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Surveying of Bird Species Diversity Indices (Case Study: Tang Soulak Protected Area, Kohkiloye and Boyerahmad Province, Iran)

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ABSTRACT

This research was carried out from March 2014 to late August 2014 in Tang Soulak protected area in the Kohgiloye - Boyer Ahmad Province, I. R. Iran. The method used in this study was based on radius point counts. In the study area, 27 terrestrial bird species were identified. According to the "Margalef Index", the most biodiversity richness was observed in May (3.12) and the least richness in March (2.92). According to "Menhink Index", the most richness was seen in March (0.53) and the least in July and August (0.44).According to "Simpson Index", the max. Biodiversity richness was in April (0.793) and the min. biodiversity was in March (0.699). According to"Shanon-viner Index" the max. Biodiversity richness was observed in April (3.396) and the min. biodiversity in March (2.892). According to "Simpson Index" the most uniformity was in April (0.193) and the least uniformity was in May and March (0.144). The diversity of species uniformity indices indicate a high habitat quality around "Tang Soulak protected area" area and status of good conditions for birds which should be considered in the management issues.

Introduction

The world's biodiversity is diminishing rapidly (Balmford et al. 2003; Jenkins et al. 2003). At the 2002 World Summit on Sustainable Development, the nations of the world agreed to pursue more effective implementation of the objectives of the Convention on Biological Diversity (CBD) in order to achieve a significant reduction in the current rate of loss of biological diversity by 2010 (Secretariat of the Convention on Biological Diversity 2003; Butchart *et al*, 2004). Biological diversity is the richness and evenness of species amongst and within living organisms and ecological complexes (Polyakov *et al.*, 2008). Biodiversity is mostly studied in species level. There are different indices to measure biodiversity. The most commonly considered facet of biodiversity is species richness. Evenness is another important factor of biodiversity. (Kharkwal *et al.*, 2004). Evenness has been considered as a fundamental fact in habitats with more than one species (Hashemi 2010). The conservation of biodiversity has become an important issue receiving national and international attention (Noss, 1991; Noss and Cooperrider, 1994; Wilson, 1992). Species diversity has two basic components: richness, or number of species in a given area, and evenness, or how relative abundance or biomass is distributed among species (Huston, 1994; Purvis and Hector, 2000; Magurran, 2001; Jahanbakhsh Gange *et al*, 2013). Examine patterns of species diversity in habitats, it can be very efficient in planning for habitat management. Measuring diversity and examining the long-term changes in species diversity, can provide us a pattern of environmental changes. Birds are among the best monitors of environmental changes and have been used to evaluate the environment throughout the history as biomonitors and the changes in their population, behavior patterns and reproductive ability have most often been used to examine the long term effects of habitat fragmentation. (Harisha and Hosetti, 2009). Birds constitute one of the common fauna of all habitat types, and because they are responsive to changes, their diversity and abundance can reflect ecological trends in other biodiversity (Furness and Greenwood, 1993). Because of their highly-specific habitat requirements, birds become increasingly intolerant of even slight ecosystem disturbance (Schwartz and Schwartz, 1951). An assessment of the abundance and diversity of bird species in ecosystem can, therefore, serve as a good indication of the health of the environment in and around the ecosystem (Bowden, 1990). Jarvinen and Vaisenen (1978) used line-transect data on bird abundance to monitor the effect of habitat change in Nordic countries, and reported that a change in forest structure caused changes in bird populations in Northern Finish forest. Hence they are the good indicators of ecological status of any given ecosystem (Bilgrami, 1995). So study the biodiversity of birds is very important as the basis for other studies of ecosystem. Many studies have been carried out on bird biodiversity indices around the world. For example, Elemberg, *et al*. 1994) in Finland and Sweden, (Herremans, 1999) in Botswana, (Mae and Hattori, 2001) in Japan., (Ratti , *et al*. 2001) in Dakota America in and (Yang and Quan, 2002) in China can be named.

Main objective of this study was to quantitatively analyse the biodiversity of birds in Tang Soulak protected area, Kohkiloye and Boyer Ahmad province, I. R. Iran.

