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VEGETATION STRUCTURE OF *OLEA FERRUGINEA* ROYLE FORESTS OF LOWER DIR DISTRICT OF PAKISTAN

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Abstract

Thirty stands were sampled in forests dominated by *Olea ferruginea* during summer in 2008. Phytosociological attributes like relative frequency, density, basal area and absolute values such as density ha^{-1} and basal area m^2 ha^{-1} of stands and species are presented. Based on importance values and floristic composition following 10 communities were recognized.

1, *Olea- Punica* community 2, *Olea- Ficus* community 3, *Platanus-Morus* communities 4, *Olea– Ailanthus* community 5, *Morus-Celtis* community 6, *Olea-Acacia* community 7, *Olea- Morus* community 8, *Olea- Monotheca* community 9, *Olea- Quercus* community 10, *Pure Olea* community. Most of these showed similar floristic composition with different quantitative values. Though no significant relation between density/basal area, elevation/density and elevation/basal area was obtained, however trends of these possible relations are described. Structure of *Olea ferruginea* and associated tree species in each stand is presented. Due to unbalanced forest structure and continuous disturbance, no future trends could be predicted for these forests.

Introduction

Olea ferruginea, a native broad leaved tree species of sub continent is distributed from 500 to 2000m in sub tropical, dry temperate and moist temperate regions of Pakistan. It was recorded from Afghan border, Western hills of Baluchistan, Dir, Chitral, Salt range, lower hills of Azad Kashmir, Waziristan, Swat and Murree hills (Baquar, 1969; Sheikh, 1993). This frost and drought resistant species has adapted 250mm to 1000mm per year precipitation and -10^oC to 40^oC temperature, therefore can easily be planted on wide areas of arid, semi arid and dry temperate regions of Pakistan with minimum input. This way, watershed, microclimatic, environmental and edaphic conditions of the area can be improved through plantation of this tree. In addition its leaves, fruit and wood may be utilized as fodder, oil, fuel and construction respectively. A lot of quantitative phytosociological work has been published from various areas of Pakistan, however, little attention is paid to include single tree species or forest dominated by a single tree species. Beside some work of Cheema & Qadir (1973) on *Acacia senegal*, Beg & Khan (1984) on dry oak forests of Swat, Ahmed *et al*., (1990a 1990b, 1991 and 2008) on Juniper forest of Rodhmallazi, Juniper Track of Ziarat, *Pinus gerardiana* forest of Zhob District, Baluchistan, *Cedrus deodara* forest respectively and Siddiqui *et al*., (2009) on *Pinus roxburghii* of subtropical region of Pakistan have been reported. No comprehensive studies were carried

out in Pakistan on *Olea ferruginea*. Considering environmental, economical and ecological importance of *Olea ferruginea*, detailed vegetation study was carried out at 30 different locations of Dir District. It is hoped that present studies would increase our knowledge in terms of its community and association.

Methods

Since graveyards are considered least disturbed locations of any area (Hussain *et al*., 1993, Chaghtai *et al*., 1983, 1984), during summer 2008, 30 graveyards were sampled quantitatively in the various places of Lower Dir District. Point Centered Quarter method (PCQ) of Cottam & Curtis (1956) was used to evaluate the quantitative vegetational composition of these forests. At each sampling point, in each of four quadrants, the nearest tree species (>6cm dbh) was located and point to plant distance and diameter at breast height (dbh) were recorded. At each sampling stand, 20 PCQ points were taken at 25 meter interval. To increase the sample size for relative density, a second nearest tree (Ahmed, 1984) was also recorded. The distance was not measured for this tree but dbh was recorded. Density, frequency and basal area of each species were calculated following Mueller – Dombois & Ellenberg (1974). Species were ranked according to their importance value (Brown & Curtis, 1952) and the species with the highest importance value in the stand was considered the dominant species of the stand. Species were identified with the help of flora of Pakistan (Nasir & Ali, 1972).

Results and Discussion

Ecological characteristics of sampling sites, total density and basal area of each stand are presented in Table 1. The stands are distributed at lower hills from 685m to 1580m on fairly flat surface. The sampling area fall under the dry temperate broadleaved forest (Champion *et al.*, 1965, Ahmed *et al.*, 2006). Stand density ranged from 56 to 1089 tree ha^{-1} while stand basal area was recorded from 6.62 to 37.90 m^2 ha^{-1}. *Olea ferruginea* and associated species had diversity of density and basal area from site to site and within a stand (Table 2).

Relationship between density/basal area, elevation/density and elevation/basal area are shown in Fig. 2. Density/basal area relation was found negative, non significant with wide variance. Low basal area is associated with higher density stands, due to a large number of young trees, while small density stands contained large sized trees in the study area. Ahmed *et al.*, (1990b) found highly significant relation between these variable, in Juniper forests of Ziarat, Baluchistan, while Ahmed (1984) and Ahmed *et al.*, (1990b) found no relation in *Agathis australis* forests in New Zealand and Juniper forests of Rodhmallazi, Baluchistan, respectively. A non significant trend was also observed from elevation/density regression analysis. This trend showed that density decreases with higher elevation. This species has restricted elevation range for its distribution and closed to its upper limit, its number gradually decreases. Elevation and basal area indicated positive but non significant relation with wide variance. Low density stands are located at higher elevation (elevation/density regression) and higher basal area is associated due to the presence of large trees in these stands. Density and basal area values greatly varies from site to site and no significant relation was found in between these variable of *Olea ferruginea* forests, therefore no proper conclusion could be made, however, as above, general trends may be described.

Table. 1. Ecological characteristics of sampling sites. Absolute density per hectare and basal area meter square per hectare of stands are also presented.

