

NORWEGIAN UNIVERSITY OF LIFE SCIENCES



Loved and Hated – Perception and Regulation of Invasive Tromsøpalme
(*Heracleum laciniatum* auct. Scand. non. Hornem.)
in Tromsø (Norway)

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Photo: author

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Declaration

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Signature.....

Date.....

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Abstract

This study investigated how invasive Tromsøpalme (*Heracleum laciniatum* auct. Scand., non Hornem.) was perceived and regulated by locals on Tromsø Island. Although Tromsøpalme has negative impacts on biodiversity and a phototoxic sap that burns human skin, it is considered as a local symbol of Tromsø and is therefore appreciated by many locals. The study examined locals'/ landowners' awareness of invasive Tromsøpalme. Furthermore, it was studied how they evaluated its values and how they ranked normative beliefs towards the regulation of this plant on Tromsø Island. Additionally it was investigated how private landowners regulated Tromsøpalme on their parcels on Tromsø Island between May and September 2012. Eleven key informants were interviewed. Furthermore, Tromsøpalme on Tromsø Island was mapped by using photos of Google Maps[®]/Street View[®]. With ArcGIS analyses and field work, private parcels were identified which contained Tromsøpalme and private parcels which did not contain Tromsøpalme. 441 mail questionnaires were sent out to the owners of these selected parcels and 199 of the returned questionnaires were included into the analysis. The key outcomes of this study were that most of the locals/landowners knew what Tromsøpalme is and whether it is on their parcel or not. Most of the respondents preferred only a partial removal of Tromsøpalme from some areas on Tromsø Island. Respondents with higher education were associated with considering Tromsøpalme as a symbol of Tromsø and evaluating a regulation of Tromsøpalme as not necessary, relative to respondents without higher education. Respondents who experienced permanent injuries of Tromsøpalme tended to think that Tromsøpalme is not important as a symbol, that Tromsøpalme is dangerous to health, and that more intrusive regulation measures are necessary, compared to respondents who did not experience injuries from Tromsøpalme. It turned out that Tromsøpalme was regulated to some degree on the parcels if, for example, somebody lived on the parcel or if the parcel was shared between several households. Parcels where Tromsøpalme was absent or was regulated so thoroughly that there was no risk of the plant setting seeds tended to be associated for example with owners living on the parcel or with one household. All key informants mentioned that although locals did not want to have Tromsøpalme in their own garden, many tolerated it in other areas on Tromsø Island. It is important that authorities communicate the issue of Tromsøpalme and the necessity to regulate it objectively. Authorities should include the locals in their decisions about regulation measures. Also, authorities could support specific private landowners, for example, those of parcels without (current) residents and of parcels shared by several households. *Key words: invasive plants, values, normative beliefs, regulation behavior, landowners, mail questionnaire, GIS mapping, case-control approach*

Sammendrag

Denne studien undersøkte hvordan den fremmede arten Tromsøpalme (*Heracleum laciniatum* auct. scand., non. Hornem.) ble oppfattet og regulert av lokalbefolkningen på Tromsøya. Selv om Tromsøpalme har en negativ påvirkning på biologisk mangfold og har en etsende saft som brenner hud, regnes den som et lokalt symbol i Tromsø og er derfor verdsatt av mange innbyggere. Studien undersøkte Tromsøs innbyggeres/private grunneieres bevissthet av Tromsøpalme. Det ble undersøkt hvordan innbyggerne/grunneierne vurderte Tromsøpalme og normative holdninger i forhold til regulering av Tromsøpalme på Tromsøya. Videre ble det undersøkt hvordan private grunneierne regulerte Tromsøpalme på eiendommene sine på Tromsøya mellom mai og september 2012. Elleve nøkkelrespondenter ble intervjuet. Videre ble Tromsøpalme kartlagt på Tromsøya med bilder fra Google Maps[®]/Street View[®]. Private eiendommer hvor det vokste Tromsøpalme og private eiendommer hvor det ikke vokste Tromsøpalme i vegetasjonsperioden 2012 ble identifisert ved hjelp av ArcGIS analyser og feltarbeid. 441 spørreskjemaer ble sendt ut til grunneierne av disse utvalgte eiendommer. 199 respondenter (grunneiere) til spørreskjemaet ble inkludert i analysen. De viktigste resultatene av denne studien var at de fleste innbyggere og respondenter vet hva Tromsøpalme er og om Tromsøpalme var på eiendommen deres. De fleste respondentene foretrakk bare en delvis fjerning av Tromsøpalme fra enkelte områder på Tromsøya. Et høyere utdanningsnivå blant respondentene var assosiert med å anse Tromsøpalme som et symbol på Tromsø og å vurdere en regulering av Tromsøpalme som ikke så nødvendig, i forhold til respondenter uten høyere utdanning. Respondenter som opplevde varige skader fra Tromsøpalme hadde en tendens til å tenke at Tromsøpalme ikke er viktig som symbol, at Tromsøpalme er farlig for helsen, og syntes at grundigere reguleringstiltak av Tromsøpalme er nødvendig, i forhold til respondenter som ikke opplevde skader fra Tromsøpalme. Det viste seg at *H. laciniatum* i det minste ble delvis regulert dersom for eksempel eiendommene var bebodd og dersom eiendommene ble brukt av flere husholdninger. Eiendommer som ikke hadde Tromsøpalme eller hadde Tromsøpalmen som var så grundig regulert at planten ikke fikk noen blomster og ikke kunne spre seg viste en tendens til å være for eksempel bebodd av grunneier og til å være assosiert med en husstand. Ifølge informanter, selv om lokalbefolkningen ikke ønsket å ha Tromsøpalme i sin egen hage, tolererte mange at Tromsøpalme vokser på andre områder på Tromsøya. Fordi planten er verdsatt av noen innbyggere, er det viktig at myndighetene informerer på en objektiv måte om Tromsøpalme og nødvendigheten av å regulere planten. Myndighetene bør inkludere lokalbefolkningen i sine beslutninger om reguleringstiltak. Myndighetene må også kunne støtte spesifikke private grunneiere, for eksempel eiere av eiendommer uten (nåværende) beboere, og eiere av eiendommer delt mellom flere husstander. *Nøkkelord: fremmed planter, verdier, normative holdninger, regulering, grunneiere, spørreskjemaet, GIS kartlegging, case-control metoder*

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Abbreviations

NPRA – Norwegian Public Road Administration (Statens vegvesen)

GWN – Green Warriors of Norway (Norges Miljøvernforbund)

1 Introduction

“The world is globalizing and nature is no exception.” (van der Weijden et al. 2007: 5)

Due to increasing globalization, the issue of alien and invasive species has moved in the focus of public and scientific attention (McNeeley 2001). The term “alien species” means that species are non-native and human-introduced, while the term “invasive species” additionally means that the species are able to spread considerably in the area where they are introduced (Richardson et al. 2000). The International Union for Conservation of Nature and Natural Resources (IUCN) defines “invasive species” as human-introduced species that spread, threaten ecosystems and/or human health, and that lead to high economic costs (McNeeley 2001). Alien plants which become invasive are characterized, for example, by vigorous seed development, effective seed spreading mechanisms (for example by humans, roads, and water), the ability to suppress competitive plants, effective defense mechanisms against herbivores, and high ecological adaptability (Heger & Trepl 2003).

