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Proximity to Urban Green Spaces for Older Adults in Specific Housings - a Case Study of Malmö, Sweden

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Master thesis, 30 credits, in Geographical Information Sciences

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ABSTRACT (ENG)

With regard to current worldwide urbanisation and ageing, available Urban Green Spaces (UGS), have been proposed by the World Health Organization, to be one of the important factors for ensuring healthy ageing in urban areas' outdoor spaces. Since it is particularly the oldest proportion of the older adults that are increasing in global population statistics, this study focused solely on available UGS for older adult specific housings, a rare scientific basis in environmental inequity research but a common housing option for many older adults.

This study explored UGS availability, by measuring Euclidean and network distances (200m, 300m, and 500m) from home address locations to the closest UGS border, using geographic information systems. The study was a case study in Malmö municipality's urban areas, in Sweden. Due to the previous lack of research with a basis in older adult specific housings, the objectives of this study were to assess if these older adults had poorer UGS proximity compared to other demographic groups, and if this proximity differed depending on the type of housing (categorized between type 1-4). The results were assessed to evaluate if the physical planning in Malmö's urban areas could be claimed to be discriminating towards these individuals.

This study showed that for the older adults that lived in the included specific housings for this study, they as a group had better UGS proximity than all other demographic groups. Older adults in specific housings type 3, had the poorest UGS proximity. However, relatively few individuals lived in that housing category. Instead, this study showed that most of the older adults, that fell outside the different distance thresholds used in this study, lived in type 1 housings. This was the specific housing type where older adults required the most extensive care and service.

In conclusion, this study found no evidence for that the physical planning in Malmö's urban areas were discriminating towards older adults in specific housings. These individuals as a group did not experience any environmental inequity in comparison to other urban dwelling demographic groups.

Keywords: Urban Green Spaces, Older Adults, Proximity, Distance, GIS.

ABSTRAKT (SVE)

Världshälsoorganisationen har, med hänsyn till den världsomfattande urbaniseringen och åldrandet, föreslagit att tillgängliga grönområden i städers utomhusmiljöer är en viktig aspekt för det hälsofrämjande åldrande. Med anledning av att det främst är den äldre andelen av äldre som ökar globalt, fokuserar denna studie på att undersöka tillgängligheten av grönområden för de äldre som bor i boenden specifikt inriktade för äldre (kategoriserade i typ 1–4). Detta görs med argumenteten för att det är ett relativt sällsynt utgångsläge för forskning som fokuserar på miljöorättvisa men samtidigt är en vanlig boendeform för många av de äldsta äldre.

Denna studie undersökte tillgängligheten av grönområden genom att mäta euklidiskt avstånd och nätverksavstånd (200, 300m och 500m) mellan äldres boendeadresser och närmsta grönområde med hjälp av geografiska informationssystem. Studien var en fallstudie i Sverige, i Malmö kommuns tätorter. Med anledning av att tidigare identifierad forskning sällan utgått från boenden specifikt inriktade för äldre så var syftet med denna studie att undersöka ifall äldre i dessa boendeformer hade sämre närhet till grönområden än andra demografiska grupper, och ifall deras närhet till grönområden skiljde sig åt beroende på typ av boende. Resultatet från dessa frågor sammanställdes för att utvärdera om Malmös stadsplanering kunde anses vara diskriminerande gentemot dessa individer.

Studien visade att för de inkluderade boendena i denna studie, så hade äldre som grupp, bättre närhet till grönområden än alla övriga demografiska grupper. Äldre som bodde i typ 3 boenden hade de längsta avstånden till grönområden, däremot var det procentuellt få som bodde i typ 3 boenden. Flest äldre, i antal räknat, som hamnade utanför de olika avståndsgränserna bodde i typ 1 boenden, typ 1 boenden var det typ av boende där äldre med de största vård- och omsorgsbehoven bodde.

Sammanfattningsvis så visade denna studie att äldre som bodde i boenden specifikt inriktade för äldre i Malmös kommuns tätorter inte diskriminerades i stadsplaneringen. Dessa individer som grupp utsattes inte för någon orättvisa i deras tillgång till grönområden vid jämförelse med andra demografiska grupper av stadsbor inom kommunen.

Nyckelord: Grönområden, Äldre, Närhet, Avstånd, GIS.

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ABBREVIATIONS

AFC	Age-friendly cities
GIS	Geographic information system
NDVI	Normalized difference vegetation index
OASH	Older adult specific housings
OSM	OpenStreetMap
PA	Physical activity
SPAR	Swedish state personal address register
UGS	Urban green spaces

1. INTRODUCTION

1.1. Background

1.1.1. Healthy Ageing

Worldwide population ageing is a fundamental demographic trend that have been well-known for decades (United Nations, 1956) and in global interpolations for future coming decades, the same demographic change is calculated to continue, but now instead with a faster rate than ever before (United Nations, 2001). Older adults have historically been defined as adults 65 years old or older (United Nations, 1956). It is this group of individuals that constitutes the fastest growing demographic group in the world. The proportion of older adults are globally increasing because societies are both getting more older adults and the older adults themselves are ageing. In fact, it is the oldest older adults, aged 80 or above, that is growing the fastest among the older adults (United Nations, 2001). In Sweden the same demographic change is occurring, Sweden is getting more older adults (Statistics Sweden, 2023c) and the older adults themselves are ageing (Statistics Sweden, 2022).

Another worldwide change currently, and historically, in progress is urbanisation. A change, not estimated to cease. Most of the world's population is urban, that is, are living in cities. By 2050, 68% of the world's population is estimated to be living in cities, for Sweden, that number is predicted to be 93.2% (United Nations, 2019). This urbanisation trend applies to the older adults population as well, older adults is urbanised in the same pace as younger citizens (World Health Organization, 2007).

With the knowledge of worldwide ageing and urbanisation, both internationally and in Sweden, the claim that it is the urban older adults that is increasing the most and will continue to do so in the future is supported. This knowledge and claim will be used as justification as to why this study's focus is on urban older adults.

Worsened public health is a threat to societies if the trends of urbanisation and ageing is not properly faced. These trends put new challenges on societies and requires adaptations. To ensure good public health in urban areas, the World Health Organization (WHO), in the beginning of the 21st century presented an Age Friendly Cities (AFC) framework. This AFC framework consisted of recommendations and guidelines for achieving healthy ageing in societies worldwide. In the framework, eight core domains related to healthy ageing were identified and one of these domains was called "Outdoor Spaces and Buildings". The AFC framework was based on a public participatory approach and when older adults discussed this specific domain, green spaces were considered one of the important features of outdoor environments for the aim of healthy ageing in urban areas (World Health Organization, 2007). The focus of this study is on these, according to older adults, important green spaces.

1.1.2. UGS and Health in Older Adults

Green spaces in urban areas are in research context often referred to as Urban Green Spaces (UGS). UGS is defined as "an outdoor space covered by green vegetation in urban areas, such as forests, parks, grasslands, green belts, river wetlands, etc." (Li et al., 2023). The following text will intentionally be delimitated to the physical and general health benefits for older adults using UGS for the purpose of Physical Activity (PA). Physical activity is defined as body movements that consumes energy and are performed by skeletal muscle (Portegijs 2020). The positive associations between PA and UGS have been established for older adults when researching self-rated general health (de Vries et al., 2003; Huang et al., 2019; Parra et al., 2010) and physical health (Li et al., 2023). In large urban environments, research have also shown that having walking distances to UGS, in fact increased the longevity in older adults (Takano et al., 2002). The World Health Organization (2016) have also recently concluded that health benefits from UGS is particularly noticeable in older adults. Research suggests that older adults' physical outdoor environment, and in this case specifically UGS, directly impacts their general and physical health.

Ali et al. (2022) state in their research that benefits of UGS for older adults' physical health relates to the regular PA that is carried out in such environments. Research supports this connection between UGS and PA. UGS usage (Vich et al., 2021), UGS spatial extent (Hooper et al., 2020; Li et al., 2005; Li et al., 2008; Zandieh et al., 2019) and proximity to UGS (Booth et al., 2000; Michael et al., 2010) have shown to be positive correlated to PA among older adults, and UGS proximity has also shown to increase the likelihood of meeting PA recommendations (Li et al., 2008). World Health Organization (2016) similarity states that UGS is one way of encouraging PA towards older adults and therefore is important for the public health.

The relationship between UGS and PA implies that the benefits associated with PA indirectly is also related to UGS usage among older adults. Epidemiological review studies of older adults' health states that increased PA results in decreased risks of physical limitations, in increased physical capacity (Manini & Pahor, 2009), support to prevent numerous chronic diseases, e.g., certain cancer types, stroke, and osteoporosis, and is negatively related to mortality rates (Singh, 2002). This means that research suggests that UGS have impact on older adults' general and physical health, both directly and indirectly via PA. Since UGS is a part of urban areas' physical outdoor environment, UGS related benefits for older adults is used as arguments in this study as to why it is important to ensure environmental equity and good urban physical planning in urban areas for sake of the public health.

For urban older adults to be able to use UGS, and benefit from its associated PA, it becomes essential to make sure that older adults' preferences and needs are met in UGS. Since urbanisation inevitably entails that the closest green space for most people worldwide will be UGS, it becomes especially important to make sure that UGS meet older adults needs and preferences to ensure healthy ageing and good public health. Especially since research globally have shown that urbanisation is negatively correlated with the extent of various types of UGS (de Vries et al., 2003; Girma et al., 2019; Li et al., 2019; Nazombe & Nambazo, 2023; Zhou & Wang, 2011).

1.1.3. Cultural and Regional Differences

Identifying what older adults need and value in UGS is an important and fundamental step when making sure that older urban dwellers can access UGS and benefit from them. Identifying such characteristics is important since UGS is of no use for older adults if they are not accessible. When embarking on such a compilation, research benefits from using a bottom-up participatory approach. A bottom-up participatory approach allow for more local perspectives to be included and allow older adults to describe themselves what UGS features they need and preference for the sake of healthy ageing. (World Health Organization, 2007).

The benefits of paying attention to local differences among older adults when compiling needs and preferences in UGS was also supported by a recent systematic literature review by Wen et al. (2018). The authors emphasized that, even though they showed that it indeed was possible to summarise the needs and preferences in UGS by such a large and culturally diverse group as merely older adults, extra consideration ought to be given to differences related to culture, region and the purpose of using the UGS. As a response to the calls of highlighting cultural and regional differences, as well as differences related to the various purposes of using UGS (Wen et al., 2018), this study focuses on values and preferences stated in Swedish, Nordic, or European research about older adults' usage of UGS for the sake of PA.

1.1.4. Older Adults' Preferences in UGS

In this study's literature search for values and preferences by older adults in UGS with the purpose of PA, few Swedish scientific articles were identified. However, by summarising national, Nordic, and European research, this author claims that a well-founded assumption nevertheless could be made.

A recent Swedish study showed that the main green space feature valued by older adults was proximity. The green space feature was not expressively for the purpose of PA, but nevertheless, the main activity among the older adults in the green spaces were PA, specifically walking (Zingmark et al., 2021). Nordic research supports this finding by proving that older adults visited UGS in closer proximity to their residence, in comparison to UGS further away, more than any other age group of urban dwellers (Laatikainen et al., 2017; Schipperijn, Stigsdotter, et al., 2010), and that having walking distances to green spaces was the number one facilitator for PA (Eronen et al., 2014).

The Swedish preference of proximity to UGS (Zingmark et al., 2021) is also supported by European research. Proximity to UGS is one of the important values for PA among older adults in care facilities in Europe (Artmann et al., 2017). Wen et al. (2018) in their international literature review supports this, older adults value accessibility to UGS more than what younger adults do and the most common accessible feature mentioned was proximity (Wen et al., 2018).

Just like the older adults in the AFC-framework, which stated that green spaces were important in urban areas' "Outdoor Spaces and Buildings" for the sake of healthy ageing, Swedish older adults also value UGS as important for their health. Over 90% of the Swedish older adults states that green spaces is either completely or somewhat positive for their health (Fredman et al., 2019). Simultaneously, older adults in Sweden state that they wished they could spend more time in green spaces (Grahn & Stigsdotter, 2003; Zingmark et al., 2021). For context, the most common PA in UGS among older adults is walking (Fredman et al., 2019; Zingmark et al., 2021)

Another argument that supports the claim that one of the most valued UGS features by older adult's is proximity, is the fact that older adults' barriers for using UGS are not the same as the rest of the population. Fredman et al. (2019) have shown that older adults most common barrier is not lack of time as other age groups states, instead the largest barrier was that the activity was too physical demanding. This barrier by older adults was supported by another Swedish study that concluded that the main barrier was changes in personal health, followed by the fact that the activity was too physical demanding (Zingmark et al., 2021).

Overall, when interpretating the previous stated research, it implies that Swedish older adults' value green spaces, use them mainly for walking, wish they spent more time in green spaces but are somewhat unable to do so in the extent that they wish for because it is often too physical demanding. That older adults value proximity may relate to the fact that the main barriers for using UGS are changes in personal health and that using UGS are often too physical demanding. One way of working against the barriers stated by older adult's is to make sure that older adults have UGS in close proximity to their residences. For example, walking to an UGS in close proximity can be claimed to be less challening than walking to an UGS located further away. The next section continues this proximity discussion.

1.1.5. Older Urban Dwellers Proximity to UGS

Urban dwellers in Sweden have in general relative good proximity to UGS from their residences (Statistics Sweden, 2019a) compared to other international statistics (European Union, 2018; Kabisch et al., 2016; Schipperijn, Stigsdotter, et al., 2010). In Sweden, UGS proximity statistics, for three different distances, have already been calculated for every urban area by Statistics Sweden (2019a). These proximity statistics have also been categorized into age, gender, and regions, see Table 1 for age group differences. The statistics reflect proximity by Euclidean distances and were computed based on urban dwellers address locations. In general, the relationship is the following (even though the correlation is weak): the larger the urban area, the poorer the proximity to UGS.

Table 1. Proximity statistics in percentage to year-around publicly available UGS > 0.5 ha for urban dwellers in Sweden. Statistics are categorized into different age groups (Statistics Sweden, 2019b).

Demographic group	200 m	300 m	500 m
Children 0-6	95	99	100
Children 7-15	95	99	100
Adolescents and adults 16-64	94	99	100
Older adults	94	99	100
All urban dwellers	94	99	100

In Swedish research, when studying urban dwellers proximity to UGS, no significant differences have been shown for age, not in the beginning of the 21st century (Grahn & Stigsdotter, 2003), or in more recent years (Statistics Sweden, 2019a). However, one of the drawbacks of previous research and statistics is that no attention has been given to older urban dwellers' different housing types or locations. This is claimed to be a valid starting point when researching older adults' proximity to UGS since many older adults leave their previous housings due to changes in personal health (Boverket, 2023a). The questions that this entails, and that previously have not been studied in Sweden, is: what does this move mean for older adults' proximity to UGS?