Stand No.	Location	Latitude N	Longitude E	Elevation in (m)	Den. ha-1	B.A (m² ha-1)
1	Goron Khur	34 º 44	71 º 49	724	219	7.50
2	Bandagie	34 º 45	71 º 50	750	170	8.74
3	Utala Dushkel	34 º 45	71 º 50	814	130	28.91
4	Bagh	34 º 43	71 º 48	1090	154	14.74
5	Kattan Pahjron	34 º 43	71 º 48	1106	93	9.29
6	Anzoro Dushkhel	34 º 43	71 º 48	1320	158	5.66
7	Dera Kambar Meiden	34 º 57	71 º 49	1079	586	24.82
8	Manyal Meiden	34 º 57	71 º 47	1096	619	8.65
9	Khazana (Klurra)	34 º 45	71 º 50	685	724	10.23
10	Shamsabad (Kolalano Shah)	34 º 57	71 º 47	1157	175	6.62
11	Sher Khan (Meidan)	34 º 54	71 º 49	939	1089	15.01
12	Kotow Hajiabad	34 º 53	71 º 46	930	374	5.92
13	Kat Kala	34 º 43	71 º 56	938	697	14.18
14	Sarai Bala	34 º 43	71 º 56	966	163	10.20
15	Rahmanabad Talash	34 º 44	71 º 54	915	500	10.74
16	Mazuab Baba	34 º 39	72 º 02	719	266	16.39
17	Gambat Ziarat Talash	34 º 44	71 º 52	904	400	8.46
18	Ghurgi Yar Khan Banda	34 º 47	71 º 51	1088	177	7.53
19	Miayan Banda	34 º 55	71 º 71	804	196	22.04
20	Navagie	34 º 47	71 º 68	1350	211	37.90
21	Said Shah Baba	34 º 48	71 º 47	1385	85	29.80
22	Zakho Baba	34 º 49	71 º 50	1415	78	18.48
23	Qari Said Mula	34 º 50	71 º 49	1440	108	19.92
24	Mula Momen	34 º 53	71 º 48	1370	109	22.73
25	Tormang Baba	34 º 53	71 º 75	1580	101	18.88
26	Derie	34 º 46	71 º 43	950	88	25.96
27	Soghalie	34 º 45	71 º 47	970	90	34.05
28	Bagham Dara	34 º 43	71 º 52	826	101	22.68
29	Ghurgae	34 º 47	71 º 61	1135	56	11.19
30	Paito Dara	34 º 47	71 º 50	853	79	20.93

Note: Den. ha-1 = density per hectare, B.A (m² ha-1) = basal area meter square per hectare

Olea ferruginea is the most abundant and widely distributed species. Out of 30 sites, it is absent in only Mazuab Baba area (Table 2) which may be due to cutting. The other widely distributed species, *Morus alba* was recorded from 13 location while *Monotheca buxifolia* and *Punica granatum* is distributed in 10 and 9 stands respectively. Out of 14 tree species recorded in sampling area, *Quercus ilex, Ailanthus alltissima, Acacia modesta* and *Ficus palmata* were found in 5 to 7 locations. *Celtis australis* was distributed in three stands, while *Prunus armeniaca, Salix tetrasperma, Melia azedarach, Platanus orientalis* and *Juglans regia* were rarely recorded from one or two locations.

Phytosociological attributes indicates that *Olea ferruginea* occupied 100% of importance value forming a pure stand in 5 stands. In these stands its density ranged from 90 to 1089 ha^{-1} while basal area ranged from 9 to 38 m^2 ha^{-1}. However in mixed stands its density ranged from 7 to 425 individuals ha^{-1} while basal area from 0.7 to 26.51 m^2 ha^{-1}.

Table 2. Summary of Phytosociology studies and absolute density and basal area of different species in various sampling stands and communities.

Community	Stand No.	Name of species	IVI	Den.ha^{-1}	B.A.m^{2}ha^{-1}
1	9	*Olea ferruginea*	64.27	488.4	7.14
		Punica granatum	18.82	144.7	1.46
		Ficus palmata	16.91	90.5	1.64
2	10	*Olea ferruginea*	78.5	140.3	6.16
		Punica granatum	6.55	8.8	0.14
		Ficus palmata	14.95	26.3	0.32
3	3	*Olea ferruginea*	21.97	32.4	3.57
		Morus alba	25.76	42.1	3.31
		Monotheca buxifolia	8.72	13	0.54
		Platanus orientalis	40.11	36	21.33
		Salix tetrasperma	3.44	6.5	0.16
4	30	*Olea ferruginea*	56.61	41	16.84
		Morus alba	17.33	12	1.13
		Monotheca buxifolia	6.39	4	0.76
		Ailanthus altissima	19.67	22	2.19
5	16	*Morus alba*	66.85	192.6	12.36
		Ailanthus altissima	9.28	19.9	0.75
		Celtis australis	23.88	53.1	3.29
6	19	*Olea ferruginea*	85.49	171	21.5
		Acacia modesta	14.51	24.5	0.54
	12	*Olea ferruginea*	50.82	205.8	2.95
		Ficus palmata	13.38	46.8	0.79
		Acacia modesta	35.79	121.6	2.18
7	1	*Olea ferruginea*	62.58	153.1	4.67
		Morus alba	26.36	49.2	2.16
		Punica granatum	2.97	5.5	0.06
		Juglans regia	5.04	5.5	0.53
		Ficus palmata	3.05	5.5	0.08
	2	*Olea ferruginea*	59.33	127.2	3.43
		Morus alba	37.58	38.1	4.99
		Punica granatum	3.1	4.2	0.05
	4	*Olea ferruginea*	45.79	69.2	7.88
		Morus alba	29.96	46.2	4.73
		Monotheca buxifolia	7.83	7.7	1.09
		Punica granatum	3.9	7.7	0.17
		Juglans regia	9.45	19.2	0.7
		Prunus armeniaca	3.08	3.8	0.18
	14	*Olea ferruginea*	37.04	65.1	3.58
		Morus alba	28.78	36.6	4.47
		Punica granatum	5.65	8.1	0.4
		Ficus palmata	11.13	20.3	0.5
		Ailanthus altissima	17.4	32.5	1.25
	17	*Olea ferruginea*	49.8	229.8	3.08
		Morus alba	50.2	169.8	5.39
	26	*Olea ferruginea*	52.93	48	15.82
		Morus alba	18.09	19	2.06
		Monotheca buxifolia	6.63	7	0.74
		Celtis australis	5.9	7	0.18
		Platanus orientalis	16.5	7	7.16

