

## **WHEN GEOPOLITICAL AND LIMNOLOGY COLLIDE: NEW REPRESENTATION OF LAKE BORDERS**

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**ABSTRACT.** This work should demonstrate the interest of a new concept to show the link between limnology and geopolitics. With the term of “limnic border”, we can demonstrate the difference between the zonal border in two dimensions, typical for geopolitics and the deep border, typical for limnology. The introduction will constitute a resume of the historic and epistemological evolution of the vision about border and natural lake and how geopolitical and limnology develop in different ways. We demonstrate the interest to associate these two views, with regard to a general approach associating “biophysical vision” and “anthropic vision”. With the definition of how we can think multiple separation about transboundary lake, we should demonstrate the accuracy and the interest of a new three-dimensional vision, “the limnic border”. We will demonstrate how we can show the accuracy of this new concept by a description of a cross methodology, included limnologic measures and survey.

**Keywords:** natural lake, limnic border, limnology, limnic territory, hydropolitics

### **1. INTRODUCTION**

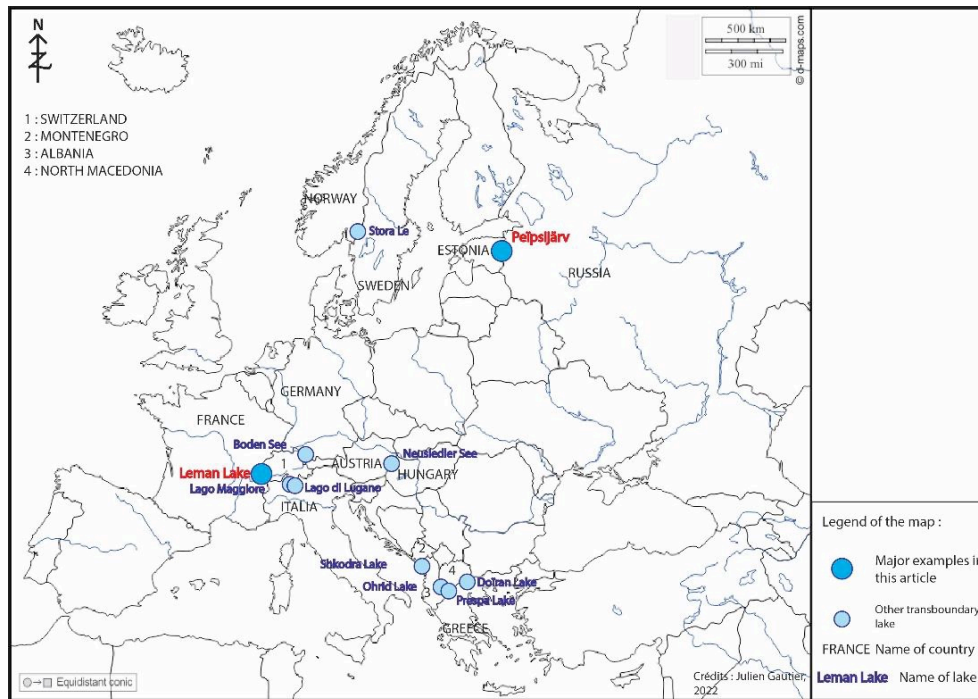
Limnology and geopolitics can appear as distant sciences from each other. On the one hand, limnology sees the border like a geophysical entity which a vertical vision of the border (thermocline or chimiocline). Since François Alphonse Forel, limnology has growing like a geophysics science during the 20th century. In the other hand, geopolitics see the border like a straight line or a zone. While geopolitics give some importance to study see’s borders or transnationality, they forgot the particularity of a lake border. In Europe, some cases of lake are concerned by an international border (figure 1). The most famous are the Lemman Lake but type of lakes or type of borders can be different. In the European Union, the Peïpsi Lake will be a good example. Split between Estonia and Russia, the border lake is very important for the region. We can use more example with other geographic and historical context, just like the Bodensee, Neusiedlersee or Ohrid Lake.

Faced with this lack of crossed-research between these two sciences, geography can be the aggregative science with the work around the water territory. In this paper, we should demonstrate how the confrontation of the functioning of the lake and his

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constituents (plankton, fish...) can be related with the human representation of a border lake territory (representation, move around the lake, economic and cultural activities...).