The fact that many older adults are required or want to move housings inevitably entails that many older adults in Sweden gather in specific parts of urban areas. They gather in housings that are better suited to their needs, thus they become dependent on the locations of these better suited housings. In Sweden, no research (to the author's attention) has studied older adults' proximity to UGS based on such specific housings. In all previous proximity and accessibility UGS research, older adults have been grouped together as one unit. This grouping of older adults has left space for new potential discoveries about a subgroup of older adults' proximity to UGS, a subgroup not previously studied. This is the focus of this study.

1.1.6. Older Adult Specific Housings as a Starting Point

In Sweden there are various housing options for older adults with different levels of service and care, in this study those housing options is collectively called Older Adult Specific Housings (OASH). To clarify, these OASH are housings targeted specifically towards older adults on the housings market. Some types are similar to "normal" housings targeted towards all types of citizens and some types offers care and service for the older adults.

Older adults in Sweden are more inclined to move to OASH that provides more care and services as they age. Only 1.5% of the older adults between 65 - 80 years old live in the OASH with the most extensive care and services, but 14% of older adults above 80 do. The main reason for leaving the ordinary housing and moving to OASH is because of decline in physical capacity. In recent years, fewer older adults have moved to OASH that provides the most extensive care and services because of better public health and physical capacity (Boverket, 2023a), however, with increasing amounts of older adults (Statistics Sweden, 2023c), and especially the oldest older adults (Statistics Sweden, 2022), basing UGS proximity studies on these specific housings become a well motived choice.

The arguments for having OASH as a starting point in an UGS proximity study are many. First of all, it aligns with target seven of goal 11 in the Sustainable Development Goals (United Nations, 2015), "By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities". Focusing on older adults in specific housings can be claimed to check two of the boxes in the citation above, older adults and person with disabilities. Research have shown that older adults have more disabilities in comparison to adults below 65 years old (Okoro et al., 2018).

Secondly, older adults that are planning to move to, or are living in OASH, have more limited housing options available on the housing market that suit their needs. Boverket (2023a) states that the decline of physical capacity in older adults puts challenges and demands on the housings suitable for these individuals. These stated demands can be used as a claim to why these individuals do not have the same freedom of choice on the housing market and therefor becomes a more vulnerable group in urban areas' physical planning. This argument is reinforced by the fact that many municipalities in Sweden state that they currently, or in the future will, have too few OASH available (Boverket, 2023b).

Thirdly, older adults state that with age, the perceived restrictions in everyday life increases, especially outside of their homes (Wilkie et al., 2006), this restriction among older adults, especially to the neighbourhood they live in, is something that previously have been expressed in green space research (de Vries et al., 2003). Restrictions in outside environments is a characteristic measured in research by life-space mobility. Life-space mobility is defined as the area an individual have travelled or moved within, regardless of which mode of transport, during a specific time in his or her daily life, both in- and outside of the home. (Baker et al., 2003).

Older adults have shown to have more functional limitations with age (Ferrucci et al., 1996) and poorer muscle strength and endurance (Singh, 2002). Since physical performance have shown to determine a substantial part of older adults' life-space mobilities (Portegijs et al., 2014), as older adults age they can be claimed to generally get more restricted life-space mobilities. These restrictions align with research stating that fewer older adults drive in comparison to younger urban dwellers, instead, walking or using transit is often the chosen mode of transport for everyday life (Cao et al., 2010). The claimed more restricted life-space mobility among older adults is also supported by the fact that older adults rely more on walking (Cao et al., 2010) but simultaneously experience decreases in both gait speed and stability with age (Singh, 2002). Overall, it is not surprising that research have shown: that older adults spend more time in their neighbourhoods and close to their housings (Portegijs et al., 2014; Varjakoski et al., 2023), are more affected by neighbourhood characteristics and designs for PA (Cao et al., 2010), that the local environment and barriers in the neighbourhoods affects their mobility (Varjakoski et al., 2023), and that they walk shorter distances in comparison to younger urban dwellers to reach UGS (Laatikainen et al., 2017; Schipperijn, Stigsdotter, et al., 2010).

Collectively, the arguments above, all support the claim that older adults as a group are extra sensitive to poor urban physical planning and environmental inequity. Therefore, studying and making sure that older adults, living in OASH, have access to UGS becomes a well-motived choice in the context of healthy ageing. Since there in Sweden are no prior statistics and research in this subject, this study attempts to fill this identified knowledge gap.

1.1.7. Project Delimitations

The basis for this study was the preferences and needs for using UGS for PA by Swedish older adults. Values and preferences for using UGS were first and foremost derived from Swedish research to ensure that local perspectives and experiences were reflected. Due to that reason, Nordic research findings were secondly used, European research thirdly, and other international research lastly. By mainly concentrating on national research findings, a closer match to actual Swedish older adults' opinions, behaviours, and perceptions of urban physical environments, was intended to be better reflected. As Wen et al. (2018) summarised in their literature review: the advantage of this delimitation is that the older adults included share more cultural contexts, values, and beliefs, with each other.

Additionally, this study did not intend or aim to explore or reflect on the differences in proximity or preferences by any other demographic subgroup among older adults, for example older adults with different genders, socio-economic backgrounds, religions, or education. Differences in preferences and proximity by older adults in urban, suburban, or rural areas were also intentionally not explored in this study. This is an important declaration since older adults have complexed preferences and older adults in different environments automatically do not share preferences with each other (Wen et al., 2018).

1.2. Research Questions and Objectives

1. Do UGS in Malmö municipality meet one of the main preferences, that is proximity, of Swedish older adults?
2. Are there differences in urban older adults' proximity to UGS in Malmö municipality based on the type of OASH?
3. Do urban older adults in Malmö municipality, in OASH, have poorer proximity to UGS compared to other urban dwellers?
4. Do the results from research question two and three collectively imply that urban physical planning is discriminating towards older adults in OASH?

The above mentioned research questions will be answered by the following objectives.

- Determine what percentages of urban older adults in OASH, in Malmö municipality, have UGS within 200 m, 300m, and 500m proximity, studied by both Euclidean distance and network distance.
- Explore this study's result by categorising the UGS proximity into OASH types.
- Compare this study's result to Statistics Sweden's (2019a) UGS proximity statistics for other demographic groups of urban dwellers in Malmö municipality.

2. METHODODOLGY

2.1. Study Area

Among Sweden's 290 municipalities, 19 have over 100,000 inhabitants (Statistics Sweden, 2023a). Among these 19, Malmö municipality is the one were urban dwellers have the poorest proximity to UGS (Statistics Sweden, 2019c), see Table 2. Malmö municipality is an interesting study area since it allows for greater variation among its urban dwellers. Malmö municipality has the third largest population (357,377) (Statistics Sweden, 2023a) and is the fourth most densely populated municipality in Sweden (2,277/km^2) (Statistics Sweden, 2023b). 15.15% of the citizens are older adults and this percentage is similar to the proportions of Sweden's other two bigger municipalities, Stockholm and Gothenburg. In Malmö, the older adult's population correspond to 54,161 citizens. Even though the proportion of older adults in Sweden varies notably between municipalities, ranging from 13% to 38%, no other municipality, due to their smaller population sizes, have more older adults than Stockholm, Gothenburg, or Malmö (Statistics Sweden, 2023a).

Table 2. The proportion of average and older urban dwellers' proximity to urban green areas (> 0.5 ha) in Sweden and in Malmö municipality (Statistics Sweden, 2019b, 2019c).

	200 m	300 m	500 m
SWEDEN			
urban dwellers in general	94%	99%	100%
urban older adult	94%	99%	100%
MALMÖ MUNICIPALITY			
urban dwellers in general	85%	95%	100%
urban older adult	88%	96%	100%

Malmö municipality is the study area of this thesis, see Figure 1. The biggest urban area in Malmö municipality is Malmö. An important clarification of this study is that Malmö's urban area is not restricted to solely Malmö municipality, a small part of the northeastern urban area is located in the adjacent municipality, Burlöv. This part of Malmö's urban area is called Arlöv city. Arlöv will not be included in this study. The other urban areas in Malmö municipality, called Bunkeflostrand, Tygelsjö, and Oxie, will however be included in this study.

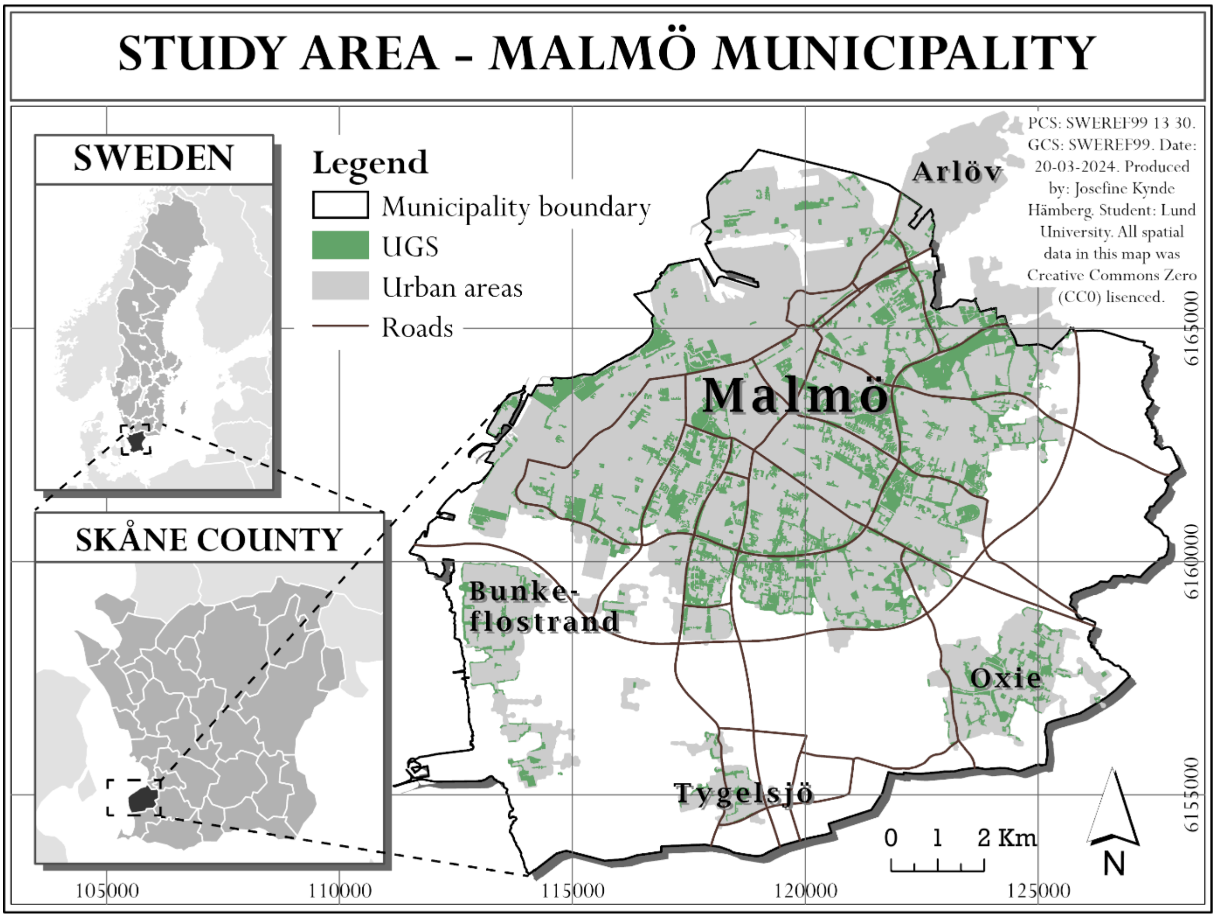

Figure 1. Map showing the study area for this thesis, Malmö municipality, as well as the extent of urban areas and some larger roads. The UGS shown in the map above are defined as year-around publicly available green spaces larger than 0.5 ha inside urban areas.

2.2. Data

Table 3. Geographic data used in this study, both for analysis and for visualisation.

Data	Original data name	Geometry type/ Data type	License/ Spatial extent	Last updated/ PCS or GCS	Source/ Download date
Addresses	Adresser	Point Shapefile	CC0 1.0 Malmö municipality	2024-02-18 WGS 1984	Malmö open data platform 2024-02-21
Counties and municipalities	Digitala gränser	Polygon Shapefile	CC0 Sweden	--- SWEREF99 TM	Statistics Sweden 2024-02-28
Countries' boundaries	Admin o Countries version 5.11	Polygon Shapefile	CC0 The World	2022-05-12 WGS 1984	Natural Earth 2024-02-28
Buildings	Primärkarta	Polygon, line, and point / Shapefile	CC0 1.0 Sweden	2024-02-18 WGS 1984	Malmö open data platform 2024-02-21
Malmö boundary	Geografiska statistikområden	Line Shapefile	CCO 1.0 Malmö municipality	2024-01-22 SWEREF99 13 30	Malmö open data platform 2024-02-19
Parks and urban squares	Parker och torg	Polygon Shapefile	CC0 1.0 Malmö municipality	2024-02-18 WGS 1984	Malmö open data platform 2024-02-21
Roads	Vägdata för transportplanering	Line Geopackage	CC0 1.0 Sweden	2024-02-13 SWEREF99 TM	Swedish Transport Administration/ 2024-02-20
Roads	Roads	Line Shapefile	CC BY-SA 2.0 Malmö municipality	--- WGS 1984	OpenStreetMap 2024-02-22
Urban Area Boundary	Tätorter 1980-2020	Polygon Geopackage	CC0 Sweden	--- SWEREF99 TM	Statistics Sweden 2024-02-19
Urban Green Spaces > 0.5ha	Grönområden i tätorter (2015)	Polygon WFS	CC0 1.0 Sweden	2020-12-01 SWEREF99 TM	Statistics Sweden 2024-02-19