Table 2. (Cont'd.).

Community	Stand No.	Name of species	IVI	Den.ha^{-1}	B.A.m^{2}ha^{-1}
	28	*Olea ferruginea*	64.43	61	20.15
		Morus alba	23.7	25	1.63
		Ailanthus altissima	11.88	15	0.9
8	5	*Olea ferruginea*	76.95	72.3	8.44
		Monotheca buxifolia	16.81	16.3	0.74
		Punica granatum	6.24	4.7	0.11
	6	*Olea ferruginea*	61.37	106.4	3.62
		Monotheca buxifolia	24.4	31.5	1.52
		Acacia modesta	14.24	19.7	0.52
	15	*Olea ferruginea*	78.38	424	8.97
		Morus alba	8.53	37.5	0.51
		Ficus palmata	3.32	12.5	0.09
		Monotheca buxifolia	9.77	25	1.18
	18	*Olea ferruginea*	19.18	33.2	0.72
		Morus alba	6.89	11.1	0.77
		Punica granatum	4.44	7.4	0.06
		Monotheca buxifolia	62.28	117.9	5.28
		Melia azedarach	7.2	7.4	0.69
	21	*Olea ferruginea*	71.73	60	26.51
		Morus alba	3.05	2	0.12
		Monotheca buxifolia	25.21	23	3.17
	29	*Olea ferruginea*	21.69	7	4.12
		Monotheca buxifolia	55.9	38	5.32
		Ailanthus altissima	15.33	7	1.39
		Celtis australis	7.09	4	0.36
9	13	*Olea ferruginea*	47.35	296.3	7.81
		Punica granatum	4.23	34.9	0.3
		Acacia modesta	15.88	122	1.91
		Quercus ilex	32.53	244	4.15
	22	*Olea ferruginea*	38.8	27	8.26
		Acacia modesta	9.16	8	0.31
		Quercus ilex	52	43	9.91
	23	*Olea ferruginea*	41.1	35	9.55
		Quercus ilex	58.91	73	10.37
	24	*Olea ferruginea*	64.29	66	18.83
		Acacia modesta	6.55	8	0.24
		Quercus ilex	29.16	35	3.66
	25	*Olea ferruginea*	30.76	27.9	8.03
		Ficus palmata	2.79	2.5	0.06
		Ailanthus altissima	6.89	7.5	0.39
		Quercus ilex	48.44	58	7.14
		Platanus orientalis	11.13	5	3.26
10	7	*Olea ferruginea*	100	586	24.82
	8	*Olea ferruginea*	100	619	8.65
	11	*Olea ferruginea*	100	1089	15.01
	20	*Olea ferruginea*	100	211	37.9
	27	*Olea ferruginea*	100	90	34.05

Note: IVI = Importance value index, Den.ha^{-1} = Density per hectare, B.A.m^{2}ha^{-1} = Basal area meter square per hectare.

