

(Fagus orientalis)

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Moshtagh)

(et al., 2001

(Härdtle, 2004)

Mohadjer(1975) .

Jongman et al.,)

:(1995

Sabeti,)

(1976

Tabatabaei & Yasini,)

(1984

(1948) (Djavanshir, 1994)

Saei

Habibi Kaseb (1974)

%

%

¹ Monotonically increasing or decreasing

² Unimodal

³ Bimodal

Wittaker (1956)

Habibi Kaseb (1974)

(Oksanen & Minchin, 2001)

Gorji Bahri & Sagheb)

Sagheb)

(2003)

)

(Talebi, 1987

(Talebi, 1996

Mataji

(

Gulisashvili et al (1975)

(Kent & Coker, 1992)

Transcaucas

(μ)

:

(t)

(h)

Harris (2002) .

⁴ Unimodal Response Curve

⁵ Symmetric Gaussian Response Function

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GLM $\mu = h \exp\left[-\frac{(x - u)^2}{2t^2}\right]$

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(Guisan *et al.*, 2002)

Oksanen *et*)

(*al.*, 2001

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$\mu = \exp(b_0 + b_1x + b_2x^2)$

Austin *et al* (1984)

GLM

(Seavy *et al*, 2005)

$\mu = \exp(b_0 + b_1x)$

$b_2 < 0$

(%)

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$$u_x = -\frac{b_1}{2b_2} \quad t_x = \sqrt{-\frac{1}{2b_2}} \quad h = \exp\left(a - \frac{b_1^2}{4b_2}\right)$$

$b_2 \quad b_1 \quad b_0$

(Odland *et al.*, 1995)

$h \quad t \quad \mu$

⁶ Generalized Linear Model

⁷ Residual Deviance

⁸ Overdispersion

(Nayshabouri, 2003)

Odland et al.,)

:(1995

$$\text{Link}(E_y) = b_0 + b_1 \cos(x - \mu) \quad ()$$

.(Zuur *et al.*, 2007)

$$\mu \quad x$$

quasi-poisson quasi-likelihood

$$\cos(x - \mu)$$

$$\cos(x - \mu) = \cos(x) \cdot \cos(\mu) + \sin(x) \cdot \sin(\mu)$$

$$\text{Link}(E_y) = b_0 + (b_1 \cos(\mu)) \cos(x) + (b_1 \sin(\mu)) \sin(x) = c_0 + c_1 x_1 + c_2 x_2$$

n) n %

$$x_2 = \sin(x) \quad x_1 = \cos(x)$$

$$b_0 \quad c_2 \quad c_1 \quad c_0$$

$$\mu \quad b_1 \quad ($$

.(Jongman *et al.*, 1995)

$$C_0 = b_0$$

$$c_1 = b_1 \cos(\mu)$$

$$c_2 = b_1 \sin(\mu)$$

$$c_1^2 + c_2^2 = b_1^2 \cos^2(\mu) + b_1^2 \sin^2(\mu) = b_1^2$$

$$b_1 = (c_1^2 + c_2^2)^{0.5}$$

$$\mu = \cos^{-1}(c_1 / b_1)$$

$$\mu \quad (\quad)$$

$$(\dots) \quad) \quad b_1$$

(Ferrer-Castan *et al.*, 1995)

.(Austin 2002)

%

$$(\quad)$$

x

...

51°32'

36°40'

36°27'

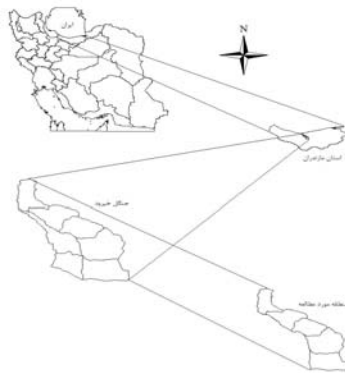
51°32'

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(GPS)