2.3. Methodological Overview

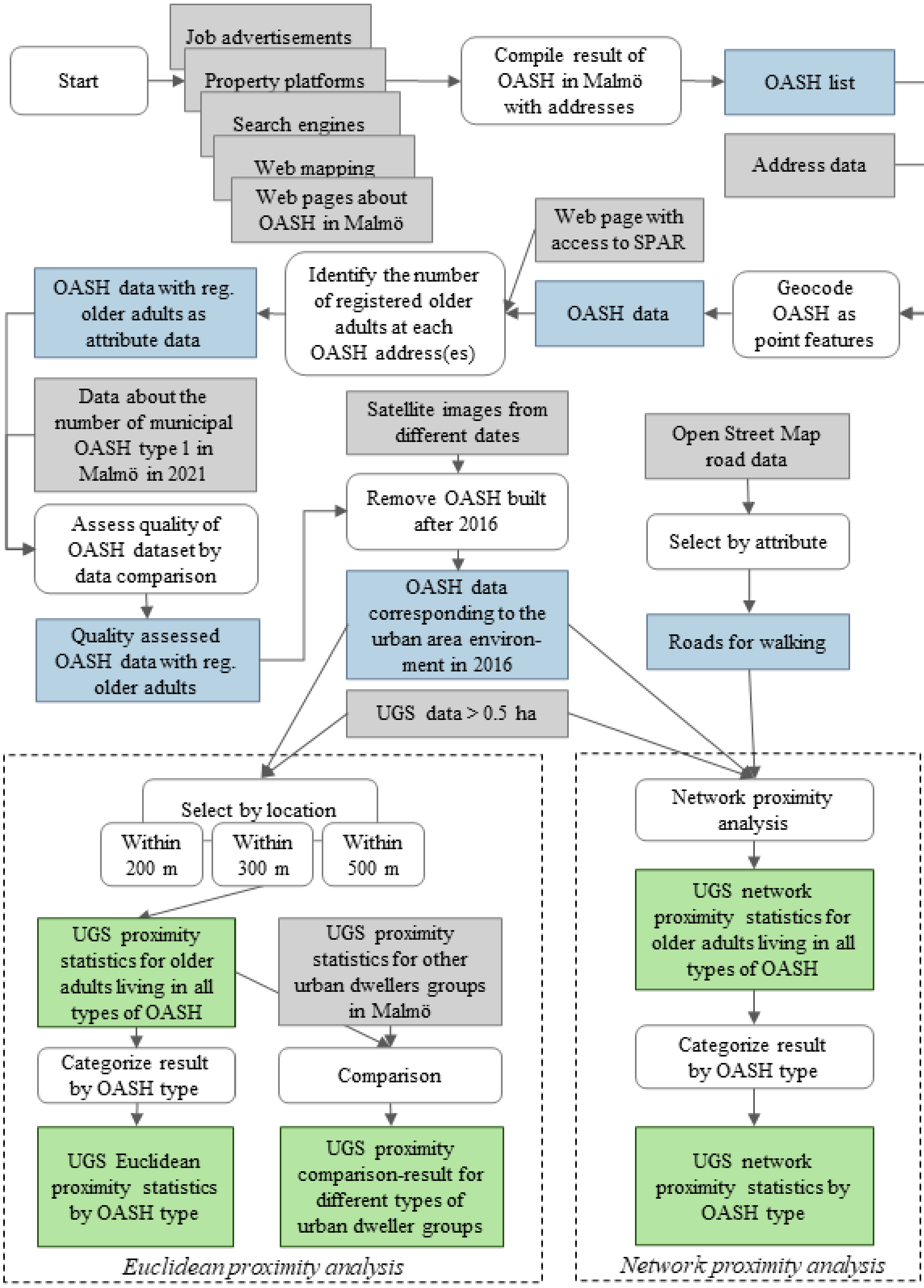

Figure 2. Flowchart describing the general methodology for this study's proximity analyses. The white boxes represent methods used or steps taken in this study, the grey boxes represent input data, the blue boxes represent output data, and the green boxes represent the results and the final data.

2.4. OASH Data

There are numerous different kinds of OASH in Malmö (Boverket, 2023b), four types of OASH were included in this study, see Figure 3. There are no standard translations of these OASH types to English, and hence, for convenience they will in this study be called type 1 – 4. Type 1 refer to the type with the most extensive care and service, type 4 to the least.

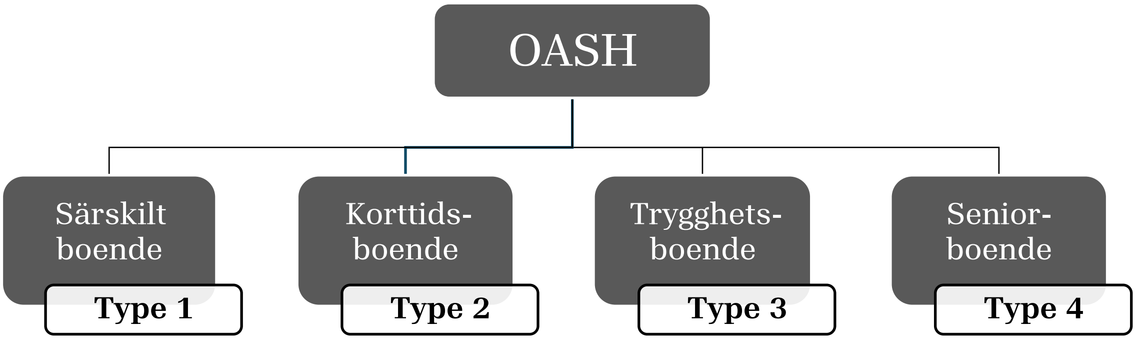

Figure 3. The OASH types available in Malmö municipality and included in this study (Boverket, 2023b).

The following list provides a short description of the different types of OASH in Malmö:

Type 1. A permanent housing option that provides full time care, meals, and services. It is generally the older older adults that live in OASH type 1. To be able to move into this housing option, older adults need an aid decision by a social service officer according to the Social Services Act in Sweden (Boverket, 2023a). In Malmö, OASH type 1 normally corresponds to apartments that are smaller than 2 rooms and have a private bathroom and kitchenette (Socialstyrelsen, 2022).

Type 2. A temporary housing option that provides the same fulltime care, meals, and services, as OASH type 1. This housing type is provided as a temporarily solution, e.g. after surgery, in sickness, or when waiting for a vacant OASH type 1. Just like type 1, type 2 also requires a aid decision by a social service worker (Malmö stad, 2023b).

Type 3. A housing option that provides safeness, some personnel, and a sense of community for citizens above a certain age, with that said, there is no clear definition of this housing type. OASH type 3 is intended to fill the gap between OASH type 1 and individuals' earlier ordinary housings. Generally, no services or care are included and hence no aid decision is required to move into type 3 housings. Since 2019 in Sweden, there however also exists OASH type 3 that require aid decisions, since they indeed offer some services or care (Boverket, 2023a). Malmö municipality have however not implemented this specific type 3 housing and therefore there is no need for distinguishing between the two in this study (Boverket, 2023b).

Type 4. A housing option that in many aspects are like ordinary housings for urban dwellers. The characteristics of these housings varies greatly, however, the unique characteristic is typically that residents must be above a certain age before moving to this type of OASH, like in type 3. The main difference between OASH type 3 and 4 is that type 3 must include activities and areas where older adults can socialize in a safe way. Type 4 do not have such requirements, nevertheless this housing options often fulfils them anyway (Boverket, 2023a).

The OASH in this study were identified in a list by the following online sources: Malmö municipality's website *Malmö Stad* that listed available OASH, *Seniorval* website that listed OASH by municipality, numerous different job advertisement platforms, numerous different property platforms, search engines, and web mapping platforms. Addresses, type of OASH, ownership (municipal or private), and number of offered apartments in each OASH were compiled with the same set of methods and saved as attribute data. A OASH was classified as municipal if the housing were provided and driven by the municipality or if the housing company was a public housing, meaning, Malmö municipality owned the housing company. Data about the ownership were gathered in order to later perform an OASH quality assessment, see section 4.6.1.

Malmö municipality data portal's open access address data were used to geocode the OASH list to geographic data in the form of point features, see Table 3 to see this data set and others used in this study. Address geocoding is one of the most common geocoding methods and is the process of converting addresses to locations with x and y or longitude and latitude coordinates (Goldberg et al., 2007). Geocoding addresses is a method often used in research when studying urban dwellers surrounding environments and PA (Hooper et al., 2020; Portegijs et al., 2017; Schipperijn, Stigsdotter, et al., 2010). Home address locations when geocoding for proximity analyses is commonly used in research (Koohsari et al., 2015). In this study, each geocoded OASH point feature corresponded to the entrance location of that building. Every standalone building was created as a unique OASH point feature in this study to better reflect real-life proximity. Buildings that had several entrance locations, for example due to addresses such as "Maple Street 3A-D", were represented by one OASH point feature only in this study.

The number of registered older adults at each OASH address were compiled by utilizing web pages with access to the Swedish state personal address register (SPAR). In Sweden there are several web pages that freely provide access to information in SPAR. In SPAR information such as name, address, age, etc, are compiled. Examples of web pages with such online services are: *Hitta*, *Eniro, Upplysning, MrKoll,* and *Ratsit*. In this study, such online services were used to be able to set a threshold of age 65 when compiling the number of residents at each OASH address. The age thresholds excluded younger spouses, children, and any other adults below 65. The use of the age threshold hence guaranteed that no residents younger than 65 were included in this study.

The OASH data were further delimitated by removing all OASH built after 2016. This step in the housing data production was taken to better match the UGS data used for this study's proximity analyses. The UGS data used in this study had been produced based on urban area data from 2016 in Malmö municipality. Any urban area changes that have occurred after 2016, were therefore not reflected in the UGS data. To increase the quality and to decrease any potential sources of errors of this study's proximity analyses, OASH built after 2016 were excluded. OASH built after 2016 were identified by visual interpretation of Google Earth Pro remote sensing images of different dates for the study area, see Table 10 in section 7.2 for such examples. Also, see Figure 2 above to visually see the steps taken to create the OASH data set.

2.5. UGS Data

The results of older adults' proximity to UGS in this study was compared to other demographic groups' proximity to UGS in Malmö. The statistics that this study's result was compared to was derived from Statistics Sweden (2019a). Because comparison was made, it was important to make sure that the datasets, calculations and methods used for computing urban dwellers' proximity matched. For the benefit of this study, Statistics Sweden have published both their used UGS data and their UGS proximity statistics as open data.

The UGS data used in this study and by Statistics Sweden, were defined as, year-around publicly available green spaces larger than 0.5 ha in urban areas, see Table 3 for more information about the data set used. Since the data only included year around publicly available UGS, some land uses and built-up areas were removed, e.g., private gardens, allotments, and arable lands. Examples of land uses and built-up areas that were included as UGS was pastureland, cemeteries and forests (Statistics Sweden, 2019a). Urban areas are in Sweden defined as areas with more than 200 inhabitants that have housings less than 200 m apart (Nationalencyklopedin, n.d.). The UGS size of 0.5 ha was used as it is the recommended size when studying UGS accessibility according to the World Health Organization (2016). In addition, both European (Zandieh et al., 2019) and international (Hooper et al., 2020; Li et al., 2005; Li et al., 2008) research have showed that older adults PA level increases with UGS size.

The open UGS data from Statistics Sweden, did not include green spaces outside urban area's boundaries. However, Statistics Sweden's open UGS proximity statistics were computed by also including green spaces outside of urban area's boundaries, in order to create more realistic green space proximity statistics for residents that live close to urban area boundaries. The differences between the provided open UGS data and the open UGS proximity statistics was a possible drawback in this study.

The main drawback of the UGS data for this study was however not the strict urban area boundary in the UGS data, but rather the date of it. In the production of the open UGS data, multispectral sentinel-2 satellite images dated between 2015 to 2018, and with a resolution of 10x10 m were used. These satellite images were used to classify and distinguish between green surfaces and impervious surfaces using normalized difference vegetation index (NDVI) threshold values and an NDVI algorithm. The NDVI algorithm also utilized infrastructure vector data in its classification. The classified green and impervious surface were additionally processed using several vector data sets derived from 2016: buildings polygon data, railway line polygon and road line polygon data. Together these datasets automatically classified underlying areas as impervious surfaces. Property boundaries from 2016 were also used to match information in the 2016 real estate tax assessment register to exclude any private areas from the UGS data. Lastly the UGS data was clipped to the 2015 urban area boundaries (Statistics Sweden, 2019a).

2.6. Proximity Analyses

Proximity between OASH and UGS were explored though quantitative geography. Proximity is a measure that can be directly quantified to metric measures and metric measures are commonly used in proximity analysis (Koohsari et al., 2015). In this study's proximity analyses, two types of distance measures were calculated to reflect proximity in two different ways for older adults, Euclidean and network distances.

Both Euclidean and network distances are common and suitable measures in research of UGS accessibility (World Health Organization, 2016). However, different distance measures used in the same proximity analyses can often yield different results, especially at local level and in sub-urban areas. Thus, the choice of distance measures is an important part of many proximity analyses (Apparicio et al., 2008). For example, in a Danish study, shortest Euclidean and Network distances to UGS yielded large differences for proximity values for urban dwellers (Schipperijn, Stigsdotter, et al., 2010).

In this study, both proximity analyses were calculated using planar distances in meters. Planar distances are often sufficiently good assumptions in small study areas (Pilesjö et al., 2020, p. 218). All proximity analyses to public UGS were calculated in the geographic information system software ArcGIS Pro. GIS methods are commonly used in research when studying individuals proximity to, usage of, and PA level, related to UGS (Hooper et al., 2020; Koohsari et al., 2015; Li et al., 2005; Maat & de Vries, 2006; Schipperijn, Stigsdotter, et al., 2010; Vich et al., 2021; Zandieh et al., 2019). In the GIS software, all geographic data were projected to the local southern Swedish projected coordinate system SWEREF 99 13 30 before any proximity analyses were performed.

In the proximity analyses, distances were calculated to UGS polygon borders. This was the methodology used by Statistics Sweden (2019a) in their Euclidean proximity analysis and was hence used in this study to better compare the computed proximity statistics. Using polygon borders for proximity analyses is a better choice than using the centroid positions for the UGS, however it is a poorer choice than using the actual entrance locations for an UGS (Koohsari et al., 2015). According to World Health Organization (2016) using UGS polygon borders is reasonable and suitable in UGS accessibility research. In the Euclidean UGS proximity statistics from Statistics Sweden, proximity thresholds of 200m, 300m, and 500m, were used from residents' housing locations Statistics Sweden (2019a). The same distance thresholds were used in this thesis.

The World Health Organization (2016) states that even though there are no universally agreed upon distance threshold in research that states if an UGS is accessible or not, they suggest based on reviewed research, that 300 m is a suitable threshold in UGS accessibility research. 300 m corresponds to a 5 minute walking time based on an average gait speed for adults. They also state that UGS should have a minimum size of 0.5 ha and that accessibility can be measured with Euclidean distances but that network distances are believed to be a more accurate measure.

The 300 m distance threshold is commonly used in UGS research (Ahmed et al., 2023; Kabisch et al., 2016; Martins, 2022; Schipperijn, Ekholm, et al., 2010; Schipperijn, Stigsdotter, et al., 2010; Sick Nielsen & Bruun Hansen, 2007; Sikorska et al., 2020), the 500 m limit is also quite common (Ahmed et al., 2023; Kabisch et al., 2016; Wüstemann et al., 2017). The specific 200 m distance threshold is more rarely used, however, it is not unusual to encounter even smaller distance limits (Ahmed et al., 2023; Schipperijn, Stigsdotter, et al., 2010). Even though the 200 m limit is rarely used, since Sweden have been proven to have better UGS proximity in comparison to other countries (European Union, 2018; Kabisch et al., 2016) and since older adults have slower gait speeds and more functional limitations (Ferrucci et al., 1996; Singh, 2002), the 200 m limit is argued to be a valuable measure in this study. See Figure 2 to visually see the steps taken in this study's Euclidean and network proximity analyses.

Lastly, one clarification of this study's UGS proximity analyses is that the OASH data, and the number of registered older adults at addresses, is not sample data for the study area (e.g. by random, systematic, or stratified). Instead, the OASH data is population data. This means that this study's UGS proximity analysis represents population parameters instead of sample statistics which leads to limitations for what type of comparisons that can be made to proximity statistics from Statistics Sweden. The Euclidean proximity result for older adults living in OASH in this study will not be comparable to the general older adults' UGS proximity Malmö municipality from Statistics Sweden (2019a), because this study's population data is not independent from that one. The older adults in OASH in this study is in fact a part of the older adult proximity data from Statistics Sweden. Because of this, the proximity statistics for older adults in OASH in this study will only be comparable to other demographic groups' UGS proximity statistics.