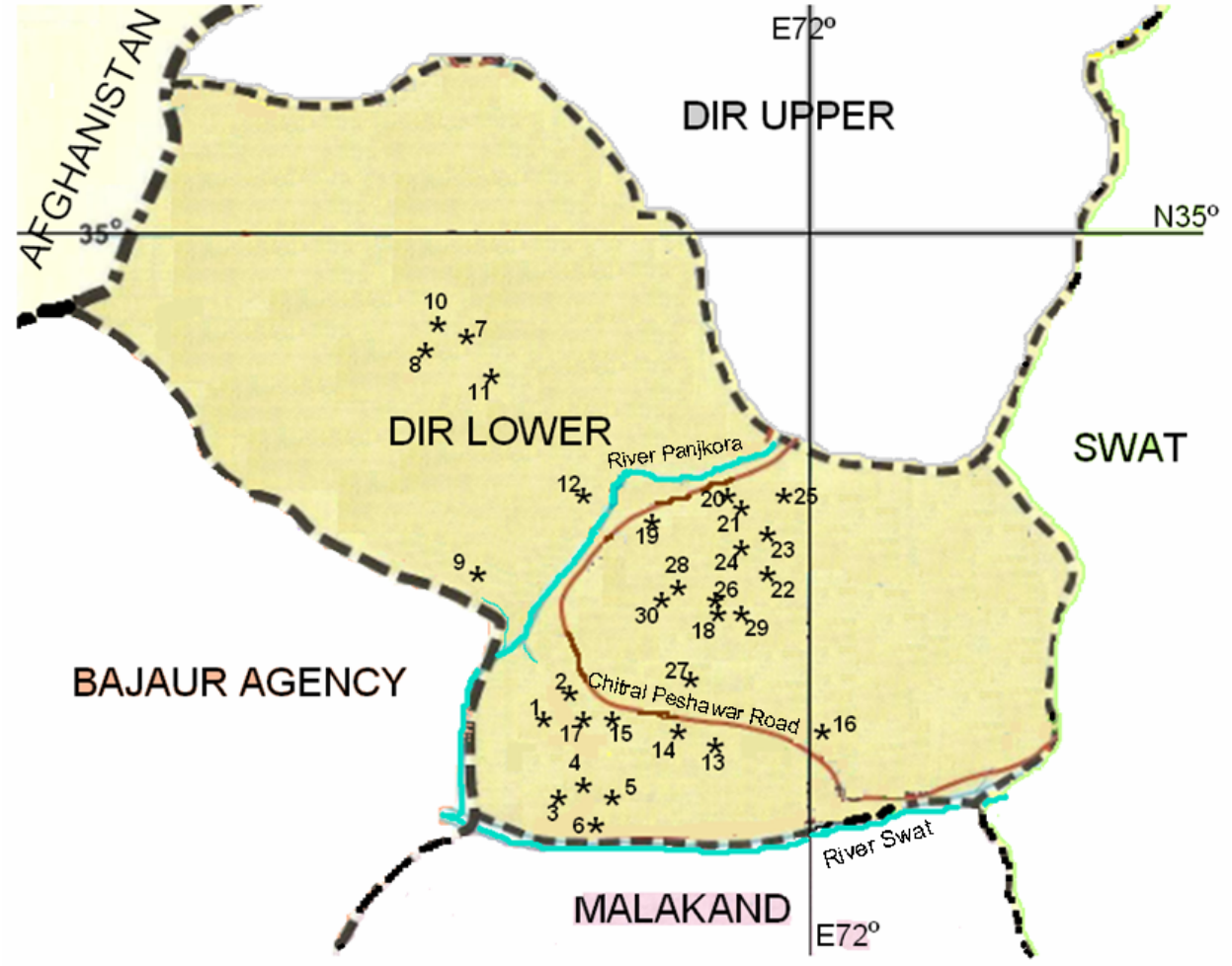


Fig. 1. Map of sampling sites of *Olea ferruginea* stands in Lower Dir. For site name and location refer to Table.1

Some other density and basal area values are available from different forests of *Olea* communities. It was recorded at Tukht-e-Sulaiman range from 1950 to 2130 meter with a co-dominant species *Pistacia Khinjuk* under dry temperate broad leaved forest. Density of this species was 200 ha^{-1} with 28 m^2 ha^{-1} basal area. In subtropical and moist temperate ecotonal zone, density of *Olea* was recorded 378 ha^{-1} with 16 m^2 ha^{-1} basal area, in *Quercus incana* community under Broad leaved forest. Ahmed *et al.*, (2006) also reported this species on lower elevations of Murree Road, Malakand and Marghzar area occupying density ranged from 92 to 620 ha^{-1} with 10 to 26 m^2 ha^{-1} basal area. In these areas *Olea* was associated with *Acacia modesta* and *Pinus roxburghii*. It is suggested that density and basal area of present study is within the range of other studies in Pakistan.

Since importance values show the relative ecological importance of each species in a stand (Brown & Curtis 1952), species were ranked accordingly and since sampling was restricted to dense populations of *Olea ferruginea* consequently *Olea* had the highest importance value in most of the sampling sites, with exception of one stand. Therefore on the basis of importance value index (IV1), floristic composition and co-dominant species, 10 different communities are recognized in this area. *Olea ferruginea* communities were defined by their co-dominant species as follows.