Materials and Methods

Study area

The Study area, Tang Soulak protected area (2428 ha), is located in Kohkiloye and Boyerahmad province in Iran. It is between 50_ 11´- 50_ 17´ longitude and 30_ 35´ - 30_ 37´ latitude (Fig. 1). The study area is located above sea level, in 1000-2331 m range. The average annual precipitation in the study area is about 490 mm. The average annual temperature for the region during the past 20 years is 26 ° C. The number of dry months for the region, are 4 months. The study area is located in the vegetal Iranian and Turanian area and contains a large collection of plants and animals known and reported in the country. The most important mammals in the study area are the wolf, tiger, goats, boar, hyena and Iranian Squirrel...

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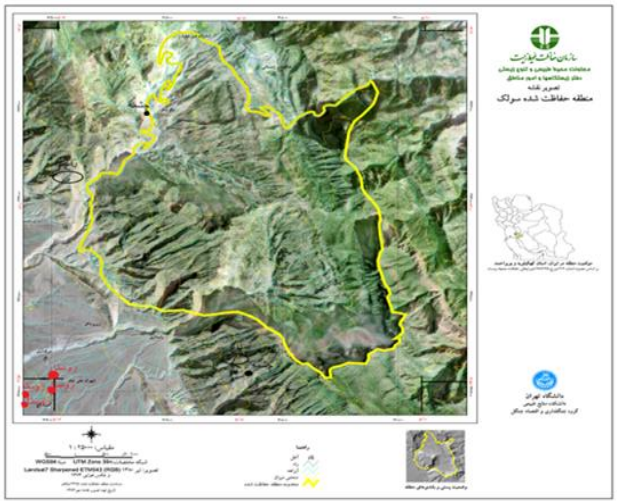

Figure 1. Tang Soulak protected area, Kohkiloye and Boyerahmad Province, Iran

Materials and Methods

We used the point count method (Manuwal and Carey, 1991) in the early morning to record birds at sampling points (Bibby et al., 2000) during the breeding season (April 3th–August 27th 2014). Each of the 50 points was visited fifteen times, over the five months. In adverse weather conditions (eg strong winds) or limited visibility we stopped working (Selmi, et a, l 2003; Bibby, et al, 1992; Mitchell, et al 2001; Kilgo, et al, 2002; Jahanbakhsh Ganje et al, 2013). Considering that the time of day affects bird activity, which in turn affects detection probability, the order of sampling points during one morning tour was alternated between start (1 h before sunrise) and finish (at the latest 5 h after sunrise) of each tour. Each visit lasted 15 . Presence of bird species was recorded visually and acoustically in a radius of 50 m, with the first 10 min of observations at the center and the remaining 5min checking areas hidden from the observer. When counting birds, we took special care that individuals were counted once only. We did not distinguish between breeders and other visitors as distinction is difficult, and over-flying birds were counted only when they were flying low and/or showed connection to the ground environment (i.e. searching for food). Species richness for each sampling point was defined as the total number of species detected during the fifteen visits. Abundance for each species and sampling point was defined as the maximum number of indi- viduals present in any of the fifteen visits. Data analysis was performed using software Ecological methodology and formulas listed in Table 1.

Results

In this study, 27 species were identified belonging to 18 families. (Table 2).

The dominant species

The results showed that among birds, *Passer domesticus*, was the dominant species in the region in all months. (Table 2).

Total number of birds

Within the study area, the most number of individual were observed in July (3396) and the least numbers were observed in March (1870). (Figure 2)

Species richness, diversity and evenness

According to the "Margalf Index", the most biodiversity richness was observed in May (3.12) and the least richness in March (2.92). According to "Menhink Index", the most richness was seen in March (0.53) and the least in July and August (0.44).According to "Simpson Index", the the max. Biodiversity richness was in April (0.793) and the min. biodiversity richness was in May (0.732).