2.6.1. Euclidean Proximity Analysis

Euclidean distance is the shortest straight line distance between two locations, often referred to "as the crow flies". Euclidean distances was the proximity measured used by Statistics Sweden (2019a), to be able to compare this study's proximity result to their statistics, the same distance measure was used. Euclidean distances are common GIS measures in proximity analyses and urban accessibility research (Apparicio et al., 2008; Koohsari et al., 2015; World Health Organization, 2016) and is useful when comparing research due to its objectivity (World Health Organization, 2016). Euclidean buffers as a method in environmental studies were used early in proximity analysis, during the 90's (Maantay, 2002), it is hence argued to be a well-established and basic methodology in GIS analysis. Overall, using Euclidean distances to UGS polygon borders is in UGS accessibility research a reasonable proxy for individuals walking distances in urban areas (World Health Organization, 2016).

2.6.2. Network Proximity Analysis

Even though Euclidean distances are commonly used in UGS research, network proximity analysis for the shortest distance between two locations yield more accurate true walking distances for urban dwellers. Network distance is a distance measure suitable for pedestrians (Apparicio et al., 2008; World Health Organization, 2016). A comparison between the result of Euclidean and network distances, for an arbitrary OASH in this study, is shown in Figure 4 below. Compared to the Euclidean distance calculation, network distances are more complex to calculate, however with the evolution of GIS software during the beginning of the 21st century, network distance analysis tools are nowadays often integrated in GIS software. Because of this, in combination with more available street network data, there are no longer any large obstacles for performing network analyses (Apparicio et al., 2008).

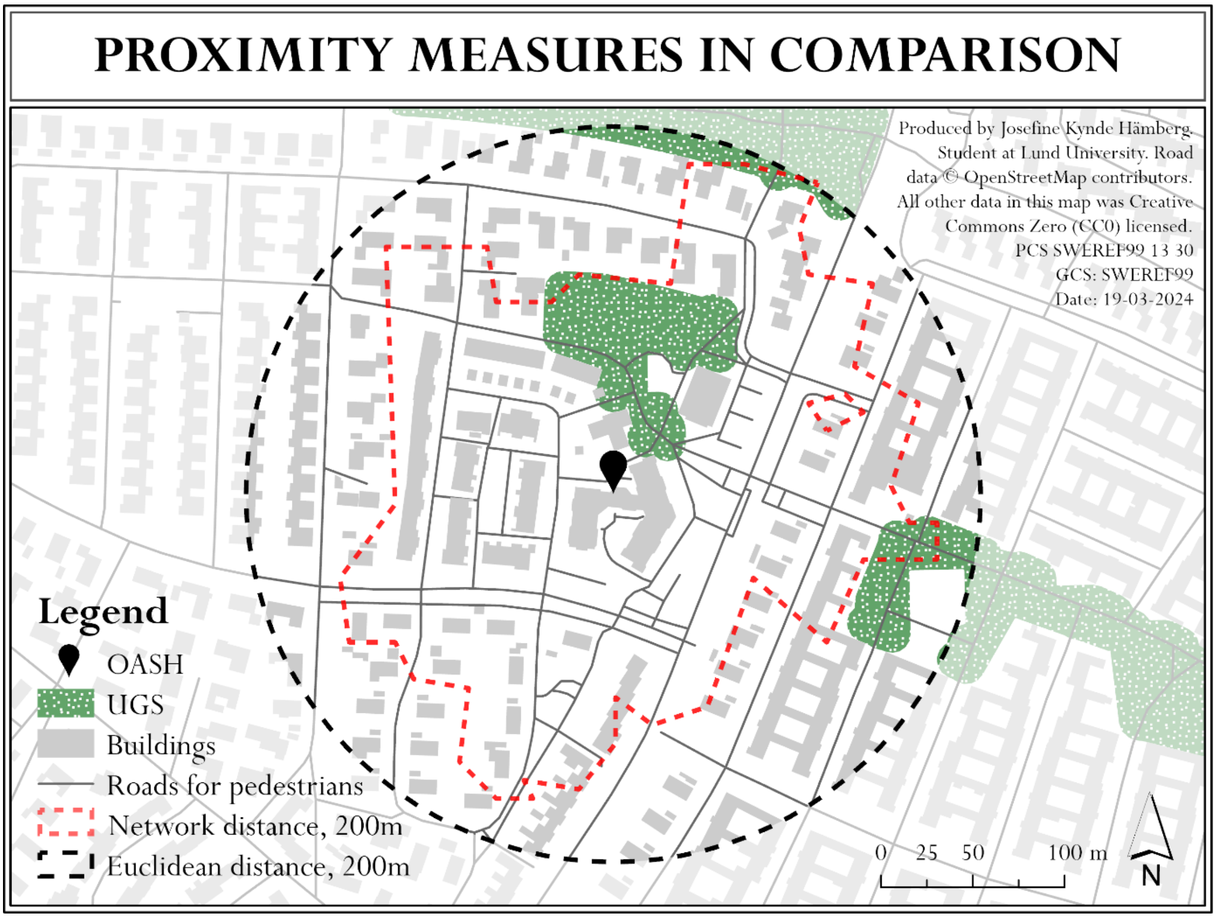

Figure 4. Map showing the difference between Euclidean and network distance measures for the same OASH. The starting point for the distance measures was the address location for the OASH.

Many network proximity research, does not exclusively include routes available for pedestrians, instead all kinds of routes in the network data are included (Koohsari et al., 2015). A Danish UGS proximity study by (Schipperijn, Stigsdotter, et al., 2010) only included routes available for pedestrians and cyclists in their analysis, and their study revealed large proximity differences when compared to Euclidean distance results for the same area. The European Union (2018) have recently also studied urban dwellers access to UGS by using network analysis only based upon paths suitable by pedestrians. This study's network analysis used the same kind of network delimitation, the delimitation was used to better match the real walking distances of older urban adults and to exclude unsuitable walking routes in the analysis, such as motorway and larger roads. In this study, specific road data types from OpenStreetMap (OSM) were used for the network analysis (OpenStreetMap Contributors, 2024), Table 4.

Table 4. The table lists the OSM road data types used to create the network dataset for the network proximity analysis. The road types in the column "types included" were used together to create the network dataset for the analysis. The road types in the column "types excluded" were not included when creating this study's network dataset. Data originates from OpenStreetMap Contributors (2024).

ROAD DATA	TYPES INCLUDED	TYPES EXCLUDED
OSM	Bridleway, corridor, cycleway, footway, living street, path, pedestrian, platform, residential, road, service, steps, track, unclassified	Bus-stop, busway, construction, elevator, motorway, motorway link, primary, primary link, proposed, raceway, secondary, secondary link, tertiary, tertiary link, trunk, trunk link.

The road data were used to create a multimodal network dataset, no elevation model was used. Pedestrians in the network analysis were "allowed" to cross any line segment intersection, despite of road type. This setting was used to better reflect walking distances in smaller roads in urban areas and to not constrain pedestrians to only cross roads at pedestrian crossings. Since the network dataset excluded larger roads, and automatically hence busier roads, this relatively free walking option in the analysis was regarded to better reflect real life walking of urban dwellers. In the network analysis the municipality line was uses as a boundary.

Walking distances to UGS from OASH were computed by identifying service areas of the distances: 200m, 300m and 500m. Thereafter the statistics for older adults living in OASH who had access to UGS within the different service area polygons were calculated. Service area polygons within a specific distance set is a methodology used before in UGS proximity and network analysis research (European Union, 2018).

3. RESULTS

3.1. OASH Data Characteristics

At the time of the OASH data production in this study, 8% (4,282) of the older adults in Malmö municipality lived in OASH. All OASH were located in urban areas, see Figure 5. 83% of the older adults lived in OASH built before 2017. The older adults that lived in these older housings had the following distribution: 38% lived in OASH type 1, an unknown percentage lived in type 2, 2% in type 3, and 60% in type 4, see Figure 6. For more detailed OASH information, see Table 9 in the Appendix section. The number of older adults that lived in OASH type 2 could not be calculated since type 2 is not permanent housing options in Sweden, meaning, no older adults were registered at those addresses. However, for context, Malmö municipality stated in 2023 that they had 176 OASH type 2 available (Boverket, 2023b). The proximity results described in the following result sections below, describes the situation for the 83% of older adults that lived in OASH built before 2017 in Malmö municipality.

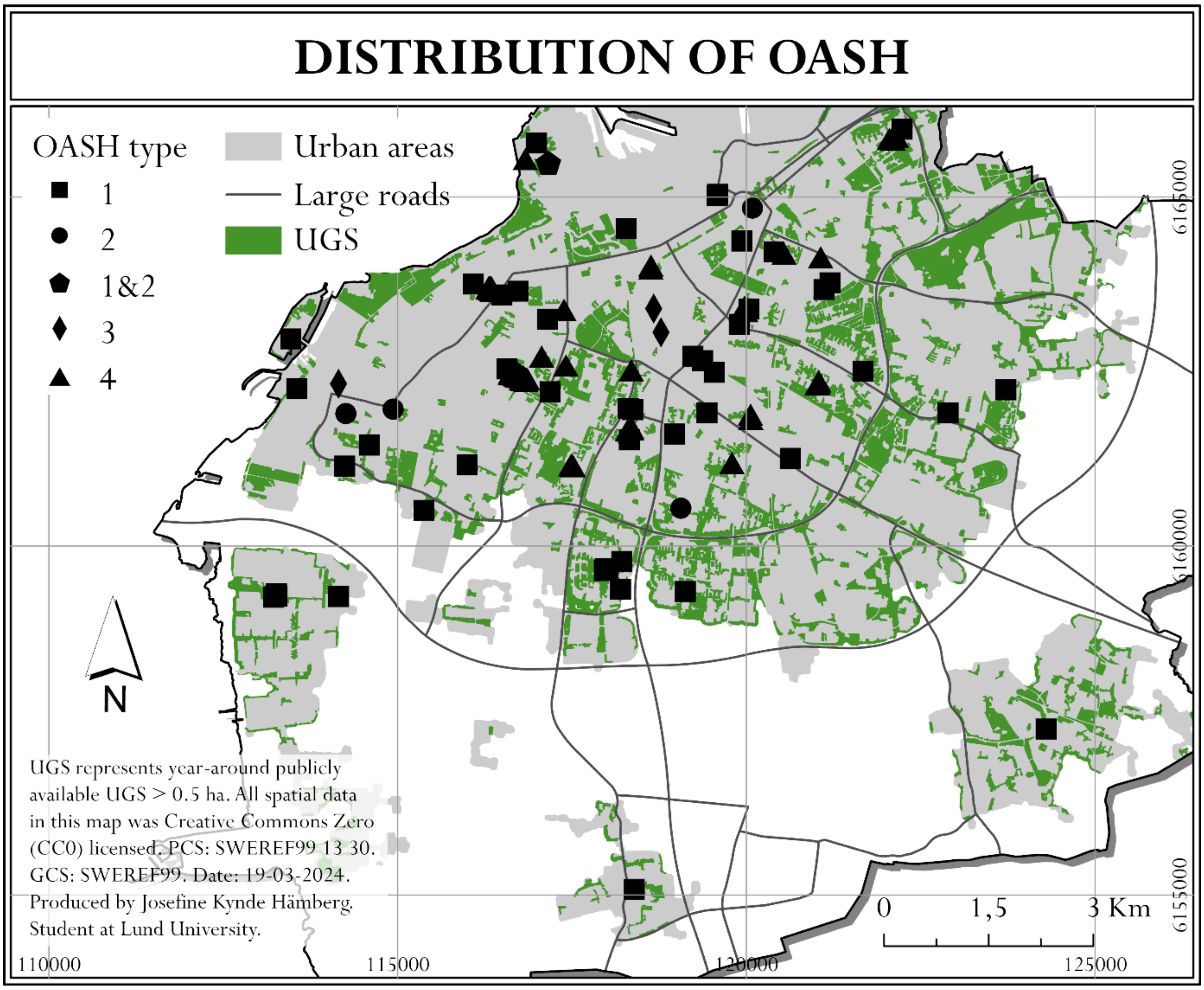

Figure 5. The figure shows the spatial distribution of OASH in Malmö municipality. The different OASH types are visualised with different symbols. All the housings were located inside the municipality's urban areas.

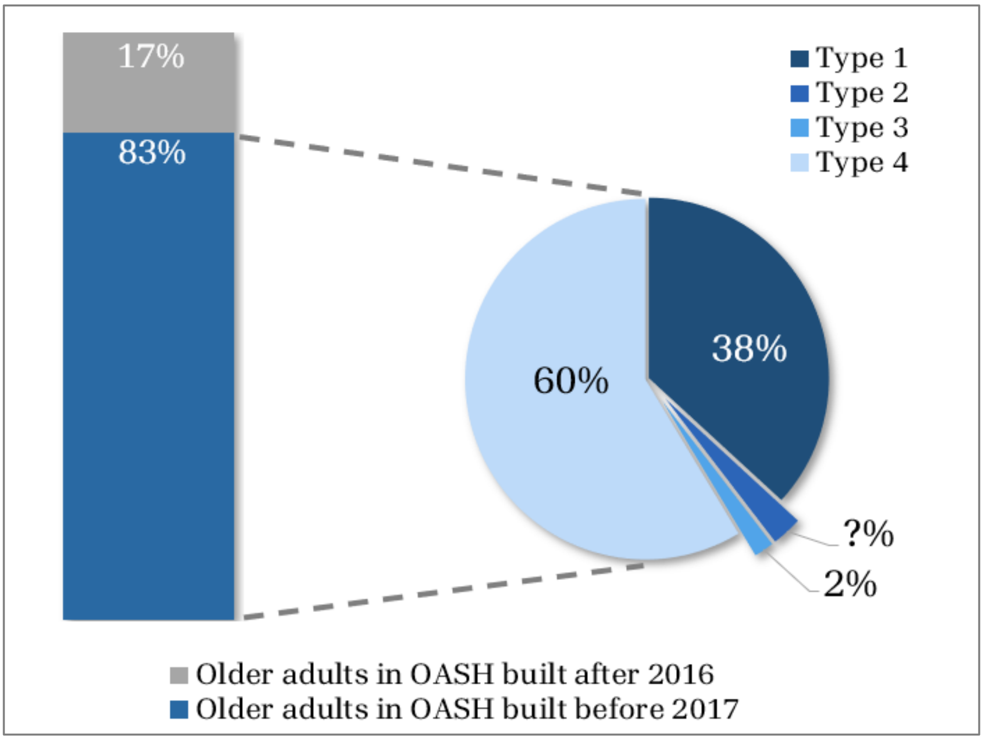

Figure 6. The bar and pie chart displays data characteristics from the produced and geocoded OASH in this study.

