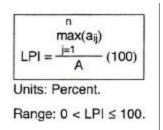
Appendix 2 - Formulas used for the computation of metrics for landscapes, classes, and patches in Machadinho d'Oeste and Vale do Anari (McGarigal and Marks 1995).

Term	Definition
E′	Total length (m) of edge in landscape; includes entire landscape boundary and background edge segments regardless of whether they represent true edge
eik	Total length (m) of edge in landscape between patch types (classes) i and k; includes landscape boundary segments representing tree edge only involving patch type i
e'ik	Total length (m) of edge in landscape between patch types (classes) i and k; includes all landscape boundary and background edge segment involving patch type i, regardless of whether they represent true edge
e"ik	Total length (m) of edge in landscape between patch types (classes) i and k; includes the entire landscape boundary and background edge segments, regardless of whether they represent true edge
N	Total number of patches in the landscape, excluding any background patches
$n = n_i$	Number of patches in the landscape of patch type (class) i
n <sub>ij</sub> c	Number of disjunct core areas in patch ij based on specified buffer width (m)
m	Number of patch types (classes) present in the landscape, excluding the landscape border if present
m′	Number of patch types (classes) present in the landscape, including the landscape border if present
$m_{\text{max}}$	Maximum number of patch types (classes) present in a landscape
gik	Number of adjacencies (joins) between pixels of patch types (classes) i and k
Pi	Proportion of the landscape occupied by patch type (class) i

Term	Definition
Subscripts:	1,, m or m' patch types (classes)
j	1,, n patches
k	1,, m or m' patch types (classes)
Symbols:	Total landscape area (m <sup>2</sup> )
a <sub>ij</sub>	Area (m <sup>2</sup> ) of patch ij
aijs	Area (m <sup>2</sup> ) of patch ijs within specified neighborhood (m) of patch ij
a <sub>ij</sub> c	Core area (m <sup>2</sup> ) of patch ij based on specified buffer width (m)
a <sub>ijq</sub> c	Area (m <sup>2</sup> ) of disjunct core area q in patch ij based on specified buffer width (m)
Pij	Perimeter (m) of patch ij
Pijk	Length (m) of edge of patch ij adjacent to patch type (class) k
E	Total length (m) of edge in landscape; includes landscape boundary and background edge segments if the user decides to treat boundary and background as edge; otherwise, only boundary segments repre- senting true edge are included

## METRICS USED FOR LANDSCAPES

• LARGEST PATCH INDEX: percentage of landscape accounted for by largest patch



• PATCH DENSITY: number of patches per 100 ha for a landscape

$$PD = \frac{N}{A} (10,000)(100)$$

Units: Number per 100 hectares.

Range: PD > 0, without limit.

• MEAN PATCH SIZE: average patch size for a landscape

$$MPS = \frac{A}{N} \left( \frac{1}{10,000} \right)$$

Units: Hectares.

Range: MPS > 0, without limit.

 PATCH SIZE STANDARD DEVIATION: population standard deviation for patch sizes of a landscape

$$PSSD = \sqrt{\frac{\sum_{i=1}^{m} \sum_{j=1}^{n} \left[a_{ij} - \left(\frac{A}{N}\right)\right]^{2}}{N}} \left(\frac{1}{10,000}\right)$$

Units: Hectares.

Range: PSSD ≥ 0, without limit.

 PATCH SIZE COEFFICIENT OF VARIATION: population coefficient of variation in patch size relative to the mean patch size for a landscape

$$PSCV = \frac{PSSD}{MPS} (100)$$

Units: Percent.

Range: PSCV ≥ 0, without limit.

• EDGE DENSITY: length of edge per hectare for a landscape

$$ED = \frac{E}{A} (10,000)$$

Units: Meters per hectare.

Range: ED ≥ 0, without limit.

• LANDSCAPE SHAPE INDEX: ratio of sum of edge lengths to total area for a landscape measured against a circle standard

$$LSI = \frac{E'}{2\sqrt{\pi \circ A}}$$

Units: None.

Range: LSI ≥ 1, without limit.

 AREA-WEIGHTED MEAN SHAPE INDEX: average perimeter-to-area ratio for a landscape, weighted by the size of its patches

$$\mathsf{AWMSI} = \sum_{i=1}^m \sum_{j=1}^n \left[ \left( \frac{p_{ij}}{2\sqrt{\pi \circ a_{ij}}} \right) \left( \frac{a_{ij}}{\mathsf{A}} \right) \right]$$

Units: None.

Range: AWMSI ≥ 1, without limit.

• TOTAL CORE AREA INDEX: core area defined by specified edge distance from the patch perimeter for the entire landscape as a percentage of total landscape area

$$TCAI = \frac{\sum_{i=1}^{m} \sum_{j=1}^{n} a_{ij}^{c}}{A}$$
(100)

Units: Percent.

Range: 0 ≤ TCAI < 100.

 MODIFIED SIMPSON'S DIVERSITY INDEX: proportional abundance of each patch type within the landscape

$$MSIDI = -ln \sum_{i=1}^{m} P_i^2$$

Units: None.

Range: MSIDI ≥ 0.