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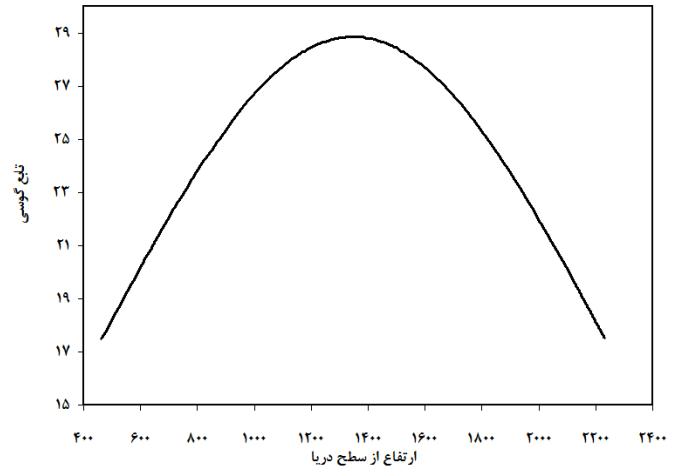
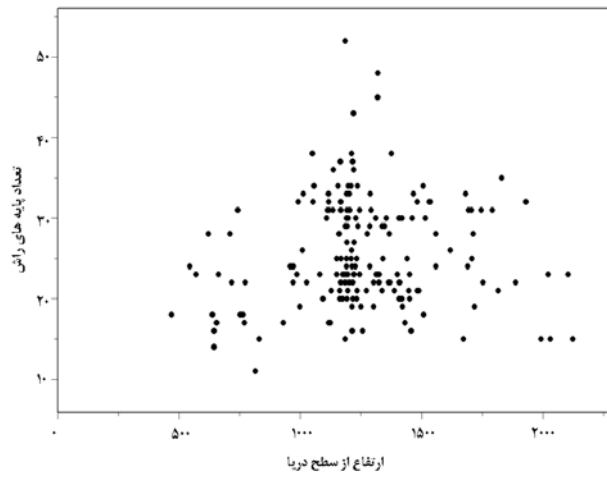
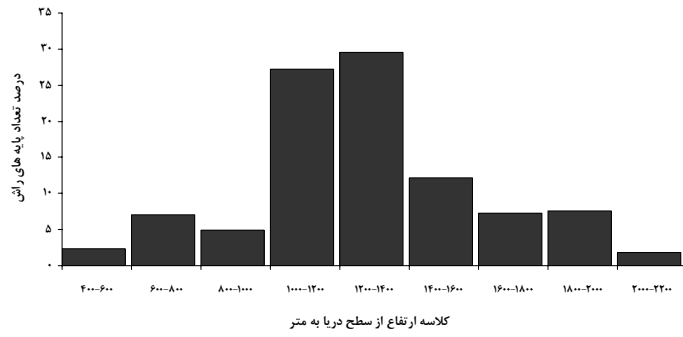
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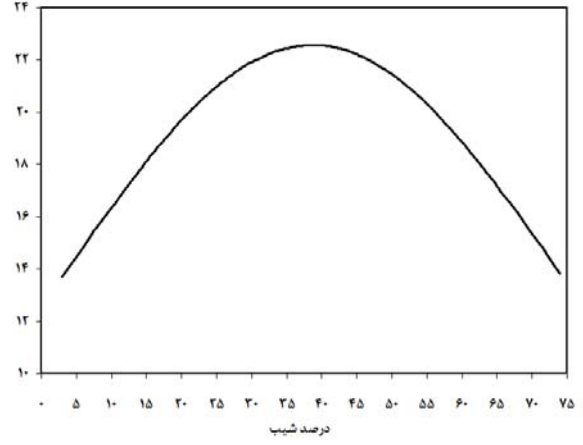
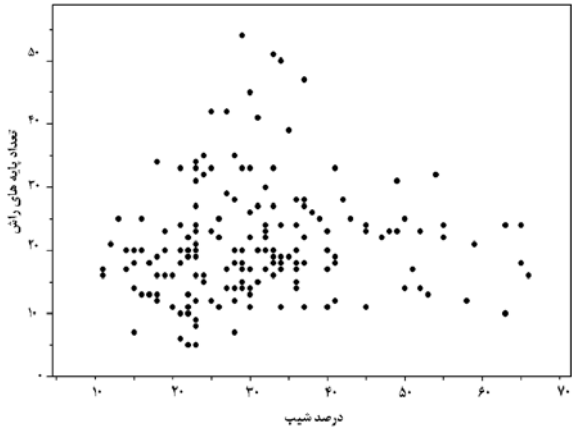
