

# Water sources' key role in the Vomb basin biosphere reserve.

An analysis of ecosystem services

OUSAYMA BAKIR 2022  
MVEK12 BACHELOR THESIS 15 HP  
ENVIRONMENTAL SCIENCE | LUND UNIVERSITY



# Water sources' key role in the Vomb basin biosphere reserve.

An analysis of ecosystem services

Ousayma Bakir

2022

Picture: Snogeholmssjön, Skåne, Sweden.

Taken by: Ousayma Bakir



**LUNDS**  
UNIVERSITET

Ousayma Bakir  
MVEK12 Bachelor thesis 15 hp, Lund university  
Internal supervisor: Johanna Alkan Olsson, Centre for Environmental and  
Climate Science (CEC), Lund university  
External supervisor: Anna-Karin Poussart, Lund Municipality

CEC - Centre for Environmental and Climate Science  
Lund university  
Lund 2022



## Abstract

This study was done to gain an understanding of the importance of 12 water sources that are in the Vomb biosphere reserve. To do so, an ecosystem services analysis that included the four following types of ecosystem services: provisioning, supporting, regulating and cultural services, was conducted. The ecosystem services analysis was done by using indicators for each service. A final score based on the status of indicators was given to each of the four ecosystem services for every water source. The study was limited to Lund Municipality. The results were as follows. Both provisioning and cultural services turned out to be in a bad status in most water sources. Regulating services had moderate status in most water sources. For supporting services, an equal number of water sources had good and moderate status respectively. The conclusion is that better information should be available about cultural facilities as well as provisioning services such as fishing. Ecological status needs to be classified for many of the small lakes in the area such as Bysjön and Gröne damm. For future studies, it is of interest to include smaller water sources such as wetlands. It would also be of benefit to assess ecosystem services for the whole biosphere reserve inclusive of all the 3 municipalities.

**Keywords:** Ecosystem services analysis, biosphere reserve, water sources, classification, Vomb, Skåne, south of Sweden.



# Table of contents

|  |           |
|--|-----------|
| <b>Abstract</b> .....                                      | <b>5</b>  |
| <b>1. Introduction</b> .....                               | <b>9</b>  |
| 1.1 <i>Purpose and research questions</i> .....            | 11        |
| 1.1.1 <i>Research questions</i> .....                      | 11        |
| 1.1.2 <i>Limitations</i> .....                             | 11        |
| <b>2. Methodology</b> .....                                | <b>13</b> |
| 2.1 <i>Identifying water sources</i> .....                 | 13        |
| 2.2 <i>Ecosystem services analysis</i> .....               | 14        |
| 2.3 <i>Classifying and rating ecosystem services</i> ..... | 15        |
| 2.4 <i>Ethical reflection</i> .....                        | 15        |
| <b>Results</b> .....                                       | <b>17</b> |
| 3.1 <i>Provisioning services</i> .....                     | 17        |
| 3.2 <i>Cultural services</i> .....                         | 18        |
| 3.3 <i>Supporting and regulating services</i> .....        | 19        |
| 3.4 <i>Overall ecosystem services analysis</i> .....       | 20        |
| <b>4. Discussion</b> .....                                 | <b>23</b> |
| 4.2 <i>Cultural services</i> .....                         | 23        |
| 4.3 <i>Supporting and regulating services</i> .....        | 24        |
| 4.4 <i>Overall classification</i> .....                    | 25        |
| 4.5 <i>Limitations and future studies</i> .....            | 25        |
| <b>Conclusion</b> .....                                    | <b>27</b> |
| <b>Acknowledgement</b> .....                               | <b>29</b> |
| <b>References</b> .....                                    | <b>31</b> |
| <b>Appendix</b> .....                                      | <b>35</b> |



