Proposal of a simple tool to evaluate the risk assessment of fish species

The first step to initiate conservation actions for endangered organisms is to identify the populations or species that are in decline or are faced with risk of extinction. There are different national, regional and international lists for threatened species. But inspite of that, many of the vulnerable species are not included in any list. According to this, there is an urgent need for action concerning this matter. In this paper I propose a simple tool to determine which species could be under a potential risk, with the help of the known geographical distribution range and the number of known locations of occurrence.

As a result of this, it is possible to calculate a meaningfull index value for each species and to use this results for a further and detailed evaluation of the species status using other sources and criteria.

1. Determination of the geographic distribution range

a. With the help of available database from museums (Fishbase, GBIF, Fishnet2, SpeciesLink, etc) and appropriate sientifical literature it is possible to determine the distribution range of a species.
b. Herewith it is possible to calculate the circumference of this distribution range
c. But it is important to work very skeptical and critical. There are a lot of mistakes in datasets and studies. All dubious records and outlier / spikes have to be ignored or rather analysed in detail.
   i. Example I:*Cichlasoma portalegrense*: Althought this species inhabit only the Lagoa dos Patos drainage and other nearby atlantic tributaries in southeastern Brazil (Kullander 1983), there are reports from Suriname, Colombia, Bolivia, Paraguay, Argentina and Peru. They presumably arise from missidentifications of similar species. Only the reports from the Lagoa dos Patos should be considred in the evaluation.
   ii. Example II: *Gymnogeophagus gymnogenys* also inhabits only the Lagoa dos Patos drainage (Malabarba et al 2015). But this was a “catchall taxon“ for different similar species until the formal description of the populations from the Uruguay River made by Malabarba et al 2015. Of course the databases are not yet actualised. Reports from Rio Negro could be considered as *G cf mekinos*, reports from Rio Cuareim as *G cf pseudolabiatus* or a still undescribed species and reports from the upper Uruguay as *G cf lipokarenos*.

2. Number of known locations of occurrence for a species

a. With the help of available database from museums (Fishbase, GBIF, Fishnet2, SpeciesLink, etc) and appropriate sientifical literature it is possible to determine the number of known localities of a species.
b. But also in this case it is essential to work very skeptical and critical.

3. Evaluation of the results: Calculation of the index values and their median.

a. Calculation of a practical and meaningfull index value for the distribution range and the locations of occurence for each species.
b. This value can be used as an indicator for the subsequent research. Species with a high index could be desregarded and such with a low number need a detailed examination of their possible vulnerability status.

Examples for three species from the Rio de la Plata drainage

Bujurquina oenolaemus **Kullander, 1987**

There are only 2 records for this species:
Bujurquina oenolaemus - Rio Aguas Calientes, at Aguas Calientes -18.452009, -59.512961 ((Kullander, 1987 / GBIF / Fishbase / Fishnet2 / Farell et al 2007))
Bujurquina oenolaemus - Rio Tucavaca y Rio Aguas Calientes; -18.635034, -59.018111 ((Farell et al 2007))

Cichlasoma dimerus **(Heckel, 1840)**

There are over 50 records for C dimerus from the whole Paraguay, middle and lower Parana and the lower Uruguay drainages (Sources: Kullander 1983; GBIF / Fishbase / Fishnet2 / SpeciesLink). The distribution range circumference is longer than 4.000km (Fig.1).

Cichlasoma pusillum **Kullander, 1983**

This species is only known from some tributaries in the upper Paraná. The reports from the lower Uruguay (Kullander, 1983 // SpeciesLink) should be considered as missidentifications from C dimerus specimens (Kullander et al 2013). The distribution range circumference is round about 290km (Fig. 2).

Tab: Example for Index calculation of the mentioned species.