**Figure 1: Map of transboundary lake in Europe (credits: Julien Gautier, 2022)**

## 2. LIMNOLOGY AND GEOPOLITICS: IRRECONCILIABLE?

### 2.1. Limnology and geopolitical border: the end of a distant history?

Limnology can be qualified as a geophysical science and don't interest very often about the border problematic. Indeed, in France, the limnologic approach wants to develop thematic about hydrological functioning of lakes. Despite the definition of limnology by Forel like "a geography of water (...) of lakes" (Forel, 1892), limnology develops with hydrology, geology, "biology" (Touchart, 2014). In some case, limnology is a base for other science like Maurice Pardé who said he "study Lemnan Lake to better study Rhone River" (Touchart, Bartout, Nedjai, 2014).

When you do a bibliographic survey with specialized search engine, we find that a lot of actual scientific production are based on a geophysical view (table 2).

However, with the emergency of sociological and cultural approach, limnology opens more to geopolitical study. Indeed, some lakes knows some issues about the sharing of the water between countries. We can take the example of Neusiedlersee in 1919 between Austria and Hongria with the Trianon treaty or the Peipsi Lake who have been share between Estonia and Russia since the fall of USSR in 1991. With

the context of global climate change, the evolution of functioning about the natural lake should interest limnologist and geopoliticians.

**Table 2: Chart of French bibliographic research with the key word “limnologie” with a period between 1895 and 2021**

Name of the search engine	Number of results	Mainly authors	Mainly thematic
Isidore	29	Touchart	Geophysics, geography
Cairn	30	Bartout & Touchart ; Choffel ; Maleval & Pitois	Geophysics, hydrology, Limnosystem, limnic territory
Google Scholar	4120	<i>Ibidem</i>	<i>Ibidem</i> + biochemistry, biology

## **2.2. Geopolitical and geophysics: road to a separation**

In geopolitical science, border is a very known concept. Since Antiquity, humanity battles for a territory and wants to put barrier around his city. In fact, the term of “natural border”, born in the German classic geography (Ratzel, 1901), constituted a norm to define a lot of frontiers, especially with rivers (Nile, Rhine, Danube...). When you look the studies about water and border, a large majority of this production are concerning river and see. A short bibliographic survey demonstrates this fact (table 3).

**Table 3: Chart of French bibliographic research with the key word “frontière” and “lac” with a period between 1895 and 2021**

Name of the search engine	Number of results	Mainly authors	Mainly thematics
Isidore	3	Touchart, Beguin	Limnology
Cairn	11	Guibal, Millerand	Limnology or border but rarely together
Google Scholar	659	Vidal de la Blache, Linder	Epistemology, limnology

Lakes are poorly considerate by geopolitics because of the difference between see border cut and lake border cut. Indeed, see cannot be shared in this integrality (high sea) and create some tension about the repartition (EEZ with the Montego Bay Convention in 1973). The sharing of a lake is simpler because all the water is shared (except the specific case of the Caspian See) with the rule of “median line” (Touchart, 2008) in Europe (except the Prespa Lake). We can also use the study of

Philippe Pondaven (1972) who defined the legislation of many types of natural lakes border.

One of the reasons of a distinction between geopolitics and limnology is the increasing of distance between geopolitics and geophysics science. Border studies

makes the border disconnect with topography or hydrology. However, natural lake border is between sea and earth and we can cross a lake like a plain or a valley. We cannot either build a wall. We can take the example of Peipsi Lake where the border is delimited by buoy.

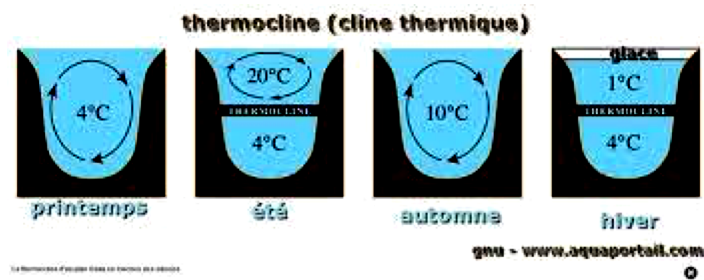


*Figure 4: Photography of a the border guard building on the Peipsi Lake (source: Julien Gautier, 2021)*

### **3. NATURAL LAKES BORDER: TWO DIFFERENTS VIEWS OF A LINE**

#### ***3.1. Limnology and the vertical border: influence of the thermocline on a natural lake border***

Limnology defines some borders on a lake. The most famous border is the thermocline. We can define some parts of a lake who changed in terms of season, solar radiation, lake morphology. These types of delimitation can be seen like a vertical border (figure 3).