Invasive species are often more frequent in urban places than in the surrounding areas. This might be related to the warmer urban climate which is preferred by many alien species (Pyšek 1998). Furthermore, in densely populated areas seeds of invasive plants could be spread easily by soil transportation and cars. Also, non-native plant species were planted in gardens and parks where they could be able to escape and to grow wild (Hodkinson & Thompson 1997; Wittig 2004). Invasive *Heracleum* plant species were brought to Europe in the 19th and 20th centuries, amongst others, as ornamental plants in parks and gardens from where they have invaded new areas (OEPP/EPPO 2009). In the city of Tromsø in Northern Norway, an invasive *Heracleum* species, in Norwegian called “Tromsøpalme” (*Heracleum laciniatum* auct. Scand. non. Hornem 1813), has spread widely since it was introduced there in the 19th century as an ornamental plant (Alm 2013). This plant has negative impacts on biodiversity and human health (Junttila 1975; Kavli & Volden 1984), see also Chapter 1.2 (p. 6).

1.1 Background: Tromsøpalme and its introduction and spread in Tromsø

1.1.1 Taxonomy and biology of Tromsøpalme and other *Heracleum* species

There are three main taxa of tall invasive *Heracleum* species (family *Apiaceae*) in Europe: Giant hogweed *Heracleum mantegazzianum* Sommier & Levier (1895) which is spread farthest in Europe, Sosnowskyi hogweed *Heracleum sosnowskyi* Mandenova (1944) which is mainly spread in Eastern Europe, and Persian hogweed *Heracleum persicum* Defs. Ex Fischer (1841) which is common in Scandinavia. These three species originate from south-east Europe and south-west Asia. They differ in morphology, such as leaf form, height, and size (OEPP/EPPO 2009).

H. persicum is often used as a scientific name for Tromsøpalme (for example Alm 2013; OEPP/EPPO 2009). But the *Heracleum* genus is relatively unknown by botanists as the plant species are hard to keep in herbaria because of their large size (Alm & Jensen 1993). Genetical studies found that Tromsøpalme might be *H. persicum* (Jahodová et al. 2007), however, Øvstedal (1987) found that many features in Tromsøpalme were different from Persian hogweed plants from Iran and Turkey. Therefore, Tromsøpalme could be a hybrid of *Heracleum persicum* (Fröberg 2010). In the literature, Tromsøpalme is also known as *Heracleum tromsoensis* Elven (2005), nom nud. or as *H. laciniatum* auct. Scand., non Hornem. (1813) (Lid & Lid 2005). In this thesis, the Latin notation *H. laciniatum* is used for Tromsøpalme.



Figure 1: Tromsøpalme at a roadside on Tromsø Island (photo: author).

Tromsøpalme (*H. laciniatum*, Figure 1, p. 2) has a one to four centimeters wide hollow stem with purple spots; and often the lower part of the stem is completely purple. The plant reaches a height of one to four meters (OEPP/EPPO 2009; Often & Graff 1994). The leaves can have one to four pairs of leaflets (Fröberg 2010). It produces white flowers (Lid & Lid 2005) between June and August (Fröberg 2010). *H. laciniatum* is perennial, reproduces only by seeds, and is polycarpic, which means it

can produce seeds several times in its life (Nielsen et al. 2005; Often & Graff 1994). One plant produces 6,000 - 8,000 seeds per season (Alm & Often 2006) on the main umbel (Often & Graff 1994). Tromsøpalme can reach the age of 50 years according to an observation of a Tromsøpalme enthusiast in Tromsø (pers. comm. 2012); but this information could not be confirmed by literature.

Tromsøpalme prefers nutrient-rich soils and sun-exposed rather than shaded areas. It cannot flower in the shade, for example in birch forests, but can persist there for a long time (Fremstad 2006). In Northern Norway, *H. laciniatum* grows close to the coast where the winter is milder, the vegetation season longer, and the climate more humid. It occurs in urban areas and cultured landscapes (Alm et al. 2006) for example in human-made, disturbed, and nutritious habitats along roads, railways, abandoned areas, parks and gardens (Fröberg 2010). But it can also be found in natural and wild landscapes (Alm et al. 2006) and along beaches (Fröberg 2010).

There are some occurrences of Giant hogweed (*H. mantegazzianum*, Norwegian: Kjempebjørnekjeks) in Tromsø (Alm et al. 2004). In the 1980s, it was planted at the Tromsø University from where it has spread along a main road (Often 1994). Giant hogweed is more common in Southern Norway while there are only few occurrences in the North (Fremstad & Elven 2006). Giant hogweed does not seem to thrive as well as Tromsøpalme in the subarctic climate (Alm et al. 2004; Often 1994). This species originated from the Western Greater Caucasus, including Russia and Georgia (OEPP/EPPO 2009). In the 19th century, Giant hogweed was planted as an ornamental plant in botanical gardens and parks all over Europe (Nielsen et al. 2005).

Giant hogweed shows a reproductive biology and morphology different from Tromsøpalme. It flowers and produces seeds only once in its life, after which it dies (monocarp). Giant hogweed produces more seeds than Tromsøpalme (up to 100,000 seeds per season), which ripen on the main and the side umbels (Often & Graff 1994; Tiley et al. 1996). Giant hogweed also can become taller than Tromsøpalme and reaches a height between two and five meters while the stem can have a diameter of up to ten centimeters. The flowers are white, sometimes pinkish (Tiley et al. 1996). The leaves can have one to two pairs of leaflets (Fröberg 2010). A Giant hogweed plant can persist between three to twelve years (Nielsen et al. 2005; Pergl et al. 2006). In the territory it invades, Giant hogweed prefers similar habitats as Tromsøpalme: human-altered habitats, roads, river margins, and forest edges (Thiele & Otte 2006).

A further *Heracleum* species is found in Tromsø, Siberian hogweed (*Heracleum sphondylium* L. subsp. *Sibiricum* L., Norwegian: Sibirisk bjørnekjeks), which is native in some parts of Europe (Alm et al. 2004; Øvstedal 1985). This species is smaller (0.5 to 1.5 meters) than Tromsøpalme and Giant hogweed and has yellowish green flowers (Alm & Often 2006; Lid & Lid 2005). Even though the plant is alien in Norway, Siberian hogweed so far has not been considered as a problematic species such as the tall *Heracleum* species, Giant hogweed and Tromsøpalme (Gederaas et al. 2012). Probably, Siberian hogweed seeds were introduced together with agricultural crops to Northern Norway. It was noticed in Northern Norway for the first time in the 19th century (Alm & Often 2006).

The hybrid between Siberian hogweed and Tromsøpalme is called “Polarpalme” which is smaller than Tromsøpalme and quite common in Tromsø (Alm & Often 2006; Øvstedal 1985). Tromsøpalme seems also to hybridize with Giant hogweed (Alm & Often 2006; Often 1994). The hogweed species can be confused easily; therefore Siberian hogweed and Giant hogweed and the hybrids may have been mistakenly included into this study even though they are not the focus of this investigation. Nevertheless, most of the *Heracleum* species in Tromsø might be Tromsøpalme (Alm et al. 2004; Alm & Often 2006).