3.2. Older Adults' Proximity to UGS

None of the OASH included in this study were located closer than 500 m to an urban area boundary. Hence, the fact that this study did not include any green areas outside of urban area boundaries in the calculations of UGS proximity statistics, but Statistics Sweden did in the calculation of their statistics, have no implications for this study. Neither for this study's proximity result or for the comparison made to Statistics Sweden's UGS proximity statistics.

95% of the older adults in OASH, built before 2017, in Malmö municipality, had access to year-around publicly available UGS (> 0.5 ha) in less than 200 m from their housings, measured with Euclidean distances. 89% of the older adults had access to UGS within 200 m from their housing, measured with network distances. Based on these statistics, without categorizing the result into different OASH types, this result showed that real-life walking distances at this local scale differed from Euclidean distances by only approximately 6 percentage points. As the distance limits increased from 200m to 500m, the percentage difference between the two proximity measures decreased gradually, see Table 5 and Table 6 for comparison. All older adults in OASH in Malmö municipality had, Euclidean measured, an UGS within 500 m from their housing address. The small percentual differences between the network and Euclidean distances in this study, differed from the previous larger differences shown between the two measuring methods in Nordic research (Schipperijn, Stigsdotter, et al., 2010). Instead, the results from this study, supports the statement from World Health Organization (2016) that Euclidean distance is a reasonable proxy for walking distances.

3.2.1. Categorized by OASH Type

See Figure 7 for a visual comparison of the UGS proximity for different OASH types. The proximity statistics showed that OASH type 4 had the best UGS proximity, in both measures.

OASH type 3 had the poorest percentual proximity statistics to UGS, in both measures. OASH type 3 was, for example, the only housing option in the study that had more than 500 m to the closest UGS in measured network distance. 65 older adults lived in OASH type 3 in the study area, that number corresponded to 2% of the older adults. This meant that even if this housing type had poor proximity percentage wise, the poor proximity did in real life not affect many of the older adults. However, with that said, these statistics also inevitably entails that if an older adult plan to move to a OASH type 3 in Malmö municipality, chances are high that they will not have UGS within, what can be considered, close proximity.

When focusing on the proximity results for the 200 m distance limit, even though OASH type 3 had the poorest percentual UGS proximity, type 1 had the largest number of older adults that did not have UGS within 200 m, both Euclidean and network measured. Approximately 4/5 of the older adults that lived in type 1 housings, individuals requiring the most extensive care and service, had walking distances to an UGS within 200 m. 4.9% of the older adults in OASH type 1, had to walk between 300 m to 500 m to reach an UGS.

When focusing on older adults' proximity to UGS for those that lived OASH type 2, all addresses were located within 200m distances, both Euclidean and network measured. Even though no data about the number of registered older adults at each address could be located in this study, this implies that for the older adults that temporarily live there, 100% have access to UGS within 200m, 300m and 500m, regardless of what method for calculating distances was used.

Table 5. Categorised Euclidean proximity statistics to year-around publicly available UGS > 0.5 ha in Malmö municipality based on older adults in different types of OASH (built before 2017).

EUCLIDEAN PROXIMITY						
OASH Type	Within 200 m		Within 300 m		Within 500 m	
	%	n	%	n	%	n
1	93.9	1,264	98.3	1,323	100	1,346
2	-	0	-	0	-	0
3	0	0	30.8	20	100	65
4	97.9	2,097	100	2,143	100	2,143
Total	94.6	3,361	98.1	3,486	100	3,554

Table 6. Categorised network proximity statistics to year-around publicly available UGS > 0.5 ha in Malmö municipality based on older adults living in different types of OASH (built before 2017).

NETWORK PROXIMITY						
OASH Type	Within 200 m		Within 300 m		Within 500 m	
	%	n	%	n	%	n
1	82.2	1,106	95.1	1,280	100	1,346
2	-	0	-	0	-	0
3	0	0	30.8	20	64.6	42
4	96.1	2,059	100	2,143	100	2,143
Total	89.1	3,165	96.9	3,443	99.4	3,531

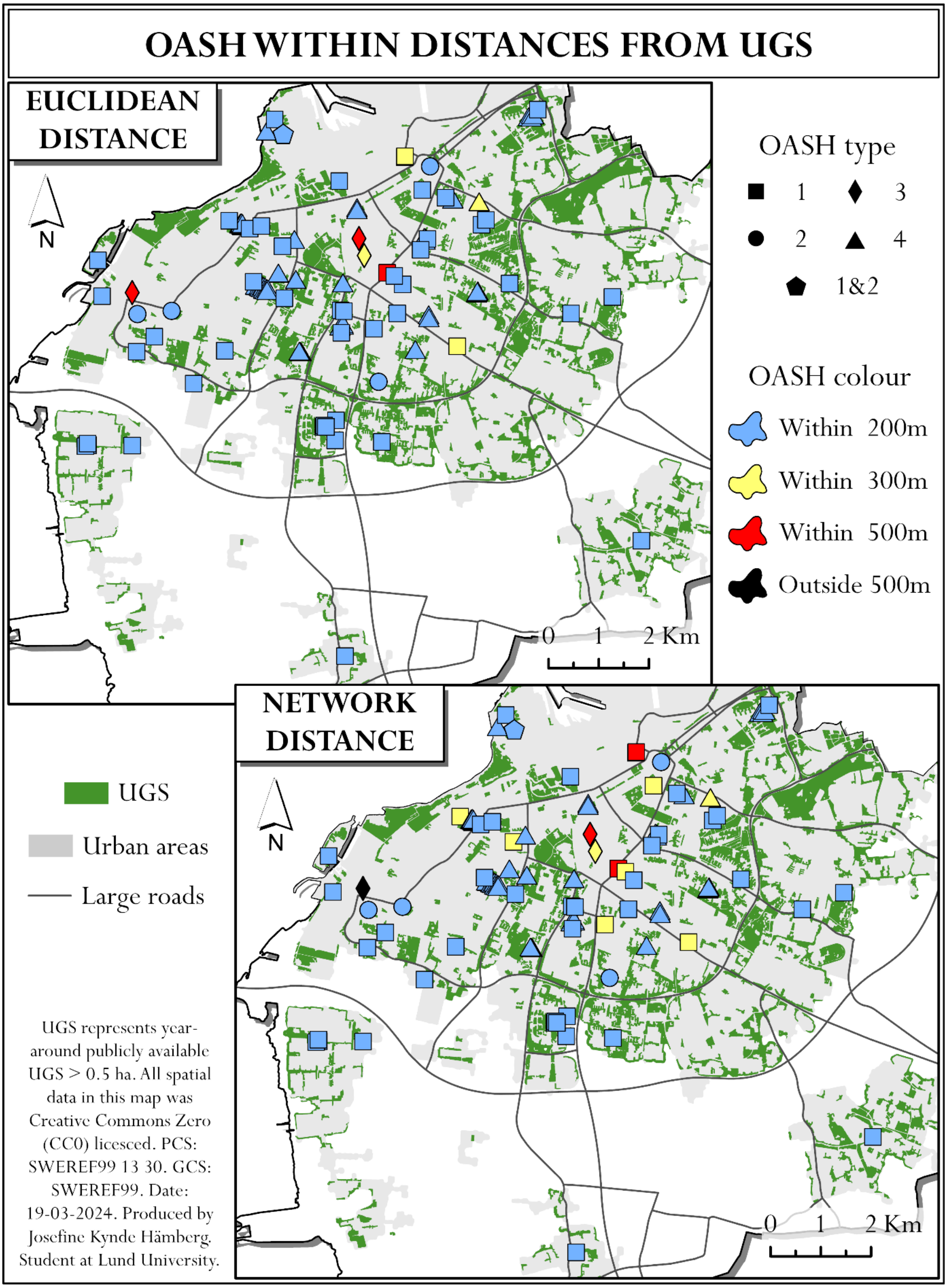

Figure 7. The map shows which OASH that had access to UGS within 200m, 300m, and 500m, both with Euclidean and network distances. Network distances were calculated using OSM road data, that is not the same data as the generalised roads visualised in this map and that is because the OSM data was too compact and detailed to be visible. Larger scale versions of this map are available in the appendix section, see section 7.3 and 7.4.

3.3. Older Adults Proximity to UGS in Comparison to other Demographic Groups

This study's Euclidean analysis showed that older adults in OASH, built before 2017 in Malmö municipality, did not have poorer proximity to UGS, compared to other urban age groups (Statistics Sweden, 2019c). On the contrary, older adults that lived in OASH, collectively had better proximity to UGS than any other urban age group in Malmö municipality, see Table 7. As a result, there is nothing in this study that supports the hypothesis behind the research question that older adults in OASH have poorer proximity to UGS than other urban dwellers.

Table 7. Comparison of Euclidean proximity statistics to year-around publicly available UGS > 0.5 ha in Malmö municipality. Statistics were derived from this study's Euclidean proximity result, based on older adults in OASH (built before 2017), and from Statistics Sweden (2019c) for the three other demographic groups in the table.

Demographic group	200 m	300 m	500 m
Children, 0-6	87%	96%	100%
Children, 7-15	88%	96%	100%
Young adults and adults, 16-64	84%	94%	100%
Older adults in OASH, 65+	95%	98%	100%

4. DISCUSSION

4.1. Discriminating Urban Planning and Deprived Zones

This study found no evidence for discriminating urban planning in Malmö municipality for older adults in OASH. Instead, the locations of OASH led to the conclusion that older adults in OASH collectively had better proximity to UGS compared to other urban dwellers. When comparing this study's derived local proximity statistics to national proximity statistics, older adults in OASH in Malmö municipality, had UGS proximities similar to the Swedish average urban dweller, for comparison see Table 2 in section 2.1 and Table 7 in section 3.3. That is, even though older adults in OASH had better proximity than other demographic groups in Malmö municipality, they did not have better proximity compared to the general Swedish urban dweller.

When specifically studying the spatial distribution of UGS in Malmö city's urban area (the urban area where most of the OASH were located), this study found an uneven distribution of publicly available UGS. Based on a 200 m Euclidean distance threshold, most of the UGS deprived zones were relatively small. However, there were some larger continuous zones as well: (1) the harbour area in northern Malmö and some if its surrounding regions, (2) the western neighbourhoods Limhamns hamnområde and Bellevue, and (3) the neighbourhoods east of the park *Pildammsparken*, see Figure 8.

The largest UGS deprived zone (1) was an industrial area. Not many individuals live there and therefore the potential drawbacks of too few UGS can be argued to be small. The second largest deprived zone (2) was mainly an area covered by detached single family houses, few OASH were located there. The third deprived zone (3) was close to the geographic centre of Malmö city and consisted of a mix of apartment buildings and detached single family houses, this was the zone with most OASH located in it. Providing more UGS in region 3 would benefit older adults in OASH the most in Malmö.

Related to the subject of UGS deprived zones, this study discovered that several identified UGS during the last years had decreased in size or been completely removed in Malmö city. Figure 8 shows one example of a removed UGS, located adjacent to an identified UGS deprived zone. This study found that the loss of UGS spatial extent in some parts of Malmö city in turn led to that some of the UGS deprived zones today is even larger than what is displayed in Figure 8..

The loss of UGS have shown to be related to urbanisation (de Vries et al., 2003; Girma et al., 2019; Li et al., 2019; Nazombe & Nambazo, 2023; Zhou & Wang, 2011) and this study support that claim by identifying signs of similar trends in Malmö's urban area. The loss of UGS spatial extent can be argued to be a negative trend for PA among older adults since international research have shown that UGS size is positively correlated to PA in older adults (Hooper et al., 2020; Li et al., 2005; Li et al., 2008; Zandieh et al., 2019).

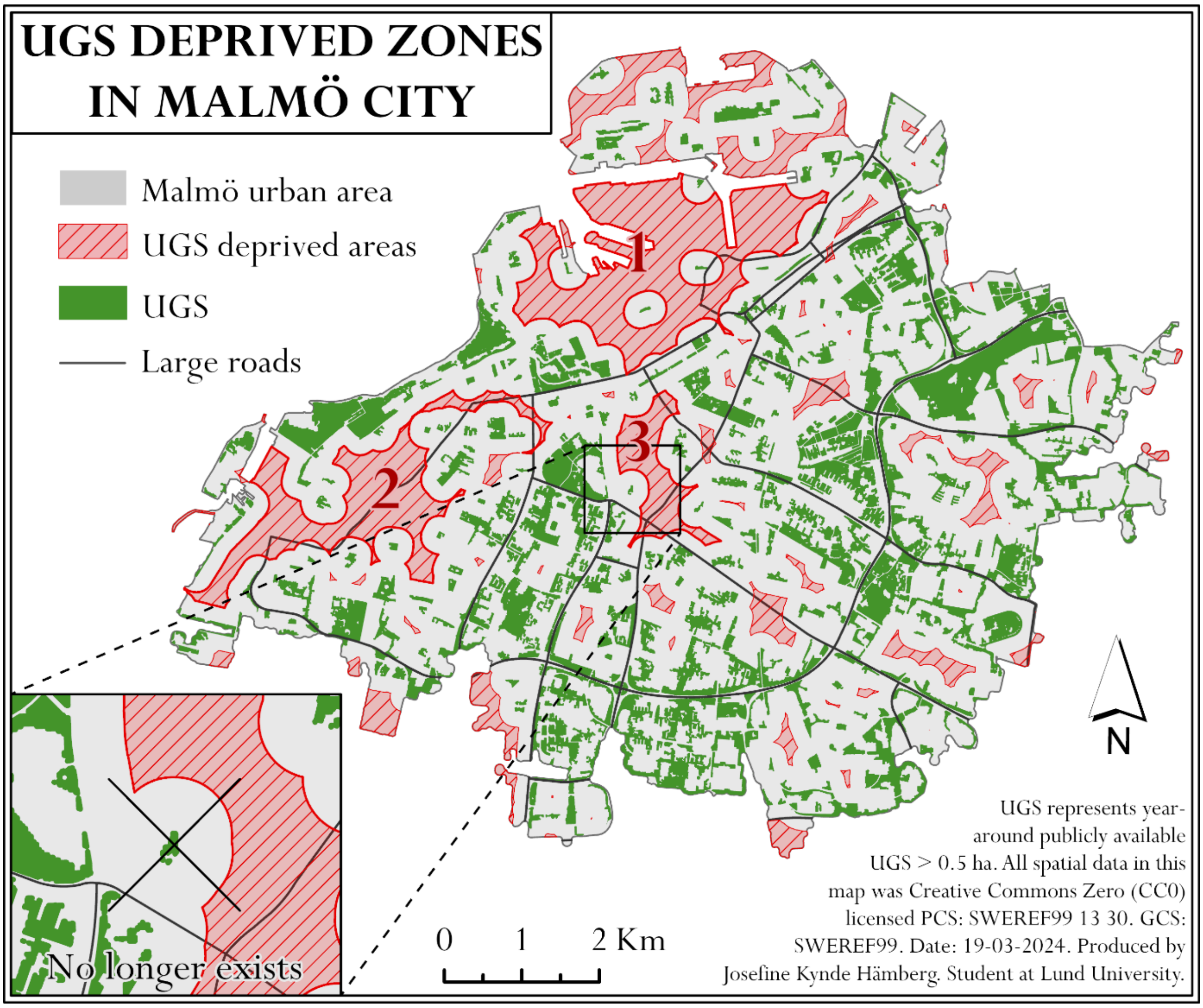

Figure 8. The map shows the distribution of UGS deprived zones in Malmö city, based on a 200 m Euclidean threshold. The three largest UGS deprived zones are highlighted with red borders. The map also shows an example of a recently removed UGS adjacent to one of the deprived zones. See section 7.5. in the Appendix section for a larger scale version of this map.

