit lines were withdrawn (Ashamu and Abiola, 2012). Also, banks with high foreign currency exposure were negatively affected, as they lost some financial assets deposited with foreign correspondent banks (Adamu, 2009). Financial institutions in economically advanced countries reduced their investments in the Nigerian financial system, thereby causing the collapse of the stock market (Aluko, 2008). Between 2002 and 2008, the stock market capitalisation climbed to a high of N12.6 trillion. However, by March 2009, the capitalisation of the stock market had fallen to N4.5 trillion (Sanusi, 2011). The Nigerian capital market lost over N6 trillion in share value, with banking stock as one of the most affected (Offonago, 2008, cited in Okoroanyawu and Adesida, 2008). The stock market was inaccessible to raise fresh funds for capital investments as a result (Ojeaga, 2009). Investors saw the value of their stock depreciating consistently; this led to a loss of confidence in the capital or stock market (Aluko, 2009). The above factors reduced the liquidity of Nigerian banks.

Post Financial Crisis

The recovery from the global financial crisis has been uneven and sometimes anaemic. Many experts are already predicting another downturn, as output growth continues to decline, especially, in developed economies (UN, 2011). The problem the global economy is facing is multifaceted and interconnected, the most critical of which is probably the severe job crisis. For instance, one out of four Greeks is unemployed and the country is in its fifth year of successive economic downturn (Georgiopoulos, 2012). Similarly, Spain is suffering from double dip recession, which could last till 2014 (Elliott, 2012). Growth has been slow in the European area and other developed economies, as the impact of economic miseries in Greece, Portugal, Ireland, Spain, and Italy are increasingly felt by the rest of Europe, as a result of the interconnectedness of the global economy (Economist, 2012). Luckily, most African economies came out of the crisis in better fiscal situations than the developed economies (Brixiova, 2010). Many African economies returned to the growth forecasts they had before the financial crisis by the end of 2010 and are expected to account for seven of the ten fastest growing economies (Novel Capital Partners, 2011).

In Nigeria, the growth projections are encouraging. It is projected that the government will be able to meet her target of bringing down inflation to a single digit in 2013, as the inflation rate continues to fall yearly, having reached a high in 2008 (AfDB, 2012). The fiscal measures introduced by financial regulators and the easing of food prices, will help realise these projections (AfDB, 2012).

SUB-SAHARAN AFRICA REGIONAL FORECAST

	'10	'11	'12	'13	'14
1. GDP at market prices	5.0	4.7	5.0	5.3	5.2
2. GDP per capita, constant \$	2.4	2.7	3.0	3.3	3.2
3. PPP GDP	5.2	5.0	5.3	5.5	5.4
4. Private consumption	4.9	4.5	4.6	4.8	4.8
5. Government consumption	9.0	6.0	5.6	5.3	4.9
6. Fixed investment	10.6	10.4	6.2	7.6	6.1
7. Exports, GNFS	5.0	3.8	6.9	5.9	5.9
8. Imports, GNFS	7.2	11.2	7.6	7.2	6.2
9. Net exports, contribution to growth	-1.0	-2.9	-0.8	-1.0	-0.6
10. Current Account Balance, % of GDP	-1.6	-0.7	0.6	0.1	-0.1
11. GDP deflator, median in LCU	7.9	5.3	5.5	5.8	5.8
12. Fiscal Balance, % of GDP	-4.0	-1.7	-2.8	-2.1	-1.6
SSA excluding South Africa	6.1	5.6	6.2	6.3	6.0
SSA Oil Exporters	6.1	5.3	6.5	6.5	6.1
Sub-Saharan Africa CFA	4.5	3.1	5.0	5.2	4.7
South Africa	2.9	3.1	2.7	3.4	3.5
Nigeria	7.9	7.4	7.0	7.2	6.6
Kenya	5.8	4.4	5.0	5.1	4.7

Source: World Bank (2011).

TABLE 1- SUB-SAHARAN AFRICA REGIONAL FORECAST (UNIT: US DOLLARS)

'10 '11 '12 '13 '14

Aim of the Study

The aim of the study is to determine whether the global financial crisis caused a reduction in the volume of bank loans SMEs received.

Methods

The area of the study is Nigeria. Nigeria is the second largest economy in Africa (Nagar and Paterson, 2012), and has a very competitive banking industry. It is the most populated country in Africa and the sixth most populated country in the world (UNPF, 2011). Nigeria is the sixth largest exporter of crude oil, which accounts for 95% of Nigeria's exports (Ambardar, 2011).

This is a survey study, carried out *ex post facto*. It involved a large volume of secondary data from the Central Bank of Nigeria (CBN) records of bank loans to the private sector from 2005-2011. The population covered all the commercial banks in Nigeria. Figures from the CBN, which showed the volume of banks' loans to the private sector, from 2005-2011, were adjusted for inflation, and expressed in 2011 price level. The data were categorised into the following periods: before the financial crisis (2005-2006), during the financial crisis (2007-2009), and after the financial crisis, and line graphs were used to visually summarize the results.

The major limitation of the study is the inability of the researcher to obtain records of bank loans, specifically to SMEs in Nigeria. The researcher had to use the records of bank loans to the private sector for the analysis, given that SMEs represent a significant proportion of the private sector.

Table 2 shows the total bank loans to the private sector in Nigeria (this includes SMEs) from 2005 to 2011

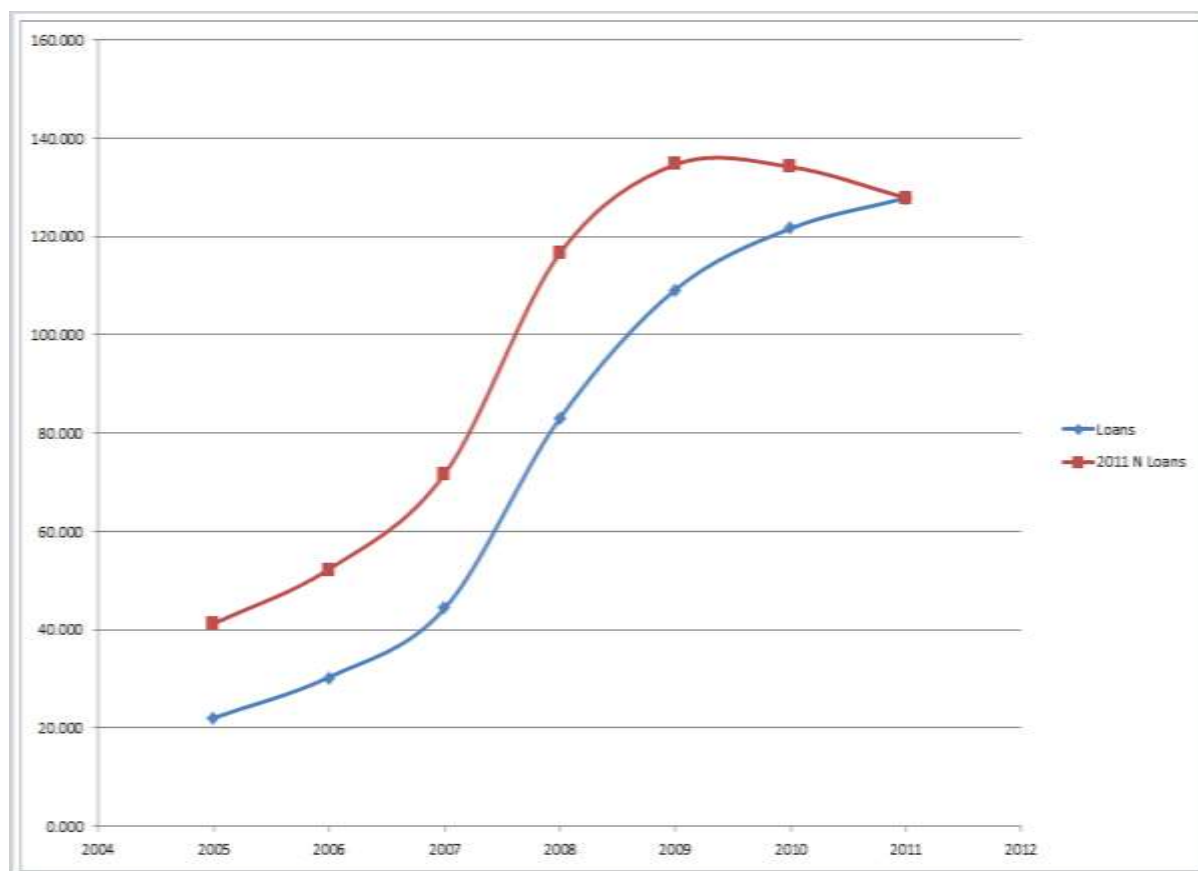
BANK CREDIT TO PRIVATE SECTOR							
	BEFORE THE CREDIT CRUNCH		DURING THE CREDIT CRUNCH			AFTER THE CREDIT CRUNCH	
YEAR	2005	2006	2007	2008	2009	2010	2011
TOTAL	22,062,679.13	30,378,697.5	44,3445,44.84	83,045,925.08	109,211,340.01	121,691,364.27	127,900,457
INF RATE	11.6%	8.5%	6.6%	15.1%	13.9%	11.8%	10.3%
MULTIPLIER	1.8698	1.7234	1.6167	1.4046	1.2332	1.1030	1.0000
INF ADJ	41,253,571.70	52,353,137.97	71,689,667.36	116,643,184.34	134,674,400.79	134,225,574.79	127,900,457

Source: CBN (2011)

TABLE 2- TOTAL BANK LOANS TO THE PRIVATE SECTOR

The graph below (Figure 1) shows the volume of loans given to the private sector from 2005 to 2011 and also shows the inflation adjusted figure, within the same period. In the graph, the blue line represents the volume of the loans, while the red line represents the inflation adjusted figures.

FIGURE 1- BANK LOAN TO THE PRIVATE SECTOR AND INFLATION ADJUSTED FIGURES



The loan figures suggest that the amounts of loans given to the private sector increased yearly within the period under review (2005-2011). However, the inflation adjusted figure shows that the real value of the loans given to the private sector, grew steadily between 2005 and 2009, and thereafter, declined slightly in 2010 and 2011.

The reviewed literature suggests that Nigerian banks were negatively affected by the global financial crisis, in terms of lack of commercial lending from abroad, financial losses (Adamu, 2009), capital repatriation (Ashamu and Abiola, 2012), and nosedive of the capital market (Aluko, 2008; Okoroanyawu and Adesida, 2008). However, the volume of loans given to the private sector between 2005 and 2011 suggests that the ability of Nigerian banks to lend was not affected. As shown in *Table 2*, the amount of loans given to the private sector continued to increase, in spite of the global financial crisis. Unlike their Western counterparts, who were grappling with the effects of the global credit crunch, Nigerian banks were desperately marketing personal and mortgage loans (Walker, 2008). The boom in the Nigerian credit market was because banks became fewer and healthier, after a government induced consolidation exercise (Walker, 2008)

Conclusion

The findings of this study suggests that the global financial crisis did not cause a reduction in the volume of bank loans SMEs received, since the volume of loans to the private sector increased steadily within the period under review (2005-2011). This suggests that the ability of Nigerian banks to lend was not affected. However, the inflation adjusted loan figures showed that there was a slight decline, in the real value of the loans, between 2009 and 2011, as a result of inflation.

Recommendation

It is recommended that the Central Bank of Nigeria (CBN) takes active steps towards reducing the rate of inflation to the barest minimum. This is because the high inflation rate in the country reduces the real value of money. If inflation is kept down, the real values of loans given to SMEs will increase. According to Giulia Pellegrini, JPMorgan's sub-Saharan Africa economist (cited in Bloomberg, 2012) Nigeria's economic outlook is improving and will get better, if policy makers curb inflation, and steady the currency.

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Examining the Function of Family Support and Company Policy as Antecedents of Employee Loyalty among Teachers in Selected Schools in Malaysia

Noraani Mustapha¹

*Faculty of Entrepreneurship and Business,
Universiti Malaysia Kelantan
noraani@umk.edu.my*

Mohammad Nizamuddin Abdul Rahim

*Faculty of Entrepreneurship and Business,
Universiti Malaysia Kelantan
nizamuddin@umk.edu.my*

Abstract

Employee loyalty is one of the factors in every organization's success. Loyal employees can be incredible assets to a growing company since it represents a cost savings over recruiting and training new workers. Moreover employee loyalty is an important measure of an organization's job environment and the quality of its management. The objective of the study is to determine the influence of family support and company policy on employee loyalty among 100 teachers in selected Islamic private schools in Kelantan. Sample was determined using systematic random procedure and data was gathered using self administered research questionnaires. Descriptive statistics was utilized to obtain data about demographic profile of the respondents and the Pearson Product Moment Correlation was used to assess the influence of independent variable on its dependent. Result indicates the positive significant relationship between variables and supports the hypotheses. This study suggests that family support and company policy influencing employee loyalty to the organization, and therefore these variables could be used by managers as dimension to promote organizational citizenship among employees.

Keywords: family support, company policy, employee loyalty

¹ Corresponding author

1. 0Introduction

Human resource professional admit that employee retention is a key factor in every organization's success. Economic growth on a global scale and the creation of thousands of jobs has generated a need for marketing and administration strategies in talent recruitment and retention (Hutchings, De Cieri, & Shea, 2011). Loyal employees represent a cost savings over recruiting and training new hires, and loyal employees can be incredible assets to a growing company.

In Malaysia it is a common phenomenon that employees shift from one organization to another within a period of five years. Employees would tend to leave their companies for slightly better pay due to low emotional attachment with their organization. According to Nijhof, de Jong and Beukhof (1998), the achievement of an organization does not only rely on how the organization utilizes its human capitals and competencies but also on how it incites commitment to the organization. Hence, the biggest challenge for Malaysian organizations is to promote a sense of commitment and belonging among their employees.

2.0 Phenomenon of the Study

The success of any company is directly linked to the satisfaction of the employees who embody that company. This means that enhancing people is critical to the success of any organization; and that no matter how temporarily challenged the economy might be, ultimately, a company's most talented performers will always have other employment options to be chosen (Freeman, 2005).

Most managers do not realize how expensive losing workers can be. Anything less than a loyal, productive worker will cost a company; which is why performance goal setting and review are critically important for weeding out the 'bad' ones; or for providing additional training and support to those who can be developed or rehabilitated (Shaw, Gupta & Delery, 2005). But there is more than just the replacement expense when a competent employee leaves. Replacement can cost a company anywhere from 35% to 50% of an hourly worker's salary. For a technical or professional worker, the cost can go as high as 125% of that worker's salary (Shaw, et al., 2005).

At another flip of a coin, employee loyalty is crucial to the organization because it's mirrored the overall organization performance. Failure in managing employee loyalty can cause employee turnover. Employee turnover has been a major focus in human resource area as it cause loses to organization in terms of institutional memory (Shaw, et al., 2005) and effects the quality of products and services offered (Johnson, 1981). Harvard leadership, Kotter (1990) professed that "good management is about evoking loyalty and commitment. Coping with chance in any complex business requires employees who have a sense of belonging and recognition, and a sense that they belong to an organization that cares about them. Nothing less will work."

According to Vacancies and Placements Statistics (2006-2010), Ministry of Human Resource Malaysia, there were 368,094 active registrants in 2010. Placements Statistics reported to the Labour Department by Industry for 2010, were 9,422 employees. Retrenchment Statistics reported to the Labour Department by Occupational Categories for year 2010 were 7,085 employees. These statistics indicate that there are a lot of sources of employees in the Malaysia marketplace. But according to the statistics, percentage of placements and retrenchment were almost equal.

The former Prime Minister, Mahathir Mohamad (1992) stressed the importance of workers' loyalty to ensure economic growth. He even wrote an article, "Loyalty is Key to

Business Success" (1992), which was published by all the national dailies. He warned that loyalty to the company was then not a virtue. Most workers laid their loyalty to those offering higher pay and perks. It is not durable. The next company to offer better rewards will kill whatever loyalty they may have for their previous employers (Mahathir Mohamad, 1992). Malaysia is one of the booming economies where the official unemployment rate is 2.8 percent effectively full employment (NST, Oct 28, 1995). Many companies run at below capacity because they cannot get (or retain) skilled workers. This is true for both operational workers and managerial. Most Malaysians can walk out of their job and into another on the same day. This scenario has jolted the country's leadership, (NST, Oct 28, 1995).

This study is focusing on the factors, which contribute to employee's loyalty. Taking a closer look, this study focuses on family supports and company policy as antecedents and how these factors play its important function in influencing teachers' loyalty in nine selected private Islamic schools in Malaysia.

3.0 Literature Review

Loyalty is the willingness to make an investment or personal sacrifice to strengthen a relationship (Reichheld, Frederick, 1998). In general, employee loyalty can be defined as a psychological attachment or commitment to the organization and develops as a result of increase satisfaction. Satisfaction results from a process of internal evaluation, and if an employee's expectation level is met or exceeded, then satisfaction grows. Employee loyalty then develops into a generalized emotional attitude towards the organization. In other words, the more satisfied an employee is regarding his or her working environment, the more likely that he or she will develop a sense of commitment towards the organization. Employee attitudes towards the organization give rise to the behavioural component of loyalty. An employee who has developed affection to the organization is more likely to demonstrate loyal behaviors and work towards the overall goals of the organization, such as improved productivity, greater efficiency, and a high-quality service orientation to customers. This paper focuses on two variables suggested by past research that have influence on employee loyalty ; family support and company policy.

3.1 The influence of family support on employee loyalty

The focus on family support on employee loyalty is theoretically grounded in the assertion that individuals whose family members provide support are less vulnerable to the negative effects of work-related stress and experience better health and overall well-being (Cohen and Syme, 1985). In fact, extending the aforementioned buffering model, arguments have noted that individuals who have at least one person in whom they can confide (emotional support) are less vulnerable to the negative impacts of stress (Cohen and Wills, 1985). In this study, emotional family support is defined as one's perception that family members are willing to listen and offer helpful advice and encouragement (King et al., 1995). Research has indicated that family support is negatively related to depression, anxiety, and somatic symptoms (Lu, 1999), and that a propensity for providing emotional support in dual career contexts can diminish discontentment (Bedeian et al., 1986). Employees are likely to discuss critical work issues (particularly turnover intentions) with family members because a decision to leave one's job dramatically affects family life. Accordingly, emotional family support should impact turnover intentions and mitigate the employee's intention to withdraw from the organization by providing the employees with an appropriate forum to vent their frustrations from work.

This study contends that emotional family support is necessary to mitigate the turnover intentions and promote employee loyalty. Thus, the following hypothesis is posited:

H1: There is a positive significant relationship between family support and employee loyalty.

3.2 The influence of company policy on employee loyalty

Organization's policy is another factor that influences the employee loyalty. One of the policies that encourage employee to stay is management support on learning. Learning can acquire knowledge and skill among workers. A knowledge employee refers to one who works primarily with information or one who develops and uses knowledge in the workplace, (Peter Drucker, 1959). Knowledge grows like organisms, with data serving as food to be assimilated rather than merely stored. Weiss (1960). Popper (1963) stated there is always an increasing need for knowledge to grow and progress continually, whether tacit (Polanyi, 1976) or explicit. Toffler (1990) observed that typical knowledge workers (especially R&D scientists and engineers) in the age of knowledge economy must have some system at their disposal to create process and enhance their own knowledge. In some cases they would also need to manage the knowledge of their co-workers. Nonaka (1991) described knowledge as the fuel for innovation, but was concerned that many managers failed to understand how knowledge could be leveraged. Companies are more like living organisms than machines, he argued, and most viewed knowledge as a static input to the corporate machine.

Knowledge workers in today's workforce are individuals who are valued for their ability to act and communicate with knowledge within a specific subject area. They will often advance the overall understanding of that subject through focused analysis, design and/or development. They use research skills to define problems and to identify alternatives. Fueled by their expertise and insight, they work to solve those problems, in an effort to influence company decisions, priorities and strategies.