1.1.2 Introduction of Tromsøpalme to Northern Norway and the beginning of its spread

Tromsøpalme seeds were probably brought from Central-Asia via Great Britain to Norway in the 19th century. In 1836, possibly, the first seeds of Tromsøpalme were brought to Hammerfest in Northern Norway by a British botanist from the Royal Botanical Garden of Kew in Great Britain (Elvebakk 1992), because Hammerfest had copper mines and trade relations with England and other European countries (Alm & Jensen 1993). Around 1850, the daughter of a rich businessman in Tromsø might have brought the first Tromsøpalme plant from Alta in Northern Norway to Tromsø as a garden plant for her home (Alm & Jensen 1993; Nilsen 1991). However, it is assumed that there were several introductions of the plant at different times via different areas in Europe (Alm & Jensen 1993).

As the plant was so decorative and was thriving so well in the harsh subarctic climate (Nilsen 1991), the seeds were shared among locals in Tromsø and with people in other parts of Norway (Alm et al. 2006). Tromsø was an economic center of this region and had a considerable upper class when the plant was introduced to Tromsø (key informant Tromsøpalme enthusiast, pers. comm. 2012). At first, the upper class in Tromsø commonly planted Tromsøpalme in the

gardens of their summer houses on Tromsø Island (Alm et al. 2006; Elvebakk 1992). Later other locals were cultivating Tromsøpalme on their land, too, for example at their houses near the shore (key informant Tromsøpalme enthusiast, pers. comm. 2012). *H. laciniatum* was often planted as a hedge and as a wind break (Alm 2006). As the seeds were so much in demand, the plant was distributed in the whole of Tromsø (Alm et al. 2006). Furthermore, people had taken seeds or whole plants with them from Tromsø into outer districts (Tromsøpalme enthusiast, pers. comm. 2012) and even to Southern areas of Norway, such as Trondheim and Oslo, where Tromsøpalme started to spread (Fremstad & Elven 2006).

As Tromsøpalme produces a lot of seeds several times in its life (polycarp), it can produce a high amount of seedlings (Alm & Often 2006). Especially from the 1960s on, when farming activities - such as grazing and hay making - declined, Tromsøpalme was able to spread uncontrolled in Tromsø (Alm & Jensen 1993). The seeds of *H. laciniatum* can be dispersed by car wheels and water currents. Therefore, the plant today is frequently found in Tromsø along roads, rivers, and the seashore, however, it is also abundant in the city center (Alm et al. 2006), see also the photo in Figure 11 (p. 109). When new roads were built, inadequate prevention might also have contributed to this spread (key informant Norwegian Public Road Administration NPRÅ, pers. comm. 2012). For many garden owners Tromsøpalme lost its attractiveness as a garden plant because it was difficult to prevent it from spreading in the garden. Also, it was not special anymore to grow it as the plant was meanwhile found in many places in Tromsø (key informant Tromsø University, pers. comm. 2012). Therefore, many garden owners thoughtlessly threw and still throw the plant waste that includes mature seeds on the neighboring parcels, and so contribute to the uncontrolled spread of the plant on the island (key informants Green Warriors of Norway GWN, Tromsø University 2012, pers. comm. 2012).

In the beginning of the 1990s, studies were carried out about the origin of *H. laciniatum* (Elvebakk 1992; Nilsen 1991). Previously, it had been assumed that Tromsøpalme had come as a weed from Siberia via the Pomor trade with ships from Russia (Nilsen 1991). The historical aspects of the plant were finally rediscovered (for example Elvebakk 1992) but at the same time, researchers raised concern about Tromsøpalme's spread (Alm & Jensen 1993). Since the end of the 1990s, authorities and the environmental organization GWN possibly have begun to worry about the ecological impacts and the high distribution of Tromsøpalme in Tromsø (key informant GWN, Troms County Governor, pers. comm. 2012).

1.2 Impact of Tromsøpalme on biodiversity and human health

Tromsøpalme alters cultural landscapes and changes the species composition in the habitats it spreads into (Alm & Often 2006). It has been shown on a local scale that Tromsøpalme shades out other plants (Myrås & Junttila 1981) and that it constraints the growth of surrounding plants by releasing inhibitive substances into the soil (allelopathy) (Junttila 1975). Due to its negative impacts on biodiversity, the Norwegian Biodiversity Information Center (Norw.: Artsdatabanken) has registered Tromsøpalme in the Norwegian black list which includes species that are considered to be invasive in Norway. However, this list does not imply that authorities are obliged to fight the species which are registered there (Gederaas et al. 2012).

In the developed urban area of Tromsø, the plant might often grow in areas that do not show high species diversity. Here, Tromsøpalme competes mainly with other invasive plants and might not threaten so much endangered plants (key informant Tromsø University, pers. comm. 2012). However, it would be problematic if Tromsøpalme would leave the urban and human altered areas and spread into the undeveloped natural areas or into conservation areas in and around Tromsø (Alm & Jensen 1993; Alm 2013). This concerns also key informants from authorities and an environmental organization (key informants GWN, NPRA, Troms County Governor, Tromsø Municipality, pers. comm. 2012).

Beside Tromsøpalme's impact on other plant species, its sap contains furocoumarines that in combination with UV-radiation lead to a phototoxic reaction which burns human skin (photodermatitis) (Kavli & Volden 1984). The affected part of the skin can develop blisters and also allergic reactions have been observed followed by a high melanin production of the affected skin (hyperpigmentation) (Kavli & Volden 1984) that can stay for several months (Kavli et al. 1983b). *H. laciniatum* contains amongst others the furocoumarine bergapten (Kavli & Volden 1984) which could be carcinogenic (Zajdela & Bisagni 1981). Children playing outdoors and people working outside, such as gardeners, have a higher risk to get in contact with *Heracleum* sap. The contact with the sap does not hurt immediately and therefore people often realize it too late (Nielsen et al. 2005). However, the sap of Tromsøpalme is considered less noxious than the sap of Giant hogweed (Alm 2013). The phototoxic furocoumarines are mainly in the leaves, flowers and roots of Tromsøpalme (Kavli et al. 1983a). They are produced in many *Heracleum* species and protect them from herbivores (Berenbaum 1978).