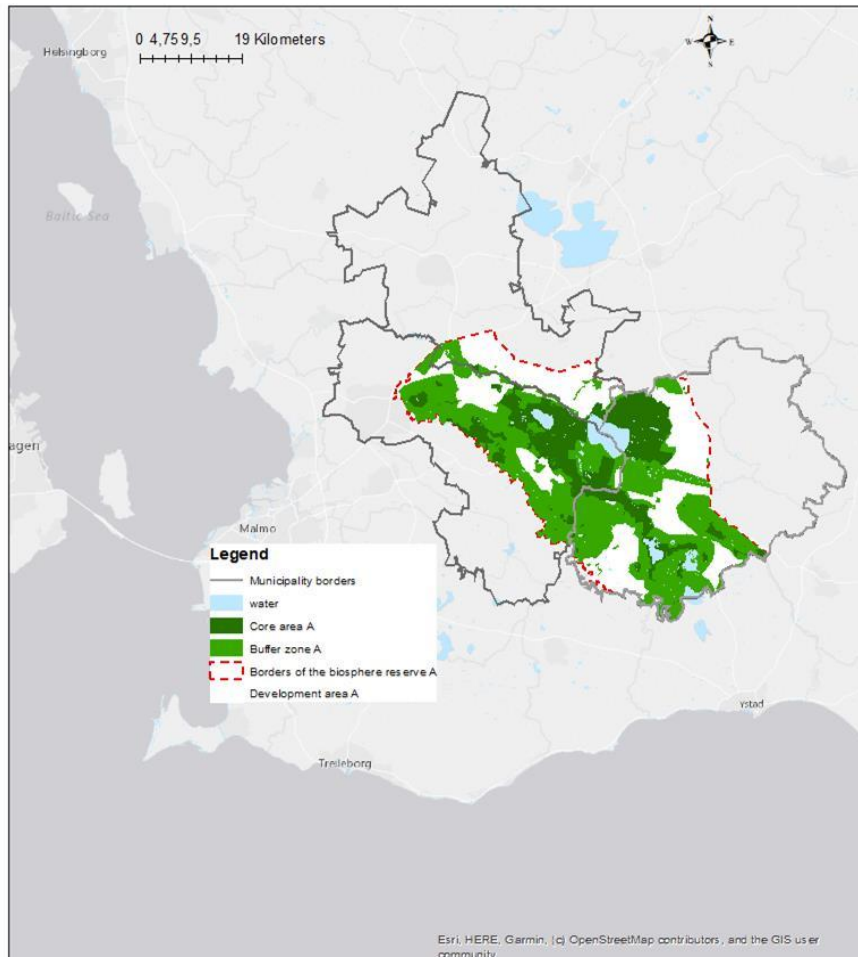


# 1. Introduction

Access to freshwater is one of the most important conditions of life on earth. Beside its importance in producing drinking water, freshwater is essential for maintaining food security in the form of agriculture and farming (Holst & Svensson, 2016). Furthermore, freshwater provides ecosystem services that are essential for many organisms on earth (Apostolaki et.al., 2020). Swedish environmental objectives were found by the Swedish parliament in the light of Agenda 2030 for sustainable development that was established by the United Nations General Assembly (Naturvårdsverket, 2018). Swedish environmental objectives are 16 environmental guidelines that form the basis of the environmental quality goals on a Swedish national level (Naturvårdsverket, 2018). Flourishing Lakes and Streams is one of those environmental objectives that is, today, accessed to not be fulfilled (Skånesmiljömål, 2020). The reason is the ecological status of lakes and streams that is not good enough especially in Scania province where only 17% of surface water bodies are in good ecological status (Skånesmiljömål, 2020). For this reason, protection of both streams and lakes has been prioritized but the actual action is going slow (Skånesmiljömål, 2020).

Man, and the Biosphere program (MAB) is a program that was founded by UNESCO (United Nations Educational, Scientific and Cultural Organization) (UNESCO, n.d.-a). According to UNESCO, the MAB program has a purpose to improve the relationship between people and their environment (UNESCO, n.d.-a). To achieve that purpose, areas that are called biosphere reserves were introduced (UNESCO, n.d.-b). A biosphere reserve is an area that acts as an example of successful sustainable development where interaction is present between social and ecological aspects (UNESCO, n.d.-c). Vomb basin is an area of unique biological and geological value that it has been nominated in November 2020 by the national committee for biosphere reserves to be one of UNESCO's biosphere reserves (UNESCO, 2022). Vomb basin is a flat valley of grasslands that covers sandy soils between the municipalities of Lund, Eslöv and Sjöbo in the province of Scania, the southernmost part of Sweden (UNESCO, 2022). Land use in the area is characterized by farmlands, agricultural areas as well as the presence of coniferous and deciduous forests (Sjöbo, Lund och Eslövs kommuner, 2019).

This study gives an overview of the important role of the water sources that are located within the borders of the suggested biosphere reserve (Figure 1) in the form of the ecosystem services that these water bodies provide.



**Figure 1. The defined borders and contents of Vomb basin biosphere area.**

Lund Municipality to the bottom left, Sjöbo on the right and Eslöv in the middle top. Only suggestion A (the one of interest) is shown in the figure. The map was retrieved from the website Vombsjösänkan (n.d.) and is available for public. The map has then been moved to GIS program to add the different legends and the distance scale.

## 1.1 Purpose and research questions

To obtain an overview of the important role that water bodies have in the biosphere reserve area of Vomb basin. The role of water bodies will be determined in terms of the ecosystem services that each water body provides. The study results are expected to be used as a support in the application for the Vomb basin to be a biosphere reserve.

### 1.1.1 Research questions

- What is the existing information about water bodies in the Vomb basin biosphere reserve?
- What are the knowledge gaps about water bodies in the area?
- What are the ecosystem services that each water body provide?