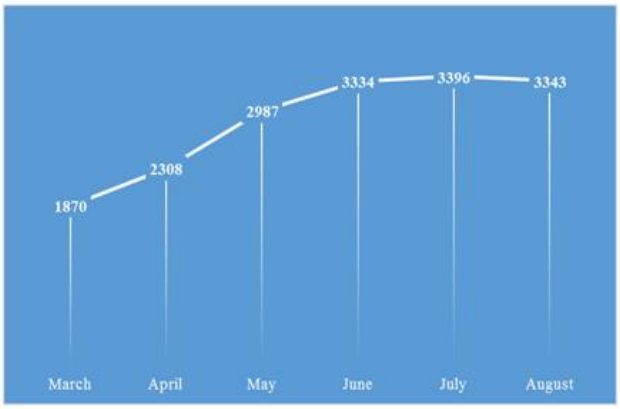

Fig 2. Average monthly number of birds in the study area since March to August 2014

According to "Shanon-viner Index" the max. Biodiversity richness was observed in April (3.396) and the min. biodiversity in March (2.892). According to "Simpson Index" the most uniformity was in March (0.53) and the least was in July and August (0.44). (Table 3).

Discussion

Monthly review of population and diversity of birds in the Tang Soulak area shows that in July, the total number of birds is more than any other months of the study. This is for two reasons: First, birds like Sparrow and Nightingale, which are breeding in the region (During the review, the nest of this species in the region were identified) increase the number of birds in this month. Second, in this month, farms and orchards in the study area provide plenty of food to feed the birds and will attract more birds to the area. Throughout the study, Sparrow, was the dominant species, which can cause reproductive success of this species and its high compatibility with human communities. Study on species richness index suggest an approximate similarity between fluctuation pattern of margalef and menhnick's index which menhnick's index shows a milder up and down during the period of study. Also by evaluating the simpson and Shannonwiener species diversity indexes, a harmony of fluctuation pattern is seen. Given that, the uniformity index species diversity, are indicators for habitat quality (Torres, 1990), the study area is suitable for birds, which this must be considered in their management.

The structure of the world's landscapes is undergoing rapid change, mainly due to human-related activities. Indeed, some estimates state that between one-third and one half of the earth's landscape has been altered by human activities (Vitousek, et al. 1997). These changes in landscape structure and organization are believed to have a significant bearing on the distribution and maintenance of ecosystem integrity (Forman & Godron, 1987; Forman, 1995; O'Neill & Hunsaker, 1997; Dale et al., 2000). In particular, as part of the need to maintain long-term biodiversity, elements of biodiversity need to be preserved at different natural levels, ranging from genetic and species scales to ecosystems and landscapes (Heywood, 1995). Diversity indices continue to be employed by ecologists to describe the composition of a landscape using a single number (Turner, 1990; Rey-Benayas & Pope, 1995; Riitters et al., 1995). Positive relationships between indices of species and ecosystem diversity have been noted (Noderhaug, et al. 2000; Pino, et al. 2000). However there is a growing awareness that, across the world, comparisons of different landscapes reveal a general and worrying decline in diversity, not least arising from different management scenarios, including undesirable ownership regimes or management practices (Nagaike & Kamitani, 1999; Bartolome, et al. 2000; Fu & Chen, 2000; Zhou, 2000).

Table 1. Indicators used to assess biodiversity monthly

The regards	How to calculate
Species Richness Margalef index(1958)	$R_1= (S-1)/LnN$
Species Richness Menhnick's Index (1964)	$R_2= S/\sqrt{N}$
Species Diversity Shannon- Wiener Index	$H^{/}= -\Sigma^{s}_{i=1}P_i \ln P_i$
Species Diversity Simpson,s Index	$\lambda = 1- \Sigma^{s}_{i=1} [\{ni(ni-1)\}/\{N(N-1)\}]$
Evenness Simpson's Index	$E= \{(1/\lambda)-1\}/(e^{H/}-1)$

S= Number of species, N= Total size of population, Pi= Relative abundance of species i, ni= Number of species i, λ = Amount of Simpson's Index, $H^{/}$= Amount of Shannon- Wiener Index, e= Natural logarithm,

Table 2. Average Monthly number of birds the study area since March to August 2014