1.3 Cultural meaning of Tromsøpalme and its use by locals in Tromsø

Beside these negative aspects of Tromsøpalme, the vigorous growth of the plant and its overall presence has given Tromsøpalme the status as a symbol of Tromsø (Alm 2013). The plant is a popular plant motif in works of art by local artists (Figure 2, p. 7), on postcards, in logos (Alm 2013), and also for embroidery on the traditional folk costume of Tromsø (the so called “Tromsø festdrakt”), designed around 1980 (Haugen 2006). Tromsøpalme is often taken as a motif in landscape photos: the full-grown plant in summer as well as the dry stems in winter time (Alm 2013). Furthermore, the *International Film Festival* in Tromsø awards a prize called “Tromsøpalmen” for movies (Tromsø International Film Festival 2013) and the home for the elderly in Tromsø is called “*Heracleum*” (Tromsø Municipality 2013). A local mentioned that the school for nurses in Tromsø had been called Tromsøpalme in the past, because the plant was representing strength and endurance. However, there was no information on the exact period of time and it was not possible to verify this information by any other source. The problematic aspects of Tromsøpalme on the one side, and its local importance as a symbol on the other side have created an ambivalent perception of locals towards the plant; the locals in Tromsø “love and hate” Tromsøpalme at the same time (Alm 2013: 1).



Figure 2: Tromsøpalme motif on a window in Tromsø (photo: author).

As the plant became so abundant in Tromsø, locals tried to make use of the plant in different ways, for instance, as firewood (Alm 2013). In the 1930s, researchers in Tromsø tried to use Tromsøpalme as a fodder plant, but the milk of the animals tasted like anise (Østerud 1935). Dried plants are used as decoration in houses and artists in Tromsø made sculptures and flutes out of Tromsøpalme (Alm 2006). In its native home range, *Heracleum persicum* (local name: Golpar) is used for medication and as a food plant (Hemati et al. 2010) and it might be that in Tromsø some locals used or still use Tromsøpalme like that as well (Alm 2006).

The word “Tromsøpalme” might have been invented by the German soldiers during the occupation of Norway in the Second World War. While the first part of the name might refer to the high density of the plant in Tromsø, the second part might be related to the fact that people were inspired by the exotic look of the plant, its large size, and the palm-like leaves (Alm 2006).

1.4 Regulation measures of Tromsøpalme by authorities in Tromsø

While this study was conducted, authorities in Tromsø (NPRA, Troms County Governor, Tromsø Municipality) had planned or already tried to reduce Tromsøpalme in some areas (key informants GWN, NPRA, Troms County Governor, Tromsø Municipality, pers. comm. 2012). A further spread of tall invasive *Heracleum* (such as Tromsøpalme or Giant hogweed) can be inhibited if at least the flowers are cut in late summer before the plant sets seeds (Nielsen et al. 2005). While no similar research has been found on *H. laciniatum*, research with Giant hogweed showed that even if umbels are cut at a time when they have no ripe seeds yet, they should not be left on the treated area because these cut umbels are still able to develop viable seeds (Pyšek et al. 2007a). Therefore, the plant waste should be removed and destroyed, for example by burning (Pyšek et al. 2007b). To remove invasive Tromsøpalme and Giant hogweed by mowing and cutting of the stems, it is important that the plants are treated three times during the vegetation season (Renna 2002) for at least five years (Nielsen et al. 2005). This takes the nutrients from the plant until it finally dies (Nielsen et al. 2005). Studies with Giant hogweed showed that when it is cut once before flowering, the plant is still able to produce new flowers with viable seeds. After the third cutting in one season, the plant might still produce flowers but without viable seeds (Otte & Franke 1998).

Furthermore, the plants can be ploughed or the roots can be dug out which is more laborious than cutting the plant but kills the plant often immediately. Cattle and sheep can graze on the area when the plants are still small at the beginning of the vegetation season. In heavily infested areas, herbicides and other chemicals are recommended. The removal of hogweed is time-consuming and needs careful and persistent measures (Nielsen et al. 2005).

The municipality of Tromsø handles Tromsøpalme as part of the normal road side cutting and as part of the maintenance processes on graveyards and in parks. In some cases also herbicides are applied. On public land, the municipality regards their activities as sufficient to control the amount of the plant. However, there were no further official measures to tackle the problem of

Tromsøpalme effectively and permanently in order to reduce the amount of Tromsøpalme in Tromsø. One reason for this might be that there is no jurisdiction for the public authorities to regulate the plant on private land from which the plant can continue to spread into public areas. Furthermore, the concern about the plant among the staff working for the municipality is not considerably high. The Tromsø Municipality focuses (with support of the Troms County Governor) on complete eradication of the plant on small islands close to the Tromsø Island in collaboration with private landowners (for example on Sessøya, Bjønøya, Gåsvær) as regulation measures are more successful in small and isolated areas (key informants Troms County Governor, Tromsø Municipality, pers. comm. 2012).

NPRA planned measures in the county of Troms and partly in the county of Finnmark in summer 2013 following the study. The NPRA would mow invasive plants along larger roads at a breadth of three meters several times in the summer. NPRA wants to get the permission from landowners to remove invasive plants on private land close to the roads when there is the risk that invasive plants spread from private parcels to the road sides. In Tromsø, the NPRA would try to remove the plant along the roads they are responsible for, which are mostly larger roads, such as the national roads and European roads (key informants NPRA, Troms County Governor, pers. comm. 2012).

The Troms County Governor supports the NPRA financially for the removal of invasive species. Furthermore, the Troms County Governor facilitates projects for regulating invasive plants in conservation areas in Troms County. All these measures are done with volunteers who are not paid, or receive only a small financial compensation. In Tromsø, the Troms County Governor Troms gave permission to a farmer to let sheep graze on Tromsøpalme in a conservation area on a small island (Grindøya) near Tromsø; here the plant could be considerably reduced within seven years. In addition, a conservation area on the top of Tromsø Island was planned, which should be kept free of Tromsøpalme in the future (key informants Troms County Governor, pers. comm. 2012).

Due to lack of staff and limited financial resources the authorities only regulate Tromsøpalme sporadically in some specific areas in Tromsø, such as parks and green spaces. Also, they try to inhibit the further spread of Tromsøpalme out of Tromsø by focusing on large roads. Authorities do not regulate Tromsøpalme actively on private land; here they count on informing landowners about health risks and methods of regulation. This means official regulation measures in Tromsø have so far not been conducted on a large scale and are often

not done persistently, with the exception of some specific areas (key informants NPRA, Troms County Governor, Tromsø Municipality, pers. comm.2012).

1.5 Problem statement, justification of the study, and previous research

Currently, Tromsøpalme is widespread in Tromsø and therefore it is a difficult task to regulate this plant (key informants Tromsø Municipality, Tromsø University, pers. comm. 2012). Controlling invasive plants is especially difficult in areas where a lot of landowners are involved (Gardener et al. 2010). In the city of Tromsø, the locals are concerned about Tromsøpalme's impacts on human health, on biodiversity, and about the spread of the plant onto their land. At the same time, Tromsøpalme has a special status in its invaded area, the city of Tromsø, as it functions as a local symbol (key informants Tromsø Municipality, Tromsø University, pers. comm. 2012).