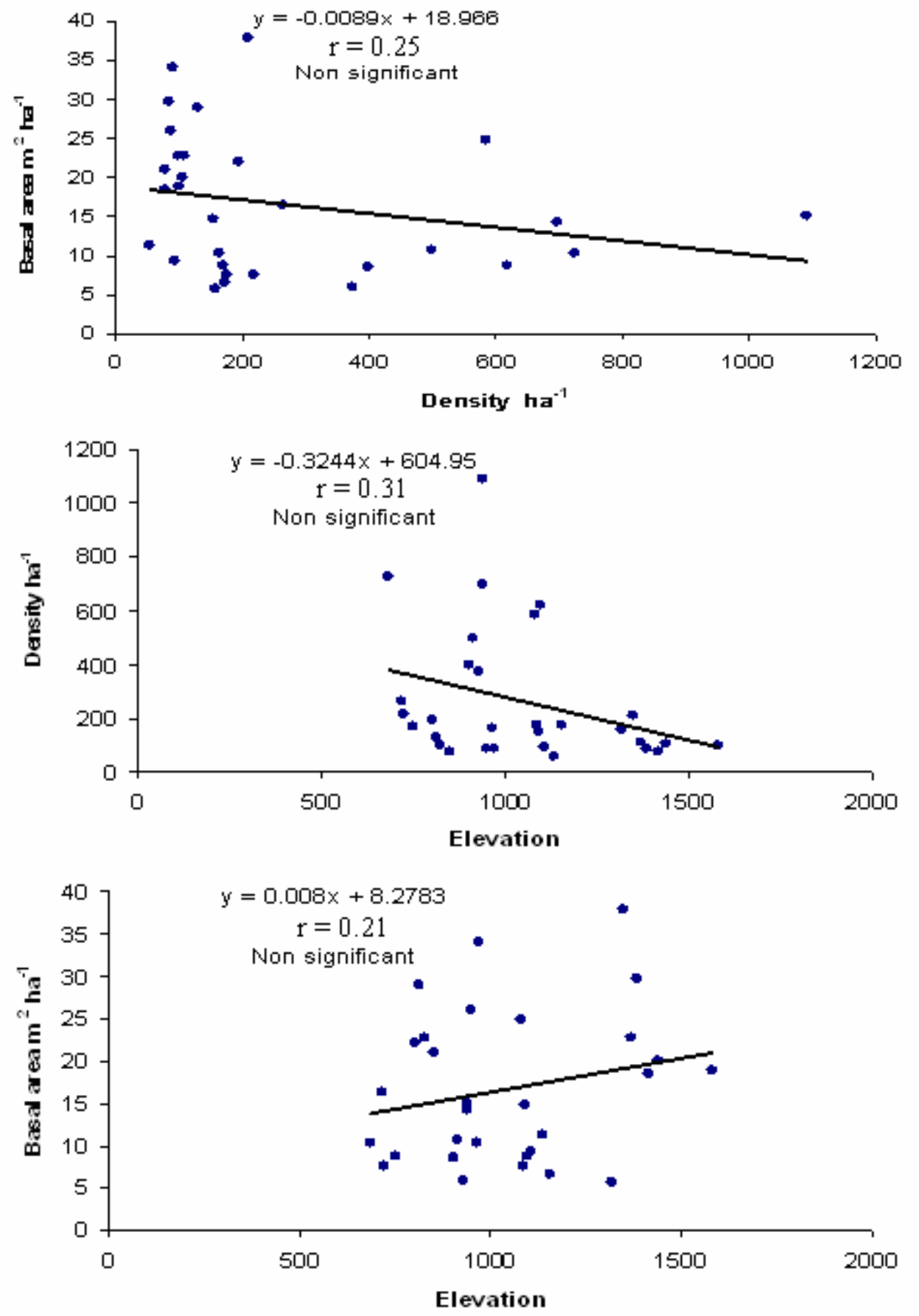


Fig. 2. Relation between density ha^{-1} and basal area $m^2 ha^{-1}$, elevation and density ha^{-1} and elevation and basal area $m^2 ha^{-1}$.

1. *Olea – Punica* community: The sampling area stands in Khazana (Klurra) at 685m elevation. *Olea ferruginea* comprised 64% of IV1 while *Punica granatum* and *Ficus palmata* had 19 and 17% IV1 respectively (Table 2). Stand density of these species ranged from 90 to 488 individual ha^{-1} with basal area ranged from 1.44 to 7.14 m^2 ha^{-1}.

2. *Olea – Ficus* community: The community was distributed on 1157m elevation at Shamsabad (Kolalano Shah). As far as the floristic composition is concerned there is no difference between this and previously described community. *Olea ferruginea* had 78% IV1with lower density (140 ha^{-1}) and basal area then previous community. The 2nd dominant species *Ficus palmate* have 26 individual ha^{-1} while *Punica granatum* attained only 7% of the total IV1 with a low density and basal area.

3. *Platanus – Morus* community: This community is located on 814m elevation at Utala Dushkhel. *Monotheca buxifolia* and *Salix tetrasperma* were associated with fairly low density and basal area. Co-dominant species of this community also occupied leading (community No. 5) and co-dominant position in community No. 7.

4. *Olea – Ailanthus* community: Paito Dara with 853m elevation was supporting this community and *Olea ferruginea* occupied 57% of the total importance value. Its 41 ha^{-1} trees showed comparatively higher (17 m^2 ha^{-1}) basal area. *Ailanthus alltissima* was associated as a co-dominant species occupied only 20% of the total importance value with 22 trees and 2.19 m^2 h^{-1} basal area. *Morus alba* (3rd dominant species) and *Monotheca buxifolia* were associated with low density and basal area.

5. *Morus – Celtis* community: The sampling site was on 719m elevation at Maguab Baba. The importance value of *Morus abla* was recorded 66% with 193ha^{-1} density and 12 m^2 ha^{-1} basal area, while 24% importance value with 53ha^{-1} density and 3.29 m^2 ha^{-1} were recorded for *Celtis australis.* Another tree species, *Ailanthus altissima* was present with low density and basal area values. The co-dominant species of community 3-7 and 3rd dominant species of community 4 (*Morus alba*) appeared as a leading dominant species in this community. Similarly *Ailianthus alltissima* of this community was the co-dominant species of community number 4, showing floristic similarities among various communities. Absence of *Olea ferruginea* in this location may be due to the cutting of this species for fuel purposes.

6. *Olea – Acacia* community: This community was distributed at Miayam Banda and Kotow Hajiabad on 804m and 930m elevation respectively. *Olea ferruginea* attained 85% important value, 171 ha^{-1} density and 21.5 m^2 ha^{-1} basal area at first location while from second location 51% importance value, with 206 ha^{-1} density and fairly low 2.95 m^2ha^{-1} basal area were recorded. *Ficus palmata* was also associated at second sampling site. It appeared as a 3rd dominant (in community No. 1), and co-dominant (in community No. 2 and in various stands of *Olea ferruginea*.

7. *Olea – Morus* community: This community was recorded at 7 locations (Table 2) from 724m to 1090m elevation, during the sampling. In these stands *Olea ferruginea* occupied from 37% to 64% importance value, 48 to 230 density ha^{-1} and 3.08 to 20 m^2 ha^{-1} basal area. Importance values ranged from 17 to 50% and density ranged from 19 to 170ha^{-1}. Basal areas ranged from 2 to 5 m^2 ha^{-1} were recorded for co-dominant *Morus*

alba. Other associates of the community were *Punica granatum*, *Juglans regia*, *Ficus palmata* (Goron Khur), *Monotheca buxifolia*, *Prunus armeniaca* (at Bagh), *Ailianthus alltissima* (Sarai Bala), *Celtis australis*, *Plantanus orientalis* (Derie) with low values.