Many companies continue to investigate various ways of rewarding employees for performance and loyalty, Huselid, M. (1995). Organizations that offer policy of a straight base salary with no chance for incentive earnings, typically ends up attracting and retaining very different individuals than one that offers large amounts of incentive pay, Lawler (1973). Organizations who reward their employees with different performance-related pay incentives are much more likely to attract the more entrepreneurial and problem solving employees than those that just offer a base salary, Lawler (1973). According to Pfeffer (1998a, p. 80), "Although labor markets are far from perfectly efficient, it is nonetheless the case that some relationship exists between what a firm pays and the quality of the workforce it attracts." Best practice advocates place great emphasis on the need to attract and retain the type of employees that will help an organisation to gain and sustain competitive advantage. Although labour intensity varies across industries and services, labour costs are a significant percentage of operating costs for most organizations. Because of this, best fit proponents argue that "...the system designer must focus on how high these costs should be and how they will vary with the organization's ability to pay." (Lawler, 1995, p. 16).

Company policy on compensation, rewards and benefits is another factor that influences employee loyalty. Once employees have done their jobs and been appraised, they expect to be paid. Each employee's pay should make sense in terms of the company's overall pay plan. Compensation is a primary motivator for employees. People look for jobs that not only suit their creativity and talents, but compensate them both in terms of salary and other benefits accordingly. Compensation is also one of the fastest changing fields in Human Resources, as

companies continue to investigate various ways of rewarding employees for performance, Huselid, M. (1995).

According to Susan M. Heathfield, About.com Guide (2009), compensation refers to all forms of financial returns and tangible services and benefits employees as part of an employment relationship. Compensation is the total amount of the monetary and non-monetary pay provided to an employee by an employer in return for work performed as required. Kinnie (2000) define compensation as a systematic approach to providing monetary value to employees in exchange for work performed. Compensation may achieve several purposes assisting in recruitment, job performance, and job satisfaction. Compensation may also be adjusted according the business needs, goals, and available resources.

Many benefits policy are not required by law, but are nonetheless common in total compensation packages. These include health insurance, accidental death and dismemberment insurance, some form of retirement plan (including profit-sharing, stock option programs, employee stock ownership plans), vacation and holiday pay, and sick leave. Companies may also offer various services, such as day care, to employees, either free or at a reduced cost. It is also common to provide employees with discounted services or products offered by the company itself. In addition, there are also certain benefits that *are* required by either state or federal law, Herzberg, F. (2001).

Individual employee behavior is motivated to work to satisfy his needs and incentives reinforce employee performance. Success in achieving goals or rewards positively influences employee performance. Vroom (1964) expectancy theory state that increased employee motivation could be achieved if he/she is capable to change his behavior and be rewarded and the incentive or the reward is sufficient to change his/her behavior. Individual performance could be attributed to the reward he received for performing in a particular way. Murlis and Armstrong (2005) sees economic and money reward as the greatest motivator. But money to Hersberg et al (1957) is hygiene factor which could be a potential dissatisfier if the amount is inappropriate. Financial rewards have to be internally equitable and externally competitive, it has to be based on pay for performance and employee has to understand how the reward system operates. Policy on financial incentive motivate individual to achieve their objective and financial reward provide financial recognition for people for their achievement. Thus, the following hypothesis is posited:

H2: There is a positive significant relationship between company policy and employee loyalty.

4.0 Research Methodology

4.1 Research Design and Procedures

This descriptive-correlation research is used to determine the relationship between family supports and company policy; and employee loyalty. Data was collected from 100 teacher respondents representing nine Islamic schools in Kota Bharu and Kubang Kerian, Kelantan, Malaysia. The respondents were randomly selected by means of systematic random procedures, whereby 98% of the respondents were Malay and rest; were Arabs.

4.2 Instrumentation

Family support was measured using 6 items developed by Benson J.S (2002). (e.g., My family supports my career in this organization.) The reliability coefficient was 0.704. Company policy was assessed using The Job Content Questionnaire developed by Meyer and Allen (1997) and Fields (2002). The 9 items questionnaire (e.g., Employer allows employee to attend outside courses in order to build up their performance) has the reliability coefficient of 0.862.

Employee loyalty to the organization was measured using an inventory developed by Weiss, Darwis, England, and Lofquist, (1967). This variable was measured using 6 items (e.g. I plan to stay with this organization for a long time to advance my career) and the reliability value was 0.84. For all variables respondents indicated their degree of agreement/disagreement on a 10-point scale ranging from 1 (Extremely disagree) to 10 (Extremely agree)..

5.0 Findings and Discussion

5.1 Demographic profile

Results of descriptive analysis shows the respondents' age are ranging from 20 to 45 years old and most of them (72%) are below 30 years of age. The highest level of education attained by respondents ranged from Sijil Pelajaran Malaysia (SPM) to Bachelor Degree. Slightly more than a half respondents (57%) completed their education with Bachelor Degree, 15% with Diploma, 8% with Sijil Tinggi Agama Malaysia (STAM), 14% with Sijil Tinggi Pelajaran Malaysia (STPM), and 6% with Sijil Pelajaran Malaysia (SPM). From the study, most respondents (61.0%) were serving the schools between one to three years and slightly above the quarter (28%) of them were working more than 5 years. From the analysis majority of the respondents (36%) had previously working with two employers, 24% with single employer, 20% with three employers, 14% with four employers, and 6% with 5 employers. Most of the respondents (88%) are teachers, 6% are senior teachers, and 6% of them are headmasters. From the study, most respondents (67%) worked about 8 hours per day and the rest (33%) worked more than 8 hours per day. The income received by respondents ranged from RM650 to RM700 were 37%, RM701 to RM750 (21%), RM751 to RM800 (2%), RM801 to RM850 (4%), RM851 to RM900 (3%), RM951 to RM1000 (15%), RM1001 to RM1050 (6%), and RM1051 to RM2000 (12%). From the analysis 45% of the respondents were married and 55% of the respondents were single. The study shown that 65% of the respondents have working spouses.

5.2 The influence of family support on employee loyalty

The finding of the data analysis indicates that as the level of family support of teachers increased, their level of loyalty ($r = 0.3437$, $p = 0.005$) increased. This finding supports the hypothesis that teachers who received high family support also experienced high level of loyalty. The result has supported finding from Guest (2000) who concluded that those who reported more family support reported a better work life balance in terms of family and life satisfaction and less intention to leave (Clark, 2000). Thus, the above hypothesis is supported.

5.3 The influence of company policy on employee loyalty

The result of the data analysis shows that as the level of understanding on company policy among school teachers increased, their level company loyalty ($r = 0.332$, $p = 0.001$) increased. This finding supports the hypothesis that teachers who experienced a favour company policy also experienced highly committed and high intention to remain with the organization. In other words, a friendly company policy will push family satisfaction and loyalty to a higher level. The result is also in line with the finding from Barnett et al. (1992) who concluded that a family friendly company policy had mitigated job stress, enhanced job satisfaction and motivated employees to remain employed (Barnett et al., 1992) and highly committed and loyalty with organization. Therefore, the above hypothesis is supported.

6.0 Conclusion

The findings suggest the importance of family support and company policy to enhance employee loyalty towards their organization. Higher level of family support and an understanding of the company policy can increase family satisfaction and therefore enhance the level of organizational citizenship amongst employee. Therefore organizations are called to use these variables as mechanism to promote loyalty amongst their employees.

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Vascular Plant Diversity of Middle Sakarya Valley (Eskişehir/Turkey)

Onur Koyuncu

Eskişehir Osmangazi University

Faculty of Science and Art, Department of Biology, 26480, Meşelik-Eskişehir, Turkey.

Derviş Öztürk

Eskişehir Osmangazi University

Faculty of Science and Art, Department of Biology, 26480, Meşelik-Eskişehir, Turkey.

Ö. Koray Yaylaci

Eskişehir Osmangazi University

Faculty of Science and Art, Department of Biology, 26480, Meşelik-Eskişehir, Turkey.

Okan Sezer

Eskişehir Osmangazi University

Faculty of Science and Art, Department of Biology, 26480, Meşelik-Eskişehir, Turkey.

Kurtuluş Özgüşi

Eskişehir Osmangazi University

Faculty of Science and Art, Department of Biology, 26480, Meşelik-Eskişehir, Turkey.

Atila Ocak

Eskişehir Osmangazi University

Faculty of Science and Art, Department of Biology, 26480, Meşelik-Eskişehir, Turkey.

Abstract

In this study, vascular flora of Middle Sakarya Valley (Eskişehir/Turkey) which located at the junction point of A3-B3 squares were investigated between 2006-2008 and about 2200 plant specimens were collected. At the end of this study, 810 plant taxa belonging to 90 families and 428 genera were determined. The largest five families from these are Asteraceae (84 taxa), Fabaceae (72 taxa), Apiaceae (62 taxa), Brassicaceae (51 taxa) and Poaceae (34 taxa). The largest genera are *Trifolium* (11 taxa), *Silene* (11 taxa), *Astragalus* (10 taxa), *Ranunculus* (9 taxa) and *Campanula* (9 taxa). Distribution of taxa according to their floristic region reveals that the Mediterranean elements are the most abundant with 16,17 % (131 taxa). Ratio of Irano-Turanian elements is 11,11 % (90 taxa) and this is followed by Euro-Siberian elements with 9,13 % (74 taxa). The rest 515 taxa (63,59 %) are elements of one or more floristic regions or their floristic regions are unknown. 78 endemic taxa (3 taxa EN, 5 taxa VU, 12 taxa NT and 58 taxa LC) were determined from study area and endemism ratio is 9,62 %.

Keywords: Flora, Biodiversity, Sakarya Valley, Eskişehir, Turkey

Introduction

Turkey has considerable topographical, climatic and ecological diversity because of the effects of different events which occurred in geological formation process (Akman, 1990). Also, Turkey is located at intersection of the Euro-Siberian, Mediterranean and Irano-Turanian floristic regions and so act as a bridge between Asia and Europe continents. From all reasons above, Turkey has very high biological diversity (about 12.000 taxa) in comparison with neighboring countries (Davis, 1965).

The first studies on flora of Turkey were started with botanical excursions of Tournefort in 1702 (Erik and Tarıkahya, 2004). Afterwards, many native and foreign researchers have studied on flora of Turkey until today. First notable study between these studies is Boissier's *Flora Orientalis*. But undoubtedly that the most important and detailed study between these is *Flora of Turkey and Aegean Islands* which performed by P.H. Davis et al. Although *Flora of Turkey and Aegean Islands* and other studies have contributed significantly to the flora of Turkey, detailed floristic structure of provinces and grids haven't been identified yet (Davis, 1965-1985; Davis et al., 1988; Güner et al., 2000; Ocak and Tokur, 2000; Türe and Tokur, 2000).

The study area located at the junction point of A3 and B3 squares according to the grid system adopted in the *Flora of Turkey and Aegean Islands*. The area at the latitudes of 40° 09' - 39° 54' N and the longitudes of 30° 35' - 31° 30' E. Altitude of area is ranging from 250 to 1350 m.

Major soil groups of the study area are composed of brown forest soil, non calcareous brown soil and alluvial soil. The most widespread is the brown forest soil type. Major rock structures are limestone (Dönmez, 1985).

Climatic features of study area have been evaluated according to the obtained data from Bilecik, Beypazarı, Nallıhan, Göynük, Gölpaazarı and Söğüt meteorological stations. The average temperature of Bilecik is 12,4 °C, Beypazarı is 13,0°C, Nallıhan is 12.3°C, Göynük is 10,6 °C, Gölpaazarı is 11,6 °C and Söğüt is 11.8 °C. Annual precipitation of Bilecik is 444.0 mm, Beypazarı is 369.0 mm, Nallıhan is 298.0 mm, Göynük is 652.8 mm, Gölpaazarı is 421.7 mm and Söğüt is 566.7 mm. When all the climatic data is evaluated according to the Emberger method, climate type of study area is determined as semi arid Mediterranean type. The precipitation regime belongs to the East Mediterranean (Akman, 1990; Türe and Tokur, 2000; D.M.İ., 2007).

There have been no other specific studies related to the flora of Middle Sakarya Valley (Eskişehir/Turkey). The aim of this study was to determine the floristic characteristics of Middle Sakarya Valley (Eskişehir/Turkey).

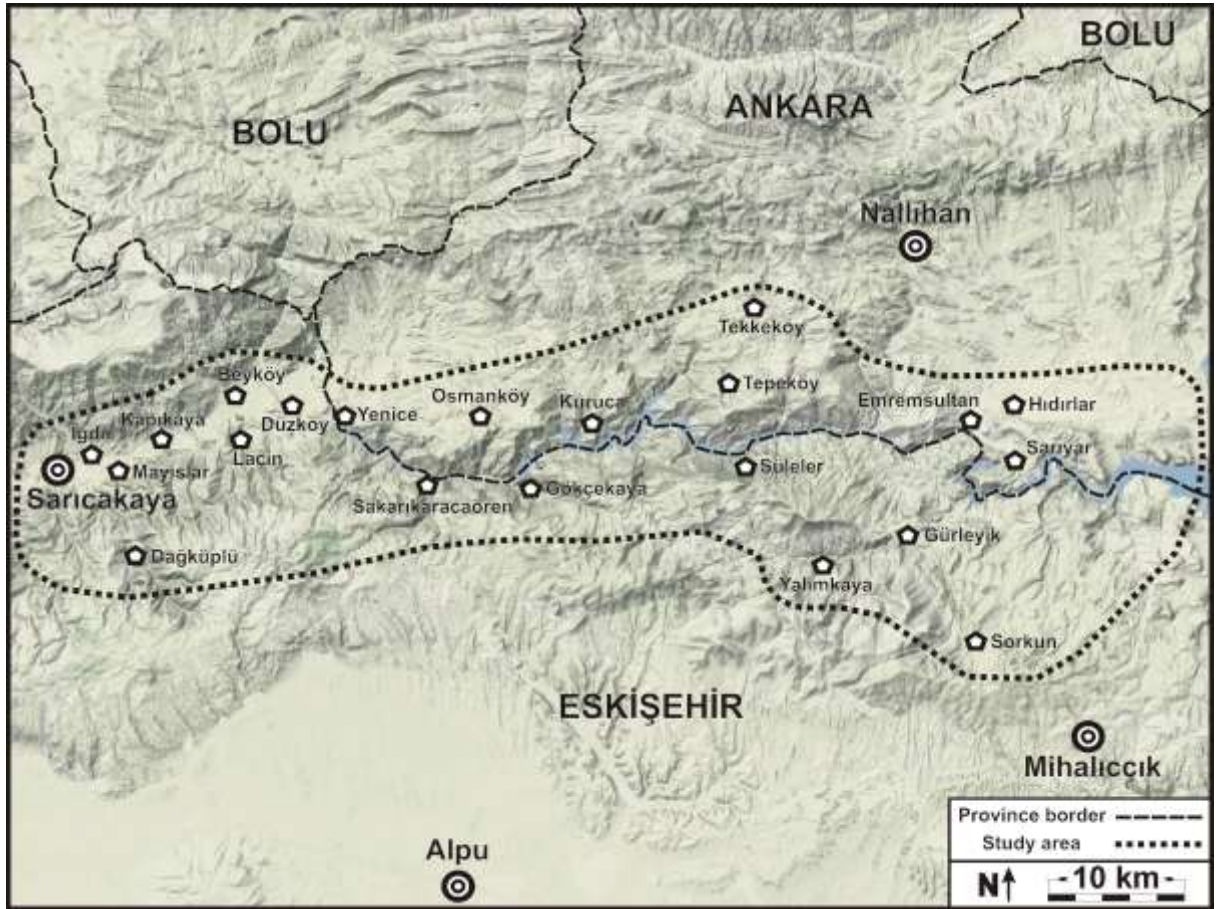


Figure 1. Geographic map of the study area.

Material and Methods

This study based on 2200 plant specimens, which were collected from 72 localities in Middle Sakarya Valley between 2006 and 2008. The majority of the specimens were identified with the help of the Flora of Turkey and the East Aegean Islands (Davis, 1965-1988; Güner et al., 2000). Some doubtful identifications were checked in Flora Europaea (Tutin et al., 1964-1980), Flora Iranica (Reichinger, 1965-1977), Flora Palestina (Zohary, 1966-1986), Flora of Iraq (Guest and Townsend, 1966-1985), Flora Orientalis (Boissier, 1867-1888). The herbaria of GAZI, ANK and OUFE were used to check the specimens. The plant specimens which were prepared for herbarium collections have been stored in the Herbarium at OUFE. The floral data are listed in the appendix. All taxa in the floristic list are given according to the Angiosperm Phylogeny Group (APG III, 2009). In the floristic list, locality, altitude, OUFE number, collection date, phytogeographical region, whether the plant is endemic or not and threatened categories it belongs to are mentioned at the end. Author's abbreviations follow Brummitt and Powell (1992) and The International Plant Names Index (2012). Threatened categories are proposed for endemic and some non-endemic taxa according to IUCN risk categories (IUCN, 2001; Ekim et al., 2000). The abbreviations used in the text and the floristic list are as follows: EN: Endangered; VU: Vulnerable; NT: Near threatened; LC: Least concern; ANK: Ankara University Herbaria; GAZI: Gazi University Herbaria; OUFE: Eskişehir Osmangazi University Herbaria.

Result and Discussion

In this study, 810 spermatophyta taxa belonging to 90 families and 428 genera were identified. 8 of these taxa are Gymnospermae and 801 of these taxa from the Angiospermae.

The Angiospermae includes 675 taxa from the Magnoliopsida and 127 taxa from Liliopsida. The dispersion of the plant taxa that were defined in the study area according to the large taxonomical groups is shown in Table 1.

Phytogeographical distributions of 295 taxa are given in Table 1. Apart from these, other 515 taxa are multi-regional elements or their phytogeographic region is unknown. The percentage of phytogeographical origins of 131 taxa (16,17 %) Mediterranean, 74 (9,13 %) Euro-Siberian, and 90 (11,11 %) Irano-Turanian. The rest of the 515 (63,59 %) taxa are either multi-area elements or single elements which have not yet been accepted as members of the phytogeographical area.

The largest families of study area according to number of taxa are Asteraceae (84 taxa), Fabaceae (72 taxa), Apiaceae (62 taxa), Brassicaceae (51 taxa) and Poaceae (34 taxa) (Table 2.). The richest genera of study area according to number of taxa are *Trifolium* (11 taxa), *Silene* (11 taxa), *Astragalus* (10 taxa), *Ranunculus* (9 taxa) and *Campanula* (9 taxa) (Table 3).

Endemism ratio of study area is 9,62 % and includes 78 taxa (3 taxa EN, 5 taxa VU, 12 taxa NT and 58 taxa LC). Endemism ratio of study area is very low in comparison with the average endemism ratio (34.5%) of the Flora of Turkey (Güner et al., 2000).

This study will make contribution to the all related researches and plant diversity of Turkey.

Table 1. Floristic properties of the research area.

	Taxonomic Groups			Total	Ratio of total taxa in the research area (%)
	Gymnospermae	Angiospermae			
		Dicots	Monocots		
Families	4	73	13	90	-
Genera	4	358	66	428	-
Species and Under Species Taxa	8	675	127	810	100
Species	8	667	126	801	98,88
Subspecies	-	3	-	3	0,37
Varieties	-	5	1	6	0,75
Distribution of taxa to Phytogeographic Regions					
Euro-Siberian (Total)		60	14	74	9,13
Mediterranean (Total)					
Mediterranean		69	27	96	11,85
E. Medit. (mt)	1	24	10	35	4,32
Irano-Turanian		81	9	90	11,11
Others	7	441	67	515	63,59
Endemism and Risk Categories (IUCN 2001).					
Endemic Taxa		70	8	78	9,62
EN		3		3	0,37
VU		5		5	0,61
NT		9	3	12	1,48
LC		53	5	58	7,16

Table 2. Terms of number of taxa included in the large families.

	Number of taxa	ratio of (%)
<i>Asteraceae</i>	84	10,37
<i>Fabaceae</i>	72	8,88
<i>Apiaceae</i>	62	7,65
<i>Brassicaceae</i>	51	6,30
<i>Lamiaceae</i>	48	5,93
<i>Poaceae</i>	34	4,20
<i>Caryophyllaceae</i>	34	4,20
<i>Asparagaceae</i>	34	4,20
<i>Boraginaceae</i>	19	2,35
<i>Orchidaceae</i>	16	1,98
Others	356	43,94

Table 3. Terms of number of taxa included in the large genera.

