### The Geranium indexes explained

#### Building blocks of the conservation concern assessment

First, the experts were asked to assess the level of concern of each activity for every CF in every month of the year, ultimately assigning one of the levels of concern (M, N, S) according to their definitions above (*see Section 3*). Note that *not applicable* (*N/A*) was also applied when an activity cannot physically overlap with a CF during that month. Assessing concern level by month allows the seasonality of concern to be taken into account, which is important since seasonal dynamics play a significant role in the Arctic ecosystem.

Therefore, the concern level of any given CF from a commercial activity in a given month when all levels of concern are included () is:

Where - a commercial activity, - a CF, and is for a month.

*W* – is a weight score assigned to a level of concern, where

When only *significant* level of concern is considered (), then:

#### Concern levels for CFs, commercial activities, AOIs.

and are “building blocks” allowing to measure concern levels for CFs, commercial activities and AOIs simply by summarising all or all within selected entity (CF, commercial activity or AOI).

Concern levels for selected entities are calculated as follows:

Or

Where is cumulative conservation concern level for a selected CF or commercial activity, or AOI, and is a cumulative level of significant conservation concern.

#### Indexes allowing comparison between concern levels

To compare concern levels between each other and with average for ArcNet domain, they must be normalised. One way to do it is to compare concern level for a given CF, commercial activity or AOI with a baseline (*Bij, base significant units*) - the highest possible concern level for them: a hypothetical situation when *significant* concern is assigned for every month of the year, for every activity, and for every CF.

This baseline was calculated as following:

Where M – number of months (*M* = 12).

Then **MNSCF** **(Overall Conservation Concern Level for CF)** is the index that shows how concern levels compare to the maximum possible for a selected CF.

**MNSIA (Overall Conservation Concern Level for Commercial Activity)** is the index that show how concern levels compare to the maximum possible for a selected commercial activity.

Where *Fj* is coverage, i.e., the proportion of CF, area in an area where commercial activity physically possible to the total area of the CF.

**SA (Significant Conservation Concern Level for AOI)** and **MNSA (Overall Conservation Concern Level for AOI)** are indexes showing how cumulative concern levels for an AOI compare to the maximum possible concern for the given AOI.

*\*100%*

Another way to normalise concern levels is to compare their average values per PU. This method applies to concern levels for AOI only.

**MNSR** **(Overall Conservation Concern Level for AOI, Relative)** and **SR** **(Significant Conservation Concern Level for AOI, relative)**

\*100%

where is for ArcNet domain,

, number of PUs in an AOI;

, number of PUs in the ArcNet domain, where

#### Case study for conservation concern indexes

Consider an area of interest (AOI) that contains three CFs, , and where only three commercial activities are physically possible, .

A completed concern table is shown in Table 1.

Table 1. Conservation concern assessment table for our AOI.



In the calculation of the indexes, the three levels of concern have been given weight scores, (*W*) to reflect their relative importance, where:

Another important piece of information is that the AOI overlaps with 70%, 10%, and 100% of the total areas of CF1, CF2, and CF3, respectively.

Therefore, the *coverage,* , of the CFs in the AOI are:

,, and .

Substituting these weights into Table 1 and adding a column for coverage, *F*, gives Tables 2 and 3 for *MNSC* and *SC*, respectively.

Table 2. Conservation concern assessment table with MNSC weights.



Table 3. Conservation concern assessment table with SC weights.



The “building blocks” and for AOI will be calculated as following:

[1]

where *CFiAj* represents the sum of the cells across 12 months for *CFi* and *Aj*. Expanding this equation for our example gives:

Similarly, the **SC** index for the activities and CFs in our AOI is the sum of all the cells in Table 3 and is defined as:

[2]

Expanding this equation for our example gives:

The next indexes, **MNSA** and **SA,** express **MNSC** and **SC**, respectively, as a proportion of a baseline called the *base significant units* (*Bij*). This is the highest possible concern level for any given AOI, where *significant* concern is assigned for every activity, for every CF, and for every month of the year (Table 4) and it is defined by:

Thus, like equation [1] or [2] *Bij* for AOI:

Expanding this equation for our example gives:

Building on equation [1] then, the **MNSA** index is given by:

\*100% [4]

and building on equation [2], the **SA** index is given by:

[5]

Table 4: Theoretical conservation concern assessment table for the base significant units, Bij.