rows	family	species	Average number in the months					
			March	April	May	June	July	August
1	Falconidae	*Falco tinnunculus*	4	3	3	4	3	3
2	Columbidae	Streptopelia turtur	30	37	35	41	39	40
3	Apodidae	Apus apus	100	150	200	200	200	150
4		Apus pallidus	50	100	150	150	150	150
5	Meropidae	Merops orientalis	2	100	100	170	170	170
6		Merops superciliosus	0	0	50	50	50	50
7	upupidae	Upupa Epops	7	10	25	24	24	27
8	Hirundinidae	Hirundo rustica	0	100	100	150	150	150
9		Hirundo daurica	0	100	100	150	150	150
10	Motacillidae	Motacilla alba	70	75	70	64	70	55
11	laniidae	Lanius excubitor	11	21	24	23	27	32
12	Muscicapidae	Erithacus rubecula	23	28	26	28	36	39
13		Irania gutturalis	19	21	32	39	38	44
14	Turdidae	Luscinia megarhynchos	32	36	34	38	49	51
15		Oenanthe lugens	21	22	31	30	46	42
16	Muscicapidae	Muscicapa striate	36	32	39	38	49	53
17	paridae	Parus ater	65	67	73	75	96	94
18		Parus Major	54	52	53	67	75	72
19	Sittidae	Sitta tephronata	46	52	56	69	68	73
20	Fringillidae	Carduelis carduelis	35	32	45	76	74	76
22	sturnidae	Sturnus valgaris	43	49	32	45	46	40
23	Corvidae	Pica pica	32	31	26	26	24	23
24		Corvus corax	56	43	32	28	15	11
25	picidae	Dendrocopos medius	14	27	31	49	47	48
26	Ploceidae	Passer domesticus	1000	1000	1500	1500	1500	1500
27		Petronia Brachydactyl	120	120	120	200	200	200

Table 3. Amount of monthly index of biodiversity birds in in the study area since March to August 2014

	Index	Month					
		March	April	May	June	July	August
Richness	Margalef	2.92	3.09	3.12	3.08	3.07	3.08
	Menhink	0.53	0.52	0.47	0.45	0.44	0.44
Species diversity	Shannon-Wiener	2.892	3.396	3.143	3.323	3.366	3.351
	Simpson's	0.699	0.793	0.732	0.778	0.786	0.780
Eveness	Simpson's	0.144	0.193	0.144	0.173	0.179	0.175

As a response to this decline, many studies have noted that the maintenance of high diversity is often a desirable objective for managers (Del Valle, et al. 1998; Bartolome et al., 2000; Fairbanks & Benn, 2000; Fu & Chen, 2000). To this end, quantification of diversity has become increasingly crucial, both in the management of ecosystem and in the evaluation of their underpinning diversity. Species richness and species diversity are generally considered good indicators of the quality of nature and ecosystem health (Rapport, 1999). However, they have limitations and do not elucidate all aspects of the community dynamic: species richness does not consider the differences in species composition and diversity metrics have a limited comparability between points (Jost, 2006). Community analyses are used to explain changes in community composition (Moretti et al., 2006). The importance to identify thresholds of particular habitat vari- ables which, if exceeded or undercut would cause biodiversity to be maintained or even enhanced in the environment, has been highlighted by several studies (Marzluff and Ewing, 2001). Such predicted thresholds are important tools for convincing envi- ronmental managers and politicians of the effectiveness of specific measures. In addition, there is an increasing consensus that biodiversity is important for the quality of life of the people in general. Birds are often chosen as indicators of habitat quality. Their ecology is well known and species respond well to the availabil- ity of habitat structures (Clergeau et al., 1998; Evans et al., 2009). Due to lack of proper management in the study area, Bird habitats, including orchards and fields, oak trees and other habitats are destruction rapidly and in the not too distant future, we will see a sharp decline in the number of species of birds in this in this region.

Refrences

Balmford A, Green RE, and Jenkins M. Measuring the changing state of nature. Trends Ecol. 2003; (18): 326–330.

Bartolome J, Franch J, Plaixats J, and Seligman N. G. Grazing alone is not enough to maintain landscape diversity in the Montseny Biosphere Reserve. Agriculture, Ecosystems & Environment. 2000; (77): 267–273.

Bilgrami KS. *Concept and Conservation of Biodiversity*. CBS Publishers and distributors, Delhi. 1995.

Bowden CGR. Selection of foraging habitat by woodlarks nesting in pin plantation. *Appl. Ecol.* 1990; *(27***)**: 410– 419.

Bibby J C, Burgess ND, Hill DA, and Mustoe SH. Bird Census Techniques, Academic Press, 1992.pp302.

Dale VH, Brown S, Haeuber RA, Hobbs NT, Huntly N, Naiman RJ, Riebsame WE, Turner MG, and Valone JJ. Ecological principles and guidelines for managing the use of land. Ecological Applications. 2000; (10):639–670.