	Number of taxa	ratio of (%)
<i>Trifolium</i>	11	1,36
<i>Silene</i>	11	1,36
<i>Astragalus</i>	10	1,23
<i>Ranunculus</i>	9	1,1
<i>Campanula</i>	9	1,1
<i>Centaureae</i>	8	0,98
<i>Alyssum</i>	8	0,98
<i>Salvia</i>	8	0,98
<i>Colchicum</i>	7	0,86
<i>Geranium</i>	6	0,74
Others	723	89,31

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FLORISTIC LIST

SPERMATOPHYTA

GYMNOSPERMAE

PINACEAE

Pinus L.

P. nigra Arn. subsp. *nigra* var. *caramanica* (Loud.) Rehd.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 16780, 08.iv.2006.

P. brutia Ten.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16781, 24.vii.2007, East Mediterranean Element.

TAXACEAE

Taxus L.

T. baccata L.

B3 Eskişehir: Sündiken Mountain, Kirazlıdere turn, N 39°29'308"-E 030°21'190", 1357m, OUFE: 16782, 23.vii.2007.

CUPRESSACEAE

Juniperus L.

J. oxycedrus L. subsp. *oxycedrus*

B3 Eskişehir: Sündiken Mountain, Kirazlıdere turn, N 39°29'308"-E 030°21'190", 1357m, OUFE: 16783, 23.vii.2007.

J. foetidissima Willd

A3 Ankara: Tepeköy, N 40°04'781"-E 031°11'253", 1015m, OUFE: 16784, 28.v.2006.

J. excelsa M.Bieb.

A3 Eskişehir: Süleler, N 40°02'54.6"-E 031°13'56.5", 604m, OUFE: 16785, 17.vi.2006.

J. deltoides R.P. Adams

A3 Ankara: Tepeköy, N 40°04'781"-E 031°11'253", 1015m, OUFE: 16786, 01.v.2007.

EPHEDRACEAE

Ephedra L.

E. major Host

A3 Eskişehir: Yalınkaya, N 40°00'46.3"-E 031°12'57.8", 1333m, OUFE: 16787, 07.v.2007.

ANGIOSPERMAE

DICOTYLEDONAE

RANUNCULACEAE

Nigella L.

N. arvensis L. var. *glauca* Boiss.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16788, 18.v.2006.

N. arvensis L. var. *involuta* Boiss.

A3 Ankara: Hıdırlar, N 40°03'569"-E 031°25'353", 616m, OUFE: 16789, 20.v.2006.

N. damascena L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16790, 17.vi.2007.

Delphinium L.

D. fissum Waldst. & Kit. subsp. *anatolicum* Chowdhuri & P.H.Davis

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16791, 13.v.2006, Endemic, (LC).

D. peregrinum L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16792, 16.viii.2006.

D. venulosum Boiss.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16793, 04.viii.2007, Irano-Turanian Element, Endemic, (LC).

Consolida Gray

C. thirkeana (Boiss.) Bornm.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16794, 16.viii.2006, Endemic, (LC).

C. orientalis (J.Gay) Schrödinger

A3 Eskişehir: Mayıslar, N 40°02'285"-E: 030°39'837", 240m, OUFE: 16795, 17.vi.2006.

C. regalis Gray subsp. *paniculata* (Host) Soó

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 16796, 18.vii.2008.

C. raveyi (Boiss.) Schrödinger

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16797, 14.vii.2008, Irano-Turanian Element, Endemic, (LC).

C. hellespontica (Boiss.) Chater

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16798, 20.vii.2008.

Anemone L.

A. blanda Schott & Kotschy

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16799, 08.iv.2007.

A. coronaria L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16800, 01.v.2007, Mediterranean Element.

Clematis L.

C. orientalis L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16801, 09.vii.2008.

C. viticella L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16802, 17.vi.2007.

C. cirrhosa L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16803, 08.iv.2007, Mediterranean Element.

Adonis L.

***A. annua* L.**

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16804, 08.iv.2007,
Mediterranean Element.

A. aestivalis* L. subsp. *aestivalis

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16805, 15.iv.2006.

***A. flammea* Jacq.**

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16806,
23.iv.2006.

Ranunculus L.

***R. dissectus* M.Bieb. var. *sibthorpii* P.H.Davis**

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16807,
17.vi.2006.

***R. neopolitanus* Ten.**

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16808, 11.v.2008.

***R. repens* L.**

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16809,
17.vi.2007.

***R. constantinopolitanus* (DC.) d'Urv.**

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16810,
28.v.2006.

***R. damascenus* Boiss. & Gaill.**

A3 Ankara: Tepeköy, N 40°04'781"-E 031°11'253", 1015m, OUFE: 16811, 11.v.2008,
Irano-Turanian Element.

R. illyricus* L. subsp. *illyricus

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16812,
17.vi.2007.

***R. cadmicus* Boiss.**

A3 Eskişehir: Enterence of Sarıyar dam area, N 40°03'315"-E 031°24'221", 377m, OUFÉ: 16813, 05.v.2006.

R. isthmicus Boiss. subsp. *stepporum* P.H.Davis

B3 Eskişehir: Exit of Mihalıççık, N 39°53'292"-E 031°28'154", 1465m, OUFÉ: 16814, 05.v.2006.

R. arvensis L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFÉ: 16815, 28.v.2006.

Ficaria Haller

F. verna Huds. subsp. *ficariiformis* (Rouy & Foucaud) B.Walln.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFÉ: 16816, 23.iv.2007.

Thalictrum L.

T. lucidum L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFÉ: 16817, 17.vi.2006.

T. flavum L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFÉ: 16818, 17.vi.2006.

PAEONIACEAE

Paeonia L.

P. arietina G.Anderson

B3 Eskişehir: Karanlıkdere, N 39°54'278"-E 031°19'214", 1537m, OUFÉ: 16819, 28.v.2006.

P. peregrina Mill.

B3 Eskişehir: Karanlıkdere, N 39°54'278"-E 031°19'214", 1537m, OUFÉ: 16820, 11.v.2008.

BERBERIDACEAE

Berberis L.

B. vulgaris L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16821, 18.v.2006.

B. crataegina DC.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16822, 01.v.2007.

PAPAVERACEAE

Chelidonium Tourn. ex L.

C. majus L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16823,
17.vi.2007, Euro-Siberian Element.

Glaucium Mill.

G. corniculatum (L.) Curtis subsp. *corniculatum*

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16824, 17.vi.2006.

G. flavum Crantz

A3 Eskişehir: Süleler, N 40°02'546"-E 031°13'565", 604m, OUFE: 16825, 28.v.2006.

Roemeria Medik.

R. hybrida (L.) DC. subsp. *hybrida*

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16826,
08.iv.2007.

Papaver L.

P. triniifolium Boiss.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16827,
17.vi.2006, Irano-Turanian Element, Endemic, (LC).

P. rhoeas L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16828, 01.v.2007.

P. dubium L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16829,
17.vi.2007.

P. hybridum L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16830, 27.v.2008.

Hypecoum L.

***H. procumbens* L.**

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16831, 28.v.2007, Mediterranean Element.

Corydalis Medik.

***C. cava* (L.) Schweigg. & Körte subsp. *marschalliana* (Willd.) Hayek**

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 16832, 19.v.2008.

C. solida* (L.) Clairv. subsp. *solida

A3 Ankara: Tepeköy, N 40°04'781"-E 031°11'253", 1015m, OUFE: 16833, 20.iv.2006.

Fumaria L.

***F. officinalis* L.**

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16834, 01.iv.2006.

***F. parviflora* Lam.**

A3 Eskişehir: Düzköy, N 40°05'504"-E 030°48'335", 261m, OUFE: 16835, 09.v.2006.

BRASSICACEAE

Brassica L.

***B. elongata* Ehrh.**

A3 Eskişehir: Mayıslar, N 40°01'360"-E 030°46'114", 596m, OUFE: 16836, 18.v.2007.

Sinapis L.

***S. arvensis* L.**

A3 Eskişehir: Laçın, N 40°01'413"-E 030°43'987", 697m, OUFE: 16837, 13.v.2006.

Diplotaxis DC.

***D. tenuifolia* (L.) DC.**

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16838, 01.iv.2006.

Eruca Mill.

E. vesicaria (L.) Cav.

A3 Eskişehir: Sarıyar dam area, N 40°03'315"-E 031°24'221", 160m, OUFE: 16839, 05.v.2006.

Raphanus L.

R. raphanistrum L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16840, 15.iv.2007.

Calepina Adans.

C. irregularis (Asso) Thell.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16841, 23.iv.2006.

Crambe L.

C. tataria Sebeok var. *tataria*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16842, 05.v.2006.

C. orientalis L. var. *orientalis*

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16843, 05.v.2006, Irano-Turanian Element.

Rapistrum Crantz

R. rugosum (L.) All.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16844, 18.v.2007.

Cakile Mill.

C. maritima Scop.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16845, 17.vi.2006.

Conringia Heist. ex Fabr.

C. orientalis (L.) Dumort.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16846,
08.iv.2007.

Lepidium L.

L. latifolium L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 16847,
01.v.2007.

L. draba L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16848, 01.v.2007.

Isatis L.

I. glauca Aucher ex Boiss. subsp. *glauca*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16849, 17.vi.2006,
Irano-Turanian Element.

I. floribunda Boiss. ex Bornm.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16850,
28.v.2007, Irano-Turanian Element, Endemic, (LC).

Iberis L.

I. simplex DC.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16851, 19.v.2008,
East Mediterranean Element.

I. carnosa Willd.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 16852, 27.v.2008,
East Mediterranean Element.

Aethionema W.T.Aiton

A. iberideum (Boiss.) Boiss.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 16853,
28.v.2007.

A. armenum Boiss.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16854, 08.iv.2007,
Irano-Turanian Element.

Thlaspi L.

***T. arvense* L.**

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16855,
23.iv.2006.

***T. perfoliatum* L.**

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16856,
05.iv.2006.

***T. lilacinum* Boiss. & A. Huet**

A3 Eskişehir: Sarıyar dam area, N 40°03'31.5"-E 031°24'22.1", 150m, OUFE: 16857,
23.iv.2007, Endemic, (LC).

Capsella Medik.

***C. bursa-pastoris* (L.) Medik.**

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16858,
17.vi.2006.

Boreava Jaub. & Spach

***B. orientalis* Jaub. & Spach**

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16859, 28.v.2006.

Neslia Desv.

***N. paniculata* (L.) Desv. subsp. *thracica* (Velen.) Bornm.**

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16860, 05.v.2006.

Fibigia Medik.

***F. clypeata* (L.) Medik.**

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16861, 09.v.2006.

Alyssum L.

A. desertorum* Stapf var. *desertorum

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16862,
28.v.2007.

***A. simplex* Rudolph**

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704"', 197m, OUFE: 16863, 17.vi.2006.

A. strigosum Banks & Sol. subsp. *strigosum*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379"', 303m, OUFE: 16864, 28.v.2006.

A. hirsutum M.Bieb.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279"', 223m, OUFE: 16865, 17.vi.2006.

A. trichostachyum Rupr.

A3 Eskişehir: Yalım kaya, N 40°00'463"-E 031°12'578"', 1333m, OUFE: 16866, 11.v.2008.

A. murale Waldst. & Kit. var. *murale*

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374"', 250m, OUFE: 16867, 01.v.2007.

A. floribundum Boiss.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704"', 197m, OUFE: 16868, 20.v.2007, Endemic, (LC).

A. sibiricum Willd.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975"', 299m, OUFE: 16869, 20.v.2007.

Draba L.

D. brunifolia Steven subsp. *olympica* (DC.) Coode & Cullen

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980"', 240m, OUFE: 16870, 08.iv.2007.

Erophila DC.

E. verna (L.) DC. subsp. *verna*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837"', 240m, OUFE: 16871, 08.iv.2007.

Arabis L.

A. alpina L. subsp. *caucasica* (Willd.) Briq.

A3 Ankara: Tepeköy, N 40°04'781"-E 031°11'253"', 1015m, OUFE: 16872, 01.v.2007.

Nasturtium R.Br.

N. officinale R.Br.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16873, 08.iv.2007.

Rorippa Scop.

R. sylvestris (L.) Besser

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16874, 18.viii.2008.

Aubrieta Adans.

A. deltoidea (L.) DC.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16875, 17.vi.2007.

Cardamine L.

C. bulbifera (L.) Crantz

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16876, 17.vi.2006, Euro-Siberian Element.

C. impatiens L. subsp. *pectinata* (Pall. ex DC.) Stoj. & Stef.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16877, 14.vii.2008, Euro-Siberian Element.

Matthiola R.Br.

M. longipetala (Vent.) DC. subsp. *bicornis* (Sm.) P.W.Ball

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16878, 19.v.2008.

Chorispora R.Br. ex DC.

C. purpurascens (Banks & Sol.) Eig

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16879, 19.v.2008, Irano-Turanian Element.

Hesperis L.

H. kotschy Boiss.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16880, 28.v.2007, Irano-Turanian Element, Endemic, (LC).

H. bicuspidata Poir.

B3 Eskişehir: Sorkun, N 39°58'207"-E 031°22'415", 962m, OUFE: 16881, 11.v.2008.

Malcolmia R.Br.

M. africana (L.) R.Br.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16882, 28.v.2006.

Alliaria Scop.

A. petiolata (M.Bieb.) Cavara & Grande

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16883, 11.v.2008.

Sisymbrium L.

S. altissimum L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16884, 15.iv.2006.

S. loeselii L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16885,
23.iv.2006.

Descurainia Webb & Berthel.

D. sophia (L.) Webb ex Prantl

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16886, 05.v.2006.

CAPPARACEAE

Capparis L.

C. sicula Duhamel

A3 Eskişehir: Sarıyar dam area, N 40°03'315"-E 031°24'221", 150m, OUFE: 16887,
17.vi.2006.

RESEDACEAE

Reseda L.

R. lutea L. var. *lutea*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16888,
01.v.2007.

R. luteola L.

A3 Eskişehir: Süleler, N 40°02'546"-E 031°13'565", 604m, OUFE: 16889, 20.vii.2008.

CISTACEAE

Cistus L.

C. creticus L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16890, 19.v.2008.

C. salviifolius L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16891, 28.v.2007.

C. laurifolius L.

A3 Ankara: Tekkeköy, N 40°08'585"-E 031°12'661", 993m, OUFE: 16892, 28.v.2007, Euro-Siberian Element.

Helianthemum Adans.

H. nummularium (L.) Mill. subsp. *lycaonicum* Coode & Cullen

A3 Ankara: Tekkeköy, N 40°08'585"-E 031°12'661", 993m, OUFE: 16893, 28.v.2006, Endemic, (LC).

H. oelandicum (L.) DC. subsp. *incanum* (Willk.) G.López

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16894, 17.vi.2007.

Fumana Spach

F. paphlagonica Bornm. & Janch.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16895, 14.vii.2008, Irano-Turanian Element.

F. laevis (Cav.) Pau

B3 Eskişehir: Bozan plantation area, N 39°47'265"-E 031°05'137", 878m, OUFE: 16896, 15.iv.2006, Mediterranean Element.

VIOLACEAE

Viola L.

V. odorata L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16897, 20.iv.2006.

V. occulta Lehm.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16898, 05.v.2006.

V. kitaibeliana Schult.

A3 Ankara: Tekkeköy, N 40°08'585"-E 031°12'661", 993m, OUFE: 16899,
23.iv.2007.

POLYGALACEAE

Polygala L.

P. supina Schreb.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16900, 17.vi.2006.

P. pruinosa Boiss. subsp. *pruinosa*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16901,
28.v.2006.

P. anatolica Boiss. & Heldr.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16902, 18.vii.2008.

PORTULACACEAE

Portulaca L.

P. oleracea L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16903,
20.vii.2008.

CARYOPHYLLACEAE

Arenaria L.

A. serpyllifolia L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16904, 19.v.2008.

Minuartia L.

M. hirsuta (M.Bieb.) Hand.-Mazz. subsp. *falcata* (Griseb.) Mattf.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16905,
17.vi.2006.

M. hamata (Hausskn.) Mattf.

A3 Eskişehir: Laçın, N 40°03'942''-E 030°45'810'', 306m, OUFE: 16906, 28.v.2007.

Stellaria L.

S. media (L.) Vill. subsp. *media*

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 16907, 19.v.2008.

S. holostea L.

A3 Eskişehir: İğdir, N 40°02'799''-E 030°39'704'', 197m, OUFE: 16908, 28.v.2007, Euro-Siberian Element.

Myosoton Moench

M. aquaticum (L.) Moench

A3 Ankara: Tekkeköy, N 40°08'585''-E 031°12'661'', 993m, OUFE: 16909, 17.vi.2006, Euro-Siberian Element.

Cerastium L.

C. banaticum (Rochel) Heuff.

A3 Eskişehir: Beyköy, N 40°05'745''-E 030°47'104'', 250m, OUFE: 16910, 18.vii.2008.

Holosteum Dill. ex L.

H. umbellatum L. var. *umbellatum*

A3 Eskişehir: Düzköy, N 40°05'880''-E 030°50'374'', 250m, OUFE: 16911, 08.iv.2007.

Moenchia Ehrh.

M. mantica (L.) Bartl. subsp. *mantica*

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 16912, 08.iv.2007.

Dianthus L.

D. crinitus Sm. var. *crinitus*

A3 Ankara: Hıdırlar, N 40°03'569''-E 031°25'353'', 613m, OUFE: 16913, 17.vi.2006.

D. erinaceus Boiss. var. *alpinus* Boiss.

A3 Eskişehir: İğdir, N 40°02'799''-E 030°39'704'', 197m, OUFE: 16914, 09.vii.2008, Endemic, (VU).

D. zonatus Fenzl var. *zonatus*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16915, 20.vii.2008.

D. cruentus Griseb.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16916, 04.vi.2006.

D. lydus Boiss.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16917, 17.vi.2007, Endemic, (LC).

Vaccaria Medik.

V. hispanica (Mill.) Rauschert

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16918, 12.iv.2006.

Saponaria L.

S. glutinosa M.Bieb.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16919, 20.v.2007.

S. kotschyi Boiss.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16920, 20.viii.2007, Endemic, (LC).

Gypsophila L.

G. viscosa Murray

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16921, 19.v.2008, Irano-Turanian Element.

G. pilosa Huds.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 16922, 11.v.2008, Irano-Turanian Element.

Petrorhagia (Ser.) Link

P. alpina (Hablitz) P.W.Ball & Heywood subsp. ***olympica*** (Boiss.) P.W.Ball & Heywood

A3 Eskişehir: Gökçekaya dam lake, N 40°03'332''-E 031°14'545'', 382m, OUFE: 16923, 14.vii.2008.

Silene L.

S. italica (L.) Pers.

A3 Eskişehir: Beyköy, N 40°04'994''-E 030°45'980'', 240m, OUFE: 16924, 17.vi.2006.

S. cappadocica Boiss. & Heldr.

A3 Ankara: Hıdırlar, N 40°03'569''-E 031°25'353'', 613m, OUFE: 16925, 17.vi.2006, Irano-Turanian Element.

S. conoidea L.

A3 Eskişehir: Beyköy, N 40°05'745''-E 030°47'104'', 250m, OUFE: 16926, 04.vi.2006.

S. pruinosa Boiss.

B3 Eskişehir: Sorkun, N 39°58'207''-E 031°22'415'', 962m, OUFE: 16927, 28.v.2006.

S. vulgaris (Moench) Garcke var. *vulgaris*

A3 Ankara: Tekkeköy, N 40°08'585''-E 031°12'661'', 993m, OUFE: 16928, 20.vii.2008.

S. compacta Fisch.

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 16929, 20.vii.2008.

S. latifolia Poir. subsp. *latifolia*

A3 Ankara: Yenice, N 40°04'183''-E 030°54'666'', 537m, OUFE: 16930, 17.vi.2006.

S. dichotoma Ehrh. subsp. *dichotoma*

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 16931, 28.v.2006.

S. gallica L.

A3 Eskişehir: İğdir, N 40°02'799''-E 030°39'704'', 197m, OUFE: 16932, 18.v.2006.

S. conica L. subsp. *subconica* (Friv.) Gavioli

A3 Eskişehir: Laçın, N 40°03'942''-E 030°45'810'', 306m, OUFE: 16933, 14.vii.2008.

S. coronaria (Desr.) Clairv. ex Rchb.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16934,
20.vii.2008, Euro-Siberian Element.

Agrostemma L.

A. githago L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16935, 11.v.2008.

Herniaria L.

H. incana Lam.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16936,
17.vi.2007.

Paronychia Mill.