### 1.1.2 Limitations

This study is limited to the areas of the biosphere reserve that are in Lund Municipality. This means that only suggestion A of suggested biosphere reserve area was used since it is the only one that has parts in Lund Municipality. Another limitation is that only water bodies that could be identified by names on the map were included in the study. The reason is that information could easily be obtained when using the water sources' name to search. Taking into consideration the study's' small extent, only limited factors were used as indicators for different ecosystem services.



## 2. Methodology

### 2.1 Identifying water sources

As a first step, water sources within the suggested biosphere reserve were identified by using an ArcGIS map (Figure 1) that is provided by the official website of Vomb basin (Sjöbo, Lund och Eslöv kommuner, 2019). The map is defined by the borders of the biosphere reserve as well as the borders of the concerned municipalities. As mentioned earlier, only water sources that are in Lund Municipality were included. A list with all the water sources that has been possible to identify has been conducted (Table 1). Further in the study, Kävlingeån has been divided into 2 sections as following: Kävlingeån: Vombsjön-Klingavälsån and Kävlingeån: Klingavälsån-the sea. This has been done to give the results more accuracy since the stream (Kävlingeån) stretches over a big area.

**Table 1. Water sources that are included in the study**

Water sources that are in Vomb biosphere reserve and belong to Lund Municipality.

| Water sources   | Category |
|-----------------|----------|
| Krankesjön      | Lake     |
| Vombsjön        | Lake     |
| Klingavälsån    | Stream   |
| Bysjön          | Lake     |
| Dalby Stenbrott | Lake     |
| Häljasjön       | Lake     |
| Gröne damm      | Lake     |
| Glomsjön        | Lake     |
| Tvedörasjön     | Lake     |
| Kävlingeån      | Stream   |
| Ålabäcken       | Stream   |

## 2.2 Ecosystem services analysis

After identifying water sources by their names, further information about each water source has been collected using two different databases that are Vatteninformationssystem Sverige (VISS) and Vattenatlas. VISS and Vattenatlas are both databases that were created to compile and follow the status of different water sources in Sweden such as ecological status classification, environmental quality standards, environmental monitoring, and protected areas (VISS, 2021, Vattenatlas, 2022). The collected data has been used to assess the importance of water bodies in terms of the ecosystem services that they provide. An Ecosystem analysis (ESA) has been performed according to the Millennium Ecosystem Assessment (MEA) that divides ecosystem services into four different categories based on the benefits that they provide (Table 2) (Lindblom & Holmgren, 2016). Vattenatlas and VISS were mainly used to access both regulating and supporting services. For the cultural services, different map programs such as google maps, Naturkartan (n.d.) and even maps that are provided by Lund Municipality and County Administrative Board were used (Lunds kommun, n.d., Länsstyrelserna, n.d.). For provisioning services, information about fishing areas were obtained from Eklöv (2003). While information about water sources that are used for drinking water production was retrieved from Naturvårdsverket (n.d.-b) where water protection areas are defined on the map (Miva, 2022). Another useful source for information about drinking water production was obtained from Lunds kommun and VA SYD (2017). In case of a missing status of an indicator for one water source, the status of the whole catchment area has been used instead.

**Table 2. Types of ecosystem services**

Definitions of the different types of ecosystem services that are included in this study and their indicators.

| Type of service       | Benefit                               | Indicators   |
|-----------------------|---------------------------------------|--|
| Provisioning services | Drinking water and food (fishing)     | Fishing and drinking water production              |
| Regulating services   | Water regulation and flood prevention | Hydrological regime and morphology                 |
| Cultural services     | Recreation                            | Availability of 6 facilities                       |
| Supporting services   | Nutrients cycling and Biodiversity    | Ecological status of nutrients and protected areas |

## 2.3 Classifying and rating ecosystem services

The following step was to classify and rate the overall state of each of the 4 ecosystem services. The classification criteria for the overall state were based on the rating/availability of the forementioned indicators (Table 2). Each of the ecosystem services was given a score from 1-3 (unsatisfactory status, moderate status, and good status) based on the conditions that it fulfils (Table 3). The final score of a service with indicators that had an ecological status (hydrological regime, morphology, and nutrients), was based on the indicator with the worse status (Caruso et.al., 2013). For provisioning services, a water source was given 1 point for having 1 type of fishing available, 2 points for having 2 types of fishing and 3 points for having 2 types of fishing plus being a drinking water source. For supporting services, water sources were given an extra point if they happen to be in one or more type of protected areas.