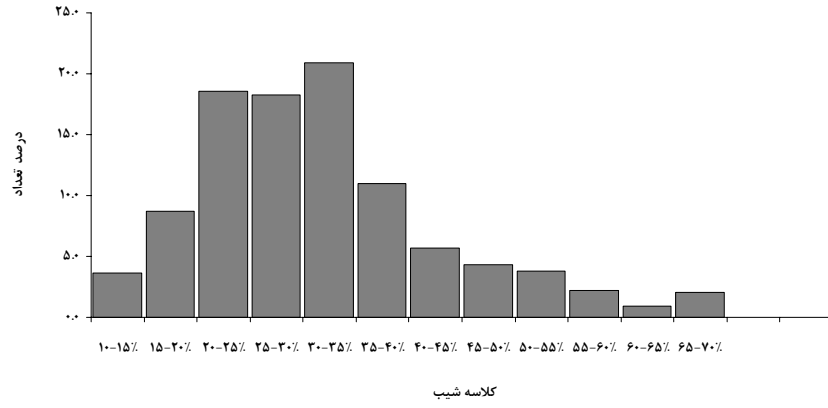
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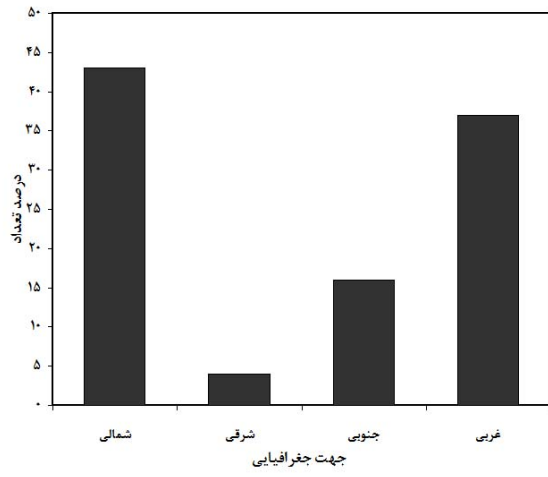
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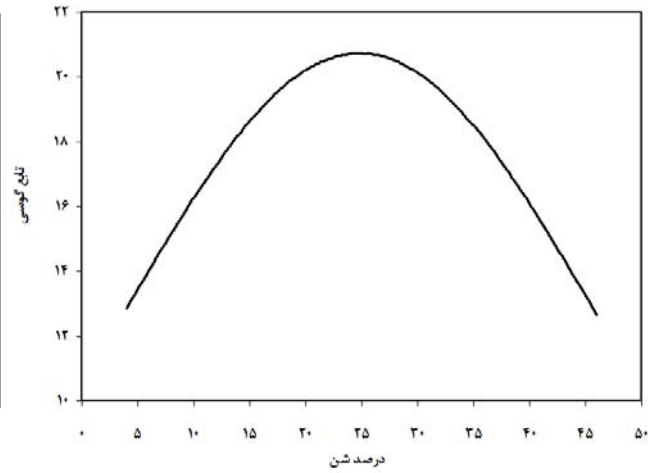
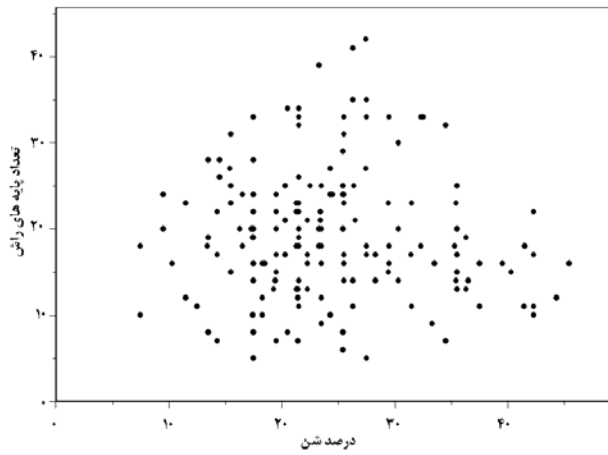