8. *Olea – Monotheca* community: Kattan Pahjron, Anzaro Dushkhel, Rahmanabad Talash, Said Shah Baba and Ghurgi Yar Khan Banda and Ghurgae were located from 915m to 1385m elevation. These sites were supported by this community on the basis of floristic composition of species, however on the basis of importance value, at last two locations *Monotheca buxifolia* appeared as a leading dominant species. Highest importance value (78% and 62%) of *Olea ferruginea* and *Monotheca* were recorded from stand number 15 and 18 respectively. *Panica granatum* (stand 5), *Acacia modesta* (Stand 6), *Morus alba*, *Ficus palmata* (stand 15), *Media azedarch* (stand 18) were the associated species with low values.

9. *Olea – Quercus* community: From 938m to 1370m elevation at Kat Kala and Mula Momen, *Olea ferruginea* appeared as a leading dominant species while at higher elevations from 1415m to 1580m at Zakho Baba, Qari Said Mula and Tormany Baba, *Quercus ilex* occupied the leading position on the basis of importance value. However on the basis of floristic composition, all stands may be considered as a one community. Highest density of *Olea ferruginea* (296 ha^{-1}) and *Quercus ilex* (244 ha^{-1}) were recorded from stand number 9 and 13 while highest amount of basal area (18.8 and 10.4 m^2 ha^{-1}) of these two species were recorded from stand 24 and stand 23 respectively. A considerable higher density (122 ha^{-1}) of *Acacia modesta* was recorded in stand 13 at low elevation, while at higher elevation (stand 22+24) is associated with fairly low density. *Punica granatum* (stand 13), *Ficus palmata*, *Ailianthus alltissima* and *Plantanus orientalis* (stand 25) were the other associates of this community with low values.

10. *Olea* community: Sampling stands of these monospecific broad leaved forests were located at Sher Khan, Soghalie, Dera Kambar Meiden, Manyal Meiden and Navagie from 939m to 1350m elevation (Table 1, 2). Highest density (1089 ha^{-1}) with comparatively low basal area (15 m^2 ha^{-1}) was recorded from Sher Khan (stand 11) while highest basal are (37.90 m^2 ha^{-1}) with low (211 ha^{-1}) *Olea ferruginea* density was calculated from monospecific stand of Navagie. No other tree species exist in these stands.

It is evident that in most cases the co-dominant species of any particular community is also prominent in other communities and much overlap in species composition exists. When the floristic composition was the only criterion, the numbers of communities were reduced, further more if the basal area and density was taken into account, due to big difference between *Olea ferruginea* and other associates all communities might be considered to all under one "pure olea" stand or forest. Ahmed (1984, 1988) and Ahmed & Ogden (1991) discovered the same results while working on *Agathis australis* Salisb forests of New Zealand.

Size class structure: Size structure diagrams for *Olea ferruginea* and associated tree species were prepared for each stands. Fig. 3 indicated that all the stands are composed of mosaic and mixed size classes and in some stands many individuals are found in young classes with a gradual decrease in number in higher bigger size classes. In many stands the size class distribution is highly skewed. Some sites have similar number of *Olea ferruginea* individual ha^{-1} but show different size structure. Several stands show one or