Del Valle HF, Elissalde NO, Gagliardini DA, and Milovich J. Status of desertification in the Patagonian region: assessment and mapping from satellite imagery. Arid Soil Research and Rehabilitation. 1998; (12): 95–121.

Elemberg PN, Poeysae H, Sjoeberg K. Relationship between species number, lake size and resource diversity in assemblages of breeding water. J Biol. 1994;(21): 75–84.

Evans KL, Newson SE, and Gaston KJ. Habitat influences on urban avian assem- blages. Ibis. 2009; (151): 19–39.

Fairbanks D H K, and Benn G A. Identifying regional landscapes for conservation planning: a case study from KwaZulu-Natal, South Africa. Landscape and Urban Planning. 2000; (50): 237–257.

Forman RTT, and Godron M. *Landscape ecology*. New York: Wiley. 1987.

Forman RTT. *Land mosaics: the ecology of landscapes and regions*. Cambridge: Cambridge University Press. 1995.

Fox AD, and Bell MC. Breeding bird communities and environmental variable correlations of Scottish peatland wetlands. In Aquatic-Birds in the Trophic Web of Lakes. (ed) Kerekes J .1994; 297-307.

Fu BJ, and Chen LD. Agricultural landscape spatial pattern analysis in the semi-arid hill area of the Loess Plateau, China. Journal of Arid Environments. 2000; (44): 291–303.

Furness RW, and **Greenwood JJD.** *Birds as a Monitor of Environmental Change.* Chapman and Hall, London. 1993.

Harisha MN, and Hosetti BB. DIVERSITY AND DISTRIBUTION OF AVIFAUNA OF LAKKAVALLI RANGE FOREST, BHADRA WILDLIFE SANCTUARY, WESTERN GHAT, INDIA. Ecological Society (ECOS), Nepal. 2009 ;(16): 21-27.

Hashemi SA. Evaluation plant species diversity and physiographical factors in natural broad leaf forest. Amer J Environ Sci. 2010; 6 (1): 20-25.

Hattori A, and Mae S. Habitat use and diversity of water-birds in a coastal lagoon Biwa. J Ecol Res. 2001 ;(16): 543–553.

Heywood, V.H. (Ed.). (1995). *Global biodiversity assessment*. Cambridge: Cambridge University Press.

Herremans M. Water-bird diversity, densities, communities and seasonality in the Kalahari basin, Botswana. J Arid Environ. 1999 ;(43): 319–350.

Huston MA. Biological Diversity. Cambridge University Press, Cambridge, UK. 1994.

Jarvinen O, and Vaisenen RA. Recent changes in forest bird population in Northern Finland. *Anim. Zool.* (1978); **(15**) 279–289.

Jenkins M, Green RE, Madden J. The challenge of measuring global change in wild nature: Are things getting better or worse? Conserv Biol. 2003; (17): 20–23.

Jost L. Entropy and diversity. Oikos. 2006; (113): 363–374.

Keller V, Zbinden N, Schmid H, and Volet B. Rote Liste der gefährdeten Brutvo- gelarten der Schweiz. Bundesamt für Umwelt, Wald und Landschaft (BUWAL) and Schweizerische Vogelwarte, Bern and Sempach. 2001.

Kharkwal G, Mehrotra P, Rawat YS, Pangtey YPS. Comparative study of herb layer diversity in pine forest stands at different altitudes of central Himalaya. Appl Ecol Environ Res. 2004; 2 (2): 15-24.

Kilgo JC, Gartner DL, Chapman BR, and Dunning JB. A test of an expert-based bird habitat relationship model in South Carolina. Wildlife Society Bulletin. 2002; (30): 783-793.

Magurran AE, and Phillip D. Implications of species loss in freshwater fish assemblages. Oikos. 2001; (94):645–650.

Manuwal DA, and Carey AB. Methods for measuring populations of small, diurnal forest birds, wildlife-habitat relationships: Sampling procedures for Pacific Northwest vertebrates, USDA Forest Service. General Technical Report PNW-GTR-278. 1991.

Marzluff JM, and Ewing K. Restoration of fragmented landscapes for the con- servation of birds: a general framework and specific recommendations for urbanizing landscapes. Restor. Ecol. 2001; (9): 280–292.