Name:	Range (km)*	Index Range**	Localities***	Index Localities****	Index (Median)	Standard deviation
***Bujurquina oenolaemus* Kullander, 1987**	110	3,69	2	1,50	**2,60**	1,1
***Cichlasoma dimerus* (Heckel, 1840)**	4000	10,00	50	10,00	**10,00**	0,0
***Cichlasoma pusillum* Kullander, 1983**	290	4,83	6	2,87	**3,85**	1,0

* Range in km: Circumference with a maximum of 4.000km
** (X^0,2776): with an Index range of 1 to 10: 1 means only one single locality known; 10 means a circumference of the distribution range of at least 4000km.
*** Known localities with a maximum of 50
**** (X^0,5885): with an Index range of 1 to 10: 1 means only one single locality known; 10 means at least 50 localities documented.

Results for this example: *C dimerus* could be considered as a wide distributed and abundant species (LC status according to IUCN). *B oenolaemus* and *C pusillum* are candidates for a detailed examination of their real status.

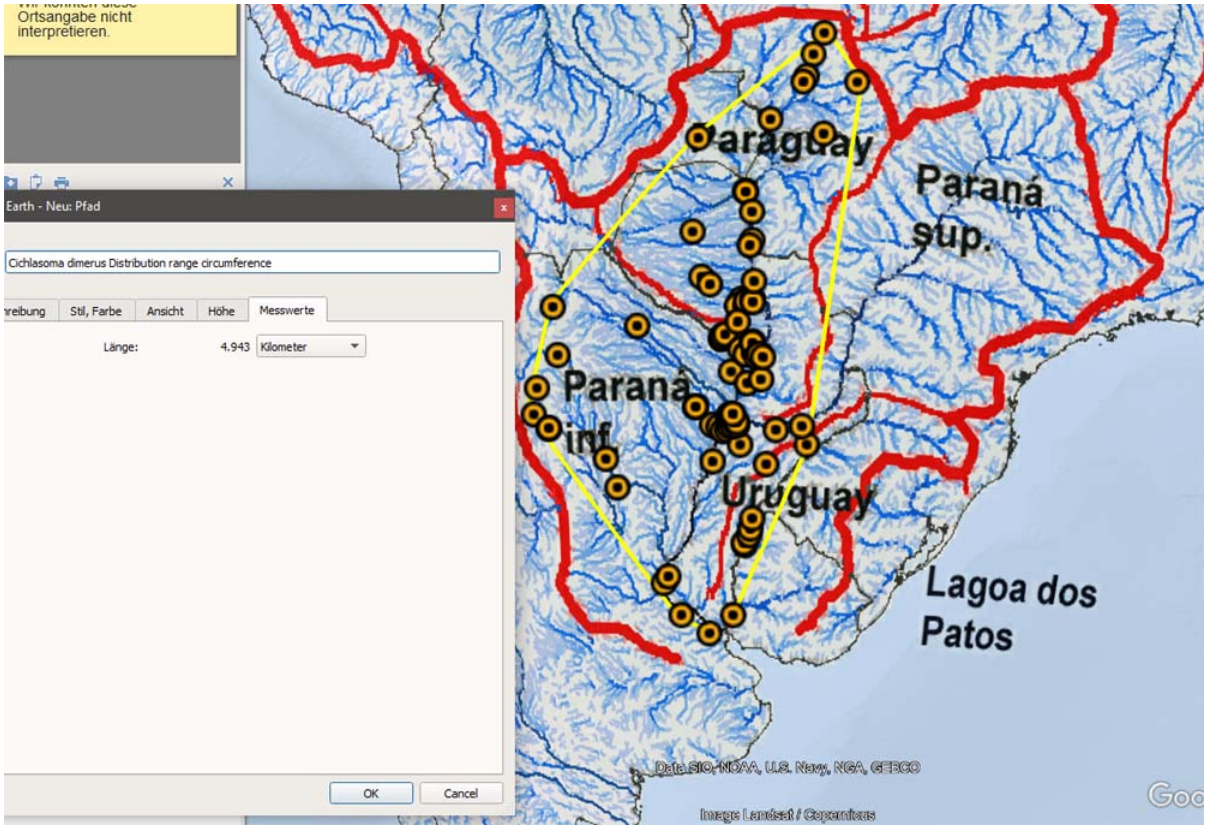

Fig.1. Geographical distribution of *C dimerus* and the calculation of circumference using GoogleEarth