Due to the ecological impacts of invasive species, nature conservationists and managers justify controlling and eradicating them (Rotherham & Lambert 2011). But often management plans do not consider that, for example, an invasive plant might be perceived as a useful and ornamental garden plant by some of the locals and might have other positive aspects, such as a local importance or economic values; therefore the support of control programs by the locals can be low (Blossey 1999; Gardener et al. 2010; Rotherham & Lambert 2011). Some researchers criticize that alien species are automatically seen as bad by many conservationists just because the species are alien (for example Peretti 1998; Warren 2007). So, perceptions of invasive species are based on both personal values and scientific arguments, which confuses the debates about invasive species (Lodge & Shrader-Frechette 2003). This is what happens in Tromsø as well, where the topic of invasive Tromsøpalme is discussed in the local newspapers (for example Sveen 2007). Furthermore, urban citizens have different concepts about wildlife and invasive species and their regulation, compared to inhabitants in rural areas (Fitzgerald et al. 2007; Manfredo et al. 2003; Staples 2001). As the issue of invasive species is so controversial because they can have both negative and positive aspects, it is important to examine the public's perception (values and normative beliefs) of invasive species to develop management strategies (McNeeley 2001; Rotherham & Lambert 2011).

Studies found that especially in the case of invasive species which have social, economic, or aesthetical functions for the locals it is important to consider the values of the locals in the management of these invasive species (Aitken et al. 2009; Gardener et al. 2010; Qvenild 2013;

Schüttler et al. 2011; van Wilgen 2012). Furthermore, studies found that within a population, different groups can hold different values and normative beliefs towards wildlife in general and their management (for example Manfredo et al. 2003; Skogen 2001; Teel et al. 2002; Thompson & Barton 1994; van der Berg & Koole 2006; Vaske et al. 2001; Zinn & Pierce 2002) as well as invasive species and their management (Bremner & Park 2007; Fischer & van der Wal 2007; Fitzgerald et al. 2007; Garcia-Llorente et al. 2008). Some important terms that are used in this thesis need to be defined. Values describe positive or negative feelings towards something (Rokeach 1979); these values can for example refer to the aesthetical or symbolical value of nature (Kellert 1996). Normative beliefs describe what somebody thinks somebody else should do (Fishbein & Ajzen 1975). Normative beliefs can refer to how people evaluate measures against wildlife (Zinn et al. 1998) (for a more precise definition of values and normative beliefs, see Endnote #1, p. 152).

Research found that values and normative beliefs can play a role in behavioral decisions (for example Ajzen & Fishbein 1977; Homer & Kahle 1988), also in decisions regarding environmental-friendly behavior (for example Kollmuss & Agyeman 2002), as well as voting decisions regarding wildlife management (Bright & Manfredo 1996; Vaske & Donnelly 1999). Fischer and Charnley (2012) and Daab and Flint (2010) investigated specifically how values and normative beliefs influence the regulation of invasive plants by private forest landowners in Oregon and general home owners in five counties in Colorado. Furthermore, they investigated the influence of awareness (if landowners know about invasive plants), socio-demographic variables, and parcel characteristics on the regulation behavior. Based on the former studies mentioned in this section, this study focuses on urban citizens'/private landowners' awareness, perceptions (values and normative beliefs), and regulation practices towards invasive Tromsøpalme.

1.6 Objectives of the study

This study deals with the awareness (definition of awareness, see Endnote #1, p. 152) of private landowners/locals on Tromsø Island towards Tromsøpalme. Furthermore, private landowners'/locals' perceptions are examined, which includes both the evaluation of Tromsøpalme's values (aesthetical, health-related and symbolical) and normative beliefs towards potential regulation measures of Tromsøpalme on Tromsø Island taken by local authorities. Also, it is studied how socio-demographic variables relate to evaluations of values and normative beliefs. Finally, the regulation behavior of the landowners on their parcel

(between May and September 2012) was investigated and how this behavior was determined by values, normative beliefs, socio-demographic characteristics (such as age, gender, level of education, etc.), and parcels characteristics (for example if the owner lived on the parcel vs. only renters vs. no residence on the parcel or the number of households sharing the parcel). For the different variables included into the study, see also Table 3 (p. 37).

The regulation behavior was measured in different degrees: full regulation, no plant flowered between May and September 2012; partial regulation, at least one plant flowered (which means the plant could still spread); no regulation, the plant could grow and spread unhindered on the parcel. The regulation behavior was further measured in the parcels' contribution to the spread of Tromsøpalme between May and September 2012 (full regulation or Tromsøpalme absent vs. no or partial regulation). Regulation includes all sorts of measures that can be taken to prevent the spreading of Tromsøpalme, such as cutting of the stems, cutting of the flowers, digging out the roots, or mowing. The more detailed definition of terms used in the thesis (for example awareness, values, normative beliefs, behaviors, regulation) can be found in Endnote #1 (p. 152).

For the data gathering, a mixed-methods design was used with qualitative and quantitative data collection (Creswell 2009). Interviews were conducted with key informants from authorities in Tromsø (NPRA, Troms County Governor, Tromsø Municipality), from an environmental organization (GWN), from the Tromsø University, and from Tromsø Arts Association. Furthermore, a local Tromsøpalme enthusiast was interviewed and conversations with private landowners were held. In the interviews and conversations, key issues of Tromsøpalme (history of introduction, biology, etc.) were explored as well as locals/landowners' values and normative beliefs regarding Tromsøpalme and the regulation of Tromsøpalme by landowners. In the next step, a mail questionnaire was sent to a sample of private landowners on Tromsø Island. This sample included landowners who regulated Tromsøpalme on their parcels to different degrees and landowners who did not have Tromsøpalme on their parcel. The questionnaire data were supposed to give insight into associations between socio-demographic characteristics, parcel characteristics (independent variables), values, normative beliefs (independent variables and outcome variables), and regulation behaviors (outcome variables).

The results of the study might be helpful for managers to monitor invasive species and to understand how values of an invasive plant and normative beliefs of its regulation are evaluated

by locals/private landowners in an urban area. Furthermore, the study might give hints about the type of private parcels which contribute more to the spread of Tromsøpalme than others.

The next section summarizes the objectives and research questions of the study. The research questions of objective 1 were answered by using key informant interview data (here referred to as locals) and questionnaire data and anecdotal information (gathered from private landowners). The research questions of objective 2 were answered mainly by using data of the questionnaire and anecdotal information from conversations (private landowners).

Objective 1: To assess the private landowners'/locals' awareness and values of Tromsøpalme as well as normative beliefs of potential regulation of the plant on Tromsø Island taken by local institutions and to examine what factors influence values and normative beliefs

- 1) What is the level of awareness of the landowners/locals regarding Tromsøpalme in general and the level of awareness of the landowners regarding the presence/absence of Tromsøpalme on their own parcel?
- 2) How are the *values* regarding Tromsøpalme (*aesthetic, symbolic and health value*) evaluated by the landowners/locals, and how do these evaluations relate to *socio-demographic characteristics*?
- 3) How are the *normative beliefs* evaluated by the landowners/locals regarding a regulation of Tromsøpalme on Tromsø Island by local institutions and how do these evaluations relate to *socio-demographic characteristics and values*?

Objective 2: To assess private landowners' regulation behaviors regarding Tromsøpalme on their parcel and to examine what factors influence landowners' regulation behaviors

- 4) How did the landowners regulate Tromsøpalme on their parcels between May and September 2012?
- 5) How are *socio-demographic characteristics, parcel characteristics, values, and normative beliefs* related to the *regulation degree* (no, partial, or full regulation) of Tromsøpalme on the landowners' parcels?
- 6) How are *socio-demographic characteristics, parcel characteristics, values and normative beliefs* related to the parcels' contribution to Tromsøpalme's spread (defined as no regulation/partial regulation vs. full regulation/Tromsøpalme absent)?