Mitchell MS, Lancia RA, and Gerwin JA. Using landscape level data to predict the distribution of birds on a managed forest effect of scale. Ecological Modelling. 2001; (11): 1692-1708.

Moretti M, Duelli P, and Obrist MK. Biodiversity and resilience of arthro- pod communities after fire disturbance in temperate forests. Oecologia. 2006; (149): 312–327.

Nagaike T, and Kamitani T. Factors affecting changes in landscape diversity in rural areas of the Fagus crenata forest

region of central Japan. Landscape and Urban Planning. 1999; (43):209–216.

Noderhaug A, Ihse M, and Pedersen O. Biotope patterns and abundance of meadow plant species in a Norwegian rural landscape. Landscape Ecology. 2000; (15): 201–218.

Noss Reed F. From endangered species to biodiversity. In: Kohm, K., ed. Balancing on the brink of extinction: the Endangered Species Act and lessons for the future.Washington, DC: Island Press. **1991.**318 p.

Noss Reed F, Allen Y. Saving nature's legacy: protecting and restoring biodiversity. Washington, DC: Island Press. **1994.** 416 p.

O'Neill RV, and Hunsaker CT. Monitoring environmental quality at the landscape scale. BioScience. 1997; (47): 513–519.

Pino J, Roda F, Ribas J, and Pons X. Landscape structure and bird species richness: implications for conservation in rural areas between natural parks. Landscape and Urban Planning. 2000; (49): 35–48.

Polyakov M, Majumdar I, and Teeter L. Spatial and temporal analysis of the anthropogenic effects on local diversity of forest trees. Forest Ecol Manag. 2008; (255): 1379-1387.

Purvis A, and Hector A. Review article: getting the measure of biodiversity. Nature. 2000; (405):212–219.

Quan R X, and Yang X. Effect of human activities on migratory water-birds at Lashihai lake, China. J Boil Conserv. 2002; (108): 273–219.

Rapport DJ. Perspective ecological integrity.Environ. 1999; (8): 116–118.

Ratti JT, Rocklage AM, Gindice JH, Gartoh EO, and Golner DP. Comparison of avian communities on restored and Natural wetland in north and South Dakota. J Wildlife Manage. 2001; (5): 679–648.

Rey-Benayas JM, and Pope KO. Landscape ecology and diversity patterns in the seasonal tropics from Landsat TM imagery. *Ecological Applications*. 1995; (*5*):386- 394.

Riitters KH, O'Neill RV, Hunsaker CT, Wickham JD, Yankee DH, Timmins SP, Jones KB, and Jackson BL. A factor analysis of landscape pattern and structure metrics. Landscape Ecology. 1995; (10): 23–39.

Secretariat of the Convention of Biological Diversity. Handbook of the Convention on Biological Diversity (2nd edition). London: Earthscan. 2003. 937 p.

Selmi S, Boulinier T, and Faivre B. Distribution and abundance patterns of newly colonizing species in Tunisian oases: the common black bird. Ibis. 2003;(145): 681-688.

Schwartz CW, and Schwartz ER. An ecological reconnaissance of the pheasants of Hawaii. *Auk.* 1951; **(68)**: 281– 314.

Stuart B, Stattersfield AJ, Bennun LA, Shutes, Akcakaya HS, Baillie JEM, Stuart SN, Hilton Taylor HC, and Mace GM. Measuring Global Trends in the Status of Biodiversity: Red List Indices for Birds. PLoS Biol, 2004; 2(12):0001-0011.

Torres M. Waterfowl community structure of Laguna Santo Domingo (Cordoba) during and annual cycle. Rev Asoc Scienc Nat Litor St Tome. 1990; (26): 33-40.

Turner MG. Spatial and temporal analysis of landscape patterns. Landscape Ecology. 1990; (4): 21–30.

Vitousek PM, Mooney HA, Lubchenco J, and Melillo JM. Human domination of Earth's ecosystems. Science. 1997; (277): 494–504.

Wilson Edward O. The diversity of life. Cambridge, MA: Belknap Press of Harvard University Press. **1992.**424 p.

Zhou, ZZ. Landscape changes in a rural area in China. Landscape and Urban Planning. 2000; (47): 33–38.