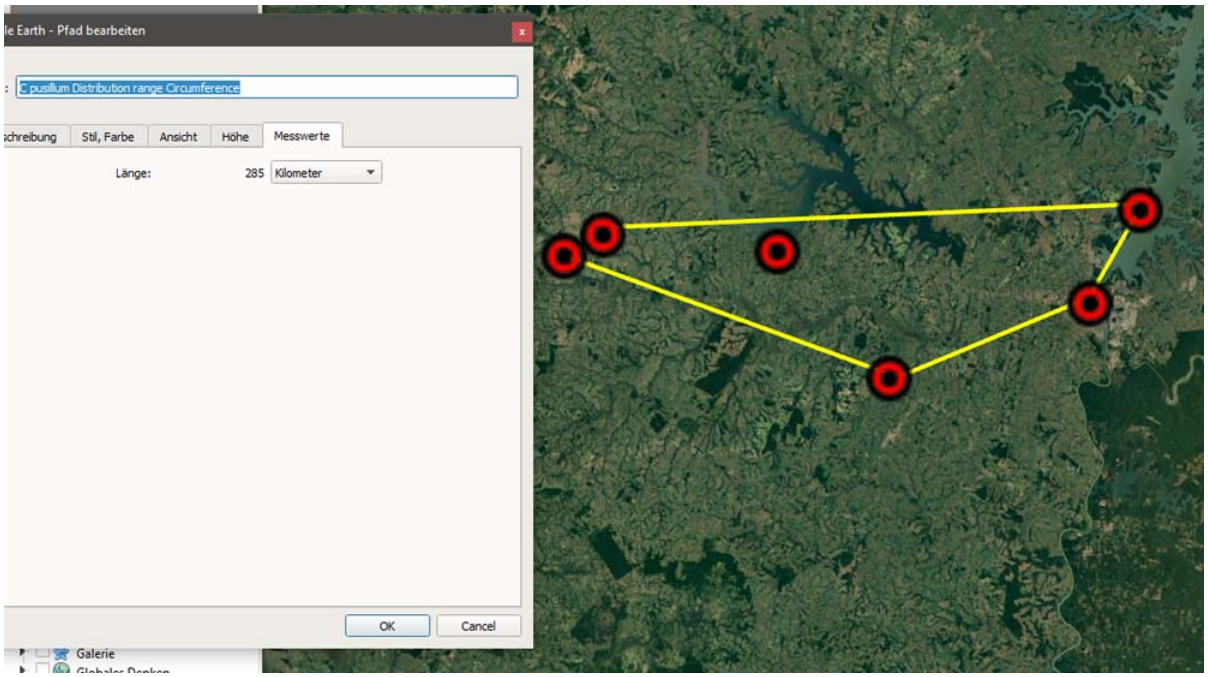

Fig.2. Geographical distribution of *C pusillum* and the calculation of circumference using GoogleEarth

Discussion:

This tool can not consider all risks for species and can not be used as unique approach to evaluate the status of every species (e.g. the ongoing hybridisation of *Oreochromis mossambicus* with *O. niloticus* in their natural habitat). But it is a fast and efficient procedure to screen scarce and potentially endangered species with a small distribution range.

The standard deviation can be used as an indicator for potential errors. A species with a supposed wide distribution range, but only a few records, should be studied in detail.

- Potentialy missidentification of records; two different species
- Potentialy erroneous indication of the locality or geographical coordinates
- Or if it is really a rare species with a fragmented distribution range.

Why circumference and not the full area?
Fishes have rather a linear than a two dimensional distribution pattern. Thats why I propose the consideration of a circumference, instead of an area calculation.
As mentioned in the IUCN-Guidelines: „There is a concern that grids do not have much ecological meaning for taxa living in "linear" habitat such as in rivers or along coastlines.“ (IUCN)

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