4.2. Older Adults in OASH Type 1

Most of the older adults in OASH (counted in numbers) that did not have access to UGS within certain distance thresholds, regardless of which distance method used, lived in OASH type 1. The only exception is for the Euclidean 300m distance limit, for that threshold more older adults lived in OASH type 3. Six of the OASH type 1 buildings in the study area had between 200m and 300m in network distance to an UGS, and two of the OASH type 1 buildings had between 300m and 500m in network distance to an UGS, see Figure 7 in section 3.2.1. These older adults, apart from belonging to the category of older adults in OASH with the poorest proximity to UGS, were simultaneously the subgroup of older adults with the most extensive care and service needs. Even though approximately 800 more older adults in the study area lived in OASH type 4 than 1, see Figure 6 in section 3.1., more older adults (counted in numbers) from type 1 housings fell outside the distance thresholds.

As stated in the methodology part, older adults in Sweden are only permitted to move to OASH type 1 by getting an aid decision by a social service officer (Boverket, 2023a). In Malmö municipality, older adults that are about to move to a OASH type 1 have the opportunity to leave a wish for a specific OASH to move to, however, a residence at the desired OASH is not guaranteed (Malmö stad, 2023a). In five years' time, Malmö municipality have estimated to have too few OASH type 1 available (Boverket, 2023b) and it is therefore reasonable to assume that older adults with extensive care and service needs in the future will be given less freedom of choice concerning choosing their residences. This is an unfortunate future view and situation for older adults in Malmö that belong to the most vulnerable older adult subgroup in this study and that simultaneously value proximity to publicly available UGS. With less freedom of choice, proximity to UGS risks becoming less of an option for many older adults.

4.3. Local and Global Objectives for Proximity to UGS

Globally there are no determined threshold for what proximity urban dwellers should have to an UGS for the UGS to be regarded as accessible. However, UGS proximity objectives/guidelines often exists on national and local levels. Determining such objectives for UGS proximity involves the consideration of numerous features and setting several delimitations, e.g., what is feasible with the current data availability, should only public UGS be included, what definition of UGS should be used, what proximity measure should be used, should proximity be calculated to the UGS borders or to the entrance points? (World Health Organization, 2016)

In Sweden every municipality have their own comprehensive plan, which involves a green plan. In the green plan, objectives for the urban dwellers' proximity to UGS is often stated. Malmö municipality have different objectives for network distances to publicly available UGS based on UGS size. Malmö municipality strive that 95% of the citizens should fulfil the proximity objectives below (Malmö stad, 2019):

> "Within 300 m for publicly available green space > 0.2 ha, minimum width of 30 m.
> Within 500 m for publicly available green space > 1.0 ha, minimum width of 50 m"

This study's proximity result to UGS > 0.5 ha is not directly relatable to Malmö municipality's objectives due to the different size delimitations used. However, the proximity statistics from this study can be argued to fall in between the local 300m and 500m objectives. Undertaking Malmö municipality's objectives as a starting point, then every single OASH building in this study (built before 2017), except from one, had acceptable network distances to UGS. The single OASH outside the 500 m walking distance boundary, entailed that 99.4% (see Table 6 in section 3.2.1.) of the older adults in OASH achieved the local UGS proximity objective. Malmö's objective of 95% proximity achievement is fulfilled based on this study's results.

4.4. Walking Time as a Measure for Proximity

In this study's UGS proximity result, older adults in OASH type 1 are considered extra interesting to focus upon since they belonged to the housing type with the poorest UGS proximity and since they can be argued to require closer proximity to UGS due to their extensive care and service needs. Research have shown that average gait speed for older adults in nursing homes is between 0.6 and 0.66 m/s (Fien et al., 2019; Rizka et al., 2021). Nursing homes is an equivalent to OASH type 1 even though the definition and delimitations of nursing homes differ between countries. However, gait speeds of 1 m/s is often used in UGS proximity research and Swedish general plans, e.g., Gothenburg's general plan (Göteborg Stad, 2022), and in the recommendations by World Health Organization (2016). That means that research have shown that older adults in nursing homes walks slower (Fien et al., 2019; Rizka et al., 2021) than what many objectives for UGS proximity walking time accounts for (Göteborg Stad, 2022; World Health Organization, 2016). Overall, the fact that older adults in OASH type 1 have slower gait speed is of no surprise when combined with knowledge about ageing and decreasing life-space mobilities (Wilkie et al., 2006), functional limitations (Ferrucci et al., 1996), poorer muscle strength and endurance (Singh, 2002).

There are no globally determined threshold for what the proximity to UGS should be in order for these areas to be regarded as accessible (World Health Organization, 2016), however in a recent research study by the European Union (2018), a 10 minute walking threshold was used when studying accessibility to UGS. When using walking time as a measure for UGS proximity, as opposed to distances, different gait speeds impact the accessibility results. Having a 10 minute walking limit as a starting point and combining it with a 1m/s gait speed results in longer walking distances than what gait speeds of 0.6m/s allows for.

In this study, two of the OASH type 1 buildings had between 300 m to 500 m of network distance to the closest UGS. When using a gait speed of 1 m/s, a 300 m distance takes 5 min to walk, and 500 m takes roughly 8 min. Reaching an UGS between 300 m to 500 m away therefore becomes of no problem for individuals that share this common gait speed. However, the situation is not the same for slower walking individuals, for example older adults in OASH type 1. Basing the calculations on a gait speed of 0.6 m/s entails that walking 300 m roughly takes 8 min and walking 500 m roughly takes 13 min. That means that having 300 m to 500 m to the closest UGS does not automatically entail a 10 minute walk for all urban dwellers. This comparison shows how older adults in OASH type 1 do not necessarily have the same prerequisites for accessibility as other urban dwellers and simultaneously in this study are shown to be the subgroup with the largest amount of older adults that have to walk the furthest to reach these areas.

Overall, this also shows that using walking time measures as objectives for proximity to UGS might not suit all urban dwellers and that using a gait speed of 1 m/s is a simplified representation of urban dwellers. Older adults as a group benefit from studies like this one in which UGS proximity is studied in greater detail and where these kinds of differences among urban dwellers can be highlighted. Since OASH gather individuals that share a lot of common characteristics and limitations, e.g. gait speed, UGS proximity assessments that reflect this can give new useful insights of how accessible UGS are in reality for these individuals. It is not unreasonable to assume that the slower gait speed and decreased life-space mobilities shared by many older adults is a part of the reason to why UGS proximity is valued and demonstrated by Nordic (Laatikainen et al., 2017; Schipperijn, Stigsdotter, et al., 2010; Zingmark et al., 2021) and international older adults (Wen et al., 2018). In addition, the benefits of discussing gait speed differences can also be argued to better reflect the situation shared by children and younger individuals with disabilities that also possibly do not share the common gait speed of 1 m/s.

4.5. Complexities in UGS Preferences by Older Adults

Gait speed differences, displays one way of how older adults' prerequisites for using UGS might differ from other urban dwellers when studying accessibility. However, this study does not try to argue that proximity is the only UGS feature that affects how older adults use UGS or is the only UGS preference expressed by older adults. To claim such a thing would be a large simplification of reality and the complexity and diversity of older adults' preferences as a group.

Research have shown that apart from proximity, Swedish older adults value marked trails and paths when choosing green spaces to use, along with other factors such as if the environments are peaceful, familiar, safe, if they have seatings to rest at, have good mobile phone coverage, etc. (Zingmark et al., 2021). Other international preferences in green spaces by older adults have been shown to be similar, often mentioned preferences are: slope-free and barrier free trails, seating, toilets, cafés, green areas with low crime, good visibility (safety), recreational facilities, etc (Wen et al., 2018). In a European study about older adults in care facilities, research have also showed that for those individuals that do not have private UGS, invitations from family members and care staff to visit public UGS was more important than the actual access to the UGS itself (Artmann et al., 2017). It is clear that even though proximity is a common UGS feature mentioned by older adults, it is not the only one.

Another important aspect to reflect upon and to discuss when studying accessibility, especially proximity, to UGS for the sake of PA for older adults, is that the research in this field is not united. Even though the most common activity among Swedish (Zingmark et al., 2021) and international (Wen et al., 2018) older adults in UGS is PA, even though UGS proximity have been shown to be positively correlated to PA among older adults (Booth et al., 2000; Michael et al., 2010), even though proximity to UGS have shown to increase the likelihood of meeting PA recommendations (Li et al., 2008), even though the World Health Organization (2016) states that UGS is one way of promoting PA among older adults: there is also research that shows that proximity to UGS in fact have no impact on PA among older adults (Kaczynski et al., 2008). These mixed research results between PA and UGS proximity have even led researchers to publish research papers where they exclusively evaluate how the research methodology in this subject can be improved or delimitated in order to work against these kinds of research result inconsistencies (Koohsari et al., 2015).

4.6. Data Quality Assessments

4.6.1. OASH Data

This study's produced OASH data were quality assessed by comparing this study's identified municipal OASH and their available apartments, to statistics in last year's national housing market survey by Boverket (2023b). Boverket is a Swedish government agency that yearly sends out questionnaires to Swedish municipalities asking about the housing market, including the older adult housing market. In the data for Malmö municipality, information about the number of available municipal OASH type 1, 2 and 4 were included (note: not the number of registered older adults in OASH). No data about available private OASH is included in Boverket's housing market survey.

This study's produced OASH data listed 11 more municipal type 1 apartments than stated in the housing market survey, and 47 less available municipal type 4 apartments than stated in the survey, see Table 8 below. The additional 11 apartments appeared reasonable due to the one year gap between the questionnaire from Boverket (2023b) and the date of data production in this study. It is not unimaginable that the additional apartments have been added to former municipal OASH type 1 buildings. The missing 47 apartments is a greater concern. However, despite the missing type 4 apartments, this study's produced type 4 data still led to an above 95% data accuracy for the municipal type 4 apartments. That accuracy percentage was regarded as an acceptable quality level and did not hinder this study's proximity analyses.

Table 8. Table showing the difference between the produced OASH data and the reported municipality data in the housing market survey by (Boverket, 2023b).

Municipal OASH types	Produced OASH data	Housing market survey
1	1483	1472
2	?	176
3	22	0
4	925	972

One possible explanation for the data differences for the OASH type 4 apartments is that since older adults do not require an aid decision from a social service officer to be able to move to type 4 housings, it is possible that the data stated in Boverket's housing market survey is not quality verified in the same extent by Malmö municipality.

Due to lack of online data about the number of available apartments in municipal OASH type 2 housings, no quality assessment could be made for that housing type. Regarding municipal type 3 housings, Malmö municipality had in the housing market survey reported that no municipal type 3 housings were available, however the OASH data in this study stated that 22 municipal type 3 housings were available. The housings were classified as municipal since the housing company was a public one. Overall, in the quality assessment the municipal OASH data was considered to match satisfactory with the reported data in the housing market survey (Boverket, 2023b). No quality assessment could be made for the private OASH types, and hence, that is a weakness of this study.

4.6.2. OSM Data

The road data in this study's network analysis originated from OSM (OpenStreetMap Contributors, 2024). OSM is based upon volunteered geographic information, meaning, the geographic data depend on free mapping by its users/contributors. OSM have been available for 20 years and its original purpose was to provide free road and street data to the public, nowadays geographic data beyond these categories are included. In recent years, OSM have been given more attention due to its vast potential in research and GIS-related disciplines. However, the quality of the geographic data has shown to vary across the world and the quality and accuracy of OSM data is often one of the biggest criticisms of the data source. Sweden has however a great number of contributions and belongs to the second highest category of average number of active contributors to the total population (Arsanjani et al., 2015). In all, despite the heterogeneity of the data quality in OSM, Sweden as a country can despite that be argued to be categorized as a region with relatively greater geographic data quality.

A visual assessment of the OSM data quality was also performed in this study. In Sweden, the Swedish Transport Administration offer free road data, easily accessed online. However, by visual interpretation, OSM road data were assessed to better reflect and include the type of roads often chosen by pedestrians in the study area, and hence OSM data were used for the network analysis instead of data derived from the Swedish Transport Administration. The open free data from the Swedish Transport Administration appeared to put emphasis on roads for cars mainly, and in some cases for bicycles. Emphasis on pedestrian routes and tracks appeared not to be prioritized. When OSM road data were visually compared to road data from the Swedish Transport Administration, it did not seem to be deprived of any road lines compared to that dataset, it seemed to merely include more road options for pedestrians. See Table 11 in section 7.6. for a visual comparison between the data sets. The table suggest that the OSM data have high road data completeness and positional accuracy. In addition, this study's relatively small differences between the Euclidean and network distances can by itself be used as an argument for the relatively high OSM data quality in Malmö municipality.

4.7. Limitations and Sources of Errors in this Study

One of the larger limitations of this study was the old date of the UGS data and statistics used for the UGS proximity analyses and comparison. The UGS data from Statistics Sweden were produced by using remote sensing images from 2015 to 2018 and further processed by additional 2015 and 2016 detailed urban datasets, and the proximity statistics were produced based on 2015 population data (Statistics Sweden, 2019a). The old UGS dataset used in this study posed limitations on the interpretation on this study's result since the urban areas in Malmö municipality have evolved and changed since then. For example, numerous new OASH have been built in Malmö after the production date of the UGS data. The data date problem was tackled by not including any OASH built after 2016 in this study. By doing so, the data used as a basis in this study's proximity analyses became more like the data used as a basis for Statistics Sweden's proximity analyses.

This delimitation of not including any OASH built after 2016 resulted in that 11 OASH were excluded. Out of these 11, six were classified as type 4, four were classified as type 1, and one was classified as type 3. Five OASH were municipal and six were private. In total the removed OASH data contained 728 registered older adults in Malmö municipality. The exclusion of buildings built after 2016 increased the quality of the proximity analysis since six of them were built in the newer local neighbourhoods (or in neighbourhood with extensive construction during the past years between 2017-2024): Limhamns hamnområde, Hyllievång, Västra hamnen and a new part of Tygelsjö. See Figure 9 below for a visual presentation of which OASH that were excluded in this study, and which of these that were located in regions with extensive construction during past years. In neighbourhoods with extensive construction the UGS datasets from Statistics Sweden were outdated and would not have resulted in realistic statistics, see Table 10 in section 7.2 for examples of how the urban areas have changes during the past years. The delimitation of not using OASH built after 2016 also excluded some newly built OASH in older neighbourhoods. Two out of the 11 OASH were built in urban areas formerly covered by UGS. Due to the construction of new housings, the UGS spatial extent in those areas had decreased since the UGS data production by Statistics Sweden.