**Table 3. Classification criteria for the overall state of ecosystem services.**

Clarification of the different conditions that needs to be fulfilled in a water source for it to be given the corresponding score.

| Score | Status         | Condition  |
|-------|----------------|--|
| 1     | Unsatisfactory | 1 or none of the indicators are available/have good status             |
| 2     | Moderate       | At least half the number of indicators is in good status/available.    |
| 3     | Good status    | More than half the number of indicators is available/have good status. |

## 2.4 Ethical reflection

As mentioned earlier, the study results might be used to support the application to make Vomb basin a biosphere reserve (see Purpose). Based on that, one ethical aspect is to have a neutral approach while performing this study. To do that, this study has only been performed using the adopted scientific methods that are mentioned above. This procedure will ensure that the results are not biased in any way and can be used in a scientific context.





# Results

## 3.1 Provisioning services

Eight out of twelve water sources had at least one type of fishing allowed (recreational, commercial, or other) while three out of those eight had two types of fishing allowed (Table 4). Information about fishing possibilities was missing for Dalby Stenbrott, Gröne damm and Tvedörasjön (Table 4). In Häljasjön recreational fishing is not allowed and the right for other fishing types is owned by Malmö Municipality. For the other kind of provisioning service, namely drinking water, only four lakes (Vombsjön, Häljasjön, Bysjön and Gröne damm) scored for being a source of drinking water production (Sydvatten, 2021, Naturvårdsverket, n.d.-b).

**Table 4. Availability of fishing and drinking water production for all the water sources**

Other types of fishing: Fishing clubs or private fishing right holders

-: no information.

| Water source                         | Fishing                               | Drinking water |
|--------------------------------------|---------------------------------------|----------------|
| Krankesjön                           | Commercial and other types of fishing | -              |
| Vombsjön                             | Recreational and commercial fishing   | Yes            |
| Klingavälsån                         | Other types of fishing                | -              |
| Dalby Stenbrott                      | -                                     | -              |
| Häljasjön                            | No                                    | Yes            |
| Bysjön                               | Other types of fishing                | Yes            |
| Gröne damm                           | -                                     | Yes            |
| Glomsjön                             | Other types of fishing                | -              |
| Tvedörasjön                          | -                                     | -              |
| Kävlingeån:<br>Vombsjön-Klingavälsån | Other types of fishing                | -              |

|                                      |   |   |
|--------------------------------------|---|---|
| Kävlingeån:<br>Klingavälsån- The sea | Recreational and<br>other types of<br>fishing | - |
| Ålabäcken                            | Other types of<br>fishing                     | - |

### 3.2 Cultural services

When it comes to cultural services, water sources with all the chosen facilities available are the exception. Only one lake which is Dalby stenbrott had all the facilities available from parking places to public transport (Table 5). However, other lakes like Bysjön and Gröne damm had none of the 6 facilities available (Table 5). The rest of the lakes/streams had some of the facilities without the others. The table below allows a comparison between the accessibility of each water source and the facilities that are available in the area.

**Table 5. Recreational facilities as indicators for cultural services.**

Comparison between the different water sources based on the availability of six recreational facilities.

| Water source                        | Parking places | Toilets | Bathing places | Resting places | Grill/fire sites | Public transport |
|-------------------------------------|----------------|---------|----------------|----------------|------------------|------------------|
| Krankesjön                          | Yes            | Yes     | No             | Yes            | Yes              | No               |
| Vombsjön                            | Yes            | Yes     | yes            | Yes            | No               | No               |
| Klingavälsån                        | Yes            | Yes     | No             | Yes            | No               | No               |
| Dalby Stenbrott                     | Yes            | Yes     | Yes            | Yes            | Yes              | Yes              |
| Häljasjön                           | No             | -       | Yes            | -              | -                | No               |
| Bysjön                              | No             | No      | No             | No             | No               | No               |
| Gröne damm                          | No             | No      | No             | No             | No               | No               |
| Glomsjön                            | Yes            | Yes     | No             | Yes            | No               | Yes              |
| Tvedörasjön                         | Yes            | No      | Yes            | No             | No               | Yes              |
| Kävlingeån:<br>VombsjönKlingavälsån | Yes            | No      | No             | Yes            | No               | Yes              |

|                                     |    |    |    |    |    |     |
|-------------------------------------|----|----|----|----|----|-----|
| Kävlingeån:<br>Klingavälsån-the sea | No | No | No | No | No | Yes |
| Ålabäcken                           | No | No | No | No | No | Yes |

### 3.3 Supporting and regulating services

For supporting services, moderate status of nutrients and water filtration has apparently dominated the results for being the status of 9/12 water sources (Table 6). Glomsjön had unsatisfactory status followed by bad status for Vombsjön and Kävlingeån: Vombsjön-Klingavälsån (Table 6). When it comes to biodiversity, it turned out that 7 water sources are in protected areas of different kinds (Table 6). Half of the water sources (6/12) are considered Natura 2000 areas (either Habitats or birds' directive or both). Tvedörasjön, Klingavälsån and Kävlingeån: Vombsjön-Klingavälsån are both nature reserves and Natura 2000 areas while Dalby Stenbrott is only nature reserve (Table 6).