P. kurdica Boiss. subsp. *kurdica* var. *kurdica*

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 16937, 04.vi.2006.

POLYGONACEAE

Persicaria (L.) Mill.

P. bistorta (L.) Samp.

A3 Ankara: Tekkeköy, N 40°08'585"- E 031°12'661", 993m, OUFE: 16938,
20.vii.2008, Euro-Siberian Element.

P. amphibia (L.) Delarbre

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 16939,
09.vii.2008.

P. lapathifolia (L.) Delarbre

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16940,
04.viii.2006.

Polygonum L.

P. cognatum Meisn.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16941,
16.viii.2006.

***P. aviculare* L.**

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16942, 20.vii.2008.

Rumex L.

***R. acetosella* L.**

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16943,
17.vi.2006.

***R. scutatus* L.**

A3 Eskişehir: Yalınkaya, N 40°00'463"-E 031°12'578", 1333m, OUFE: 16944,
20.vii.2008.

R. tuberosus* L. subsp. *tuberosus

A3 Ankara: Tekkeköy, N 40°08'585"-E 031°12'661", 993m, OUFE: 16945, 13.v.2006.

***R. crispus* L.**

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16946, 28.v.2006.

AMARANTHACEAE

Beta L.

***B. vulgaris* L.**

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16947, 14.vii.2008.

Dysphania R.Br.

***D. botrys* (L.) Mosyakin & Clemants**

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16948, 28.v.2007.

Chenopodium L.

***C. foliosum* Asch.**

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16949,
17.vi.2006.

***C. murale* L.**

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16950,
12.iv.2006.

C. album* L. subsp. *album* var. *album

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16951, 20.vii.2008.

Atriplex L.

A. hortensis L.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 16952, 17.vi.2006.

Bassia All.

B. scoparia (L.) A.J.Scott

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16953, 17.vi.2006.

Noaea Moq.

N. mucronata (Forssk.) Asch. & Schweinf. subsp. *mucronata*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16954, 11.v.2008.

Amaranthus L.

A. retroflexus L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16955, 04.vi.2007.

A. blitoides S.Watson

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16956, 18.v.2006.

TAMARICACEAE

Tamarix L.

T. smyrnensis Bunge

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16957, 17.vi.2007.

HYPERICACEAE

Hypericum L.

H. perforatum Boiss.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16958, 13.v.2007, Mediterranean Element.

H. montbretii Spach

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16959, 18.v.2006.

H. organifolium Willd.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16960, 28.v.2007.

H. aviculariifolium Jaub. & Spach subsp. *depilatum* var. *depilatum*

B3 Eskişehir: Mihallıçık, N 39°54'032"-E 031°26'564", 1558m, OUFE: 16961, 20.vii.2008, Irano-Turanian Element, Endemic, (LC).

H. perforatum L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16962, 09.v.2006.

MALVACEAE

Hibiscus L.

H. trionum L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16963, 16.viii.2006.

Malva L.

M. sylvestris L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16964, 04.viii.2007.

M. neglecta Wallr.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16965, 14.vii.2008.

Lavatera L.

L. punctata All.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 16966, 20.vii.2008.

Alcea L.

A. apterocarpa Boiss.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16967, 28.v.2007, Irano-Turanian Element, Endemic, (LC).

A. pallida (Willd.) Waldst. & Kit.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16968, 19.v.2008.

A. rosea L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16969, 14.vii.2008.

Althaea L.

A. cannabina L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16970, 20.vii.2008.

A. officinalis L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16971, 14.vii.2008.

A. hirsuta L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16972, 28.v.2007.

TILIACEAE

Tilia L.

T. rubra DC. subsp. *caucasica* (Rupr.) V.Engl.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16973, 20.vii.2008, Mediterranean Element.

LINACEAE

Linum L.

L. cariense Boiss.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16974, 17.vi.2006, Irano-Turanian Element, Endemic, (LC).

L. nodiflorum L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16975, 13.v.2006, Mediterranean Element.

L. hirsutum L. subsp. *anatolicum* (Boiss.) Hayek var. *anatolicum*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16976, 13.v.2006, Irano-Turanian Element.

L. hirsutum L. subsp. *pseudoanatolicum* P.H.Davis

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16977,
17.vi.2006, Irano-Turanian Element, Endemic, (LC).

L. tenuifolium L.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 16978, 04.vi.2007.

L. bienne Mill.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16979, 19.v.2008,
Mediterranean Element.

GERANIACEAE

Geranium L.

G. lucidum L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16980, 15.iv.2006.

G. robertianum L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 16981, 18.v.2006.

G. rotundifolium L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16982,
01.iv.2007.

G. dissectum L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16983, 15.iv.2006.

G. tuberosum L. subsp. *tuberosum*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16984, 13.v.2006.

G. pyrenaicum Burm.f.

A3 Ankara: Hıdırlar, N 40°04'201"-E 031°25'102", 596m, OUFE: 16985, 17.vi.2007.

Erodium L'Hér.

E. ciconium (L.) L'Hér.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16986,
13.v.2006.

E. cicutarium (L.) L'Hér. subsp. *cicutarium*

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 16987, 12.iv.2007.

Pelargonium L'Her. ex Aiton

P. endlicherianum Fenzl

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 16988,
08.iv.2007.

ZYGOPHYLLACEAE

Zygophyllum L.

Z. fabago L.

A3 Ankara: Sarıyar dam, N 40°03'052"-E 031°27'017", 664m, OUFE: 16989,
28.v.2007, Irano-Turanian Element.

NITRARIACEAE

Peganum L.

P. harmala L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16990, 18.v.2006.

RUTACEAE

Ruta L.

R. thesioides Fisch. ex DC.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16991, 09.v.2006.

Haplophyllum A.Juss.

H. myrtifolium Boiss.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16992, 19.v.2008,
Irano-Turanian Element, Endemic, (LC).

SIMAROUBACEAE

Ailanthus Desf.

A. altissima (Mill.) Swingle

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 16993, 28.v.2007.

SAPINDACEAE

Acer L.

A. tataricum L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 16994,
04.vi.2007.

A. campestre L. subsp. *campestre*

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 16995, 28.v.2007.

VITACEAE

Vitis L.

V. sylvestris C.C.Gmel.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 16996, 18.v.2006.

RHAMNACEAE

Paliurus Mill.

P. spina-christi Mill.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 16997,
28.v.2007.

Frangula Mill.

F. dodonei Ard.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 16998, 17.vi.2006,
Euro-Siberian Element.

AQUIFOLIACEAE

Ilex L.

I. colchica Pojark.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 16999, 04.vi.2006,
Mediterranean Element.

ANACARDIACEAE

Rhus L.

R. coriaria L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17000,
09.vii.2008.

Pistacia L.

P. atlantica Desf.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17001,
15.iv.2006.

P. vera L.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17002, 20.iv.2006,
Irano-Turanian Element.

P. terebinthus L. subsp. *palaestina* (Boiss.) Engler

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17003,
08.iv.2007, East Mediterranean Element.

CELASTRACEAE

Euonymus L.

E. verrucosus Scop.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17004, 28.v.2007.

FABACEAE

Sophora L.

S. alopecuroides L. var. *alopecuroides*

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17005, 28.v.2006.

Cytisus L.

C. hirsutus L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17006, 13.v.2006.

C. austriacus L. subsp. *pygmaeus* (Willd.) Briq.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17007, 19.v.2008,
Euro-Siberian Element.

Gonocytisus Spach

G. angulatus (L.) Spach

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17008, 20.vii.2008,
East Mediterranean Element.

Genista L.

G. tinctoria L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17009, 13.v.2007, Euro-Siberian Element.

G. lydia Boiss. var. *lydia*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17010, 19.v.2008.

G. carinalis Griseb.

A3 Ankara: Hıdırlar, N 40°03'569"-E 031°25'353", 613m, OUFE: 17011, 17.vi.2006.

Lotononis (DC.) Eckl. & Zeyh.

L. genistoides (Fenzl) Benth.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17012, 20.vii.2008, Irano-Turanian Element.

Robinia L.

R. pseudoacacia L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17013, 20.iv.2006.

Galega L.

G. officinalis L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240 m, OUFE: 17014, 17.vi.2006, Euro-Siberian Element.

Colutea L.

C. cilicica Boiss. & Balansa

B3 Eskişehir: Alpu-Gökçekaya road, N 39°52'498"-E 030°58'398", 855m, OUFE: 17015, 04.viii.2006.

Astragalus L.

A. glycyphyllos L. subsp. *glycyphyllos*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17016, 12.iv.2006, Euro-Siberian Element.

A. melanophrurius Boiss.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17017, 17.vi.2006, Irano-Turanian Element, Endemic, (LC).

A. stereocalyx Bornm.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17018, 04.vi.2006, Irano-Turanian Element, Endemic, (LC).

A. ponticus Pall.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17019, 17.vi.2006.

A. macrocephalus Willd. subsp. *macrocephalus*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17020, 20.vii.2008, Irano-Turanian Element, Endemic, (LC).

A. hololeucooides (Boiss.) Podl. & Sytin

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17021, 04.vi.2006, Endemic, (LC).

A. hirsutus Vahl

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17022, 20.vii.2008, Endemic, (LC).

A. campylosema Boiss. subsp. *campylosema*

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17023, 13.v.2007, Irano-Turanian Element, Endemic, (LC).

A. angustifolius Lam. subsp. *pungens* (Willd.) Hayek

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17024, 17.vi.2006.

A. vulnerariae DC.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17025, 17.vi.2006, Endemic, (LC).

Bituminaria C.H.Stirt.

B. bituminosa (L.) C.H.Stirt.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17026, 11.v.2008, Mediterranean Element.

Vicia L.

V. cracca L. subsp. *stenophylla* Velen.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17027, 28.v.2007.

V. hybrida L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17028, 01.iv.2006.

V. pannonica Crantz var. *purpurescens* Ser.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17029, 15.iv.2006.

V. sativa L. subsp. *sativa*

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17030, 20.iv.2006.

V. faba L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17031, 15.iv.2007.

Lathyrus L.

L. aureus (Steven) D.Brandza

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17032, 19.v.2008, Mediterranean Element.

L. digitatus (M.Bieb.) Fiori

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17033, 17.vi.2006, Mediterranean Element.

L. pratensis L.

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFE: 17034, 12.iv.2006.

L. laxiflorus (Desf.) Kuntze *laxiflorus*

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17035, 14.vii.2008.

L. cicera L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17036, 01.iv.2006.

Pisum L.

***P. sativum* L.**

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17037, 28.v.2007.

Ononis L.

***O. pusilla* L.**

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17038, 28.v.2007.

***O. spinosa* L. subsp. *hircina* (Jacq.) Gams**

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17039, 20.vii.2008, Euro-Siberian Element.

***O. spinosa* L. subsp. *leiosperma* (Boiss.) Sirj.**

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFE: 17040, 17.vi.2006.

Trifolium L.

T. repens* L. var. *repens

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17041, 11.v.2008.

T. hybridum* L. var. *hybridum

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17042, 18.v.2006.

***T. campestre* Schreb.**

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17043, 09.v.2007.

T. resupinatum* L. var. *resupinatum

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17044, 18.v.2006.

T. medium* L. var. *medium

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17045, 13.v.2006.

T. pratense* L. var. *pratense

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17046, 19.v.2008.

T. ochroleucon Huds.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFÉ: 17047, 25.vii.2008.

T. pannonicum Jacq. subsp. *elongatum* (Willd.) Zohary

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFÉ: 17048, 16.viii.2006.

T. hirtum All.

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFÉ: 17049, 01.v.2007.

T. arvense L. var. *arvense*

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFÉ: 17050, 08.iv.2007.

T. echinatum M.Bieb.

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFÉ: 17051, 08.iv.2007, East Mediterranean Element.

Melilotus Mill.

M. officinalis (L.) Pall.

A3 Eskişehir: South of Laçın, N 40°01'049"-E 030°45'403", 639m, OUFÉ: 17052, 28.v.2007.

M. albus Desr.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFÉ: 17053, 20.vii.2008.

Trigonella L.

T. cretica (L.) Boiss.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFÉ: 17054, 13.v.2007, West Mediterranean Element, Endemic, (nt).

T. spruneriana Boiss. var. *spruneriana*

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFÉ: 17055, 01.v.2007, Irano-Turanian Element.

Medicago L.

M. lupulina L.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17056, 28.v.2006.

M. sativa L. subsp. *sativa*

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFE: 17057, 28.v.2006.

M. falcata L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17058, 13.v.2006.

M. rigidula (L.) All.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17059, 11.v.2008.

Dorycnium Mill.

D. graecum (L.) Ser

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17060, 13.v.2006, Mediterranean Element.

D. pentaphyllum Scop. subsp. *anatolicum* (Boiss.) Gams

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17061, 09.v.2007.

Lotus L.

L. corniculatus L. var. *corniculatus*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17062, 20.vii.2007.

L. alpinus (DC.) Ramond

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17063, 20.vii.2007.

L. aegaeus (Griseb.) Boiss.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17064, 05.v.2006.

L. maritimus L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17065, 04.vi.2006.

Coronilla L.

C. scorpioides (L.) Koch

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17066,
01.iv.2006.

Securigera DC.

S. varia (L.) Lassen.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17067,
28.v.2007.

Hedysarum L.

H. varium Willd.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17068,
17.vi.2006, Irano-Turanian Element.

H. cappadocicum Boiss

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17069, 13.v.2007,
Irano-Turanian Element, Endemic, (LC).

Onobrychis Mill.

O. caput-galli (L.) Lam.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17070,
13.v.2006, Mediterranean Element.

O. armena Boiss. & HUET

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17071,
17.vi.2006, Endemic, (LC).

O. oxydonta Boiss.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17072, 25.vii.2008.

O. argyrea Boiss. subsp. ***argyrea***

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17073,
17.vi.2006, Irano-Turanian Element, Endemic, (LC).

O. hypargyrea Boiss.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17074, 11.v.2008.

Ebenus Kuntze

E. hirsuta Jaub. & Spach

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17075, 20.vii.2008, Irano-Turanian Element, Endemic, (LC).

Alhagi Tourn. ex Adans.

A. pseudalhagi (M. Bieb.) Desv. ex B. Keller & Shap.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17076, 04.viii.2006, Irano-Turanian Element.

ROSACEAE

Prunus L.

P. spinosa L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17077, 15.iv.2007, Euro-Siberian Element.

P. amygdalus Batsch

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17078, 01.iv.2006.

Cerasus Mill.

C. avium (L.) Moench

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFE: 17079, 23.iv.2006.

Amygdalus L.

A. webbii Spach

A3 Eskişehir: Gökçekaya dam, N 40°01'496"-E 030°59'347", 290m, OUFE: 17080, 08.iv.2007, West Mediterranean Element.

A. orientalis Mill.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17081, 19.v.2008, Irano-Turanian Element.

Filipendula Mill.

F. vulgaris Moench

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17082, 19.v.2008, Euro-Siberian Element.

Rubus L.

R. ulmifolius Schott subsp. *sanctus* (Schreb.) Sudre

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17083, 20.vii.2008.

R. tomentosus Borkh. var. *canescens* (DC.) Wirtg.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17084, 04.vi.2006.

Potentilla L.

P. recta L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17085, 20.v.2007.

P. reptans L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17086, 17.vi.2006.

Fragaria L.

F. vesca L.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17087, 05.v.2006.

Geum L.

G. urbanum L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17088, 17.vi.2006, Euro-Siberian Element.

Agrimonia L.

A. eupatoria L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17089, 20.vii.2008.

Sanguisorba L.

S. minor Scop. subsp. *muricata* Briq.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17090, 12.iv.2006.

Rosa L.

R. foetida Herrm.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17091, 11.v.2008,
Irano-Turanian Element.

R. pulverulenta M. Bieb.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17092, 28.v.2007.

R. turcica Rouy

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17093, 28.v.2007.

R. canina L.

A3 Ankara: Emremsultan, N 40°04'070"-E 031°23'435", 399m, OUFE: 17094,
17.vi.2006.

Crataegus L.

C. orientalis Pall. ex Bieb. var. *orientalis*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17095, 19.v.2008.

C. microphylla C. Koch

A3 Ankara: Emremsultan, N 40°04'070"-E 031°23'435", 399m, OUFE: 17096,
20.v.2007, East Mediterranean Element.

Cormus Spach

C. domestica (L.) Spach

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17097, 19.v.2008.

Sorbus L.

S. umbellata (Desf.) Fritsch

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17098, 17.vi.2006,
Irano-Turanian Element.

Cydonia Mill.

C. oblonga Mill.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17099, 13.v.2007.

Malus Mill.

M. domestica Borkh.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17100, 11.v.2008.

LYTRACEAE

Lythrum L.

L. salicaria L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17101,
25.vii.2008.

ONAGRACEAE

Epilobium L.

E. angustifolium L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17102,
20.vii.2008.

E. hirsutum L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17103, 04.viii.2006.

E. parviflorum Schreb.

A3 Ankara: Hıdırlar, N 40°03'569"-E 031°25'353", 613m, OUFE: 17104, 04.vii.2006.

CUCURBITACEAE

Ecballium A.Rich.

E. elaterium (L.) A.Rich.

A3 Ankara: Emremsultan, N 40°04'070"-E 031°23'435", 399m, OUFE: 17105,
20.v.2007, Mediterranean Element.

CACTACEAE

Opuntia Mill.

O. ficus-indica (L.) Mill.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17106,
17.vi.2007.

CRASSULARIACEAE

Umbilicus DC.

U. luteus (Huds.) Webb & Berthel.

A3 Eskişehir: Kapıkaya, N 40°04'241''-E 030°44'279'', 223m, OUFE: 17107,
25.vii.2008.

Sedum L.

S. acre L.

A3 Eskişehir: İğdir, N 40°02'799''-E 030°39'704'', 197m, OUFE: 17108, 17.vi.2006.

S. album L.

A3 Eskişehir: Beyköy, N 40°05'745''-E 030°47'104'', 250m, OUFE: 17109,
20.vii.2008.

S. pallidum M.Bieb. var. *pallidum*

A3 Eskişehir: Düzköy, N 40°05'880''-E 030°50'374'', 250m, OUFE: 17110,
25.vii.2008.

CELASTRACEAE

Parnassia L.

P. palustris L.

B3 Eskişehir: Alpu-Gökçekaya road, N 39°52'498''-E 030°58'398'', 855m, OUFE:
17111, 16.viii.2006.

APIACEAE

Sanicula L.

S. elata Buch.-Ham. ex D. Don

B3 Eskişehir: Bozan plantation area, N 39°49'707''-E 031°08'542'', 835m, OUFE:
17112, 20.vii.2008.

Astrantia L.

A. maxima Pall. subsp. *maxima*

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17113, 04.vi.2006,
Mediterranean Element.

A. maxima Pall. var. *haradjianii* (Grintz) Rech. fil.

B3 Eskişehir: Mihalliçık, N 39°54'032''-E 031°26'564'', 1558m, OUFE: 17114,
20.vii.2008, Endemic.

Eryngium L.

E. giganteum M.Bieb.

A3 Ankara: Emremsultan, N 40°04'070"-E 031°23'435", 399m, OUFE: 17115,
17.vi.2006, Mediterranean Element.

E.creticum Lam.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17116, 04.viii.2007.

E. bithynicum Boiss.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17117,
04.viii.2006, Irano-Turanian Element, Endemic, (LC).

E. campestre L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17118,
16.viii.2006.

Echinophora L.

E. tenuifolia L. subsp. *sibthorpiana* (Guss.) Tutin

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17119, 04.viii.2006,
Irano-Turanian Element.

E. tournefortii Jaub. & Spach subsp. *sibhorbtianum*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17120, 20.vii.2008,
Irano-Turanian Element.

Physocaulis Tausch

P. nodosus Koch

A3 Ankara: Hıdırlar, N 40°04'201"-E 031°25'102", 596m, OUFE: 17121, 17.vi.2007.

Chaerophyllum L.

C. byzantinum Boiss.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17122,
08.iv.2007, Euro-Siberian.

Anthriscus Pers.

A. nemorosa (M.Bieb.) Spreng.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17123, 18.v.2006.

A. sylvestris (L.) Hoffm.

A3 Ankara: Emremsultan, N 40°04'070"-E 031°23'435", 399m, OUFE: 17124,
17.vi.2006.

Smyrniium L.