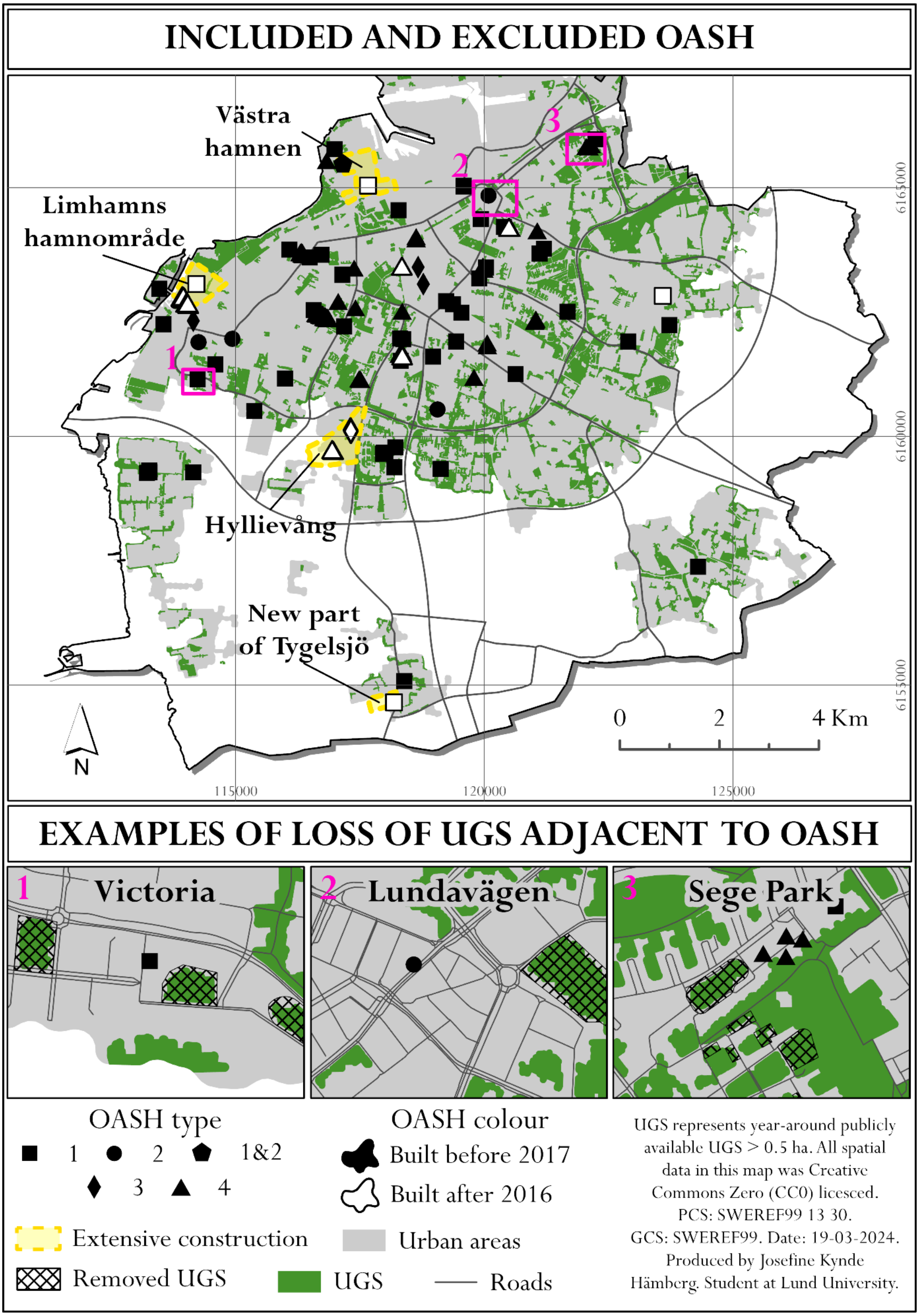

Figure 9. The map shows all the identified OASH in this study and which of them that were excluded before the proximity analyses were executed. Housings were excluded based on construction date. The map also shows three examples of how included OASH had experienced changes in adjacent UGS due to construction, but that this was not reflected in the UGS dataset used in this study.

The exclusion of the newly built OASH implied that this study's proximity results represented the situation of Malmö municipality in 2016 and not 2024. Simplified, this study's proximity analyses results can be said to reflect the 83% of older adults that today live in OASH built before 2017, see Figure 6 in section 3.1. However, this is not completely accurate. Despite only including OASH built before 2017, this delimitation did not entail that the surrounding areas of older OASH may not have changed during the years between 2017 and 2024. This is another drawback of using old UGS data. In fact, several OASH built before 2017, were identified to have suffered loss of spatial extent of close UGS. This identification was made by studying remote sensing imagery of different dates in Google Earth Pro. The loss of UGS spatial extent were in all cases due to new adjacent construction. This was for example the case for OASH type 4 – Sege Park, OASH type 1 – Victoria, and OASH type 2 – Lundavägen, see Figure 9 below. The loss of adjacent UGS to OASH buildings is similar to other international urban trends that have been identified and studied in research: that UGS spatial extent is negatively correlated to urbanisation (de Vries et al., 2003; Girma et al., 2019; Li et al., 2019; Nazombe & Nambazo, 2023; Zhou & Wang, 2011).

Another potential source of error when trying to present the 2016 urban area situation for the study area, is that those OASH available before 2017, but that are no longer available today, are not included in this study. Any OASH that might have closed during the past years have not been identified in this study's online research.

4.8. Further Research

When researching citizens' UGS usage and proximity, a common and often discussed topic is the compensations hypothesis. The compensations hypothesis state that urban dwellers with poor access to private UGS compensate by visiting public UGS more (Maat & de Vries, 2006). Swedish and European research have however showed the opposite, that it is the urban dwellers with access to private gardens that also visits and use public UGS more (Grahn & Stigsdotter, 2003; Maat & de Vries, 2006; Schipperijn, Stigsdotter, et al., 2010). This have also been specifically confirmed for European older adults living in care facilities (Artmann et al., 2017). With knowledge derived from research refuting the compensation hypothesis, an interesting further research topic would be to map which OASH in Malmö municipality that have access to private UGS and relate that to their proximity to public UGS. Such a comparison would enable to study which OASH in the study area that had weaknesses for promoting UGS usage and PA for its registered older adults, and which OASH that promoted USG usage and PA the most for its older adult residents..

5. CONCLUSSION

This study examined the proximity to public UGS above 0.5 ha for 83% of the older adults registered in OASH in Malmö municipality. For these individuals, most older adults had UGS in close Euclidean proximity to their housings: approximately 95% had UGS within 200 m, 98% within 300 m and 100% within 500 m. Overall, this led to the conclusion that older adults in OASH in fact had better Euclidean UGS proximity compared to other groups of urban dwellers in the same study area. No evidence of any discriminating physical planning for older adults in OASH were found in this study for Malmö municipality.

When examining older adults' network proximity to UGS, percentage wise, fewer older adults were categorized as having UGS within 200m, 300m and 500m. The largest difference between the measures was for the 200 m distance threshold, the smallest difference was for the 500 m threshold. In general, the percentual differences were small. When examining network distance, one OASH was however categorized as having more than 500 m to an UGS.

When studying proximity to UGS based on OASH type, the older adults that lived in OASH type 3 had the worst access to UGS, percentage wise. However, due to that relatively few older adults lived in OASH type 3, most of the adults that did not have access to an UGS within certain distance thresholds, lived in OASH type 1. This meant that the subgroup of older adults which collectively had the most extensive care and service needs in Malmö municipality simultaneously was the group of older adults with the poorest access to UGS.

Overall, based on this study's findings that older adults in Malmö municipality have notably better proximity to UGS compared to other demographic groups of urban dwellers, the conclusion is made that Malmö municipality have met one of the main preferences for UGS features by Swedish older adults: proximity.

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7. APPENDICES

7.1. Detailed OASH Data

Table 9. The table lists the OASH buildings identified in the data production, along with addresses and number of registered older adults. 11 out of the OASH buildings, highlighted in red, were removed from the dataset before analyses since they were built after 2016.

No	Name	Type	Owner-ship	No. of older adults	Addresses	Zip code
1	Annebergsgården	4	Private	279	Annebergsgatan 15A-G	214 66
2	Annetorpsgården	1	Public	20	Västanväg 119A-C	216 16
3	Apelrosen	1	Public	26	von Troils väg 8B	213 73
4	Attendo Bellevuegården	1	Private	41	Eddagatan 1	217 67
5	Attendo Bunkeflogården	1	Private	24	Norra Vägen 7	218 32
6	Attendo Fridhemmet	1	Private	37	Major Nilssonsgatan 13	217 73
7	Attendo Märsgränd	1	Private	42	Märsgränd 8	211 77
8	Attendo Västra Varvsgatan	1	Private	42	Västra Varvsgatan 50	211 15
9	Augustenborg	4	Public	104	Norra Grängesbergsgatan 42A-C + Norra Grängesbergsgatan 44	214 48
10	Basen	1	Public	23	Nobelvägen 41	214 33
11	Basunen	1	Public	28	Nordlinds väg 102	217 73
12	Belleuve park	4	Private	378	Eddagatan 5, 7, 9, 11, 13, 15, 17, 19 + Havamalsgatan 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	217 67
13	Blombuketten	1	Public	31	Stenkällevägen 83	212 33
14	Blomstergården	1	Public	21	Stengodsvägen 4	238 30
15	Bonum brf kungsliljan	4	Private	46	Sallerupsvägen 87	212 28
16	Bonum brf vågmästaren	4	Private	60	Portvaktsgatan 10 + Betonggatan 4, 6 + Sluringgatan 1	216 46
17	Celsiusgatan	1	Public	28	Celsiusgatan 22	212 14
18	Dammfrigården	4	Public	68	Köpenhamnsvägen 8	217 43
19	Danska vägen 16A	1	Public	12	Danska vägen 16A	212 29
20	Danska vägen 16C	1	Public	37	Danska vägen 16C	212 29
21	Dekoren	1	Public	25	Esperantogatan 25B	215 84
22	Forenede Care Neptunigatan 59	1	Private	9	Neptunigatan 59	211 18
23	Forenede Care Segevångsgården	1	Private	56	Kronetorpsgatan 45	212 26
24	Forenede Care Victoria	1	Private	43	Lilla Högestensgatan 2	216 32
25	Fosieborg	1	Public	40	Lindeborgsgatan 361, 363, 365	215 81
26	Havsbris	1	Public	53	Rödklintsgatan 12	218 73

27	Havslaget	4	Public	171	Betonggatan 9A-B, 13, 17 + Murbruksgatan 14A, 18, 22	216 47
28	Heleneholm	1	Public	23	Ystadvägen 23A	214 45
29	Holma	4	Public	71	Hyacintgatan 42, 44, 46	215 26
30	Husiegård	1	Public	34	Ernst Jakobssons gata 7	212 38
31	Hyllie Park	1	Private	26	Elinelundsvägen 53A-C	216 23
32	Hyllie söderläge	4	Private	46	Ymers gata 27, 29	215 35
33	Högsåkerringen	1	Public	24	Högsåkerringen 47	216 22
34	Jylland	1	Public	49	Ängdalavägen 22	217 47
35	Kasper	1	Public	43	Byggmästaregatan 6, 8	211 30
36	Katrinelund	4	Public	80	Katrinelundsgatan 4A-B	212 16
37	Katrinelund nya	4	Public	92	Östra farmvägen 6D-E	212 16
38	Kommunens rehabiliterings-avdelning och Öresundsgården	2	Public	0	Idrottsgatan 47B	216 16
39	Lekatten	3	Private	20	Södra Förstadsgatan 97	214 20
40	Lindeborgs gård	1	Public	28	Lindeborgsgatan 44	215 81
41	Lindängelund	1	Public	33	Axel Danielssons väg 24	215 74
42	Lorensborg	4	Public	85	Hallingsgatan 6A-C	217 63
43	Lotsgården	1	Public	24	Lotsplan 1	216 42
44	Lundavägen	2	Public	0	Lundavägen 6	212 18
45	Marietorp	1	Public	22	Marietorps allé 13	217 75
46	Mathildenborg	2	Public	0	Rudbecksgatan 1	216 17
47	Neptuna	4	Private	112	Scaniaplatsen 2A-F	211 17
48	Nydala	4	Public	111	Eriksfältsgatan 71A-B	214 55
49	Operan	4	Private	54	Pildammsvägen 8A-B	211 46
50	Pildammsvägen	1	Public	26	Pildammsvägen 34-36	214 66
51	Päronskogen	1	Public	31	Andersgatan 14	215 67
52	Rosenholm	1	Public	16	Kastanjegatan 1	213 63
53	Rådsmansvången/ Havsuttern	3	Public	22	Möllevångsgatan 18	214 20
54	Rönnblomsgatan	1	Public	41	Rönnblomsgatan 4A-B	212 16
55	Rönnbäret	1	Public	39	Pildammsvägen 30-32	214 66
56	Sege park	4	Private	128	Segeparksgatan 16, 17, 18, 19	212 50
57	Sjöstaden	1	Public	52	Formgatan 15	216 45
58	Skogshill	4	Private	52	Marietorps allé 28A - G	217 74
59	Solbacken	4	Public	56	Vilebovägen 27	217 63
60	Solkvarteret	4	Private	42	Dagvattengatan 14, 16	215 31
61	Soltofta	1	Public	57	Hohögsgatan 118	212 32
62	Sorgenfri	4	Public	52	Torekovsgatan 1, 3 + Arildsgatan 2	214 39
63	Stensjögatan	1	Public	35	Stensjögatan 66	217 65
64	Storskarven	1	Public	34	Norra vägen 1, 3	218 32
65	Styrkan	1	Public	22	Spånehusvägen 91	214 39
66	Södergården	1	Public	15	Jöns Risbergsgatan 4	214 32

67	Söderkulla	2	Public	0	Tornfalksgatan 5	215 60
68	Södertorpsgården	4	Private	330	Teknikergatan 23A-D, 27A-D, 29	215 68
69	Södertorpsgården	4	Private	92	Teknikergatan 27D	215 68
70	Trevnaden	1	Public	30	Lönngatan 28	214 49
71	Tryggheten	1	Public	44	Palmgatan 17	214 34
72	Tycho Brahe	3	Private	23	Tycho Brahegatan 52	216 14
73	Tygelsjögården	1	Public	20	Tygelsjö kyrkoväg 1	218 72
74	Vardaga Nattsländan	1	Private	20	Niels bunkeflos väg 1	218 40
75	Victoriahus	4	Private	101	Lugna gatan 38, Södra långgatan 23	211 60
76	Visheten	1	Public	34	Amiralsgatan 82	214 37
77	Vittlingen	1	Public	23	Strandgatan 46	216 12
78	Västergård	1	Public	34	Grynbodgatan 7	211 33
79	Örtagård	4	Public	87	Hårds väg 58, 60, 62, 64, 66	213 65

7.2. Remote Sensing Imagery with OASH Built After 2016

Table 10. The table shows a comparison of remote sensing imagery of different dates for the study area. Comparison of the images is made to show examples of regions in the study area in where new OASH buildings have been built after 2016, meaning after the date of the UGS data. These OASH buildings are examples of housing that have not been included in this study's proximity analyses. Newly built OASH buildings are highlighted with red in the up-to date remote sensing imagery in the right column.