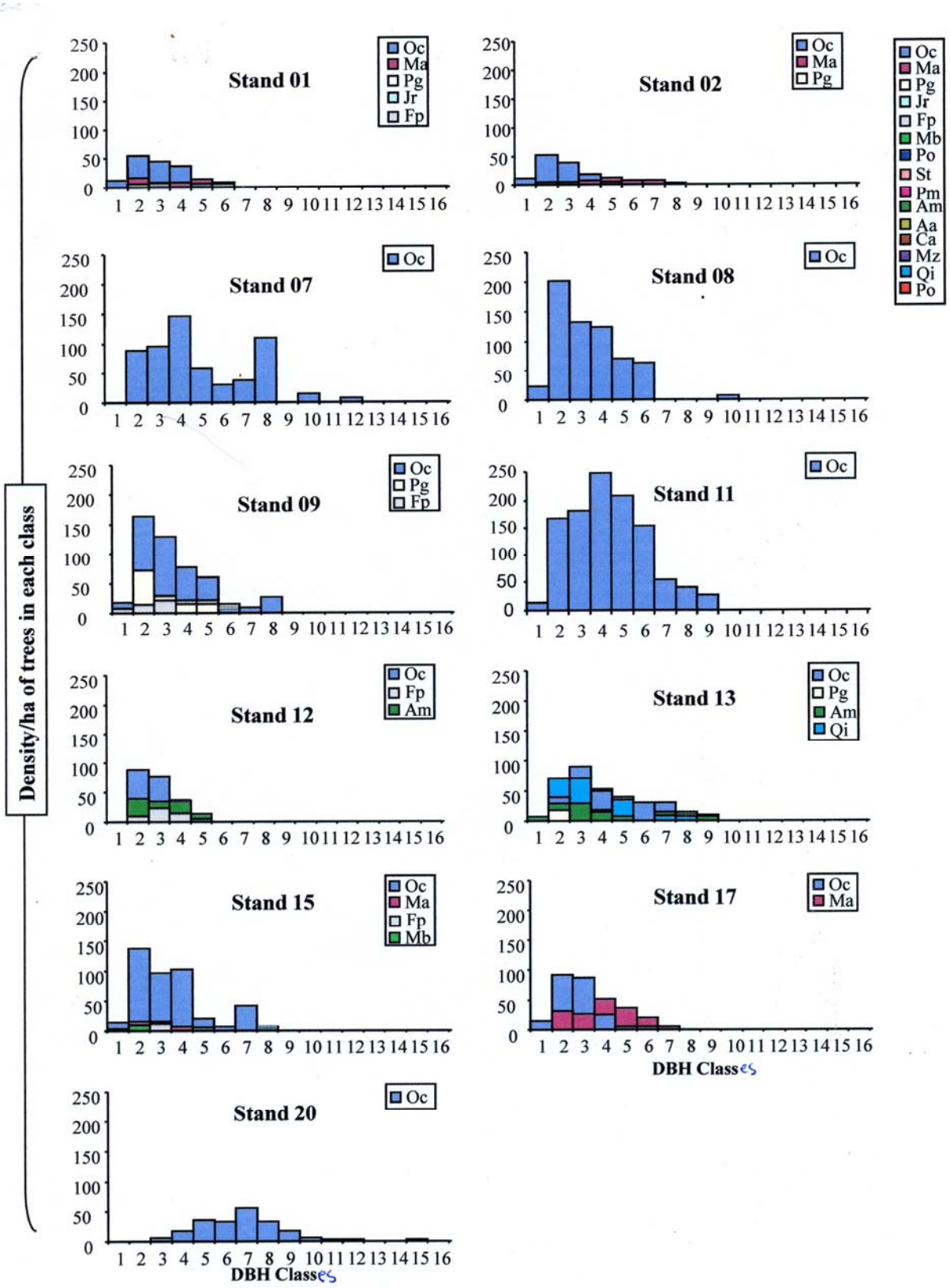


Fig. 3. Density size classes of each species in different stands of sampling area. Class interval = 10cm DBH. Species are shown by different colours.

Note: Oc= *Olea ferruginea*, Ma= *Morus alba*, Pg= *Punica granatum*, Jr= *Jugleus regia*, Fp= *Ficus pamata*, Mb= *Monotheca buxifolia*, Po= *Plantanus orientalis*, St= *Salix tetrasperma*, Pm= *Prunus armeniaca*, Am= *Acacia modesta*, Aa= *Ailianthus alltissima*, Ca= *Celtis australis*, Mz= *Melia azedarach*, Qi= *Qurcous ilex*.

Fig. 3. Cont'd.

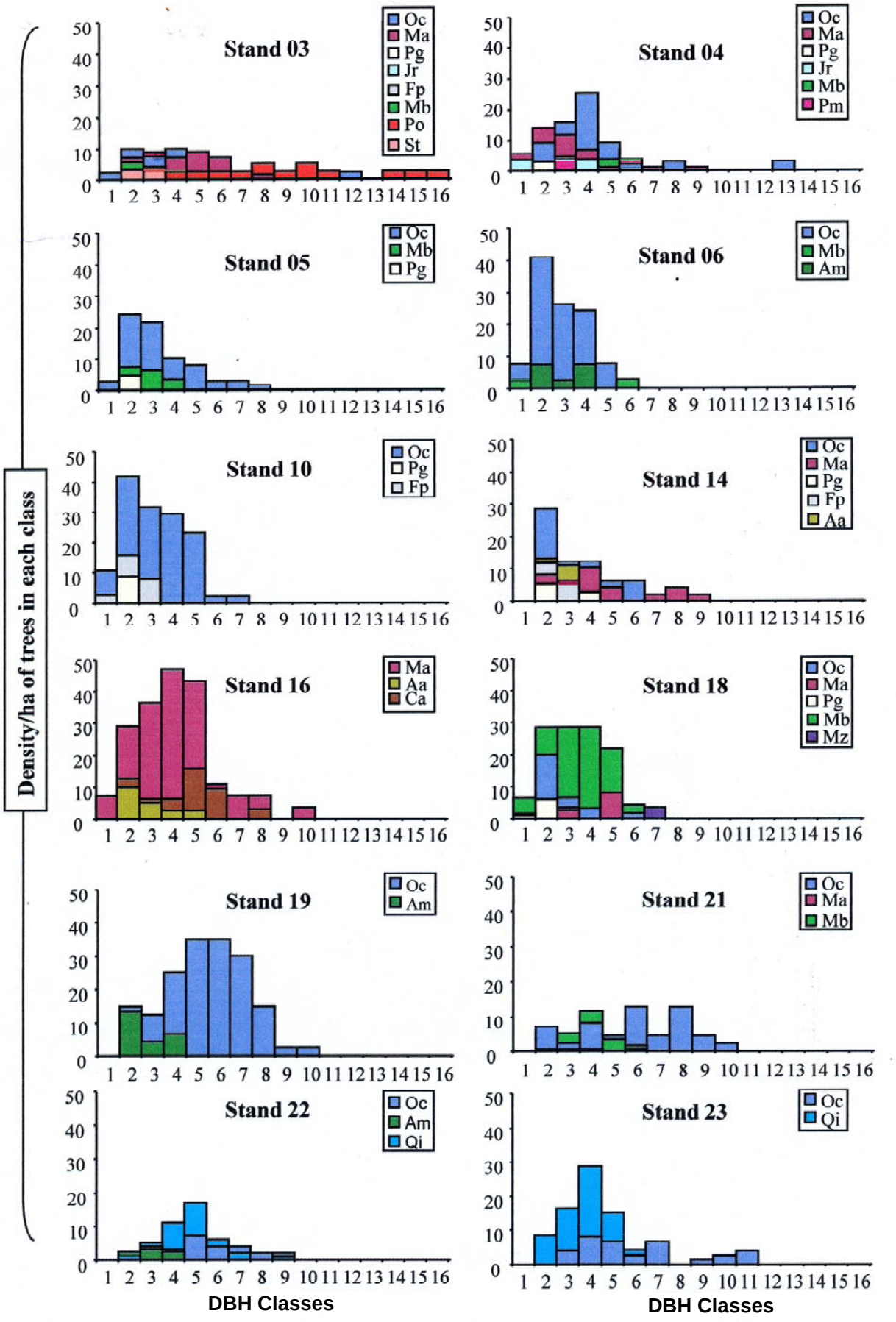
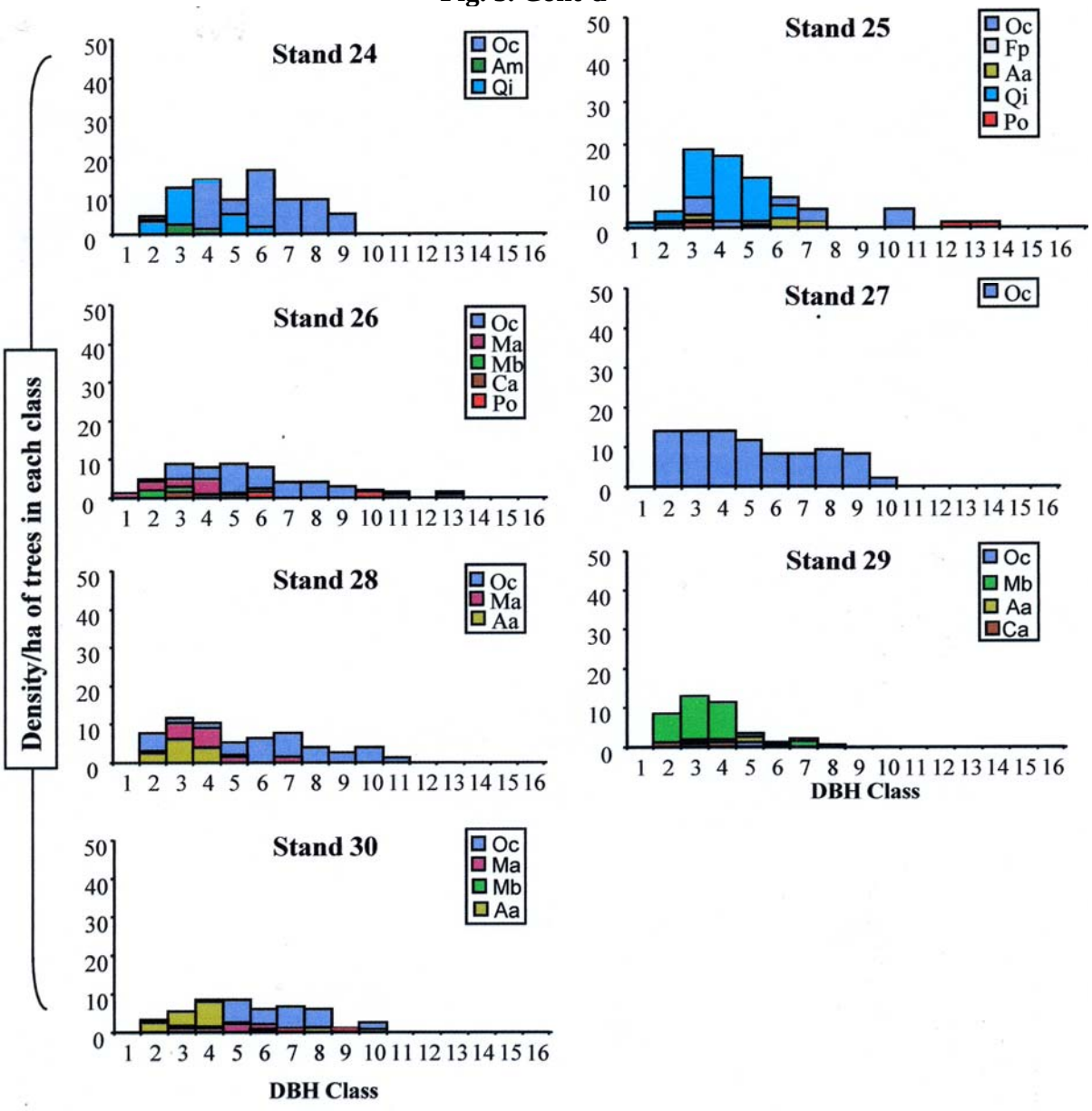