S. perfoliatum L.

A3 Ankara: Hıdırlar, N 40°03'569"-E 031°25'353", 616m, OUFE: 17125, 28.v.2006.

S. rotundifolium Mill.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17126, 13.v.2006,
East Mediterranean Element.

Bunium L.

B. microcarpum (Boiss.) Freyn & Bornm. subsp. *bourgaei* (Boiss.) Hedge & Lamond

B3 Eskişehir: Mihallıççık, N 39°54'032"-E 031°26'564", 1558m, OUFE: 17127,
25.vii.2008.

Scandix L.

S. australis L. subsp. *australis*

B3 Eskişehir: Gürleyik, N 39°59'306"-E 031°20'322", 699m, OUFE: 17128,
08.iv.2007.

S. grandiflora L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17129,
15.iv.2007.

S. iberica M.Bieb.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17130,
28.v.2007.

S. pecten-veneris L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17131,
09.v.2006.

Bifora Hoffm.

B. testiculata (L.) Roth

A3 Ankara: Osmanköy, N 40°05'143"-E 030°52'462", 306m, OUFE: 17132, 08.iv.2007.

B. radians M.Bieb.

A3 Ankara: Yenice, N 40°04'183"-E 030°54'666", 537m, OUFE: 17133, 12.iv.2006.

Pimpinella L.

P. lithophila Schischk.

A3 Eskişehir: Alpu–Gökçekaya dam area, N 40°01'496"-E 030°59'347", 290m, OUFE: 17134, 04.viii.2006.

P. polyclada Boiss. & Heldr.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17135, 17.vi.2006.

P. saxifraga L.

A3 Eskişehir: Sarıyar dam lake, N 40°03'270"-E 031°13'463", 385m, OUFE: 17136, 20.vii.2008.

P. anthriscoides Boiss. var. *anthriscoides*

A3 Ankara: Hıdırlar, N 40°03'569"-E 031°25'353", 613m, OUFE: 17137, 17.vi.2007, Irano-Turanian Element.

P. anthriscoides Boiss. var. *cruciata* (Bornm. & Wolff) Matthews

A3 Ankara: Hıdırlar, N 40°04'201"-E 031°25'102", 596m, OUFE: 17138, 04.vi.2006, Endemic, (nt).

Sium L.

S. lancifolium M.Bieb.

A3 Eskişehir: Sarıyar dam lake, N 40°03'270"-E 031°13'463", 385m, OUFE: 17139, 20.vii.2008.

Berula W.D.J.Koch

B. erecta (Huds.) Coville

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFE: 17140, 17.vi.2006.

Oenanthe L.

O. pimpinelloides L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17141,
04.vi.2006.

O. silaifolia M. Bieb.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17142, 13.v.2006.

O. sophiae Schischk.

A3 Ankara: Hıdırlar, N 40°04'201"-E 031°25'102", 596m, OUFE: 17143, 17.vi.2007.

Foeniculum Mill.

F. vulgare Mill.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17144,
17.vi.2006.

Anethum L.

A. graveolens L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17145, 17.vi.2006.

Conium L.

C. maculatum L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17146, 19.v.2008.

Hohenackeria Fisch. & C.A.Mey.

H. exscapa (Steven) Grande

A3 Eskişehir: Dağküplü, N 40°00'181"-E 030°40'265", 485m, OUFE: 17147,
19.v.2008.

Bupleurum L.

B. rotundifolium L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17148,
25.vii.2008.

B. croceum Fenzl

A3 Eskişehir: Örencik district, N 40°06'488"-E 030°47'141", 288m, OUFE: 17149,
19.v.2008, Irano-Turanian Element.

B. turcicum Snogerup

B3 Eskişehir: Mihallıççık, N 39°54'032"-E 031°26'564", 1558m, OUFE: 17150, 20.vii.2008, Irano-Turanian Element, Endemic, (LC).

Apium L.

A. nodiflorum (L.) Lag.

A3 Eskişehir: Sarıyar dam lake, N 40°03'270"-E 031°13'463", 385m, OUFE: 17151, 25.vii.2008.

Falcaria Fabr.

F. vulgaris Bernh.

A3 Eskişehir: Sarıyar dam lake, N 40°03'270"-E 031°13'463", 385m, OUFE: 17152, 20.vii.2008.

Ferula L.

F. parva Freyn & Bornm.

B3 Eskişehir: Eskişehir-Kaymaz road, Mihallıççık turn, N 39°32'140"-E 031°04'530", 915m, OUFE: 17153, 08.viii.2006, Endemic (VU).

Ferulago W.D.J.Koch

F. macrosciadea Boiss. & Balansa

A3 Ankara: Sarıyar dam, N 40°03'052"-E 031°27'017", 664m, OUFE: 17154, 28.v.2007, East Mediterranean Element, Endemic, (LC).

F. aucheri Boiss.

B3 Eskişehir: Yarımcı, N 39°53'534"-E 030°37'421", 1188m, OUFE: 17155, 17.vi.2006, Endemic, (LC).

Peucedanum L.

P. obtusifolium Sm.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17156, 16.viii.2006.

Pastinaca L.

P. sativa L. subsp. *urens* Čelak.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17157, 04.viii.2006.

Heracleum L.

H. ternatum Velen.

A3 Eskişehir: Düzköy, N 40°05'504"-E 030°48'335", 261m, OUFE: 17158, 13.v.2007, Euro-Siberian Element.

H. platytaenium Boiss.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17159, 12.iv.2006, Endemic, (LC).

Tordylium Tourn. ex L.

T. apulum L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17160, 13.v.2006, Mediterranean Element.

T. maximum L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17161, 11.v.2008.

T. aegaeum Runemark

A3 Eskişehir: İğdir, N 40°03'094"-E 030°41'040", 220m, OUFE: 17162, 11.v.2008, East Mediterranean Element.

Laser Borkh. ex G.Gaertn., B.Mey. & Scherb.

L. trilobum Borkh. ex P.Gaertn., B.Mey. & Scherb.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17163, 19.v.2008.

Torilis Adans.

T. arvensis (Huds.) Link subsp. *arvensis*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17164, 17.vi.2006.

T. neglecta Schult.

B3 Eskişehir: Yarımca, N 39°53'534"-E 030°37'421", 1188m, OUFE: 17165, 04.vi.2007.

T. leptophylla (L.) Rchb. f.

B3 Eskişehir: Karanlıkdere, N 39°54'205"-E 031°20'449", 1707m, OUFE: 17166, 28.v.2006.

Caucalis L.

C. platycarpus L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17167,
25.vii.2008.

Turgenia Hoffm.

T. latifolia (L.) Hoffm.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17168, 19.v.2008.

Orlaya Hoffm.

O. daucooides Greuter

A3 Eskişehir: Mayıslar-Laçın road, N 40°01'416"-E 030°44'403", 779m, OUFE:
17169, 28.v.2007.

Daucus L.

D. carota L.

B3 Eskişehir: Mihalliççık, N 39°54'032"-E 031°26'564", 1558m, OUFE: 17170,
25.vii.2008.

D. broteroi Ten.

B3 Eskişehir: Alpu-Gökçekaya road, N 39°52'498"-E 030°58'398", 855m, OUFE:
17171, 16.viii.2006, Mediterranean Element.

Artemisia L.

A. squamata L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17172, 28.v.2006.

Opopanax W.D.J.Koch

O. hispidus Griseb.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17173,
18.v.2006.

ARALIACEAE

Hedera L.

H. helix L.

B3 Eskişehir: Alpu-Gökçekaya road, N 39°52'498''-E 030°58'398'', 855m, OUFE: 17174, 04.viii.2006.

CORNACEAE

Cornus L.

C. sanguinea L. subsp. *australis* (C.A.Mey.) Jáv.

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 17175, 13.v.2006.

C. mas L.

A3 Eskişehir: Kapıkaya, N 40°04'241''-E 030°44'279'', 223m, OUFE: 17176, 08.iv.2007.

ADOXACEAE

Sambucus L.

S. nigra L.

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17177, 13.v.2007, Euro-Siberian Element.

Viburnum L.

V. opulus L.

A3 Eskişehir: Düzköy, N 40°05'231''-E 030°47'975'', 299m, OUFE: 17178, Euro-Siberian Element, 13.v.2006.

CAPRIFOLIACEAE

Lonicera L.

L. orientalis Lam.

A3 Eskişehir: Beyköy, N 40°04'994''-E 030°45'980'', 240m, OUFE: 17179, 04.vi.2006, Endemic, (LC).

L. etrusca Santi var. *etrusca*

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 17180, 11.v.2008, Mediterranean Element.

Valeriana L.

V. officinalis L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704"', 197m, OUFE: 17181, 17.vi.2006.

V. dioscoridis Sm.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374"', 250m, OUFE: 17182, 01.iv.2006, East Mediterranean Element.

Centranthus DC.

C. longiflorus Steven

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837"', 240m, OUFE: 17183, 13.v.2006, Irano-Turanian Element.

C. calcitrapa (L.) Dufr.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104"', 250m, OUFE: 17184, 13.v.2007, Mediterranean Element.

Valerianella Mill.

V. carinata Loisel.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837"', 240m, OUFE: 17185, 09.v.2006.

v. coronata DC.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379"', 303m, OUFE: 17186, 17.vi.2006.

Morina L.

M. persica L. var. **persica**

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837"', 240m, OUFE: 17187, Irano-Turanian Element, 17.vi.2006.

Dipsacus L.

D. laciniatus L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704"', 197m, OUFE: 17188, 16.viii.2006.

Cephalaria Schrad.

C. transsylvanica (L.) Schrad. ex Roem. & Schult.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975"', 299m, OUFE: 17189, 20.vii.2008.

Scabiosa L.

S. argentea L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17190,
24.vii.2008.

COMPOSITAE

Bidens L.

B. tripartita L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17191,
04.viii.2006.

Xanthium L.

X. spinosum L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17192,
16.viii.2006.

X. strumarium L. subsp. *strumarium*

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17193,
16.vii.2008.

Pallenis Cass.

P. spinosa (L.) Cass.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17194,
17.vi.2007, Mediterranean Element.

Inula L.

I. montbretiana DC.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17195, 04.vi.2006,
Irano-Turanian Element.

Dittrichia Greuter

D. viscosa (L.) Greuter

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17196, 04.viii.2006,
Mediterranean Element.

Pulicaria Gaertn.

P. dysenterica (L.) Bernh.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17197, 16.viii.2006.

Helichrysum Mill.

H. aucheri Boiss.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17198, 04.vi.2006, Irano-Turanian Element.

Filago L.

F. vulgaris Lam.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17199, 13.v.2006.

F. eriocephala Guss.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17200, 19.v.2008.

F. pyramidata L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17201, 11.v.2008.

F. arvensis L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17202, 28.v.2007.

Solidago L.

S. virgaurea L. subsp. *virgaurea*

B3 Eskişehir: Gürleyik, N 39°59'395"-E 031°20'315", 660m, OUFE: 17203, 16.viii.2006.

Erigeron L.

E. acer L. subsp. *acer*

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17204, 25.vii.2008.

E. acer L. subsp. *pycnotrichus*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17205, 20.vii.2008, Euro-Siberian Element.

Conyza Less.

C. canadensis (L.) Cronquist

A3 Eskişehir: Kapıkaya, N 40°04'241''-E 030°44'279'', 223m, OUFE: 17206,
16.viii.2007.

Bellis L.

B. perennis L.

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17207, 28.v.2006,
Euro-Siberian Element.

Doronicum L.

D. orientale Hoffm.

A3 Eskişehir: Düzköy, N 40°05'880''-E 030°50'374'', 250m, OUFE: 17208, 28.v.2007.

D. bithynicum J. R. Edmondson subsp. bithynicum

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 17209,
28.v.2007, Mediterranean Element, Endemic, (LC).

Senecio L.

S. aquaticus Hill subsp. barbareaifolius (Wimm. & Grab.) Walters

A3 Ankara: Osmanköy, N 40°04'312''-E 030°58'488'', 827m, OUFE: 17210,
25.vii.2008, Euro-Siberian Element.

S. leucanthemifolius Poir. subsp. vernalis (Waldst. & Kit.) Greuter

A3 Eskişehir: İğdir, N 40°02'799''-E 030°39'704'', 197m, OUFE: 17211, 19.v.2008.

Tussilago L.

T. farfara L.

A3 Eskişehir: Beyköy, N 40°04'994''-E 030°45'980'', 240m, OUFE: 17212,
08.iv.2007, Euro-Siberian Element.

Calendula L.

C. officinalis L.

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17213, 18.v.2006.

C. arvensis (Vaill.) L.

A3 Eskişehir: İğdir, N 40°02'799''-E 030°39'704'', 197m, OUFE: 17214, 19.v.2008.

Eupatorium L.

E. cannabinum L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17215,
04.viii.2006, Euro-Siberian Element.

Anthemis L.

A. cretica L. subsp. ***anatolica*** (Boiss.) Grierson

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17216,
09.v.2006.

A. cotula L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17217,
12.iv.2006.

A. tinctoria L. var. ***tinctoria***

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17218, 16.viii.2006.

A. triumfettii (L.) All.

A3 Ankara: Osmanköy, N 40°04'312"-E 030°58'488", 827m, OUFE: 17219,
04.viii.2006.

Achillea L.

A. santolinoides Lag. subsp. ***wilhelmsii*** (K.Koch) Greuter

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17220, 28.v.2007,
Irano-Turanian Element.

A. grandifolia Friv.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17221,
04.vi.2007.

A. millefolium L. subsp. ***millefolium***

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44' 279", 223m, OUFE: 17222,
16.viii.2006, Euro-Siberian Element.

A. biebersteinii Afan.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17223,
20.vii.2008, Irano-Turanian Element.

A. nobilis L. subsp. ***neilreichii*** (A.Kern.) Velen.

B3 Eskişehir: Mihallıçık, N 39°54'032"-E 031°26'564", 1558m, OUFE: 17224,
20.vii.2008, Euro-Siberian Element.

Tanacetum L. (Emend. Briq)

T. parthenium (L.) Schultz Bip.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17225, 17.vi.2007.

T. armenum (DC.) Schultz Bip.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17226, 04.viii.2006.

Tripleurospermum Schultz Bip.

T. sevanense (Manden.) Pobed

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17227, 17.vi.2006.

Artemisia L.

A. absinthium L.

A3 Ankara: Osmanköy, N 40°04'312"-E 030°58'488", 827m, OUFE: 17228, 25.vii.2008.

Arctium L.

A. minus (Hill) Bernh. subsp. *minus*

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17229, 16.viii.2006.

Onopordum L.

O. tauricum Willd

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17230, 04.vi.2007, Euro-Siberian Element.

Cirsium Miller

C. sintenisii Freyn

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17231, 04.viii.2006, Endemic, (LC).

C. italicum (Savi) DC.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17232, 20.vii.2008, Mediterranean Element.

C. vulgare (Savi) Ten.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17233,
16.viii.2006.

C. hypoleucum DC.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17234,
11.v.2008, Mediterranean Element.

C. arvense (L.) Scop. subsp. *vestitum* (Wimmer&Grab.) Petrak

A3 Ankara: Emremsultan, N 40°04'070"-E 031°23'435", 399m, OUFE: 17235,
17.vi.2006.

Picnomon Adans.

P. acarna (L.) Cass.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17236, 04.viii.2007,
Mediterranean Element.

Ptilostemon Cass.

P. afer (Jacq.) subsp. *eburneus* Greuter,

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17237, 20.vii.2008,
Endemic, (LC).

Carduus L.

C. nutans L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17238, 19.v.2008.

C. pycnocephalus L. subsp. *albidus* (Bieb.) Kazmi

B3 Eskişehir: Enterence of Çatacık, N 39°58'051"-E 031°08'049", 1566m, OUFE:
17239, 01.v.2007.

Jurinea Cass.

J. consanguinea DC.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17240,
28.v.2007.

J. pontica Hausskn. et Freyn ex Hausskn.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFÉ: 17241,
12.iv.2006, Irano-Turanian Element, Endemic, (LC).

Acroptilon Cass.

A. repens (L.) DC.

A3 Ankara: Osmanköy, N 40°04'312"-E 030°58'488", 827m, OUFÉ: 17242,
17.vi.2006.

Centaurea L.

C. kotschy (Boiss.&Ball.) Hayek var. *persica* (Boiss.) Wagenitz

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFÉ: 17243,
25.vii.2008.

C. solstitialis L. subsp. *solstitialis*

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFÉ: 17244,
20.vii.2008.

C. iberica Trev. ex Sprengel

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFÉ: 17245, 23.vi.2006.

C. urvillei DC. subsp *urvillei*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFÉ: 17246, 20.vii.2008,
Mediterranean Element.

C. triumfettii All.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFÉ: 17247,
25.vii.2008.

C. thirkei Schultz

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFÉ: 17248,
19.v.2008, West Mediterranean Element.

C. depressa Bieb.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFÉ: 17249,
11.v.2008.

C. yozgadensis Wagenitz

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17250,
17.vi.2007, Endemic, (EN).

Crupina (Pers.) DC.

C.crupinastrum (Moris) Vis.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17251, 18.v.2006

Carthamus L.

Carthamus dentatus Vahl

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17252,
20.vii.2008.

Xeranthemum L.

X. annuum L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17253,
16.viii.2006.

Echinops L.

E. ritro L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17254,
04.viii.2006.

E. microcephalus Sm.

A3 Ankara: Osmerköy, N 40°04'312"-E 030°58'488", 827m, OUFE: 17255,
20.vii.2008, Mediterranean Element.

E. viscosus DC. subsp. *bithynicus* (Boiss.) Rech.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17256,
28.v.2006.

Scolymus L.

S. hispanicus L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17257, 20.vii.2008,
Mediterranean Element.

Cichorium L.

C. intybus L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17258, 28.v.2007.

Koelpinia Pallas

K. linearis Palas

A3 Eskişehir: Laçın, N 40°01'413"-E 030°43'987", 697m, OUFE: 17259, 13.v.2006, East Mediterranean Element.

Scorzonera L.

S. lacinata L. subsp. *lacinata*

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17260, 20.iv.2006.

S. suberosa C. Koch. subsp. *suberosa*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17261, 13.v.2006, Irano-Turanian Element.

S. elata Boiss.

A3 Ankara: Osmanköy, N 40°04'312"-E 030°58'488", 827m, OUFE: 17262, 09.v.2006.

Tragopogon L.

T. longirostris Bisch. ex Schultz subsp. *abbreviatus* Boiss.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17263, 19.v.2008.

T. dubius Scop.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17264, 23.vi.2006.

Leontodon L.

L. asperrimus (Willd.) J. Ball

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17265, 17.vi.2006, Irano-Turanian Element.

L. crispus Vill.

A3 Eskişehir: Sarıyar dam lake, N 40°03'270"-E 031°13'463", OUFE: 17266, 385m, 25.vii.2008.

Picris L.

P. angustifolia subsp. *angustifolia* DC.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17267,
23.vi.2006.

Sonchus L.

S. asper (L.) Hill. subsp. *glaucescens* (Jord.) Ball ex Ball

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17268, 18.v.2006

Pilosella Hill.

P. hoppeana subsp. *macrantha* (Ten.) S.Bräut. & Greuter

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17269,
17.vi.2006.

Lactuca L.

L. hispida DC.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17270, 11.v.2008.

L. serriola L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17271, 20.vii.2008.

Scariola F.W. Schmidt

S. viminea (L.) F.W. Schmidt

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17272,
11.viii.2007.

Taraxacum F.H.Wigg.

T. serotinum (Waldst. & Kit.) Poir.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17273,
04.viii.2006.

T. officinale Webb

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17274,
25.vii.2008.

CAMPANULACEAE

Campanula L.

C. lyrata Lam. subsp. *lyrata*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17275, 13.v.2006, Mediterranean Element, Endemic, (LC).

C. rapunculus L. var. *rapunculus*

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17276, 17.vi.2006.

C. glomerata L. subsp. *hispida* (Witasek) Hayek

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17277, 20.vii.2008.

C. argaea Boiss. & Balansa

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17278, 20.vii.2008, Irano-Turanian Element, Endemic, (LC).

C. persicifolia L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17279, 23.vi.2006, Euro-Siberian Element.

C. erinus L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17280, 19.v.2008, Mediterranean Element.

C. grandis subsp. *grandis*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17281, 13.v.2006, Mediterranean Element, Endemic, (LC).