Satellite Images Google Earth Before 2017	Satellite Images Google Earth 2022-2023
Limhamns hamnområde  *Map data: Google Earth, Image © 2024 Maxar Technologies*	Limhamns hamnområde  *Map data: © Google Earth*

Västra hamnen  *Map data: Google Earth, Image © 2024 Maxar Technologies*	Västra hamnen  *Map data: © Google Earth*
Hyllievång  *Map data: Google Earth, Image © 2024 Maxar Technologies*	Hyllievång  *Map data: © Google Earth*
Tygelsjö  *Map data: Google Earth, Image © 2024 Maxar Technologies*	Tygelsjö  *Map data: Google Earth, Image © 2024 Maxar Technologies*

7.3. OASH Within Euclidean Distances from UGS – Large Scale

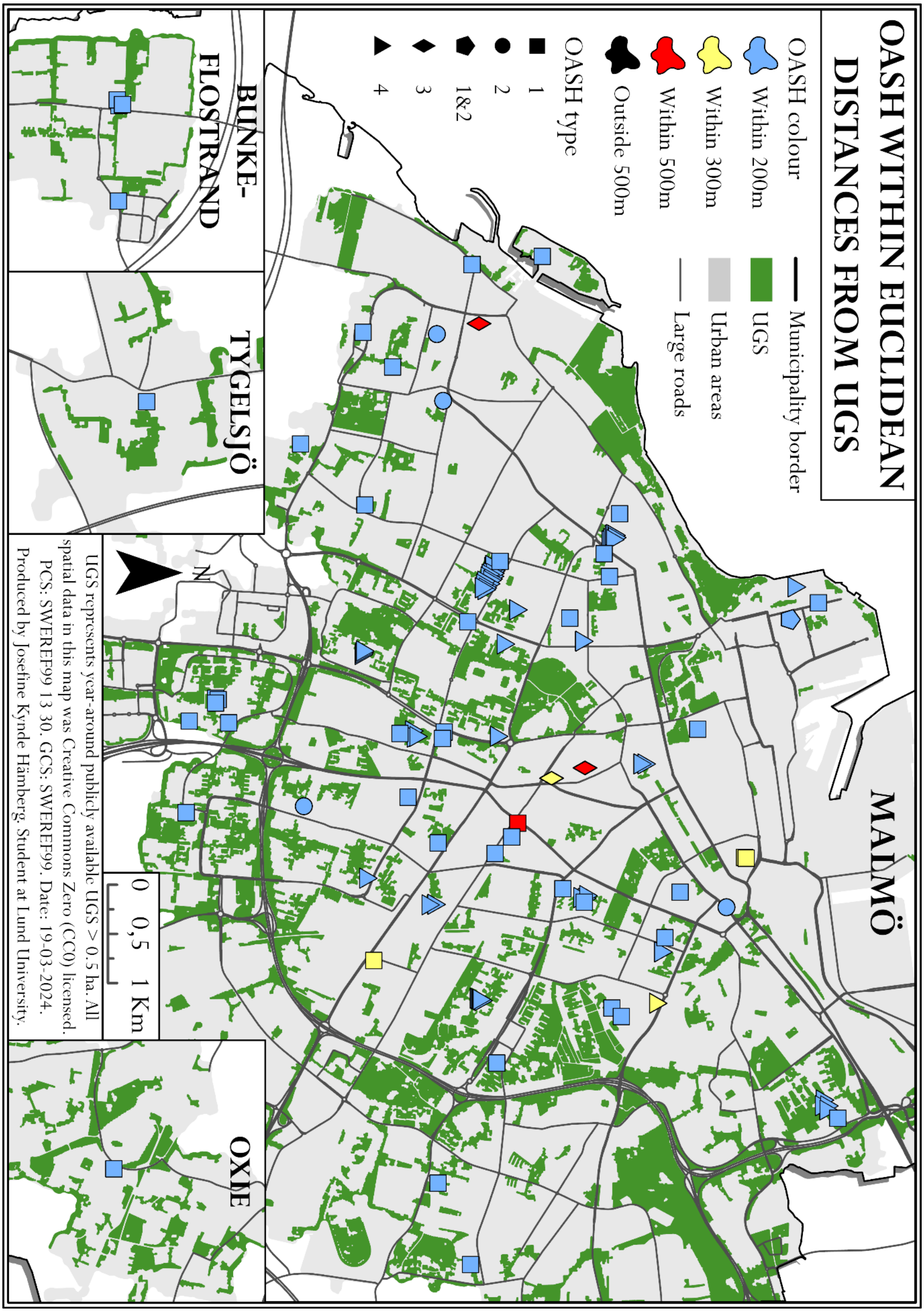


Figure 10. The map shows in more detail which OASH in Malmö municipality's urban areas that had access to UGS within 200m, 300m, and 500m, Euclidean distances measured.

7.4. OASH Within Network Distances from UGS – Large Scale

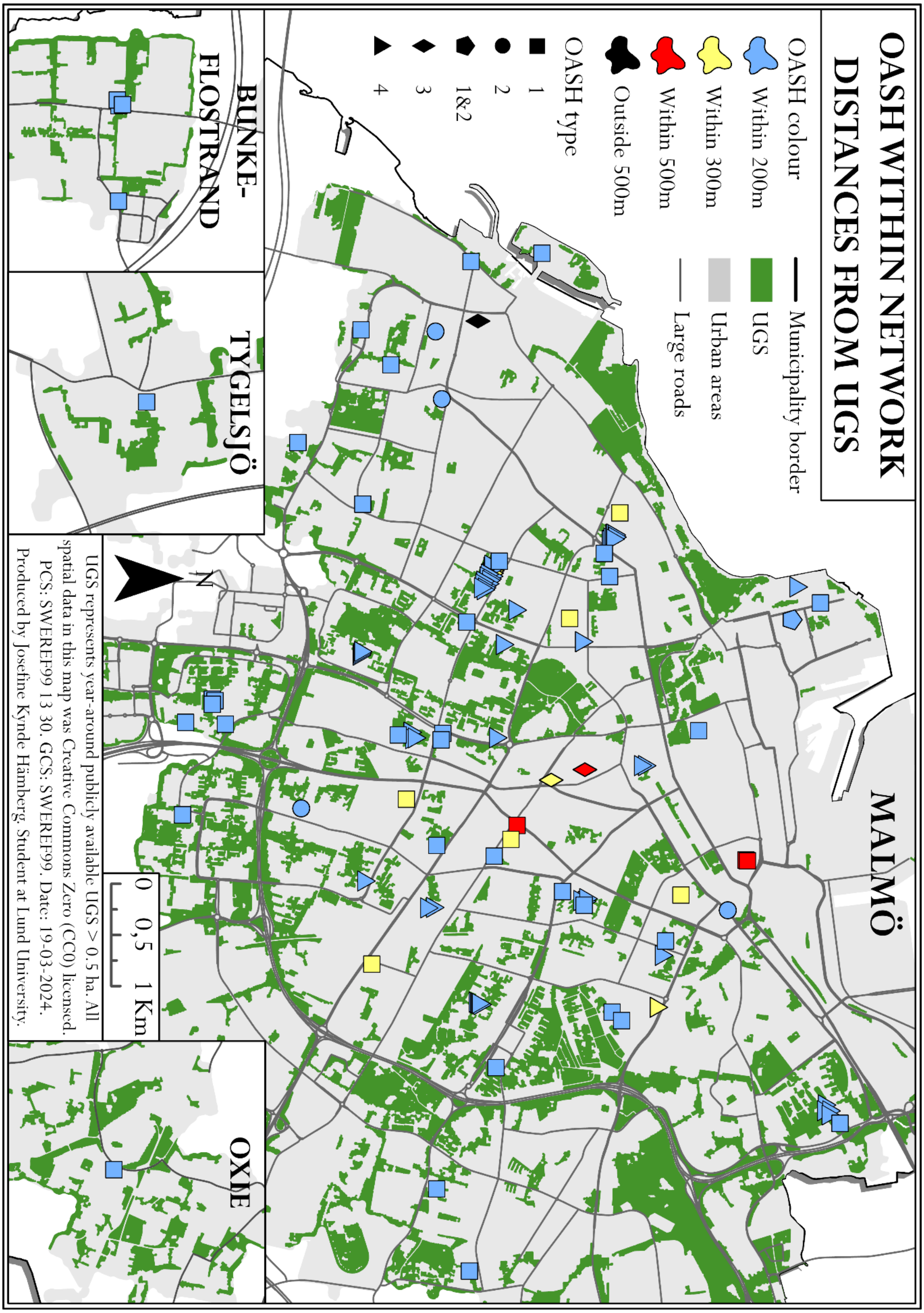


Figure 11. The map shows in more detail which OASH in Malmö municipality's urban areas that had access to UGS within 200m, 300m, and 500m, Network distances measured. Network distances were not calculated with the road data set used for visualisation in the map above.

7.5. UGS Deprived Areas in Malmö urban area – Large Scale

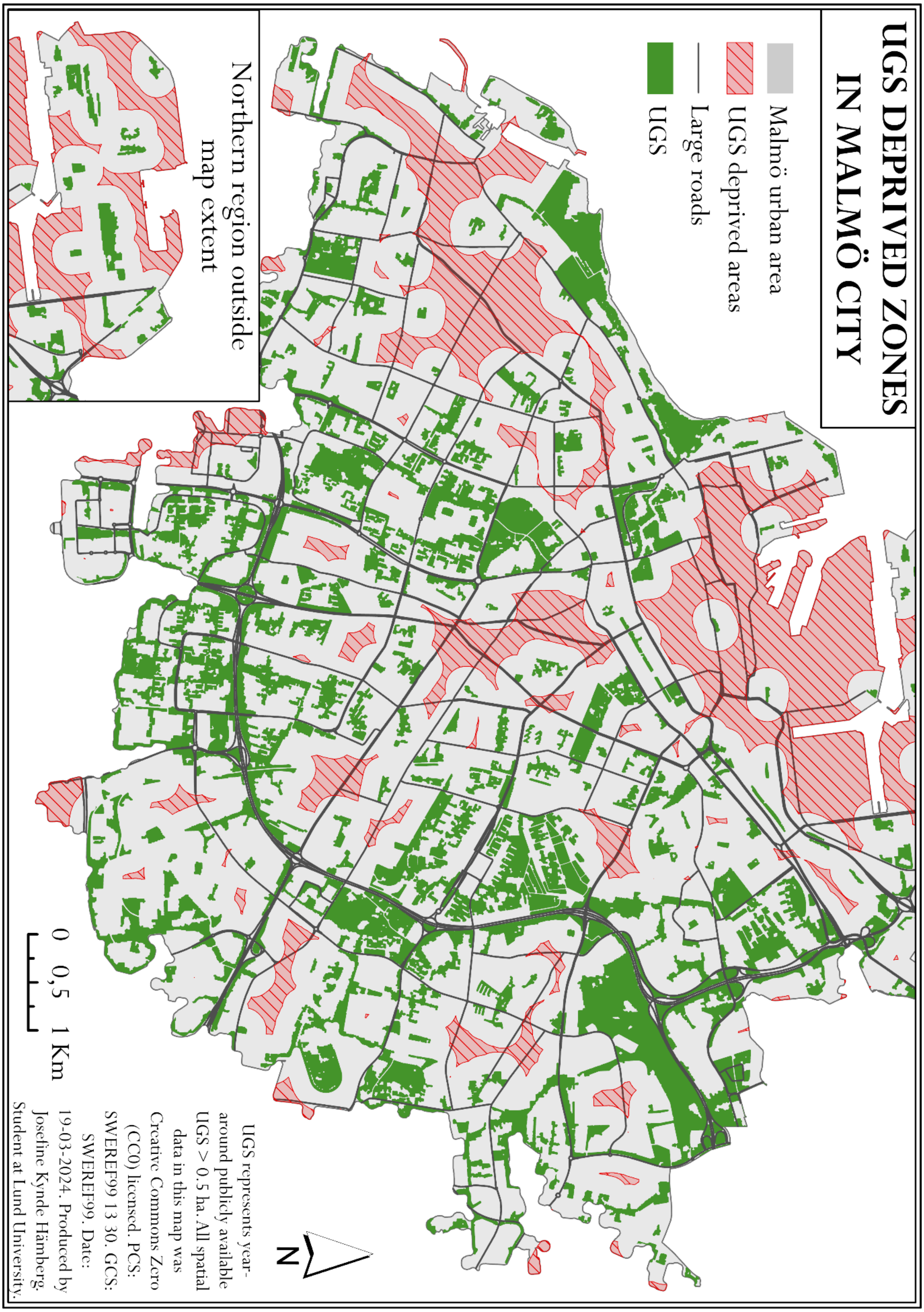
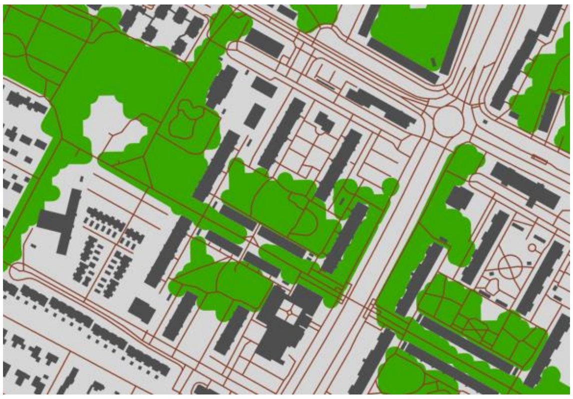
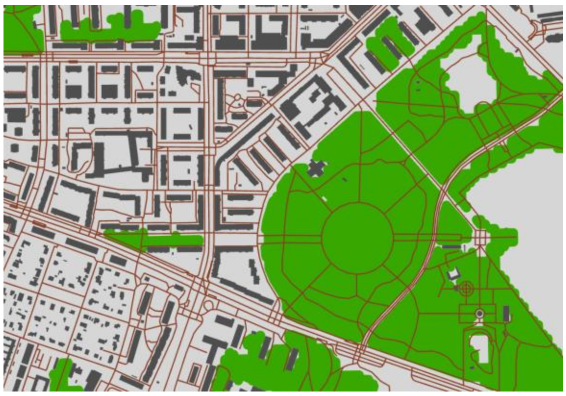


Figure 12. The map shows in more detail which regions of Malmö's urban area that were classified as UGS deprived zones based on a 200 m Euclidean distance.

7.6. OSM Road Data, Visual Evaluation of Quality

Table 11. The table enables comparison between the open free road datasets evaluated for use in this study's network analysis. By visual evaluation solely, the OSM datasets showed to involve more road lines than the dataset from the Swedish Transport Administration, which seemed to focus on roads for cars and bicycles rather than routes for pedestrians.

Road data from the Swedish Transport Administration	Road data from OpenStreetMap (OpenStreetMap Contributors, 2024)
	
	
	

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