*Figure 5: diagram of the thermocline system  
(source: [wikihydro.developpement-durable.gouv.fr](http://wikihydro.developpement-durable.gouv.fr))*

The thermocline is a geophysical phenomenon but can give some social and economic consequences. In the case of fishing, thermocline can influence the position of type of fish. In the case of a hermetic border, that constitute a difficulty for the fisherman around the lake.

### **3.2. Geopolitical and the horizontal border: the frontier**

In the case of geopolitical, the border was seen like a line on a map. This classic vision of a border is no more efficient in the border studies. We talk more about “transboundary area” but the vision stays the same. The physicality of the border is in two dimension and forget the question of the depth and the water circulation. In the case of the Peipsi Lake, pollution or fish circulation cannot be separate with a political line.

Surveillance in the lake is made with special intermediaries like rapid intervention boat and surveillance building. At the localization of the Lämmijärvi lake, the distance between Estonia and Russia is very closed (a few kilometers) and justify this type of device. However, we can translate some concept about geopolitical to geography with the study of economic activities, leisure or representation of the lake resident.

## **4. NEW CONCEPT FOR A MIX OF DATAS: THE “LIMNIC BORDER”**

The “limnic border” is a theoretical proposition to associate the limnological and geopolitical visions about a border. This concept is an attempt to develop the concept of “limnic territory” (BARTOUT, TOUCHART, 2017). The interest of this concept is the possibility to open the lake border to a different level. Not only an administrative delimitation, this border build a territory and “whose inhabitants have appropriated the image, thus building a geographical identity” (TOUCHART, 2021). This approach is not new in geography but can be more efficient with the integration of the limnology approach.

To develop this concept, we need some geophysics data who will be a classic link with the limnologic research. This will require the study of particular data who will be useful to determine a link with the border.

In first place, we need to compare forms of separation in a lake. We will use the data about the repartition of temperature in the lake. The interest will be to analyze thermocline about this lake and the consequences about fishing. We use temperature measurement every season especially with the Peipsi Lake because this lake experiences a large period of freezing in winter. For the Lemn Lake, we will use the data of Anh Dao LE THI, Francesca DE PASCALIS, Georg UMGIESSER and Walter WILDI (2012) who propose “thermal structure and circulation patterns of Lake Geneva”. For the Peipsi Lake, we will use seatemperatures.net to have some data about surface temperature and some scientific work about this subject (KANGUR, TAMMIKSAAR & PAULY, 2021). This thermocline will have an influence to the repartition of fish in these lakes. In cases of transboundary lakes, movement or change about fishes can be problematic between different states.

In second place, pollution will interest the question of border. Lakes are a body of water and anthropic inputs transform the water constitution. Phosphor in Peipsi Lake (KAPANEN, 2012) or mercury in Lemn Lake (LOISEAU *and al.*, 2013) will be useful to compare with regional actions across the border.

With this transdisciplinary and geography concept, we need to demonstrate the social impact of a natural lake border. We need a survey methodology to know the practice of all actors who have an impact of the administration of these transboundary lakes.

We decide two types of survey methodology. First, we will use a survey to define practice and representation about the lake population. It is important to define a number of people for the survey. We will use the voluntary participation to define the sample but we will follow some rules about it:

- We need to have some residents around the border to compare the vision across the lake. We need to question the commonalities and the differences with a multiscale look (international, regional, local).
- We need some quotas about the choice of the people. Some qualities will be commons (gender) but other will be very important in some cases (age for the Peipsi Lake, jobs if some actors work on the lake).

We will use a statistical method with an error interval of 5% to constitute cohorts of respondents. To choose the number of people for the survey, we use the formula of calculating sample size:

$$T = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

With T is the sample size, z the trust interval (1,96 for 5%), p the value (0,5 because it is a first survey) and e the margin of error (0,05). If we combine the information and the size of the sample, we obtain these results (table 4). We need 400 survey for each side of each lake.