C. rapunculoides L. subsp. *cordifolia* (C. Koch) Damboldt

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17282, 25.vii.2008.

C. pterocaula Hausskn.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17283, 17.vi.2006, Mediterranean Element, Endemic, (LC).

Asyneuma Griseb. & Schenk

A. amplexicaule (Wild.) Hand.-Mazz. subsp. *amplexicaule* var. *amplexicaule*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17284, 17.vi.2006.

A. limonifolium (L.) Janch. subsp. *limonifolium*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17285, 13.v.2006.

A. linifolium (Boiss.&Held.) Bornm. subsp. *linifolium*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17286, 17.vi.2007, West Mediterranean Element, Endemic (EN).

A. linifolium (Boiss.&Heldr.) Bornm. subsp. *nallihanicum* Kit Tan&B. Yıldız

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17287, 23.vi.2006, Endemic, (EN).

A. rigidum (Willd.) Grossh. subsp. *rigidum*

A3 Ankara: Osmanköy, N 40°04'312"-E 030°58'488", 827m, OUFE: 17288, 20.vii.2008, Irano-Turanian Element.

Legousia Durande

L. speculum-veneris (L.) Chaix

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17289, 19.v.2008.

L. pentagonia (L.) Thell.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17290, 11.v.2008.

PRIMULACEAE

Primula L.

P. vulgaris Huds. subsp. *vulgaris*

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17291, 01.iv.2006, Euro-Siberian Element.

Androsace L.

A. maxima L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17292, 01.iv.2006.

A. villosa L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17293, 19.v.2008.

Cyclamen L.

C. coum Mill. var. *coum*

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17294, 01.iv.2006.

Lysimachia L.

L. vulgaris L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17295, 13.v.2006.

L. atropurpurea L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17296, 13.v.2007, East Mediterranean Element.

Anagallis L.

A. arvensis L. var. *arvensis*

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17297, 19.v.2008.

A. arvensis subsp. *foemina* (Mill.) Schinz & Thell.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17298, 09.vii.2008.

OLEACEAE

Jasminum L.

J. fruticans L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17299, 19.v.2008, Mediterranean Element.

Fraxinus L.

F. angustifolia subsp. *oxycarpa* (Willd.) Franco & Rocha Afonso

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17300, 01.iv.2006.

Olea L.

O. europaea L. var. *sylvestris* (Miller) Lehr.

A3 Ankara: Osmanköy, N 40°04'312"-E 030°58'488", 827m, OUFE: 17301,
05.v.2006, Euro-Siberian Element.

Phillyrea L.

P. latifolia L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17302, 13.v.2006,
Mediterranean Element.

APOCYNACEAE

Nerium L.

N. oleander L.

A3 Eskişehir: Sarıyar dam lake, N 40°03'270"-E 031°13'463", 385m, OUFE: 17303,
25.vii.2008, Mediterranean Element.

Trachomitum Woodson

T. venetum L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17304,
20.vii.2008.

Vinca L.

V. herbacea Waldst et Kit.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17305,
08.iv.2007.

V. major L. subsp. *major*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17306, 01.iv.2006,
Mediterranean Element.

Periploca L.

P. graeca L. var. *graeca*

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17307,
20.vi.2007, Mediterranean Element.

Vincetoxicum Wolf

V. intermedium Taliev.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17308,
23.vi.2006, Irano-Turanian Element.

Cynanchum L.

C. acutum L. subsp. *acutum*

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17309,
12.vii.2008.

Cionura Griseb.

C. erecta (L.) Griseb

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17310,
17.vi.2006.

GENTIANACEAE

Centaurium Hill

C. erythraea Rafn subsp. *erythraea*

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17311,
02.vi.2006, Avrupa- Sibiry. Elementi.

CONVOLVULACEAE

Convolvulus L.

C. cantabricus L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17312, 17.vi.2006.

C. lineatus L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17313, 21.v.2007.

C. arvensis L.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17314,
20.vii.2008.

C. galaticus Rotsan ex Coisy

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17315,
12.vii.2008, Irano-Turanian Element, Endemic, (LC).

Calystegia R. Br.

C. sepium (L.) R. Br. subsp. *sepium*

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17316,
11.v.2008.

Ipomea L.

I. purpurea (L.) Roth

A3 Eskişehir: Düzköy, N 40°05'880''-E 030°50'374'', 250m, OUFE: 17317,
20.vii.2008.

Cuscuta L.

C. campestris Yunck.

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17318, 14.v.2007.

BORAGINACEAE

Heliotropium L.

H. europaeum L.

A3 Eskişehir: Kapıkaya, N 40°04'241''-E 030°44'279'', 223m, OUFE: 17319,
23.vi.2007, Mediterranean Element.

Asperugo L

A. procumbens L.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17320,
28.v.2006, Euro-Siberian Element.

Myosotis L.

M. arvensis (L.) Hill subsp. *arvensis*

A3 Eskişehir: Düzköy, N 40°05'880''-E 030°50'374'', 250m, OUFE: 17321,
17.vi.2007, Euro-Siberian Element.

M. lithospermifolia Hornem.

A3 Eskişehir: Laçın, N 40°03'942''-E 030°45'810'', 306m, OUFE: 17322, 26.v.2006

Cynoglossum L.

C. creticum Mill.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17323,
28.v.2006.

C. montanum L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E: 030° 39' 837" 240m, OUFE: 17324,
28.v.2007, Euro-Siberian Element.

Arnebia Forssk.

A. densiflora (Nordm.) Ledeb.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17325,
17.vi.2007, Irano-Turanian Element.

Buglossoides Moench

B. arvensis (L.) I.M.Johnst.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17326, 08.v.2007.

Echium L.

E. italicum L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17327, 28.v.2007,
Mediterranean Element.

E. angustifolium Mill.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17328, 15.iv.2007,
Mediterranean Element.

Moltkia Lehm.

M. coerulea Lehm.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17329, 19.v.2008,
Irano-Turanian Element.

Onosma L.

O. isaurica Boiss. & Heldr.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17330,
23.vi.2006, Irano-Turanian Element.

O. taurica Pall. ex Willd. var. *tauricum*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17331, 13.v.2006.

Cerinth L.

C. minor L. subsp. *auriculata* (Ten.) Domac

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17332, 13.v.2006, Euro-Siberian Element.

Symphytum L.

S. orientale L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17333, 13.v.2007, Euro-Siberian Element.

Anchusa L.

A. leptophylla subsp. *incana* (Ledeb.) D.F.Chamb.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17334, 17.vi.2006, Irano-Turanian Element, Endemic, (LC).

A. azurea Mill. subsp. *azurea*

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17335, 26.v.2006

Alkanna Tausch

A. orientalis (L.) Boiss. var. *orientalis*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17336, 13.v.2007, Irano-Turanian Element, 09.05.2006

A. orientalis (L.) Boiss. var. *leucantha* (Bornm.) Hub.-Mor.

B3 Eskişehir: Yarımcı, N 39°51'130"-E 030°36'614", 947m, OUFE: 17337, 23.vi.2006, Irano-Turanian Element, Endemic, (LC).

SOLANACEAE

Solanum L.

S. decipiens Opiz

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17338, 16.viii.2007.

S. dulcamara L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17339, 17.vi.2006, Euro-Siberian Element.

Lycium L.

L. chinense Mill.

A3 Eskişehir: Kapıkaya, N 40°04'241''-E 030°44'279'', 223m, OUFE: 17340,
19.v.2008.

Atropa L.

A. belladonna L.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17341,
20.v.2008, Euro-Siberian Element.

Datura L.

D. stramonium L.

A3 Eskişehir: Düzköy, N 40°05'880''-E 030°50'374'', 250m, OUFE: 17342, 13.v.2007,
Euro-Siberian Element.

D. innoxia Mill.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17343,
12.vii.2008.

Hyoscyamus L.

H. niger L.

A3 Eskişehir: Beyköy, N 40°05'745''-E 030°47'104'', 250m, OUFE: 17344, 28.v.2007.

H. reticulatus L.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17345,
20.vii.2008, Irano-Turanian Element.

SCROPHULARIACEAE

Verbascum L.

V. serratifolium (Hub.-Mor.) Hub.-Mor.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17346,
23.vi.2006, Irano-Turanian Element, Endemic, (nt).

V. deterrentum Boiss.&Heldr.

A3 Eskişehir: Düzköy, N 40°05'231''-E 030°47'975'', 299m, OUFE: 17347,
17.vi.2006, Mediterranean Element, Endemic, (VU).

V. mucronatum Lam.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17348, 23.vi.2006, Mediterranean Element.

V. splendidum Boiss.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", OUFE: 17349, 240m, 28.vi.2007, Mediterranean Element, Endemic, (LC).

V. lasianthum Boiss. ex Benth.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17350, 17.vi.2006.

V. cheiranthifolium Boiss. var. *cheiranthifolium*

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17351, 19.v.2008.

Scrophularia L.

S. scopilii Hoppe ex Pers. var. *scopilii*

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17352, 28.v.2007.

S. xanthoglossa Boiss. var. *decipiens* (Boiss.&Kotschy) Boiss.

B3 Eskişehir: Mihallıççık, N 39°54'032"-E 031°26'564", 1558m, OUFE: 17353, 12.vii.2008, Irano-Turanian Element.

OROBANCHACEAE

Orobanche L.

O. ramosa L.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17354, 17.vi.2006.

O. elatior Sutton

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17355, 23.vi.2006.

O. anatolica Boiss. & Reut.

A3 Eskişehir: Beyköy, N 40°06'011"-E 030°47'380", 278m, OUFE: 17356, 19.v.2008.

Parentucellia Viv.

P. latifolia Caruel subsp. *latifolia*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17357,
15.iv.2006, Mediterranean Element.

Pedicularis L.

P. comosa L. var. *sibthorpii* (Boiss.) Boiss

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17358, 09.v.2007.

Lathraea L.

L. squamaria L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17359, 20.iv.2006.

ACANTHACEAE

Acanthus L.

A. hirsutus Boiss.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17360,
19.v.2008, Endemic, (LC).

VERBENACEAE

Verbena L.

V. officinalis L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17361,
17.vi.2006.

LAMIACEAE

Ajuga L.

A. orientalis L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17362, 26.v.2006

A. chamaepitys (L.) Schreber

A3 Ankara: Emremsultan plantation area, N 40°04'066"-E 031°23'434", 400m, OUFE:
17363, 20.v.2007, Irano-Turanian Element.

Teucrium L.

T. orientale L. var. *orientale*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17364, 12.vii.2008, Irano-Turanian Element.

T. chamaedrys L. subsp. *chamaedrys*.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17365, 10.vii.2008, Irano-Turanian Element.

T. montanum L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17366, 20.vii.2008.

T. polium L.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17367, 04.viii.2006.

Scutellaria L.

S. albida subsp. *velenovskiyi* (Rech.f.) Greuter & Burdet

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17368, 23.vi.2007, Mediterranean Element.

Phlomis L.

P. herba-venti subsp. *herba-venti*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17369, 12.vii.2008.

P. russeliana (Sims) Benth

A3 Eskişehir: Beyköy, N 40°06'011"-E 030°47'380", 278m, OUFE: 17370, 17.vi.2006, Mediterranean Element, Endemic, (LC).

P. armeniaca Willd

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17371, 23.vi.2006, Irano-Turanian Element, Endemic, (LC).

Lamium L.

L. amplexicaule L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17372, 08.iv.2007, Euro-Siberian Element.

L. purpureum L. var. *purpureum*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17373, 15.iv.2006, Euro-Siberian Element.

L. orientale (Fisch. & C.A.Mey.) E.H.L.Krause

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17374, 15.iv.2006, Irano-Turanian Element, Endemic, (LC).

Ballota L.

B. nigra L. subsp. *anatolica* P. H. Davis

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17375, 17.vi.2006, Irano-Turanian Element, Endemic, (LC).

Marrubium L.

M. vulgare L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17376, 13.v.2006.

M. astracanicum Jacq. subsp. *astracanicum*

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17377, 17.vi.2006.

Sideritis L.

S. pisidica Boiss.&Heldr.

B3 Eskişehir: Sakarı Karacaören, N 39°59'513"-E 030°55'212", 967m, OUFE: 17378, 11.v.2008, East Mediterranean Element, Endemic, (LC).

Stachys L.

S. tmolea Boiss

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17379, 23.vi.2007, Mediterranean Element, Endemic, (LC).

S. byzantina K.Koch

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17380, 16.viii.2006, Euro-Siberian Element.

S. annua (L.) L. subsp. *annua* var. *annua* (L.) L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17381, 01.iv.2006, West Mediterranean Element.

Nepeta L.

N. italica L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17382, 23.v.2007.

N. nuda L. subsp. *nuda*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17383, 12.vii.2008.

N. caesarea Boiss.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17384, 20.vii.2008, Mediterranean Element, Endemic, (LC).

Prunella L.

P. vulgaris L.

A3 Ankara: Kuruca, N 40°04'990"-E 030°58'488", 815m, OUFE: 17385, 13.v.2006, Euro-Siberian Element.

Origanum L.

O. sipyleum L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17386, 17.vi.2006, Mediterranean Element, Endemic, (LC).

Satureja L.

S. cuneifolia Ten.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17387, 20.vii.2008, Mediterranean Element.

S. hortensis L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17388, 04.viii.2006.

Clinopodium L.

C. vulgare L. subsp. *arundanum* (Boiss.) Nyman

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17389, 23.vi.2006, Mediterranean Element.

C. graveolens subsp. *rotundifolium* (Pers.) Govaerts

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17390, 26.v.2006

Micromeria Benth.

M. myrtifolia Boiss. & Hohen.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17391, 19.v.2008, East Mediterranean Element.

Thymus L.

T. sipyleus Boiss.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17392, 28.v.2007.

T. longicaulis C. Presl subsp. *longicaulis* var. *longicaulis*

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17393, 01.v.2007.

T. longicaulis C. Presl subsp. *longicaulis* var. *subisophyllus* (Borbás) Jalas

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17394, 09.v.2007

Thymbra L.

T. spicata L. var. *spicata*

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17395, 17.vi.2006, East Mediterranean Element.

Mentha L.

M. aquatica L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17396, 16.viii.2006.

M. longifolia subsp. *typhoides* (Briq.) Harley

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17397, 04.viii.2006, Mediterranean Element.

M. spicata subsp. *condensata* (Briq.) Greuter & Burdet

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17398, 12.vii.2008.

Ziziphora L.

Z. tenuior L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17399, 18.v.2007, Irano-Turanian Element.

Z. taurica Bieb. subsp. *taurica*

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17400, 17.vi.2007, West Mediterranean Element.

Salvia L.

S. tomentosa Mill.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17401, 19.v.2008, West Mediterranean Element.

S. viridis L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17402, 11.v.2008, Mediterranean Element.

S. sclarea L.

A3 Eskişehir: İğdir, N: 40° 02' 799"-E: 030° 39' 704" 197m, OUFE: 17403, 19.v.2008.

S. aethiopsis L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17404, 26.v.2006

S. argentea L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17405, 13.v.2006, Mediterranean Element.

S. candidissima Vahl subsp. *candidissima*

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17406, 13.v.2006, Irano-Turanian Element.

S. virgata Jacq.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17407, Irano-Turanian Element.

S. dichroantha Stapf

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", OUFE: 17408, 947m, 11.v.2008, Irano-Turanian Element, Endemic, (LC).

Vitex L.

V. agnus-castus L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17409, 20.vii.2008, Mediterranean Element.

PLUMBAGINACEAE

Acantholimon Boiss.

A. acerosum (Willd.) Boiss. subsp. *acerosum*

A3 Eskişehir: Beyköy, N 40°06'011"-E 030°47'380", 278m, OUFE: 17410, 23.vi.2006, Irano-Turanian Element.

A. puberulum Boiss.& Balansa var. *puberulum*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17411, 20.vii.2008, İran-Tuan Elementi.

PLANTAGINACEAE

Plantago L.

P. major L. subsp. *intermedia* (Gilib.) Lange

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17412, 13.v.2007.

P. holosteum Scop

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17413, 17.vi.2006, Mediterranean Element.

P. lanceolata L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17414, 28.v.2007, Mediterranean Element.

Globularia L.

G. orientalis L.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17415, 17.vi.2006, Irano-Turanian Element.

G. trichosantha Fisch. & C.A.Mey.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17416, 08.iv.2007.

Linaria Mill.

L. genistifolia (L.) Mill. subsp. *genistifolia*

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17417, 11.v.2008, Euro-Siberian Element.

L. corifolia Desf.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17418, 28.v.2007, İran- Turan Elementi, Endemic, (LC).

L. simplex (Link) DC.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17419, 17.vi.2006.

Digitalis L.

D. ferruginea L. subsp. *ferruginea*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17420, 19.v.2008, Euro-Siberian Element.

D. lamarckii Ivanina

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17421, 11.v.2008, Irano-Turanian Element, Endemic, (LC).

Veronica L.

V. gentianoides Vahl

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17422, 28.v.2007, Mediterranean Element.

V. pontica Velen.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17423, 13.v.2006.

V. chamaedrys L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17424, 13.v.2006, Euro-Siberian Element.

V. pectinata L. var. *pectinata*

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17425, 15.iv.2007.

ELAEAGNACEAE

Elaeagnus L.

E. angustifolia L.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17426,
17.vi.2006.

SANTALACEAE

Osyris L.

O. alba L.

A3 Eskişehir: Kapıkaya, N 40°04'241''-E 030°44'279'', 223m, OUFE: 17427,
12.vii.2008, Mediterranean Element.

Viscum L.

V. album L. subsp. *album*

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17428, 26.v.2006

ARISTOLOCHACEAE

Asarum L.

A. europaeum L.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'' 947m, OUFE: 17429,
23.iv.2006, Euro-Siberian Element.

Aristolochia L.

A. pallida Willd.

A3 Eskişehir: Düzköy, N 40°05'231''-E 030°47'975'', 299m, OUFE: 17430, 13.v.2006.

A. hirta L.

A3 Eskişehir: İğdir, N 40°02'799''-E 030°39'704'', 197m, OUFE: 17431, 19.v.2008,
West Mediterranean Element, Endemic, (LC).

PHYLLANTHACEAE

Andrachne L.

A. telephioides L.

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 17432,
20.iv.2006.

EUPHORBIACEAE

Chrozophora A.Juss.

C. tinctoria (L.) A.Juss.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17433, 01.iv.2007.

Mercurialis L.

M. annuaa L.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17434, 08.iv.2007.

M. perennis L.

B3 Eskişehir: Kartal pass, N 39°54'140"-E 031°26'643", 1612m, OUFE: 17435, 08.iv.2007, Euro-Siberian Element.

Euphorbia L.

E. platyphyllos L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17436, 19.v.2008.

E. helioscopia L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17437, 15.iv.2006.

E. apios L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17438, 01.iv.2006, West Mediterranean Element.

E. herniariifolia Willd. var. *herniariifolia*

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17439, 09.v.2006

URTICACEAE

Urtica L.

U. dioica L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17440, 23.vi.2006, Euro-Siberian Element.

Parietaria L.

P. judaica L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17441, 22.v.2007.

MORACEAE

Morus L.

M. alba L.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17442,
05.v.2006.

M. nigra L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17443, 19.v.2008.

Ficus L.

F. carica L. subsp. *carica*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17444,
15.iv.2006, Irano-Turanian Element.

ULMACEAE

Ulmus L.

U. glabra Huds.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17445,
08.iv.2007, Euro-Siberian Element.

JUGLANDACEAE

Juglans L.

J. regia L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17446, 13.v.2006.

PLATANACEAE

Platanus L.

P. orientalis L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17447,
08.iv.2007.

FAGACEAE

Quercus L.

Q. infectoria subsp. *veneris* (A.Kern.) Meikle

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17448, 16.viii.2006.

Q. cerris L. var. *cerris*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17449, 04.viii.2007, Mediterranean Element.

Q. pubescens Willd.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17450, 04.viii.2006.

Antirrhinum L.

A. majus subsp. *tortuosum* (Bosc ex Vent.) Rouy

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17451, 17.vi.2007, Mediterranean Element.

BETULACEAE

Carpinus L.

C. betulus L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17452, 17.vi.2006, Euro-Siberian Element.

Corylus L.

C. colurna L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17453, 08.iv.2007, Euro-Siberian Element.

SALICACEAE

Salix L.