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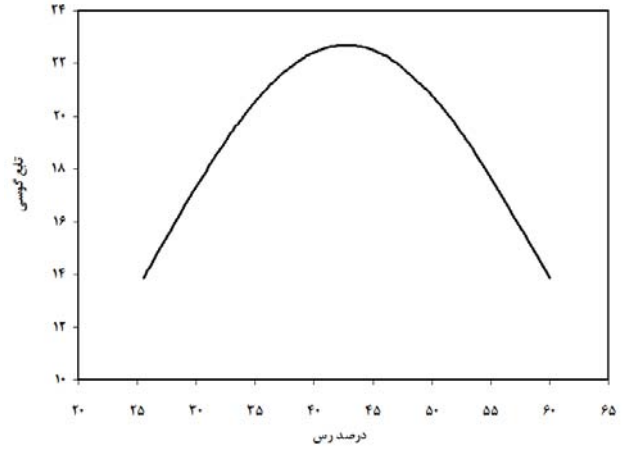
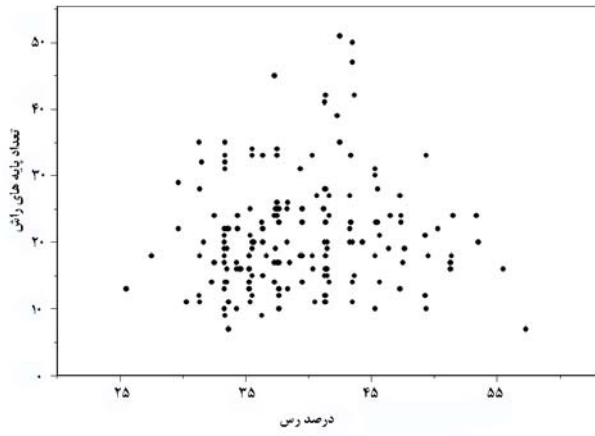
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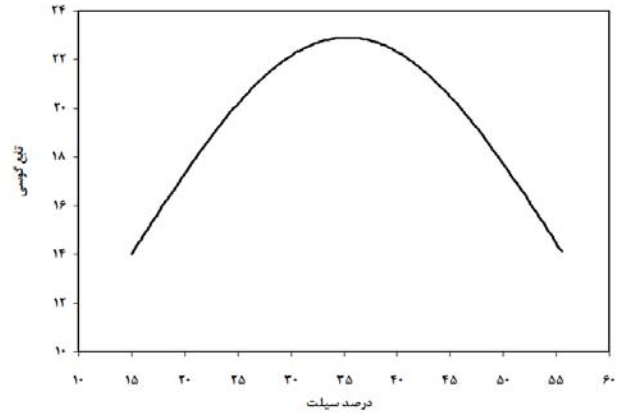
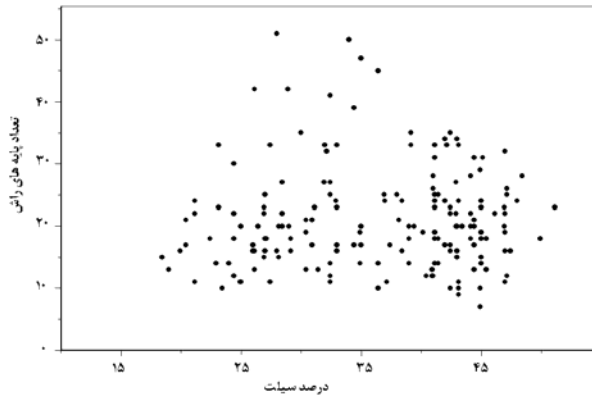
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Harris (2002)