Regarding the structure of this thesis, in Chapter 2 (p. 14) the study area is introduced, the methods of gathering data are described, and their drawbacks are discussed. Furthermore, the statistical analysis is explained. In Chapter 3 (p. 39), results from interviews and the questionnaire are presented and discussed. In Chapter 4 (p. 89), the results are summarized and implication of the results for management and further research is discussed.

2 Methods

2.1 Study area

The study area is the Tromsø Island (Tromsøya) where the majority of Tromsø city lies (69.40° North, 18.56° East; source: Google Earth 7. 1. 1. (2013)), including the city center and some residential areas (Figure 3, p. 14). The city of Tromsø in the county Troms is the largest town in Northern Norway with 67, 969 inhabitants (year: 2012); more than half of these inhabitants (36, 088, year: 2012) live on Tromsø Island (Statistics Norway 2013a). This island has an area of 22 square kilometers (map source: Norwegian Forest and Landscape Institute), so the population density on Tromsø Island is 1640 inhabitants per square kilometer.

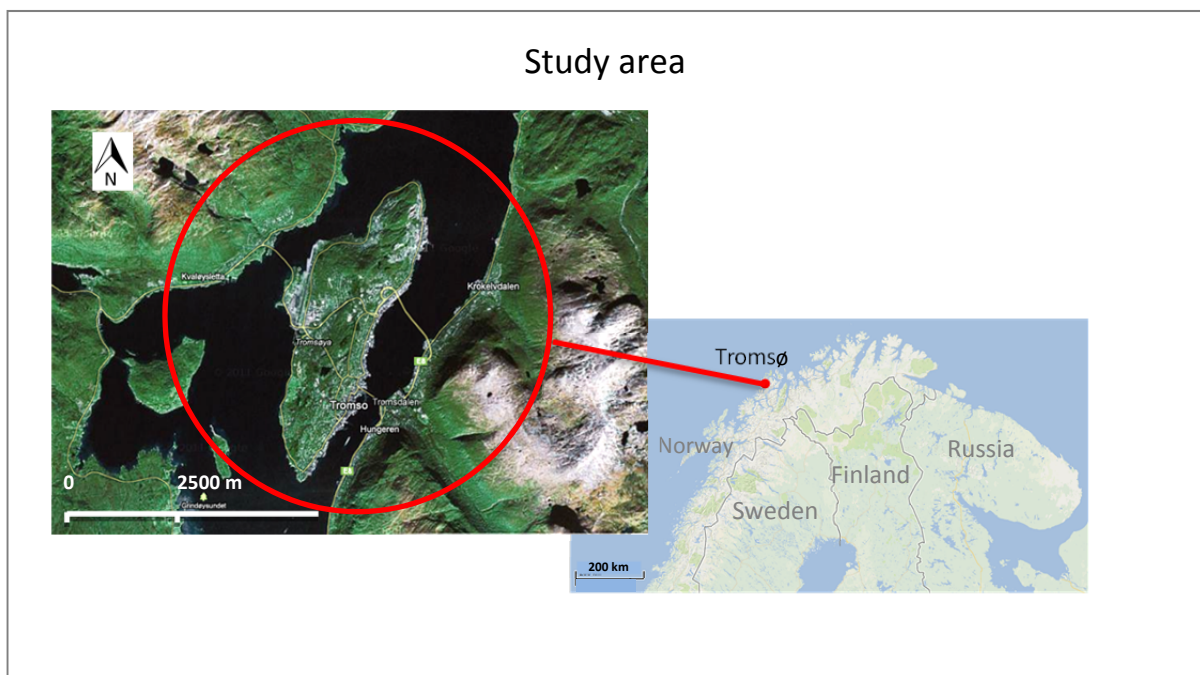


Figure 3: The study area is Tromsø Island (Norw.: Tromsøya, left map, red circle, source Norwegian Forest and Landscape Institute) where the center of Tromsø city lies. Parts of the city lie also to the east of the mainland and to the northwest on the island Kvaløya. The city of Tromsø is located in Northern Norway (right map, source: Google Maps (2013a)).

Tromsø Island was chosen as the actual study site because it is a clearly defined area. Tromsø Island is approximately 10 kilometers long and up to 3.6 kilometers wide, and ranges in altitude from 0 – 160 meters (Google Earth 7. 1. 1. 2013). Tromsø has a humid subarctic climate. The warmest month is July (mean 11.8°C) and the coldest January (mean - 4.4°C) (Norwegian Meteorological Institute 2013). The precipitation is highest in October (77% of the days with precipitation) and lowest in July (64% of the days with precipitation). Between May and July, the sun stays above the horizon (polar day) for more than 60 days; between November and January, the sun stays below the horizon (polar night) for around 50 days (Diebel & Norda 2013).

Within a radius of 40 kilometers around Tromsø Island, approximately half of the ground surface is tundra, a third is sea, and one fifth is forest (Diebel & Norda 2013). The lowlands of Troms are characterized by the middle boreal vegetation zone (middle coniferous woodland zone) which has its highest boundary in Troms at 130 meters. In that zone, Norway spruce (*Picea abies*) is common as well as bird cherry (*Prunus padus*), grey alder (*Alnus incana*), birch (*Betula* sp.), goat willow (*Salix caprea*), and rowan (*Sorbus aucuparia*) (Moen 1999).

2.2 Overview of the methods used in the study

As the data collection based on several methods, this section gives a short overview of the data collection procedures (summarized in Table 1, p. 17). At first, interviews with key informants in Tromsø were conducted about different aspects of Tromsøpalme and how locals perceive it. The key informant interviews were analyzed by identifying topics in the transcribed interviews.

In the next step, private landowners on Tromsø Island were identified who would be asked to answer a questionnaire. For the study it was important to have an almost even number of private landowners in the sample who had the plant on their parcel (did not regulate it sufficiently so that it was visible in the field in the vegetation season 2012) and private landowners who did not have the plant on their parcel (or regulated it, so that it was not visible in the field in the vegetation season 2012). Within this sample, it could be measured how these landowners differ from each other concerning values, normative beliefs, regulation behavior, socio-demographic characteristics, and parcel characteristics.

To obtain this sample of landowners, Tromsøpalme on Tromsø Island was mapped in ESRI ArcGIS 10. Information about distribution of Tromsøpalme on Tromsø Island was obtained from air photos from Google Maps[®] (year: 2007) and photos from Google Street View[®] (year:

2010) (Google Earth 7. 1. 1. 2013; Google Maps 2013b). With the help of a cadaster map and an address file, private parcels with Tromsøpalme on Tromsø Island were identified. In ArcGIS, for all parcels with Tromsøpalme, one private neighboring parcel without Tromsøpalme was selected within a 20 meters radius in a nested case-control approach (Biesheuvel et al. 2008; Schlesselman 1982). All parcels were visited in the field and the classification of the parcels (if Tromsøpalme was visible on their land or not) was checked and corrected if necessary.