S. alba L.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17454, 28.v.2007, Euro-Siberian Element.

S. elaeagnos Scop.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17455, 15.iv.2006, Euro-Siberian Element.

Populus L.

P. alba L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17456, 08.iv.2007, Euro-Siberian Element.

P. tremula L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17457, 15.iv.2006, Euro-Siberian Element.

P. nigra L. subsp. *nigra*,

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17458, 08.iv.2007, Euro-Siberian Element.

RUBIACEAE

Asperula L.

A. lilaciflora subsp. *phrygia* (Bornm.) Schönb.-Tem.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17459, 17.vi.2006, Endemic, (LC).

A. arvensis L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17460, 20.v.2007, Mediterranean Element.

Galium L.

G. odoratum (L.) Scop.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17461, 19.v.2008, Euro-Siberian Element.

G. verum L. subsp. *verum*

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17462, 23.vi.2006, Euro-Siberian Element.

G. album subsp. *pycnotrichum* (Heinr.Braun) Krendl

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17463, 06.v.2007, Euro-Siberian Element.

G. tricornutum Dandy

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17464, 13.v.2007, Mediterranean Element.

Cruciata Mill.

C. taurica (Pall. ex Willd.) Ehrend.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17465,
11.v.2008, Irano-Turanian Element.

Rubia L.

R. peregrina L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17466, 13.v.2006,
West Mediterranean Element.

MONOCOTYLEDONAE

BUTOMACEAE

Butomus L.

B. umbellatus L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17467,
17.vi.2006, Euro-Siberian Element.

ARACEAE

Arum L.

A. maculatum L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17468, 09.v.2006

A. elongatum Steven. subsp. *elongatum*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17469, 15.vi.2008.

Dracunculus Mill.

D. vulgaris Schott

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17470, 13.v.2006,
East Mediterranean Element.

Lemna L.

L. trisulca L.

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17471, 09.v.2007.

SMILACACEAE

Smilax L.

S. excelsa L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17472,
19.v.2008, Mediterranean Element.

XANTHORRHOEACEAE

Asphodeline Rchb.

A. lutea (L.) Rchb.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17473, 13.v.2007,
Mediterranean Element.

A. taurica (Pall.) Endl.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17474,
17.vi.2006, Mediterranean Element.

A. damascena (Boiss.) Baker subsp. *damascena*

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17475,
23.vi.2006, Irano-Turanian Element.

LILIACAEAE

Muscari Mill.

M. armeniacum Leichtlin ex Baker

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17476, 03.v.2006.

M. neglectum Guss. ex Ten.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17477,
01.iv.2006.

ASPARAGACEAE

Asparagus L.

A. acutifolius L.

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17478, 16.viii.2006,
Mediterranean Element.

A. aphyllus L. *orientale* Baker

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, 20.vii.2008, OUFE:
17479, Mediterranean Element.

Ruscus L.

***R. aculeatus* L.**

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17480,
01.iv.2007.

Polygonatum Miller

***P. orientale* Desf.**

A3 Eskişehir: Mayıslar, N 40°01'360"-E 030°46'114", 596m, OUFE: 17481,
13.v.2006.

Ornithogalum L.

***O. pyrenaicum* L.**

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17482, 19.v.2008.

***O. sphaerocarpum* A.Kern.**

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17483, 28.v.2007.

***O. oligophyllum* E.D. Clarke**

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFE: 17484,
08.iv.2007.

O. neurostegium* subsp. *neurostegium

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17485, 08.iv.2007.

***O. fimbriatum* Willd.**

B3 Eskişehir: Yarımcı, N 39°51'130"-E 030°36'614", 947m, OUFE: 17486,
01.v.2007, Mediterranean Element.

***O. sigmoideum* Freyn&Sint.**

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17487, 13.v.2007,
Euro-Siberian Element.

Scilla L.

***S. bifolia* L.**

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17488,
15.iv.2006, Mediterranean Element.

***Prospero* Salisb.**

P.autumnale (L.) Speta

A3 Eskişehir: Kapıkaya, N 40°04'241''-E 030°44'279'', 223m, OUFE: 17489, 07.viii.2006, Mediterranean Element.

Leopoldia Herb.

L. comosa (L.) Parl.

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17490, 28.v.2007, Mediterranean Element.

L. tenuiflora (Tausch) Heldr.

A3 Eskişehir: Düzköy, N 40°05'880''-E 030°50'374'', 250m, OUFE: 17491, 13.v.2006.

L. longipes (Boiss.) Losinsk.

A3 Eskişehir: Düzköy, N 40°05'880''-E 030°50'374'', 250m, OUFE: 17492, 06.v.2007, Irano-Turanian Element.

Hyacinthella Schur

H. lineata Steud. ex Schult. & Schult.f.) Chouard

A3 Eskişehir: Beyköy, N 40°06'011''-E 030°47'380'', 278m, OUFE: 17493, 08.iv.2007. East Mediterranean Element, Endemic, (LC).

H.micrantha (Boiss.) Chouard

A3 Eskişehir: Sarıyar dam, N 40°03'270''-E 031°24'357'', 396m, OUFE: 17494, 05.iv.2007, Endemic, (LC).

Fritillaria L.

F. fleischeriana Steud. & Hochst. ex Schult. & Schult.f.

B3 Eskişehir: Yarımcı, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17495, 19.iv.2008, Endemic, (LC).

F. pinardii Boiss.

B3 Eskişehir: Bozan plantation area, N 39°47'265''-E 031°05'137'', 878m, OUFE: 17496, 10.v.2006, Irano-Turanian Element.

Tulipa L.

Tulipa armena var. ***lycica*** (Baker) Marais

B3 Eskişehir: Bozan plantation area, N 39°47'265"-E 031°05'137", 878m, OUFE: 17497, 16.iv.2007.

Gagea Salisb.

G. taurica Steven

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17498, 08.iv.2007, Irano-Turanian Element.

G. bithynica Pascher

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17499, 19.v.2008, East Mediterranean Element, Endemic, (LC).

G. bohémica (Zauschn.) Schult. & Schult.f.

B3 Eskişehir: Bozan plantation area, N 39°47'265"-E 031°05'137", 878m, OUFE: 17500, 01.v.2007, Irano-Turanian Element.

G. peduncularis (C.Presl) Pascher

B3 Eskişehir: Bozan plantation area, N 39°47'265"-E 031°05'137", 878m, OUFE: 17501, 21.v.2007, Mediterranean Element.

G. granatellii (Parl.) Parl.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17502, 11.iii.2007, Mediterranean Element.

G. villosa (Bieb.) Duby var. *villosa*

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17503, 08.iv.2006.

G. villosa (Bieb.) Duby var. *hermonis* Dafni&Heyn

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17504, 26.v.2006

Colchicum L.

C. triphyllum G. Kunze

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17505, 21.iii.2007, Mediterranean Element.

C. burttii Meikle

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17506, 18.ii.2006, Mediterranean Element, Endemic, (LC).

C. umbrosum Steven

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17507, 16.viii.2007, Mediterranean Element.

C. szovitsii Fisch. & C.A.Mey.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17508, 19.iv.2006, Irano-Turanian Element.

C. speciosum Steven

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17509, 04.viii.2006, Mediterranean Element.

C. soboliferum (C.A.Mey.) Stef.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17510, 15.iii.2006, Irano-Turanian Element.

C. atticum Spruner ex Tommas.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17511, 20.ii.2006, Mediterranean Element.

AMARYLLIDACEAE

Allium L

A. flavum L. subsp. *tauricum* (Besser ex Rchb.) K.Richt. var. *tauricum*

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17512, 30.vii.2008, Mediterranean Element.

A. myrianthum Boiss.

B3: Sarıcakaya, landside of farms, 16.06.2001, 220 m, OUFE: 17513, 12.vii.2008, Irano-Turanian Element.

A. ampeloprasum L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17514, 11.v.2008, Mediterranean Element.

A. atroviolaceum Boiss.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17515, 17.vi.2007.

A. rotundum L.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFÉ: 17516,
19.v.2008, Mediterranean Element.

A. lycaonicum Siehe ex Hayek

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFÉ: 17517, 26.v.2007.

Sternbergia Waldst.&Kit.

S. colchiciflora Waldst.&Kit.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFÉ: 17518,
15.ix.2007.

Galanthus L.

G. gracilis Celak.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837" 240m, OUFÉ: 17519,
01.iv.2006, Mediterranean Element.

IRIDACEAE

Iris L.

I. pseudacorus L.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFÉ: 17520,
08.iv.2007.

I. orientalis Mill.

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFÉ: 17521,
28.v.2006, East Mediterranean Element.

I. kerneriana Asch. & Sint. ex Baker

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFÉ: 17522, 28.v.2007,
Endemic, (LC).

I. pumila subsp. *attica* (Boiss. & Heldr.) K.Richt.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFÉ: 17523,
20.iv.2007, East Mediterranean Element.

Crocus L.

C. ancyransis (Herb.) Maw

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17524, 15.iii.2006, Irano-Turanian Element, Endemic, (LC).

C. chrysanthus (Herb.) Herb.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17525, 09.iv.2006.

C. flavus Weston subsp. *flavus*

B3 Eskişehir: Bozan plantation area, N 39°47'265"-E 031°05'137", 878m, OUFE: 17526, 15.iii.2006, Euro-Siberian Element.

C. antalyensis B.Mathew

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17527, 01.iv.2006, East Mediterranean Element, Endemic, (LC).

C. pallasii Goldb. subsp. *pallasii*

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17528, 05.x.2006.

Gladiolus L.

G. illyricus W.D.J.Koch

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17529, 17.v.2007.

G. atroviolaceus Boiss.

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17530, 28.v.2007.

ORCHIDACEAE

Cephalanthera Rich.

C. rubra (L.) Rich.

B3 Eskişehir: Bozan plantation area, N 39°47'265"-E 031°05'137", 878m, OUFE: 17531, 03.vi.2007.

C. longifolia (L.) Fritsch

A3 Eskişehir: Beyköy, N 40°04'994"-E 030°45'980", 240m, OUFE: 17532, , 28.v.2007, Euro-Siberian Element.

Epipactis Zinn

E. helleborine (L.) Crantz

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17533, 13.vii.2008.

Limodorum Boehm

L. abortivum (L.) Sw.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17534, 17.vi.2007.

Platanthera Rich.

P. bifolia (L.) Rich.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17535, 28.v.2007, Euro-Siberian Element.

P. chlorantha (Custer) Reichb.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17536, 17.vi.2006.

Ophrys L.

O. fusca Link.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17537, 20.iv.2006, Mediterranean Element.

O. sphegodes subsp. *mammosa* (Desf.) Soó ex E.Nelson

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17538, 15.iv.2007, East Mediterranean Element.

Anacamptis Rich.

A. pyramidalis (L.) Rich.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17539, 26.v.2007.

Himantoglossum W.D. Koch

H. affine (Boiss.) Schltr.

B3 Eskişehir: Mihallıçık, N 39°54'032"-E 031°26'564", 1558m, OUFE: 17540, 16.vii.2008, East Mediterranean Element.

H. camprinum (Bieb.) Sprengel

B3 Eskişehir: Alpu-Gökçekaya road, N 39°52'498''-E 030°58'398'', 855m, OUFE: 17541, 04.viii.2007, Mediterranean Element.

Neotinea Rchb.f. & Poll.

N. tridentata (Scop.) R.M.Bateman, Pridgeon & M.W.Chase

A3 Eskişehir: Laçın, N 40°02'707'-E 030°45'379'', 303m, OUFE: 17542, 13.v.2006, Mediterranean Element.

Orchis L.

O. purpurea Huds.

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17543, 21.iv.2006, Euro-Siberian Element.

O. simia Lam.

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 17544,13.v.2006.

O. mascula subsp. *mascula*

A3 Eskişehir: Beyköy, N 40°06'011''-E 030°47'380'', 278m, OUFE: 17545, 19.vi.2008, East Mediterranean Element.

Dactylorhiza Neck. ex Nevski

D. romana (Seb.) Soo subsp. *romana*

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17546, 03.vi.2007, Mediterranean Element.

TYPHACEAE

Typha L.

T. latifolia L.

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 17547, 12.vi.2008.

T. angustifolia L.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17548, 17.vi.2006.

T. domingensis Pers.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17549,
10.vi.2007.

JUNCACEAE

Juncus L.

J. inflexus L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17550, 28.v.2007.

J. compressus Jacq.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17551, 09.v.2006.

J. bufonius L.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17552, 19.v.2008.

J. capitatus Weigel

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17553,
03.vi.2006.

CYPERACEAE

Cyperus L.

C. longus L.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFE: 17554, 17.vi.2006.

C. glaber L.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17555,
20.vii.2008.

C. capitatus Vand.

A3 Eskişehir: Düzköy, N:40° 05' 880"-E: 030° 50' 374", 250m, OUFE:
17556, 12.vii.2008.

Eleocharis R. Br.

E. palustris (L.) Roem.&Schult.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17557, 28.v.2007.

Carex L.

C. cuprina (Sándor ex Heuff.) Nendtv. ex A.Kern.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17558, 14.vi.2007.

C. acutiformis Ehrh.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17559,
16.vii.2008, Euro-Siberian Element.

POACEAE

Brachypodium P. Beauv.

B. sylvaticum (Hudson) P. Beauv.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17560,
12.vii.2008, Euro-Siberian Element.

Agropyron Gaertn.

A. cristatum (L.) Gaertn.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17561, 11.v.2008.

Elymus L.

E. repens (L.) Gourd subsp. *repens*

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFE: 17562, 03.vi.2007.

Aegilops L.

Ae. cylindrica Host

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17563, 11.05.2007,
Irano-Turanian Element.

Ae. triuncialis L. subsp. *triuncialis*

A3 Eskişehir: Beyköy, N 40°05'745"-E 030°47'104", 250m, OUFE: 17564,
17.06.2006.

Ae. geniculata Roth.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17565,
19.v.2008, Mediterranean Element.

Triticum L.

T. aestivum L.

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17566,
14.v.2006.

Secale L.

S. cereale L. var *cereale*

A3 Eskişehir: Kapıkaya, N 40°04'241"-E 030°44'279", 223m, OUFÉ: 17567, 20.vii.2008.

Hordeum L.

H. murinum L. var. *glaucum* (Steud.) Tzvelev

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFÉ: 17568, 24.v.2007.

H. bulbosum L.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFÉ: 17569, 26.v.2007.

Bromus L.

A. hordeaceus L. subsp. *hordeaceus*

A3 Eskişehir: Laçın, N 40°03'942"-E 030°45'810", 306m, OUFÉ: 17570, 12.vii.2008.

Avena L.

A. barbata Poyt ex Link subsp. *barbata*

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFÉ: 17571, 11.v.2008, Mediterranean Element.

Rostraria Trin.

R. cristata (L.) Tzvelev var. *cristata*

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFÉ: 17572, 19.v.2008.

Koeleria Pers.

K. pyramidata (Lam.) P.Beauv.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFÉ: 17573, 20.vii.2008.

Polypogon Desf.

P. viridis (Gouan) Breistr.

A3 Eskişehir: Düzköy, N 40°05'231"-E 030°47'975", 299m, OUFÉ: 17574, 12.v.2006, Euro-Siberian Element.

P. monspeliensis (L.) Desf.

A3 Eskişehir: Kapıkaya, N 40°04'241''-E 030°44'279'', 223m, OUFE: 17575, 28.v.2007.

Alopecurus L.

A. arundinaceus Poir.

B3 Eskişehir: Yarımca, N 39°51'130''-E 030°36'614'', 947m, OUFE: 17576, 17.vi.2006, Euro-Siberian Element.

Phleum L.

P. pratense L.

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17577, 18.vii.2008, Euro-Siberian Element.

P. exaratum Hoschst. ex Griseb subsp. ***exaratum***

A3 Eskişehir: İğdir, N 40°02'799''-E 030°39'704'', 197m, OUFE: 17578, 19.v.2008, East Mediterranean Element.

Festuca L.

F. pratensis Huds.

A3 Eskişehir: Beyköy, N 40°04'994''-E 030°45'980'', 240m, OUFE: 17579, 04.viii.2006.

Lolium L.

L. multiflorum Lam.

A3 Eskişehir: Laçın, N 40°02'707''-E 030°45'379'', 303m, OUFE: 17580, 15.viii.2006.

L. perenne L.

A3 Eskişehir: Mayıslar, N 40°02'285''-E 030°39'837'', 240m, OUFE: 17581, 28.v.2007, Euro-Siberian Element.

Poa L.

P. annua L.

A3 Eskişehir: Düzköy, N 40°05'231''-E 030°47'975'', 299m, OUFE: 17582, 13.v.2007.

P. trivialis L.

A3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17583, 03.vi.2006.

P. bulbosa L.

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17584, 28.v.2007.

Dactylis L.

D. glomerata subsp. ***hispanica*** (Roth) Nyman

A3 Eskişehir: Laçın, N 40°02'707"-E 030°45'379", 303m, OUFE: 17585, 13.v.2006, Euro-Siberian Element.

Briza L.

B. humilis M.Bieb.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17586, 23.v.2007.

Echinaria Desf.

E. capitata (L.) Desf.

A3 Eskişehir: Mayıslar, N 40°02'285"-E 030°39'837", 240m, OUFE: 17587, 27.v.2008.

Melica L.

M. ciliata L. subsp. ***ciliata***

B3 Eskişehir: Yarımca, N 39°51'130"-E 030°36'614", 947m, OUFE: 17588, 17.vi.2007.

Stipa L.

S. bromoides (L.) Dörf.

A3 Eskişehir: Düzköy, N 40°05'880"-E 030°50'374", 250m, OUFE: 17589, 20.vii.2008, Mediterranean Element.

Phragmites Trin.

P. australis (Cav.) Trin. ex Steud.

A3 Eskişehir: İğdir, N 40°02'799"-E 030°39'704", 197m, OUFE: 17590, 16.viii.2006, Euro-Siberian Element.

Cynodon Rich.

C. dactylon (L.) Pers var. ***dactylon***

A3 Eskişehir: Laçın, N 40°03'942''-E 030°45'810'', 306m, OUFE: 17591, 23.v.2007.

Setaria P. Beauv.

S. viridis (L.) P. Beauv.

A3 Eskişehir: Düzköy, N40° 05'231''-E 030°47'975'', 299m, OUFE: 17592, ,
04.viii.2007.

Chrysopogon Trin.

C. gryllus (L.) Trin.

A3 Eskişehir: Beyköy, N 40°05'745''-E 030°47'104'', 250m,OUFE: 17593, 03.vi.2006.

A Mixed Nonlinear Integer Programming Model for an Aggregate Production Planning Problem with Seasonal Demands

Yonca Erdem Demirtas

*Department of Quantitative Methods, Istanbul University, Istanbul
yonca.erdem86@gmail.com*

Serol Bulkan

*Department of Industrial Engineering, Marmara University, Istanbul
sbulkan@marmara.edu.tr*

Abstract

In this study, an aggregate production planning problem will be modeled and solved. The production company has full time workers; also seasonal workers are employed because of the seasonal demands. Production capacity is increased with seasonal workers by opening new production line and/or shift. According to the constraints of the firm; in one-year period, the direction of change on the number of shifts (increase-to-decrease or decrease-to-increase) defined with a certain rules. This article introduces a logical conditional constraint to control the changes of these decision variables. Finally, a mathematical model is developed with logical constraints, and then solved with ILOG CPLEX 12.2 Optimization Studio.

Keywords: Aggregate Production Planning, Mathematical Programming, Seasonal Demand

1. INTRODUCTION

Aggregate production planning (APP) is a medium range capacity planning method that typically encompasses a time horizon anywhere from 2 to 12 months (Jay and Barry, 1993). APP is an important part of the production systems; it links long-range and short-range planning activities. APP is used to determine the optimum levels of production rates, workforce levels, inventory levels, overtime work, and subcontracting rates (Jay and Barry, 1993).

As manufacturing facilities grow, the problems of production planning become extremely complex. It is hard to solve these problems with the company's goals while the manufacturing environment changes too fast.

Studies on this topic are being proposed since 1950's. There are numerous methods developed and improved to solve APP problems. The most updated state-of-the art review on models and methodologies for APP can be found in Nam and Logendran (1992). Hundreds of journals and more than a dozen books were categorized into optimal and near-optimal classifications with respect to models and methodologies.