Gulisashvili Mohadjer (1975)

et al., (1975)

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Harris (2002)

Gulisashvili et al (1975)

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Gärtner et al,)

(2008

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Habibi Kaseb (1974)

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⁹ Null Deviance
¹⁰ Residual Deviance

References

- Austin, M. P., R. B. Cunningham, and P. M. Fleming. 1984. New approach to direct gradient analysis using environmental scalars and statistical curve-fitting. *Vegetatio* 55:11-27
- Austin M.P., 2002. Spatial prediction of species distribution: an interface between ecological theory and statistical modelling. *Ecological Modelling* 157: 101-118.
- Etemad, Vahid. 2009. The Optimal Management of Kheyroud Forests: Forest Typology Map. Project of Youth Reserachers Funds. P 120
- Ferrer-Castan, Dolores. Jose F. Calvo and Miguel A. Esteve-Selma. 1995. On the use of three performance measures for fitting species response curve. *Journal of vegetation science*. 6:57-62
- Gärtner, Stefanie., Albert Reif., Fotios Xystrakis., Uwe Sayer., Nawal Bendagha & Andreas Matzarakis. 2008. The drought tolerance limit of *Fagus sylvatica* forest on limestone in southwestern Germany. *Journal of Vegetation Science* 19: 757-768
- Gorji Bahri, Yousef and Khosro Sagheb Talebi. 1987. The Effects of Late Spring Frosts on Beech Forests of Golband (Noshar). *Pazhouhesh and Sazandegi Journal*. 15: 18-21
- Guisan, Antoine ., Thomas C. Edwards., Jr and Trevor Hastie. 2002. Generalized linear and generalized additive models in studies of species distributions: setting the scene. *Ecological Modelling*. 157: 2-3, Pages 89-100
- Gulisashvili VZ, Makhatadze LB, Prilipko LI. 1975. *Rastitel'nost' Kavkaza*. Moskva: Nauka.
- Habibi Kaseb, Hossein. 1974. Investigation on the effects of soil texture on beech tree growth. *Journal of Natural Resources of Iran*. 31: 60-70
- Habibi Kaseb, Hossein. 1992. *Fundamental of Forest Soil Science*. University of Tehran Publication. 424 PP
- Härdtle, Werner., Goddert von Oheimb., Agnes Friedel, Hartmut Meyer, and Christina Westphal. 2004. Relationship between pH-values and nutrient availability in forest soils – the consequences for the use of ecograms in forest ecology. *Flora* 199, 134–142
- Harris, E. (2002). Goodbye to Beech? Farewell to *Fagus*? *Quarterly Journal of Forestry* 96 (2): 97.
- Huisman, J. H. Olf and L.F.M. Fresco. 1993. A Hierarchical Set of Models for Species Response Analysis. *Journal of Vegetation Science*, Vol.4, No.1. pp.37-46.
- Javanshir, Karim. 1994. *Dendrology, Lecture Notes*. Faculty of Natural Resources, University of Teran. 150 PP
- Jongman, R. H. G., ter Braak, C. J. F. & van Tongeren, O.F. R. 1995. *Data Analysis in Community and Landscape Ecology*. Cambridge University Press. 299 pp
- Kent, M., and P. Coker. 1992. *Vegetation description and analysis: a practical approach*. Belhaven Press, London.
- Mataji, Asadollah. 2003. *Site Classification Based on Plant Communities, Stand Structure and Physical and Chemical Conditions in Natural Forests*. PhD Thesis. Islamic Azad University. P 164
- Mohajer, Mohammad Reza. 1975. Investigation on the relationship between morphologic properties of Beech tree with its site. *Journal of Natural Resources of Iran*. 32: 14-29
- Moshtagh, Hassan., Yadollah Resaneh and Parviz Salehi. 2001. Qualitative and Quantitative investigation of Hyrcanian Forests. *Proceedings of National Conference on Management if Hyrcanian Forests and Sustainable Development*. Lecture Part. Page 55-79
- Nayshabouri, Ali Asghar. 2003. *General Ecology*. Payame Noor Publication. 328 PP
- Odland, A. H.J. Birks and J.M. Line. 1995. Ecological optima and tolerances of *Thelypteris limbosperma*, *Athyrium distentifolia* and *Matteuccia struthiopteris* along environmental gradients in Western Norway. *Vegetation*. 120:115-129
- Oksanen, Jari and Peter R. Minchin. 2001. Continuum theory revisited: what shape are species responses along ecological gradients? *Ecological Modelling* 157:119-129
- Oksanen, Jari., Esa Läärä, Kimmo Tolonen and Barry G. Warner. 2001. Confidence intervals for the optimum in the Gaussian response function. *Ecology* 82, 1191-1197.
- Sabeti, Habibollah. 1976. *Forests, Trees and Shrubs of Iran*. University of Tehran Publication. 810 PP
- Saei, Karim. 1948. *Silviculture: Volume 1*. University of Tehran Publication. 339 PP