For regulating services, most water sources (8/12) had moderate status of hydrological regime followed by 4 with bad status (Table 6). Status of morphology, however, is more diversified but moderate is still the status of 5/12 followed by unsatisfactory status of 4 water sources and lastly good status of 3 lakes (Table 6).

**Table 6. Supporting and regulating services put together for all water sources**

The status of supporting and regulating services given by two indicators for each type of service.

| Water source    | Supporting services            |  | Regulating services |            |
|-----------------|--------------------------------|--|---------------------|------------|
|                 | Nutrients and water filtration | Biodiversity   | Hydrological regime | Morphology |
| Krankesjön      | Moderate                       | Natura 2000: Habitats directive+ birds' directive                  | Moderate            | Good       |
| Vombsjön        | Bad                            | -  | Moderate            | Moderate   |
| Klingavälsån    | Moderate                       | Nature reserve+ Natura 2000: Habitats directive*+ birds' directive | Moderate            | Moderate   |
| Dalby Stenbrott | Moderate                       | Nature reserve   | Moderate            | Good       |

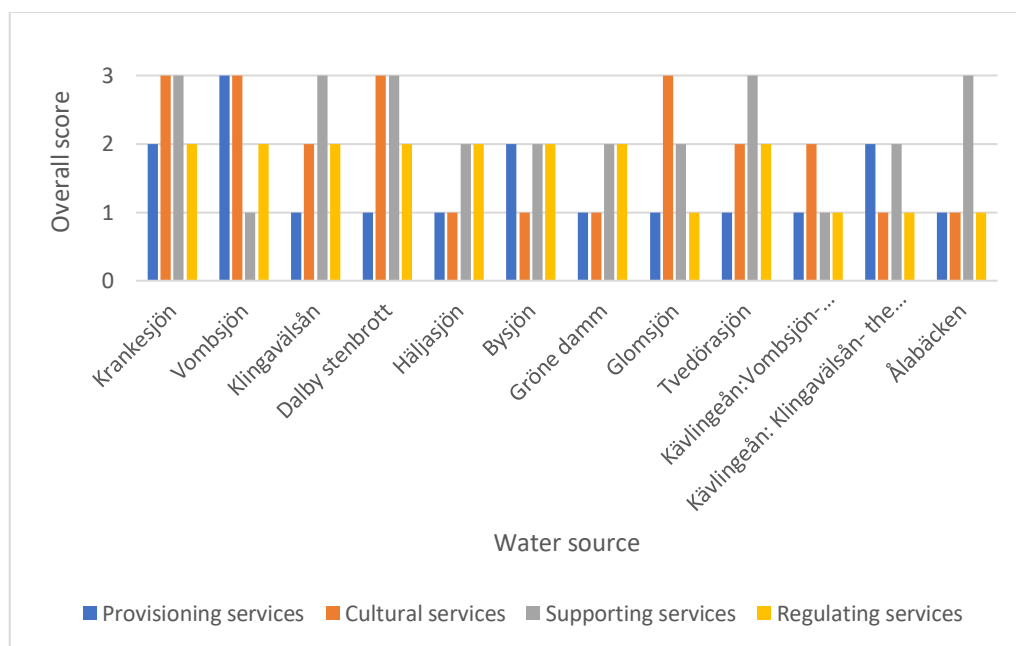
|   |                |  |          |                |
|---|----------------|--|----------|----------------|
| Häljasjön                               | Moderate       | -  | Moderate | Moderate       |
| Bysjön                                  | Moderate       | -  | Moderate | Moderate       |
| Gröne damm                              | Moderate       | -  | Moderate | Moderate       |
| Glomsjön                                | Unsatisfactory | Natura 2000:<br>Habitats directive                     | Bad      | Unsatisfactory |
| Tvedörasjön                             | Moderate       | Natura 2000:<br>Habitats directive +<br>Nature reserve | Moderate | Good           |
| Kävlingeån:<br>VombsjönKlingavälsån     | Bad            | Nature reserve +<br>Natura 2000 bird's<br>directive    | Bad      | Unsatisfactory |
| Kävlingeån:<br>Klingavälsån-<br>The sea | Moderate       | -  | Bad      | Unsatisfactory |
| Ålabäcken                               | Moderate       | Natura 2000:<br>Habitats directive*                    | Bad      | Unsatisfactory |

### 3.4 Overall ecosystem services analysis

Figure 2 illustrates an overall ecosystem services analysis of each of the studied water sources. As for Regulating services, most of the water sources (8/12) had score 2 which indicates a moderate status (Table 3) while four of them had score 1. None of the water sources had score 3 for regulating services (Figure 2). Provisioning services had mostly score 1 (in 8 water sources) followed by score 2 in 3 water sources and only one score 3 in Vombsjön (Figure 2). Cultural services had mostly score 1 (5/12 water sources), followed by score 3 (4/12) and score 2 (3/12) (Figure 2). Lastly, supporting services had an equal number of scores 3 and 2 (5 water sources each) and only 2 water sources had score 1 (Figure 2).