**Table 6. Type of information and sample size for each natural transboundary lake in the study**

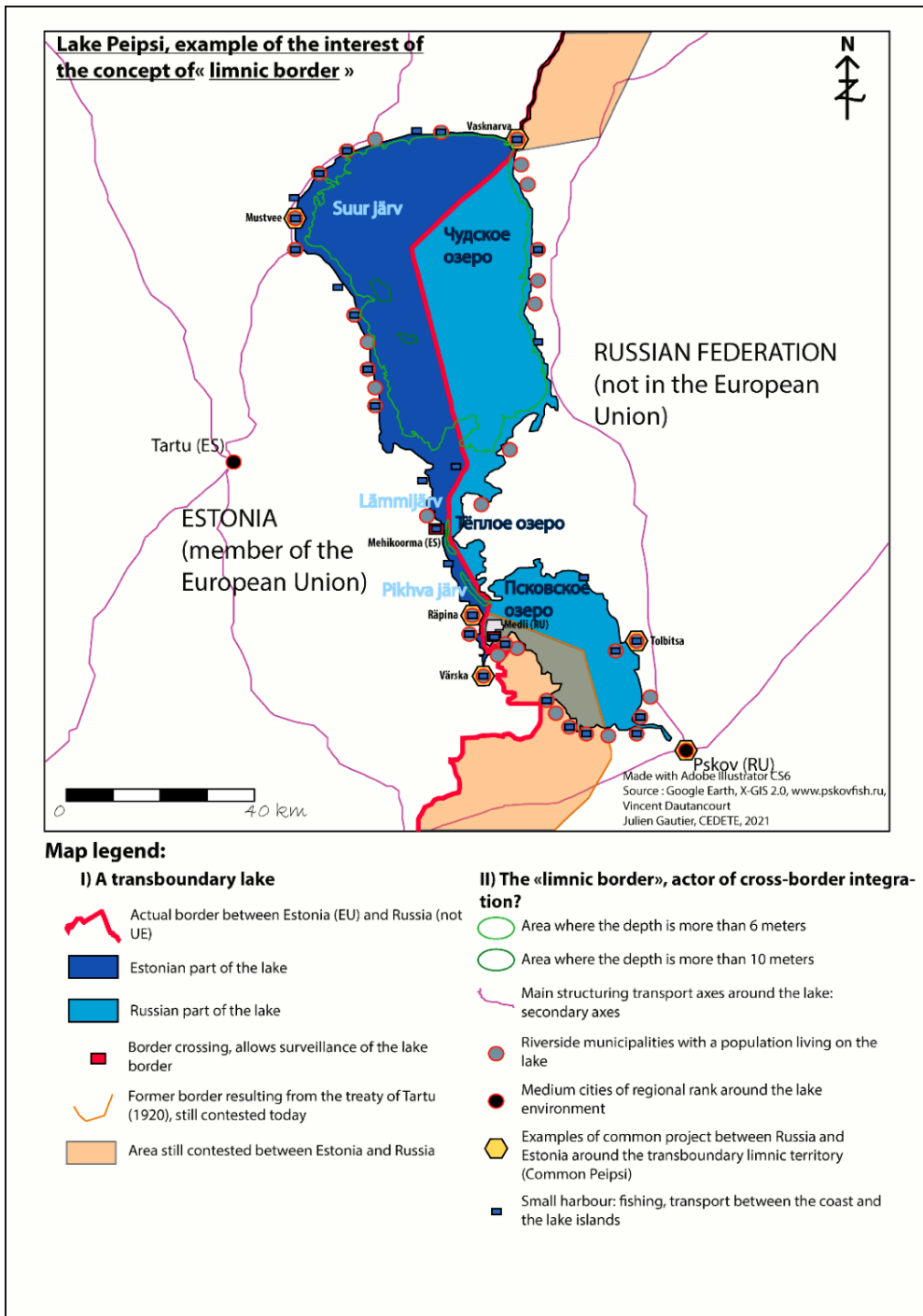
	Common information	Priority information
Peipsi Lake	Gender, identity	Age, address, job, representation, ethnic group, language
Leman Lake	Gender, age, identity, language	Address, job, representation

## 5. DISCUSSIONS

In this state of the research, we do not have the results of any survey but some visits on the place of study give us some preliminary information.

In the first place, it is possible to associate these two visions of this border and develop a new vision of transboundary lakes. This vision can permit who to think more about the sharing of water and decrease the risk of tension. We can also give more information to develop some transboundary cooperation for different actors (with different scales of action) like administration (Leman Council), association (Common Peipsi) or resident (Peipsi food street). For the Peipsi Lake, we can propose a first view of the limnic border with this hybrid methodology who associate limnological and geopolitical views (image 7).

In the second place, this concept can associate some different methodology and demonstrate a systemic vision of this border. We want to aggregate different types of data and demonstrate the interest of a spatial approach. The work on the “ecosystem service” (BAULAZ *and al.*, 2021) will complete this systemic approach and define the type of data and survey we need to complete our new concept of “limnic border”.



*Image 7. Map of the limnological and geopolitical study of the Peipsi Lake (source: Julien Gautier)*



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