 MODIFIED SIMPSON'S EVENNESS INDEX: measurement of the distribution of area among patch types within the landscape

$$MSIEI = \frac{-\ln \sum_{i=1}^{m} P_i^2}{\ln m}$$

Units: None.

Range:  $0 \le MSIEI \le 1$ .

• INTERSPERSION AND JUXTAPOSITION INDEX: observed interspersion divided by maximum interspersion for the patch types in a landscape

$$IJI = \frac{-\sum\limits_{i=1}^{m'}\sum\limits_{k=i+1}^{m'}\left[\left(\frac{e_{ik}}{E}\right)\circ In\left(\frac{e_{ik}}{E}\right)\right]}{In(1/2[m'(m'-1)])} \ (100)$$

Units: Percent.

Range: 0 < IJI ≤ 100.

## METRICS USED FOR CLASSES

• PERCENTAGE OF LANDSCAPE: percentage of landscape accounted for a class

%LAND = 
$$P_i = \frac{\sum_{j=1}^{n} a_{ij}}{A}$$
 (100)

Units: Percent.

Range: 0 < %LAND ≤ 100.

• LARGEST PATCH INDEX: percentage of class accounted for by largest patch

$$n \\ max(a_{ij}) \\ LPI = \frac{j=1}{A} (100)$$

Units: Percent.

Range: 0 < LPI ≤ 100.

• PATCH DENSITY: number of patches per 100 ha for a class

$$PD = \frac{n_i}{A} (10,000)(100)$$

Units: Number per 100 hectares.

Range: PD > 0, without limit.

• MEAN PATCH SIZE: average patch size for a class

$$MPS = \frac{\sum\limits_{j=1}^{n} a_{ij}}{n_i} \left(\frac{1}{10,000}\right)$$

Units: Hectares.

Range: MPS > 0, without limit.

 PATCH SIZE STANDARD DEVIATION: population standard deviation for patch sizes of a class

$$PSSD = \sqrt{\frac{\sum_{j=1}^{n} \left[a_{ij} - \left(\sum_{j=1}^{n} a_{ij}\right)^{2}}{n_{i}} \left(\frac{1}{10,000}\right)}$$

Units: Hectares.

Range: PSSD ≥ 0, without limit.

• PATCH SIZE COEFFICIENT OF VARIATION: population coefficient of variation in patch size relative to the mean patch size for a class

$$PSCV = \frac{PSSD}{MPS} (100)$$

Units: Percent.

Range: PSCV ≥ 0, without limit.

• EDGE DENSITY: length of edge per hectare for a class

$$ED = \frac{\sum_{k=1}^{m'} e_{ik}}{A} (10,000)$$

Units: Meters per hectare.

Range: ED ≥ 0, without limit.

• LANDSCAPE SHAPE INDEX: ratio of sum of edge lengths to total area for a class measured against a circle standard

$$LSI = \frac{\sum_{k=1}^{m} e_{ik}^{"}}{2\sqrt{\pi \circ A}}$$

Units: None.

Range: LSI ≥ 1, without limit.

 AREA-WEIGHTED MEAN SHAPE INDEX: average perimeter-to-area ratio for a class, weighted by the size of its patches

$$\text{AWMSI} = \sum_{j=1}^{n} \left[ \left( \frac{p_{ij}}{2 \sqrt{\pi \circ a_{ij}}} \right) \left( \frac{a_{ij}}{\sum\limits_{j=1}^{n} a_{ij}} \right) \right]$$

Units: None.

Range: AWMSI ≥ 1, without limit.

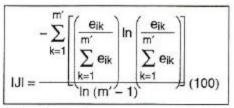
 MEAN CORE AREA INDEX: average of core areas defined by specified edge distance from the patch perimeter for the entire class as a percentage of total class area

$$MCAI = \frac{\sum_{j=1}^{n} \left(\frac{a_{ij}^{c}}{a_{ij}}\right)}{n_{i}} (100)$$

Units: Percent.

Range: 0 ≤ MCAl < 100.

• INTERSPERSION AND JUXTAPOSITION INDEX: observed interspersion divided by maximum interspersion for patches in a class



Units: Percent.

Range: 0 < IJI ≤ 100.

## **METRICS USED FOR PATCHES**

• AREA: area of the patch in hectares

Vector

$$AREA = a_{ij} \left( \frac{1}{10,000} \right)$$

Units: Hectares.

Range: AREA > 0, without limit.

• PERIMETER: perimeter of the patch, including any internal holes in the patch

Vector

PERIM = pij

Units: Meters.

Range: PERIM > 0, without limit.

• SHAPE INDEX: ratio of sum of edge lengths to total area for a patch, measured against a circle standard

$$SHAPE = \frac{p_{ij}}{2\sqrt{\pi \circ a_{ij}}}$$

Units: None.

Range: SHAPE ≥ 1, without limit.

• FRACTAL DIMENSION: degree of complexity of patches based on a perimeterto-area ratio

$$FRACT = \frac{2 \ln p_{ij}}{\ln a_{ij}}$$

Units: None.

Range: 1 ≤ FRACT ≤ 2.