**Figure 2. The overall score of ecosystem services for all water sources.**

The overall status of the four ecosystem services given by a score for each of the water sources.





## 4. Discussion

### 4.1 Provisioning services

The fishing status was generally good since most of the water sources (8/12) had at least one type of fishing available while three of those eight allowed 2 types of fishing (Table 4). Information about fishing availability was missing for three water sources, namely Dalby Stenbrott, Tvedörasjön and Gröne damm (Table 4). Fishing in Häljasjön was not included because the right of fishing is owned by Malmö Municipality (Eklöv, 2003). For drinking water, however, only four lakes (Vombsjön, Bysjön, Häljasjön and Gröne damm) had a score for being a source for drinking water production (Sydvatten, 2021, Naturvårdsverket, n.d.-b).

Vombsjön is a well-known source for drinking water production in Scania (Sydvatten, 2021). However, Häljasjön, Bysjön and Gröne damm were included as sources for drinking water production because they are considered water protected areas (Naturvårdsverket, n.d.-b, Miva, 2022). This could mean that the latter mentioned 3 lakes, might not be used for drinking water production in the meantime but might be used in the future (Miva, 2022). It is of importance to mention that in this study only two provisioning services were chosen due to their relevance but also to the limited extent of the study. It should therefore be taken into consideration that there might be more provisioning services than those chosen two that could affect the whole status/score of ecosystem services. Furthermore, the report that has been used for information about fishing (Eklöv, 2003) is from 2003. This means that the information might have been changed from 2003 until today. For a better evaluation of provisioning services, information about fishing must be updated and available about all water sources.

### 4.2 Cultural services

Many of the water sources lacked at least one or more of the recreational facilities (Table 5) resulting in an unsatisfactory score in general for cultural services. One exception was Dalby Stenbrott being the only lake that had all the facilities available in the area (Table 5). An extreme level, Bysjön and Gröne damm had none of the facilities available for recreation (Table 5).

Due to study limitation (see Limitations) and available data, only six recreational facilities could be chosen as indicators of cultural services (Table 5). The six facilities represent a small group of a wide range of recreational facilities that can make the area in question more attractive to visitors/tourists. Therefore, the limited facilities might have resulted in an underrated score of the overall cultural services for each water source. One other possible cause for underrated cultural services is protected areas such as nature reserves. As presented earlier (Table 6) almost all the water sources are in protected areas of different types such as nature reserves and Natura 2000 areas. This might have led to the absence or unavailability of some facilities that are not allowed in protected areas (Naturvårdsverket, n.d.-a) such as grill and fireplaces. Furthermore, some facilities might have been unrepresented despite their existence in an area due to lack of information. This might have been happened since the availability of different facilities was entirely based on existing information that was obtained from maps with different functions. Which means that a certain facility, such as toilets for example, might exist in an area while not being reported on the map which results in misleading results.

### 4.3 Supporting and regulating services

For regulating services, most water sources had moderate status of both morphology and hydrological regime (Table 6). However, morphology was in a better condition in general than hydrological regime since none of the water sources had bad status of morphology, only good, moderate, and unsatisfactory (Table 6). On the other hand, 3 water sources had bad status of hydrological regime while the rest water sources had moderate status (Table 6). Supporting services, more specifically, nutrients and water filtration also had moderate status of most water sources followed by one unsatisfactory and two bad status (Table 6). For biodiversity, the status is good in general since 7/12 water sources were in at least one type of protected areas (Table 6).

Information about supporting and regulating services was obtained from VISS (see methodology). As mentioned, earlier, information about ecological status for some water sources was sometimes unavailable which led me to use ecological status of the whole catchment area (see methodology). This might have caused the results to be not as accurate as they were if the ecological status about each water source was available. Furthermore, for regulating services, only two indicators were used for assessing hydromorphology (hydrological regime and morphology) (Table 6) because of the relatively limited extent of this study. The limited number of indicators should be considered as it might not reflect the whole status of hydromorphology. The same thing applies for supporting services as only two indicators were used for the evaluation process (nutrients and water filtration and biodiversity) (Table 6). As for biodiversity, protected areas of different kinds



(Natura 2000 directives and nature reserves) were used as an indicator of biodiversity (Table 2). It is of importance to mention that this method might be good to inform that there is good biodiversity in an area that is worth to be protected. However, this method does not provide information about what those different unique or vulnerable species are.