During this approach, a self-administered questionnaire was developed and pre-tested on landowners on Tromsø Island. With these landowners also conversations were held to gather anecdotal information. Finally, the questionnaire was sent by mail to all landowners of the sampled parcels. In the questionnaire, landowners provided information about themselves and their parcels. Furthermore, they answered questions concerning their perception of Tromsøpalme. The landowners were asked to report if Tromsøpalme was present on their parcel, and if so, how it had been regulated between May and September 2012. According to the landowners' answers, the classification of the parcels (based on Google Maps[®]/Google Street View[®] and field work) was revised. The questionnaire data were analyzed with univariate, bivariate and multivariate statistics. In Chapter 2.4 (p. 20), the data gathering is presented in more detail.

The preparations of the interviews with key informants and landowners and the identification of parcels and their landowners (who were sent the questionnaire) were done in Tromsø at the North-Norwegian office of the Norwegian Forest and Landscape Institute (Skog og landskap). The facilities in the main office in Ås, Akershus (South Norway) were used to print and send the questionnaires.

Table 1: Chronological order of data gathering.

Method	Sample	Purpose	Time period
Interviews (qualitative) (p. 20)	Eleven key informants (GWN, NPRA, Tromsø Arts Association, Tromsøpalme enthusiast, Troms County Governor, Tromsø Municipality, Tromsø University)	<ul style="list-style-type: none"> • <i>Information about Tromsøpalme:</i> history, distribution, biology and taxonomy, cultural meaning, uses, impacts on biodiversity and on human health • <i>Information about locals:</i> values, normative beliefs, and regulation behavior of locals regarding Tromsøpalme → development of the questionnaire 	June – September 2012
Mapping in ESRI ArcGIS 10 by using photos from Google Maps® (2007) and Google Street View® (2010) (p. 24)	Tromsøpalme on Tromsø Island	<ul style="list-style-type: none"> • Distribution map of Tromsøpalme on Tromsø Island 	June- July 2012
ArcGIS; cadastral map and address file from Norwegian Mapping authority (p. 25)	Parcels on Tromsø Island	<ul style="list-style-type: none"> • Classification of private parcels into parcels with and without Tromsøpalme 	July- August 2012
Field checks (p. 27)	Parcels on Tromsø Island	<ul style="list-style-type: none"> • Verification of classification of private parcels with and without Tromsøpalme → final sample with 441 parcels 	August – End of September 2012
Conversations (qualitative, anecdotal information) (p. 22)	17 landowners and three renters on Tromsø Island	<ul style="list-style-type: none"> • Pre-testing and development of questionnaire • Information about values, normative beliefs, and regulation behavior regarding Tromsøpalme 	August – October 2012
Mail Questionnaire sampling (quantitative) (p. 31)	199 landowners on Tromsø Island	<ul style="list-style-type: none"> • Further verification of parcel classification, • Socio-demographic characteristics and parcel characteristics, • Values, normative beliefs, and regulation behavior regarding Tromsøpalme (according to the time period May-September 2012) 	First mailing: December 2012; second mailing: January 2013; last surveys received: March 2013

2.3 Theoretical considerations of using mixed methods

The preceding section showed that this study mixes qualitative and quantitative methods, which means both interview and questionnaire data were used to answer the research questions. Both method types rely on different paradigms: quantitative methods, such as close-ended questionnaires, are based on the assumption that social phenomena can be measured objectively, which refers to the so-called positivistic epistemology. According to this approach, the researcher observes the phenomena independently from what is studied. Qualitative methods, such as unstructured open-ended interviews, are based on the assumption that social phenomena are experienced differently by different individuals and that data obtained, for example, in interviews are subjective. This approach refers to the epistemology of constructivism. Here, the researcher is seen as a part of the study setting which is influenced by him or her (Creswell 2009).

There is a dispute among scientists if quantitative and qualitative methods should be combined in studies because they define reality differently as they are based on different epistemologies (Bryman 2008). Nevertheless, mixing quantitative and qualitative methods has become more common recently. This pragmatic mixed-methods approach implies that researchers should focus more on answering the research questions instead of concentrating on one specific epistemology. However, the different epistemologies of qualitative and quantitative methods should be kept in mind during data gathering and analyzing (Morgan 2007).

A mixed methods design has several advantages towards a mono-method design. The combination of methods enlarges the options of what can be researched (Morgan 2007). In-depth information about phenomena can be obtained with qualitative methods and the relationship between phenomena can be tested with quantitative methods (Greene et al. 1989). The aspects of awareness, values, normative beliefs, and the regulation behavior of locals/landowners were explored by interviews. With the questionnaire, patterns between these variables and their association with socio-demographic variables and parcel characteristics were investigated. Furthermore, mixed-methods research is appropriate if the outcome of one method can be used to design another method (Greene et al. 1989). On the basis of the interviews, values and normative beliefs could be identified and investigated further by using a questionnaire. Furthermore, mixed methods can be conducted in order to cross-check findings from the different methods (Greene et al. 1989), in that way, findings from the questionnaire were verified by key informant interviews, landowner conversations, and field observations and

vice versa. According to Creswell (2009), qualitative data can make the quantitative data more insightful when the key informants provide background information that might help to understand the landowners' answers in the questionnaire. So, in this study the qualitative method was embedded into the quantitative approach and was used to explore the topic of research, to gather information for developing the questionnaire, and to support and discuss the questionnaire findings (Creswell 2009).

The study was designed in the way that most data were gathered with the questionnaire, which provided the main results. In that sense, the research design had a less-dominant qualitative component and a dominant quantitative component (Tashakkori & Teddlie 1998). The data gathering in this study was done in a sequential way as interviews were conducted first and questionnaire data were gathered afterwards (Creswell 2009). Data collection was conducted in several levels: qualitative data mainly derived from a group of key informants from different institutions (and from a few landowners), who provided information about the locals in Tromsø in general; quantitative data were taken only from landowners (Tashakkori & Teddlie 1998). To indicate the two levels (locals and landowners) that were studied the research questions (Chapter 1.6, p. 11) refer to both landowners and locals in Tromsø in general. In this thesis, the qualitative and quantitative results are presented and discussed together as the combination of all the methods helped to answer the research questions.

The difficulties to obtain legitimation (validity) in mixed methods - which means to what extent an issue that wants to be investigated was really captured - are to combine methods and results in a convincing and corroborative way (Bryman 2008; Onwuegbuzie & Johnson 2006). The legitimation can be impaired as the qualitative data were gathered from a small population and the quantitative data from a large population. The conclusions of the study could be different, if the qualitative sample was larger (Onwuegbuzie & Johnson 2006). But even though the sampled population for the interviews was small, key informants with a variety of different opinions towards Tromsøpalme were included into the study. In that way, both populations (local landowners and local key informants) gave complementary insight into issues around Tromsøpalme in Tromsø.