Masud and Hwang (1980) presented a multiple objective formulation of the multi-product, multi-period aggregate production planning problem. The objectives are; maximization of contribution to profit, minimization of changes of workforce level, minimization of inventory investment, and minimization of backorders. They solved a numerical example using three Multiple Objective Decision Making methods: goal programming, step method (STEM), and sequential multiple objective problem solving (SEMOPS).

Thompson and Davis (1990) proposed an integrated solution approach for studying uncertainty in the aggregate production planning problem. This modeling methodology was demonstrated on a multiple-product fixed-workforce example. The example consists of three product types, three processes, and 13 planning periods. Uncertainties are modeled in selling price, cost, demand, capacity and retention of backorders.

Baykasoglu (2001) improved Masud and Hwang's model with additional constraints such as selection of subcontractor and set-up decisions. The multiple-objective tabu search algorithm was applied to Masud and Hwang's model and the improved model. An object oriented program, MOAPPS 1.0 (Multiple Objective Aggregate Production Planning Software), was developed used to compare Masud and Hwang's model with the improved model.

Jain and Palekar (2005) consider the aggregate production-planning problem in the context of a continuous production process in which the product is differentiated at various stages of manufacturing. They presented the limitations of the traditional models that are based on resource based formulations. They also proposed a configuration based model. In their model, production process is assumed to be continuous and no in-process inventory is allowed. They concluded the study that the computational experiments show that large-scale real-world problems can be solved in reasonable time using the proposed heuristics and commercial optimization software like CPLEX.

Sillekens et. al. (2011) presented a new mixed integer linear programming approach for the problem of aggregate production planning of flowshop production lines in the automotive industry. In contrast to traditional approaches, it considered discrete capacity adaptations which originate from technical characteristics of assembly lines as well as from work regulations and shift planning. A set of primal heuristics were developed to be able to solve the problem efficiently. A case study and results based on a test set were presented to show the capability of the model and the implementation.

Mezghani et. al. (2012) developed a goal programming formulation of APP problem which could be integrated with manager's preferences and solved it by simulation.

In this article, we modeled and solved an APP for a production company. The innovation is the new logical constraint which is developed for the direction of the changes on the shifts. The new constraint includes logical expressions. In general, logical constraints are hard to be modeled and solved. Due to the structure of the problem, the mathematical model is in nonlinear form.

The rest of the article is organized as follows. In section 2, an aggregate production planning problem and proposed logical conditional rule as a constraint of mathematical model is introduced. Section 3 contains mathematical model formulation of the APP problem with the assumptions. Section 4 presents the computational results, and finally conclusion and future directions are given in section 5.

2. The Problem Definition and the Developed Logical Rule

This study is carried out in an important electronic company in Turkey. The company produces several electronic products; also it has opened new production lines to produce air-conditioner. In this study, the production lines that are used to produce air-conditioner are our interest.

The company employs full time workers and seasonal workers because of the variety of seasonal demands. Production capacity is increased with seasonal workers by opening new production line and/or shift.

The company has opportunity to change number of shifts by using seasonal workers. Since hiring and firing seasonal workers frequently reduces the motivation of the workers and finding qualified seasonal workers is difficult, company has a policy on limiting the number of hiring/firing process. This policy can be described as not to have more than one directional change in number of shifts (in one-year planning period). For example, opening a new shift in February and shutting down it in March and then reopening April are not acceptable choices.

The following figure gives an example of acceptable and unacceptable changes of shifts in 8-months production period. Line-1 and Line-2 show the number of shifts of different lines for each month, respectively.

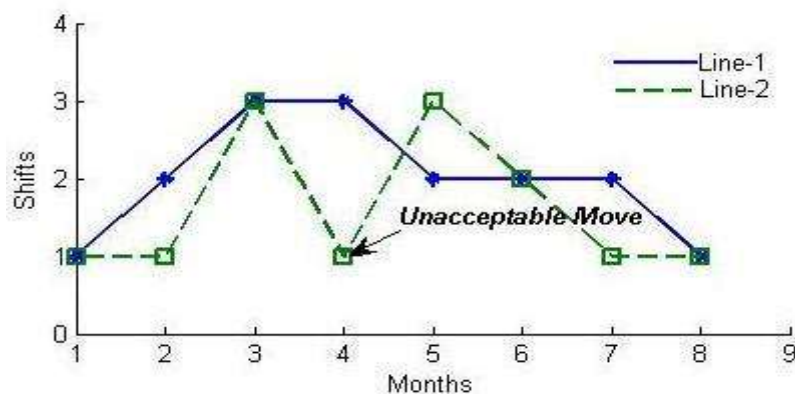


Figure 1 Example of acceptable and unacceptable changes in the number of shifts

The shifts that belong to assembly lines are; 1-2-3-3-2-2-1 for Line-1 and 1-1-3-1-3-2-1-1 for Line-2. It is seen from the Figure 1 that the changes of Line-2 has an unacceptable movement, such as decreasing from 3 to 1 in April then re-increases to 3 in May, that results in a frequent change in workforce level.

The changes of the Line-1 comply with the company's goal. We can control the changes of the number of shifts by using the developed logical rule. This rule checks the validity of shifts for every situation. That rule allows only one directional change in the number of shifts.

2.1. The developed logical rule

We can control the changes of the number of shifts by using the developed logical rule. This rule checks the validity of shifts for every situation by allowing only one directional change in the number of shifts. The mathematical formulation of the logical rule is improved in guidance of Williams (1999).

Additionally, independent from the problem type, the developed rule can be used in every optimization problem formulation in order to control the changes of any decision variables. It can be added to the mathematical programming formulation as a constraint.

Let x_t be a decision variable which can have only one directional change in values, $t=1, \dots, T$. Where T is a range (in APP problem is a planning period). The constraints for x_t can be logically written as;

$$\text{If } (x_1 < x_{max}^t) \text{ and } (x_{t-1} < x_{max}^t) \text{ then } x_t \leq x_{t-1} \quad (1)$$

$$\text{If } (x_1 > x_{min}^t) \text{ and } (x_{t-1} > x_{min}^t) \text{ then } x_t \geq x_{t-1} \quad (2)$$

Where;

$$x_{max}^t = \max\{x_1, x_2, \dots, x_{t-1}\}$$

$$x_{min}^t = \min\{x_1, x_2, \dots, x_{t-1}\}$$

For every planning period t , x_t belongs to previous periods are checked dynamically. Either (1) or (2) can be satisfied in every period. If condition (1) is valid, then the value of period t can only be less than or equal to previous period's value. If condition (2) is satisfied, then the value of period t can only be greater than or equal to the previous one.

Lastly, if none of the two equations are satisfied, then there is no limitation of the value of x_t for period t .

The number of shifts for every month is a decision variable in the problem. The production capacities of the production lines are changed while opening and closing the shifts. In this case, multiplying the number of shifts by working hours determines the production capacity in every production line. As a result, the model becomes nonlinear since it includes the constraints that formed by multiplying the two decision variables (shifts*working hours). Thus, the solution space grows exponentially.

To solve this nonlinear mathematical programming model, ILOG CPLEX Optimization Studio 12.2, which is a powerful solver for optimization models is used. Another useful advantage of this software is being capable of modeling and solving logical conditions. Since the mathematical model has nonlinear constraints the Constraint Programming engine of the CPLEX is used.

3. Problem Statement

The capacities of the regular time and overtime of the lines are calculated by multiplying the working days and the limits of the daily working hours. In one working day; the regular working time of each shift can be less than or equal to 7 hours and the overtime working hours can be less than or equal to 3 hours, respectively.

Table 1 represents the upper bounds of working hour capacities for every planning period.

There are 12 different models that produced in the external production unit. The production unit has three assembly lines (Line 1, Line 2 and Line 3) that are used to produce all of the 12 models.

Table 1 Number of Workdays and Upper Bounds

Month	Workday	Regular Time Capacity (Hour)	Overtime Capacity (Hour)
JANUARY	26	182	78
FEBRUARY	24	168	72
MARCH	26	182	78
APRIL	23	161	69
MAY	25	175	75
JUNE	26	182	78
JULY	27	189	81
AUGUST	13	91	39
SEPTEMBER	26	182	78
OCTOBER	26	182	78
NOVEMBER	26	182	78
DECEMBER	26	182	78

There are some restrictions on production of the models; such as some models cannot be produced in some lines. Table includes the hourly production capacities of the assembly lines to produce the products.

As can be seen in the Table some models cannot be produced in some assembly lines. For example while the XE1 model can be produced in all of the three lines, the XLN model can only be produced in Line 3. On the other hand the XM model can be produced in all of the three lines with the same production capacity.

The demands of the models have seasonal pattern. Except for the third model, the demands increase around the sixth month. The graphs of the monthly demands of 12 models are plotted in the Figure .

Table 2 Hourly Production Capacities of the Production Unit

	Line 1	Line 2	Line 3
XLN	0	0	110
XA2	200	0	200
XA3	195	0	195
XE	130	0	130
XE1	110	110	110
XH	0	30	0
XL	195	0	195
XM	150	150	150
XEV	0	30	0
XEN	0	40	0
XHM	0	30	0
XEM	0	40	0

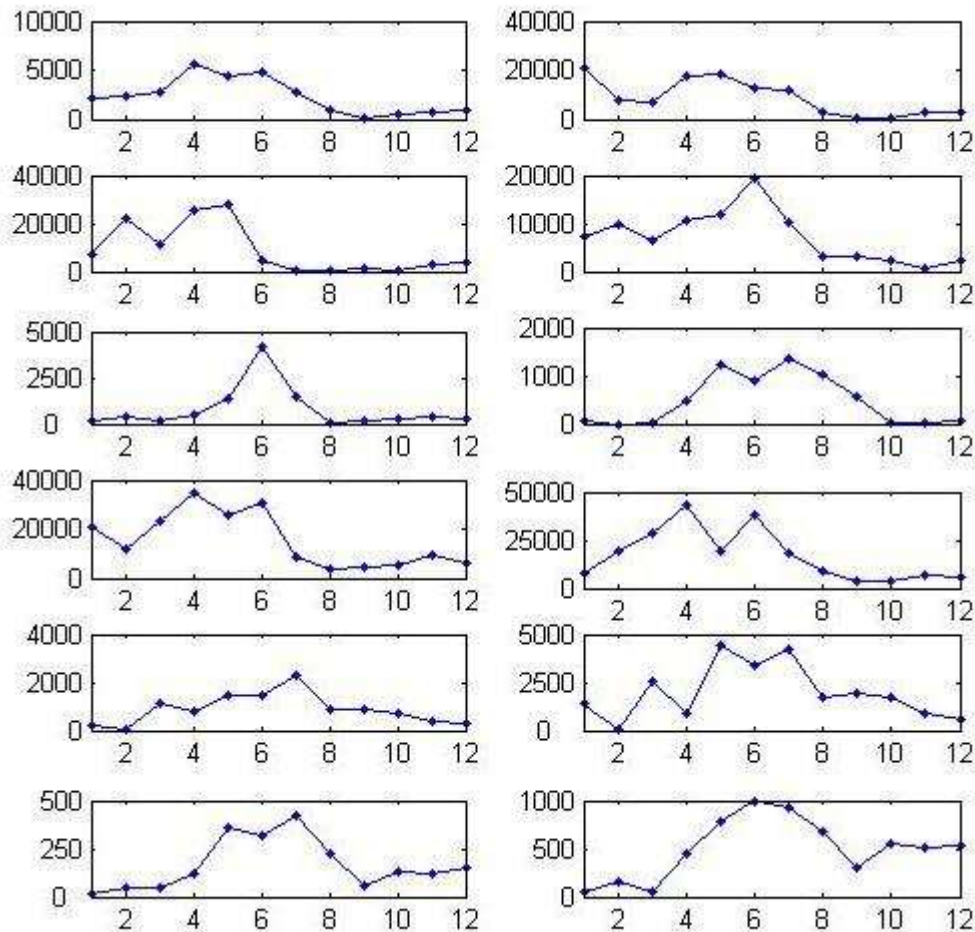


Figure 2 Monthly Demands

The demands for all 12 models have seasonal patterns. Generally, the demands increase in April, May and June, and decrease in winter months. The seasonality in demands can be seen in the plots.

3.1. Assumptions and notations

Before the mathematical model formulation of the problem is given, it is necessary to explain the assumptions of the model. The production plan is made for two production units (internal and external units of the same air conditioner) in order to plan the involved models. In this section, after stating the assumptions, the general mathematical model formulation of the problem is presented in detail. The assumptions of the proposed model are given as follows:

1. The planning horizon is 12 months.
2. The production cost of production does not change through planning horizon.
3. Backorders are not allowed.
4. The 12-month demand values are known and constant.
5. Stock capacities of the firm for every period are known.
6. All demand will be satisfied during the planning period.
7. If necessary, 24-hour working is allowed. (i.e. 3-shifts are allowed)
8. Regular time and overtime production capacities per hour are equal, but production hours are different.
9. Available regular time working hour is 7, available overtime working hour is 3 for each shift in every planning period.
10. The number of shifts of assembly lines that belong to internal and external production unit calculated separately.
11. Initial inventory level for each product is assumed to be zero.
12. Different shifts of the assembly lines have equal working hours.

Notation:

Indices:

Products: $N^* = 1, 2, \dots, N$
 Planning Periods: $T^* = 1, 2, \dots, T$
 Assembly Lines: $J^* = 1, 2, \dots, J$

Decision variables:

P_{njt} Regular working time of product n on line j in period t (hours)
 O_{njt} Overtime working of product n on line j in period t (hours)
 I_{nt} Inventory of product n on line j at the end of period t (units)
 S_{tj} Number of shifts on line in period t

Input parameters and constants:

RC_t Regular time production capacity in period t (hour)
 OC_t Overtime production capacity in period t (hour)
 α_{nj} Number of units produced for product n on line j (unit/one hour)
 D_{nt} Forecasted demand for product n in period t (units/month)
 c_m^{reg} Regular time production cost per hour (\$/hour)
 c_m^{over} Overtime production cost per hour (\$/hour)
 c_m^{inv} Inventory cost in period t for product n on line j (\$/units)
 β Cost to open new shift (\$)
 V Maximum warehouse space available (units)
 W_t Number of workday in month t

3.2. Mathematical Model of the Problem

Objective Function:

$$\text{Minimize} \left\{ \sum_{n=1}^N \sum_{j=1}^J \sum_{t=1}^T c_{tn}^{reg} P_{njt} + \sum_{n=1}^N \sum_{j=1}^J \sum_{t=1}^T c_{tn}^{over} O_{njt} + \sum_{n=1}^N \sum_{t=1}^T c_{tn}^{inv} I_{tn} + \sum_{j=1}^J \sum_{t=1}^T \beta S_{tj} \right\} \quad (3)$$

The objective is minimizing the total cost that consists of production cost in regular time, overtime, inventory holding and opening the new shift.

Subject to:

Capacity constraints:

$$\sum_{n=1}^N P_{njt} \leq RC_t \quad \forall t \in [1, T], \forall j \in [1, J] \quad 3)$$

$$\sum_{n=1}^N O_{njt} \leq OC_t \quad \forall t \in [1, T], \forall j \in [1, J] \quad 4)$$

Product balance:

$$\sum_{j=1}^J \alpha_{nj} P_{njt} S_{tj} + \sum_{j=1}^J \alpha_{nj} O_{njt} S_{tj} - I_{nt} = D_{nt} \quad \forall n \in [1, N], t = 1 \quad 5)$$

$$\sum_{j=1}^J \alpha_{nj} P_{njt} S_{tj} + \sum_{j=1}^J \alpha_{nj} O_{njt} S_{tj} + I_{nt-1} - I_{nt} = D_{nt} \quad \forall n \in [1, N], t > 1 \quad 6)$$

$$\sum_{n=1}^N I_{nt} \leq V_t \quad \forall t \in [1, T] \quad 7)$$

$$1 \leq S_{tj} \leq 3 \quad \forall t \in [1, T], \forall j \in [1, J] \quad 8)$$

Logical constraints to control the changes of shifts:

If
 $(S_{1j} < \max \{S_{1j}, S_{2j}, \dots, S_{t-1j}\} \text{ and } S_{t-1j} < \max \{S_{1j}, S_{2j}, \dots, S_{t-1j}\})$
 Then $S_{tj} \leq S_{t-1j}$ 9)

If
 $(S_{1j} > \min \{S_{1j}, S_{2j}, \dots, S_{t-1j}\} \text{ and } S_{t-1j} > \min \{S_{1j}, S_{2j}, \dots, S_{t-1j}\})$
 Then $S_{tj} \geq S_{t-1j}$ 10)

Conditional constraint to balance the work hours:

If $\sum_{n=1}^N P_{n1t} + \sum_{n=1}^N P_{n2t} + \sum_{n=1}^N P_{n3t} \leq 20H_t$
 Then $\sum_{n=1}^N O_{njt} = 0$ 12)

$I_{nt}, P_{njt}, O_{njt} \geq 0 \text{ and integer}$ 11)

Constraint (4) and (5) ensure that the total working hours for each line for the products within the capacity limit in every planning period. The constraint (4) means that the working hours for each product in regular time should be less than the available capacity and the constraint (5) means that the working hours for each product in overtime should be less than the available capacity in every period.

The production balance is represented by constraints (6), (7), (8), and (9). Constraints (6) and (7) ensure satisfying the demands for each period. Constraint (8) represents that total inventory level should be less than equal to available warehouse capacity in every planning period. Constraint (9) indicates the upper and lower bounds of the number of shifts in every production line.

The developed logical constraints are represented by constraints (10) and (11). There are two conditional constraints stand to decide the next period's shift numbers. One of the two situations can be valid for each shift number, i.e. either (10) or (11).

Constraint (12) provides the balance of the working hours; such as if there is available regular time working hour it would not be appropriate to make overtime production. The last constraint (13) provides the decision variables' range, makes the variables to take nonnegative integer values.

4. Computational Results

In contrast to traditional APP problem formulations, the mathematical model formulation of the interested problem has conditional constraints, such as If-Then condition. In addition to being fast, it is easy to implement very complex models in the ILOG CPLEX Optimization Studio. The data for the interested problem and the obtained solutions from mathematical model are given in the Table 1 and Table 2.

As can be seen in Table 3, the number of shifts satisfies developed logical rules of APP. Line 1 is working with two shifts for the first four months than one shift for the remaining part of the year. Line 2 is working with one shift for the first four months of the year and then working with three shifts for the following two months and one shift for the remaining part of the year. Lastly, Line 3 is working with one shift for the first three months of the year, than after working with two shifts for the following two months and working with one shift for the last seven months of the year. The directional changes of the number of shifts comply with the objectives of the problem and it is controlled by the proposed constraints.

Monthly production quantities for the production unit are calculated. The quantities involve both regular time and overtime productions. These quantities are obtained by multiplying hourly production capacities (input variable) by hourly working hours (decision variable) and the number of shifts (decision variable).

Other decision variables are the monthly inventory quantities of the models. The obtained results show that for every planning period the total inventory is not more than the warehouse capacity. In every planning period, demand is satisfied by the beginning inventory and production for all models.

Table 3 The best calculated number of shifts

	Line 1	Line 2	Line 3
JANUARY	2	1	1
FEBRUARY	2	1	1
MARCH	2	1	1
APRIL	2	1	2
MAY	1	3	2
JUNE	1	3	1
JULY	1	1	1
AUGUST	1	1	1
SEPTEMBER	1	1	1
OCTOBER	1	1	1
NOVEMBER	1	1	1
DECEMBER	1	1	1

There are three assembly lines in the production unit, and all of the shifts belong to lines obey the changing rule. As expected, the change of the shifts is parallel to the changes of the demands. Shifts increase when there is a high demands and decrease if the demands are low.

5. Conclusion and Future Directions

In the prosed APP, a conditional rule is developed in order to satisfy a special constraint for the production problem. It is important that this constraint can be useful for all problems that have similar limits for the decision variables.

Mathematical model formulation which includes the developed constraints is established for the APP problem and then solved with CPLEX. The obtained results comply with the firm's requirements. The most important constraint of the model, i.e. controlling the changes of shifts, is satisfied by the results.

The aim of this study is to find an appropriate solution for the APP problem and suitable model is developed with the use of a set of conditional rules. These conditional rules can be used to model similar problem easily. The next step of this research would be the development of an APP model by relaxing the assumptions made in this model.

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