#### 4.4 Overall classification

Most water sources (8/12) had bad status of provisioning services (Figure 2). The reason behind this might be that most water sources are not used for drinking water production (Table 4). The lack of information about available sites for fishing for 3 water sources (Table 4) might have also led to the bad status. Supporting services, however, had score 2 and 3 for an equal number of water sources (5 each) (Figure 2). This makes supporting services, the services with the highest number of water sources of score 3 (good status) (Figure 2). Unlike regulating services that had no water sources of score 3 (Figure 2). Cultural services, on the other hand had mostly score 1 (unsatisfactory/bad) (Figure 2).

Provisioning and cultural services must become better in general since their status was bad for most water sources (Figure 2). However, this might be hard to achieve especially for cultural services in water protected areas such as Vombsjön, Häljasjön, Bysjön and Gröne damm (Table 4). Apparently regulating services must be given more attention as none of the included water sources had good status (score 3) (Figure 2). This can be done by, for example, restoring the natural state of the lakes or streams to improve their ability for flood prevention (Lindblom & Holmgren, 2016).

#### 4.5 Limitations and future studies

Taking into consideration the limitations of this study (see Limitations), this study does not reflect the whole value of the ecosystem services in the Vomb basin reserve. The reason is that the study was limited to, first, Lund Municipality and second to the 12 water sources that could be identified on the map. Furthermore, no wetlands were included in this study which could have resulted in the loss of some aspects specially about supporting services (nutrients status).

Going back to the study's questions, one knowledge gap is the ecological status especially for the small lakes. Another one is the information about fishing that need to be updated and more defined for all water sources. For future studies concerning an analysis of ecosystem services, mapping of the chosen area/areas could probably give more accurate results especially when it comes to cultural services. By mapping, it is meant to physically visit the studied area and observe

the available facilities and services for public use. Given the fact that map programs that are provided by different websites such as Skåneleden, Naturkartan or even Google maps could miss or underrepresent the existing services in a certain area. Furthermore, other methods should be tested for assessing different indicators such as biodiversity to get an accurate final score for each of the ecosystem services. An example is species count to assess biodiversity instead of using protected areas as an indicator. This way will allow a clear and more defined comparison between water sources. As for supporting services, other factors than nutrients status can be investigated to act as indicators. An example is primary productivity. The same thing applies to regulating services as more factors can also be interesting to include to achieve better understanding of regulating services such as flood prevention. Some examples of such interesting factors are floodplain and even soil and rock types as they have an important role in flood preventing (Lindblom & Holmgren, 2016).

## Conclusion

- Cultural and provisioning services had bad status in most of the water sources.
- Regulating services need more attention as they scored moderate to bad in general for most water sources.
- Supporting services had the highest number of water sources of good status followed by an equal number of water sources of moderate status.
- Assessing ecological status of different kind (nutrients, morphology, and others) for small lakes, is of high importance for the accuracy of future studies.
- An updated and clearer information about available fishing areas should be conducted especially for lakes that lacked any information about fishing.



# Acknowledgement

I want to express my gratitude to my supervisor Johanna Alkan Olsson for the great help and support that I received from her, not to mention the inspiration that she gave me. I would also like to thank my external supervisor, Anna-Karin Poussart from Lund Municipality for providing me with support whenever I needed. A special thanks to Karl Ljung for being our supportive supervisor during group supervision sessions. I am also grateful to Maria Hansson and Nina Reistad for the information and effort that they provided from the beginning of the thesis writing process. I would as well like to extend my gratitude and give a special thanks to Katarina Hedlund and Per Persson for their precious support when I needed help. Finally, a big thank you to all my friends for the emotional support during the thesis writing process.

Thank you all!



# References

Eklöv, A. (2003). *Fiskar och fiske i Lunds kommun* (2000 ex). Lena Ingvad & Anders Åsberg, Lärande Natur, Park- och naturkontoret, Tekniska förvaltningen, Lunds kommun.

Holst, R. S. and Svensson, O. (2016). *Advective transport times in the river basin of Vombsjön*. Engineering Geology, Faculty of Engineering, Lund University.

Lindblom, E., & Holmgren, K. (2016). *Den småskaliga vattenkraftens miljöpåverkan och samhällsnytta En syntesstudie*. IVL: svenska miljöinstitutet.

Lunds kommun. (n.d.). *Badanläggningar och camping*. (n.d.). Retrieved May 10, 2022, from <https://geoportal.lund.se/portal/apps/webappviewer/index.html?id=dc109145cbc64394b6c756ed3ab15efc&extent=151273.6761%2C6170559.209%2C155242.434%2C6172413.3631%2C3008>

Lunds kommun and VA SYD. (2017 August 31). *Lunds vatten, Sjö-Och Vattendragsplan*.