Stand 03
Oc Ma Pg Jr Fp Mb Po St
Stand 04
Oc Ma Pg Jr Mb Pm
Stand 05
Oc Mb Pg
Stand 06
Oc Mb Am
Stand 10
Oc Pg Fp
Stand 14
Oc Ma Pg Fp Aa
Stand 16
Ma Aa Ca
Stand 18
Oc Ma Pg Mb Mz
Stand 19
Oc Am
Stand 21
Oc Ma Mb
Stand 22
Oc Am Qi
Stand 23
Oc Qi
Density/ha of trees in each class
DBH Classes
DBH Classes

Fig. 3. Cont'd



more gaps due to an absence of trees of the particular size classes. These gaps have been frequently reported by various workers in the population structure of many tree species (Ahmed *et al.*, 1990a,b, 1991; Wahab *et al.*, 2008). In Pakistan the cause of these gap has never been studied and most of the conclusions are based on the study of disturbed forests. It is suggested that gaps in the middle, may result from tree fall by storm or cutting while in the beginning at sapling stage, these gaps may be due to the grazing of young seedling. In many stands, smallest size class showed no or very small number of trees. This situation could be controlled by promoting regeneration in these stands. Fig. 2 also hypothesized that in some stands *Olea ferruginea* may be replaced by some associate species and in future a new dominant species may appear, (stand No. 3, 4, 23, 25, 26, 28 and 29). For example, *Olea ferruginea* is completely replaced by *Morus alba* from stand No. 16. *Monotheca buxifolia* (stand 18, 29) and *Quercus ilex* (stand 23, 25) would probably eliminate *Olea ferruginea* in future. It is also evident from Fig. 2 that no associated species is distributed with a balanced population structure. This may be due to overgrazing or removal of certain species in the past. It is suggested that due to unbalanced structure of *Olea ferruginea* and continuous anthropogonic disturbances no conclusion could be made about the future trend of these forests.

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