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- Sagheb Talebi, Khosro. 1996. Quantitative und qualitative Merkmale von Buchenjungwüchsen (*Fagus sylvatica*L.) unter dem Einfluss des Lichtes und anderer Standortfaktoren. Beiheft zur Schweizerischen Zeitschrift für Forstwesen (SZF), Nr. 78. 219p.
 - Seavy, Nathaniel., Suhel Quader, John D. Alexander and C. John Ralph. 2005. Generalized linear models and point count data: statistical considerations for the Design and Analysis of Monitoring Studies. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. P 744-753
 - Tabatabaei, Mohammad and Ali Akbar Yasini. 1984. Studying the Eastern Forests of Mazandaran. 60 PP
 - Whittaker, R. H. 1956. Vegetation of the Great Smoky Mountains. Ecol. Monogr. 26: 1-80.
 - Zuur, A.F., E.N. Ieno. And G.M. Smith. 2007. Analysing ecological data. Springer publication. 672 pp

Extracting Ecological Optimum and Amplitude of *Fagus orientalis* along environmental gradients in Kheyroud Forest, Nowshahr

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Abstract

The present research was performed in Patom, Namkhaneh, Gorazbon, Chelir and Baharbon districts in Kheyroud forest. Due to existence of forest typology map and extension of study area, this study was confined to beech dominated forests. A stratified sampling method based on landform is used to locate 1000 m² circular sample plots. The number of *Fagus orientalis* Lipsky trees ≥ 7.5 cm in DBH within each plot is recorded along with elevation, aspect and slope of the ground. Furthermore, at the center of plot, soil samples from A horizon are taken for analyzing soil texture. Gaussian response function was used. Instead of direct estimation of Gaussian parameters, it is customary to fit an equivalent polynomial model. This can be easily fitted as a generalized linear model (GLM) with a logarithmic link function. This function showed beech has 1347 and 464-2231 m a.s.l for its optimum and ecological amplitude, respectively. North-facing slopes (optimum 43 degree) are the most suitable slope for *Fagus* occurrences. Beech tree can distribute from gentle to steep slopes in the study area, but this species in 39% slope has the best performance. Using generalized linear model showed *Fagus* can tolerate slopes from 3 to 74%. In light of sand, clay and silt, Beech tree has 25%, 43% and 35 % for optimum and 4-46 %, 25-60% for clay and 15-55 % for silt for ecological amplitude, respectively.

Keywords: Beech tree, Optimum, Ecological amplitude, Gaussian response function, Generalized linear model, Soil texture, Physiographic factors