Länsstyrelserna. (n.d.). *Reservatskartan*. Retrieved May 12, 2022, from [https://ext-geoportal.lansstyrelsen.se/standard/?appid=f7055495ff9549ca8c1377966628f9ca&customquery=NV%20VicNatur%20Naturreservat,NVR\\_ID=2001549](https://ext-geoportal.lansstyrelsen.se/standard/?appid=f7055495ff9549ca8c1377966628f9ca&customquery=NV%20VicNatur%20Naturreservat,NVR_ID=2001549)

Miva. (2022 January 27). *Vattenskyddsområden*. Retrieved May 08, 2022, from [Vattenskyddsområden | Miva](https://www.miva.se/vattenskyddsomraden)

Naturkartan. (n.d.). Retrieved May 10, 2022, from <https://www.naturkartan.se/en/>

Naturvårdsverket. (n.d.-a). *Det här gäller i skyddade områden*. Retrieved June 10, 2022, from <https://www.naturvardsverket.se/amnesomraden/skyddad-natur/det-har-galler-i-skyddade-omraden/>

- Naturvårdsverket. (n.d.-b) *Skyddadnatur*. Retrieved May 15, 2022, from <https://skyddadnatur.naturvardsverket.se/>
- Naturvårdsverket. (2018). *Sweden's environmental objectives- an introduction*. Naturvårdsverket, Stockholm.
- Sjöbo, Lund och Eslöv kommuner. (2019). *Biosfärområde Vombsjösänkan*.
- Skånesmiljömål. (2020, March 24). *Levande sjöar och vattendrag*. Retrieved April 11, 2022, from <https://www.skansmiljomal.info/bedomningar-2020/levande-sjoar-ochvattendrag-2020/>
- Sydvatten. (2021). *Vombsjön*. Retrieved May 11, 2022, from <https://sydvatten.se/varhttps://sydvatten.se/var-verksamhet/rapporter-om-ravattentakter/vombsjon/verksamhet/rapporter-om-ravattentakter/vombsjon/>
- UNESCO. (n.d.-a). *About MAB*. Retrieved May 25, 2022, from <https://en.unesco.org/mab/about>
- UNESCO. (n.d.-b). *World Network of Biosphere Reserves*. (n.d.). Retrieved May 25, 2022, from <https://en.unesco.org/biosphere/wnbr>
- UNESCO. (n.d.-c). *Biosphere Reserves*. Retrieved April 10, 2022, from <https://en.unesco.org/node/314143>
- UNESCO. (2022, April 06). *Vombsjösänkan*. Retrieved April 10, 2022, from <https://unesco.se/biosfaromrade-vombsjosankan/>
- Vattenatlas. (2022, February 14). Retrieved May 10, 2022, from [Vattenatlas Informationsblad.docx](#)
- Caruso, J., Christensen, A., Gunnarsson, F., Johansson, L., Kronholm, M., Lagergren, R., Nandorf, E., Petersson, J., Rimne, A., Salonsaari, J. and Vartia, K. (2013, October 10). *Kokbok för kartläggning och analys 2013-2014 - Hjälpreda klassificering av ekologisk status (Version IV)*. Vattenmyndigheterna and Länsstyrelserna.
- VISS. (2021). *Om VISS*. Retrieved April 15, 2022, from <https://viss.lansstyrelsen.se/About.aspx>



Vombsjösänkan. (n.d.). *Biosfärområdets avgränsning (förslag)*. Retrieved June 10, 2022, from [Karta - Vombsjosankan](#).



# Appendix

**Table 1. The overall status of ecosystem services for all water sources.**

The overall score of each of the ecosystem services that has been shown in Figure 2.

| Water source                        | Provisioning services | Cultural services | Supporting services | Regulating services |
|-------------------------------------|-----------------------|-------------------|---------------------|---------------------|
| Krankesjön                          | 2                     | 3                 | 3                   | 2                   |
| Vombsjön                            | 3                     | 3                 | 1                   | 2                   |
| Klingavälsån                        | 1                     | 2                 | 3                   | 2                   |
| Dalby stenbrott                     | 1                     | 3                 | 3                   | 2                   |
| Häljasjön                           | 1                     | 1                 | 2                   | 2                   |
| Bysjön                              | 2                     | 1                 | 2                   | 2                   |
| Gröne damm                          | 1                     | 1                 | 2                   | 2                   |
| Glomsjön                            | 1                     | 3                 | 2                   | 1                   |
| Tvedörasjön                         | 1                     | 2                 | 3                   | 2                   |
| Kävlingeån:<br>VombsjönKlingavälsån | 1                     | 2                 | 1                   | 1                   |
| Kävlingeån:<br>Klingavälsån- Havet  | 2                     | 1                 | 2                   | 1                   |
| Ålabäcken                           | 1                     | 1                 | 3                   | 1                   |