Therefore, **MNSA** and **SA** are calculated as:

\*100% \*100%

Which can be interpreted as 20% and 16% from the highest possible concern for this AOI.

The next indexes, **MNSCF** and **MNSIA**, look at the **MNSC** and **SC** but by CF and commercial activity, respectively.

Therefore, **MNSCF** is given by:

and is calculated from Table 2 as follows for CF1:

\*100%

for CF2:

and for CF3:

**MNSIA** is given by:

\*100% [7]

And is calculated from Table 2 as follows for A1:

\*100%

\*100%

for A2:

and for A3:

\*100%

\*100%

The last two concern indexes, **MNSR** and **SR**, put **MNSC** and **SC**, respectively, in the context of the number of PU in the AOI (*U*) relative to the number in the ArcNet domain (*U0*). For this example, let’s take *U* and *U0* to equal 10 and 100, respectively.

So, building on equation [1], **MNSR** is given by**:**

\*100% [8]

where *MNSC0* is the MNSC index for the domain. Let’s assume for this example that *MNSC0* = 10,000. Therefore, MNSR is calculated as follows:

\*100%

\*100%

indicating that the cumulative conservation concern for the PUs in the AOI is almost 30% higher than average in the ArcNet domain.

Finally, building on equation [2], **SR** is given by:

\*100% [9]

where *SC0* is the SC index for the ArcNet domain. Let’s assume for this example that *SC0* = 9,000. Therefore, SR is calculated as follows:

\*100%

\*100%

indicating that the cumulative conservation concern for the PUs of the AOI when only considering s*ignificant* concern is slightly (17%) higher than average for the ArcNet domain.

#### Conservation Action Priority related indexes

**AAR:**

where is mean -value per region, *i. e.*, mean value of all PUs inside selected area or inside ArcNet domain.

Let’s say it is only A1 is present in AOI, its amount within AOI is 0.5, then:

AA = 0.5 + 0 + 0 = 0.5,

AAR = 0.5/ 10 = 0.05

**CAPR:**

Absolute:

CAA = 0.5\*(((12\*100) +(9\*10+3\*100) +(12\*10)) \*0.7) + 0\* (((12\*10) +(12\*10)+(12\*1))\*0.1)+ 0\* (((12\*1)+(3\*10+9\*1)+(12\*1))\*1) = 598.5

Relative:

where is for ArcNet domain.

CAPR = 0.5\*(((12\*100) +(9\*10+3\*100) +(12\*10)) \*0.7) + 0\* (((12\*10) +(12\*10)+(12\*1))\*0.1)+ 0\* (((12\*1)+(3\*10+9\*1)+(12\*1))\*1) / 1 \*(((12\*100) +(9\*10+3\*100) +(12\*10)) \*0.7) + 1\* (((12\*10) +(12\*10)+(12\*1))\*0.1)+ 1\* (((12\*1)+(3\*10+9\*1)+(12\*1))\*1) = (598.5 / 10) / (1393.2 / 100) = 4.29

Meaning that average PU in AOI has more than 4-time higher conservation action priority than average PU in ArcNet Domain. This can be explained by the fact that it’s MNSR is 40% higher than average for the Domain on the other hand half of the A1 amount is concentrated within the AOI having a very small area (10 PU vs 100 PU for the Domain). Even though no other activities are present within the AOI, it’s A1 is the most concerning for biodiversity inhabiting the AOI – its MNSIA is 0.8 vs 0.3 vs 0.1 for other activities.

**CAP:**

CAP = 0.5\*(((12\*100) +(9\*10+3\*100) +(12\*10)) \*0.7) + 0\* (((12\*10) +(12\*10)+(12\*1))\*0.1)+ 0\* (((12\*1)+(3\*10+9\*1)+(12\*1))\*1) / 1\*(3600\*0.7) + 1\* (3600\*0.1)+ 1\* (3600\*1) = 598.5 / 6480 = 0.09

This number says that even this area has a very high relative level of conservation action priority for the Arctic (more than 4 times higher than average), it still has a relatively low conservation action priority in absolute values – this is because just one activity is present, and two out of three CFs haver relatively low levels of conservation concern (MNSCF2 = 0.07 and MNSCF3 = 0.0175).

## Bibliography

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