Legitimation might also be impacted by the fact that the group studied in the qualitative part (interviewees) were not part of the population who answered the questionnaire (landowners) (Onwuegbuzie & Johnson 2006); this means the conclusions/findings from the population of selected key informants were not necessarily applicable for the larger population of landowners. But the key informants were also asked questions regarding the landowners' points

of view and regulation behaviors. Therefore, it was assumed that the opinions and experiences of both landowners and key informants were overlapping in many instances. According to Onwuegbuzie and Johnson (2006), the sequential design of the study can also influence the legitimation. The results of the study might have been different if the order of the methods had been the other way round, namely, if the questionnaires had been developed and sent out first and then based on the results of the questionnaire, interviews with the key informants and landowners had been conducted.

2.4 Data collection

2.4.1 Collection of qualitative data

2.4.1.1 Key informant interviews

Qualitative semi-structured interviews with eleven key informants were conducted. The key informants should have considerable knowledge of the Tromsøpalme in Tromsø, and so they were selected purposively, as recommended by Marshall (1996). The key informants were selected by snow-ball sampling, which means that chosen key informants provided contact to more interviewees (Marshall 1996). A main criterion for sampling was that the key informants had worked with the plant in some way. Furthermore, it was important to get a range of different opinions, views, experiences, and factual knowledge concerning the plant.

Two employees of the Tromsø Municipality (Tromsø Kommune) were interviewed, as the municipality was responsible for managing the public green areas and roads in Tromsø. Furthermore, access was provided to two employees of the County Governor of Troms (Fylkesmannen i Troms) which represents the government in the county and is also responsible for environmental protection. Also, one officer of the Norwegian Public Road Administration NPRA (Statens Vegvesen) was interviewed. The department's responsibility is to mow the vegetation along sides of major roads in the county. This is where a substantial portion of Tromsøpalme resides (pers. obs.). Contact was established to a researcher at Tromsø University who had worked with Tromsøpalme for several years. An informant of a Norwegian environmental organization in Tromsø, the Green Warriors of Norway GWN (Norges Miljøvernforbund), was interviewed as this organization advises government authorities regarding issues of invasive species. Also, three artists at the Tromsø Arts Association (Tromsø Kunstforening) were contacted who planned an exhibition about Tromsøpalme in the following months. A local newspaper had published an article about a local Tromsøpalme enthusiast

whose values and normative beliefs about Tromsøpalme were not following mainstream perceptions; therefore this person was interviewed.

The interviews were mostly carried out at the key informants' workplaces, in a quiet environment. One was done in the office of the Forest and Landscape Institute in Tromsø. The interview language was English. The key informants had to agree to the informed consent and had to give permission that the interview was audio-recorded before the interview was conducted (see informed consent in Appendix 6.3.1, p. 111 and 6.3.2, p. 112). The interviews took between thirty minutes and one hour.

The interviews were semi-structured; some questions were prepared, however, unprepared questions were also asked as a reaction to the answers of the key informants (Bryman 2008). The key informants were asked specific questions depending on the informants' profession and knowledge of the plant. Questions for staff of the government authorities and the environmental organization emphasized: regulation measures on Tromsø Island towards Tromsøpalme, environmental impacts of the plant, health impacts, as well as distribution patterns and occurrence of Tromsøpalme on Tromsø Island. The interviews with the researcher and the Tromsøpalme enthusiast were mainly about biology and taxonomy of Tromsøpalme and other *Heracleum* species, as well as the history of introduction. Interview questions for the artists addressed specifically the symbolical and local importance of *H. laciniatum* and ways of using the plant. After asking the specific questions, all key informants were asked about locals' awareness and their evaluation of values of Tromsøpalme and about the public's normative beliefs towards a potential controlling of the plant in Tromsø. They were also asked how landowners in Tromsø deal with the plant on their parcels (see interview guide in Appendix 6.3.3, p. 113).

Selecting the key informants by snowball sampling had drawbacks. The sample was not taken randomly but from a small accessible group and was probably biased towards the world view of those key informants who provided most contacts for further informants. This means potential informants who were not known by the key informants might not be accessible for the study and so had a lower likelihood to be included into the sample (Bryman 2008; Faugier & Sargeant 1997). However, snowball sampling is the most appropriate method if the total study population is not known (Faugier & Sargeant 1997). Also, some participants might have more knowledge than others (Marshall 1996). Furthermore, when conducting qualitative methods the generalizability of findings is not as important as when conducting quantitative methods (Bryman 2008).

Also the way the interviews were conducted might have led to some bias. Both the interviewer and the interviewees communicated in a foreign language which resulted in occasional misunderstandings. However, most of these language-related problems were minimized by follow-up questions which clarified the issues. The order in which the questions were asked might have led to another problem. The first questions of the interviews were often about topics with potential negative connotations, such as the distribution and occurrence of *Tromsøpalme* on Tromsø Island and its ecological and health-related impacts. These topics might have impacted the answers to the following questions about values and normative beliefs towards the plant in that way that these aspects were also rather negatively evaluated by the key informants (Schwarz & Hippler 1995).

2.4.1.2 *Landowner conversations*

Unstructured conversations were carried out during the pre-testing of the questionnaire and the field visits of parcels with seventeen arbitrarily chosen landowners and three renters who were encountered outside of their house or were answering the door. The main purpose of these unstructured “chats” was to test the questionnaire (see interview guide in Appendix 6.3.4, p. 114). These conversations helped to understand how locals regarded *H. laciniatum* and how they dealt with it on their parcel. From these spontaneous conversations, only field notes were taken. Some of these conversations were conducted in English and some in Norwegian.

2.4.1.3 *Analysis of qualitative data*

Directly after the key informant interviews were held, the recordings of the interviews were transcribed literally into an English text. In both these texts (key informant interviews) and in the field notes (landowner conversations) different topics were identified by “descriptive coding” and “initial coding” (Saldana 2013: 87-105). These topics were factual information about *Tromsøpalme*, such as “regulation measures”, “biology”, “taxonomy”, “distribution and occurrence of *H. laciniatum* on Tromsø Island”, “impact on health and biodiversity”, and “history and cultural meaning”. Furthermore, the texts were analyzed regarding the topics “awareness of *Tromsøpalme*”, “values towards different aspects of *Tromsøpalme*”, and “normative beliefs towards *Tromsøpalme*’s regulation on Tromsø Island”. Values and normative beliefs were filtered out by identifying words the key informants used to express their own feelings and the general perception of the plant by the locals referred to as “values coding” (Saldana 2013: 110-115). All text modules that fell under the same topic were put

together to a new text document and analyzed together (for example how was the symbolical aspect of the plant interpreted by different participants, what opinions did different participants have regarding regulation measures).

The weakness of coding is that the original context of the data can get lost because the texts are split into modules which are put together differently. So, the researcher has to keep the original context in mind when interpreting the data (Bryman 2008). Furthermore, the conclusions that are drawn from the qualitative analysis tend to be subjective (Bryman 2008). The interviews were not analyzed in order to build a theory because this was not the aim of the study; instead the intention of the interviews was to select information (Miles & Huberman 1994). While the interviews were conducted and analyzed, the questionnaire was developed and the parcels and their owners (questionnaire respondents) were sampled.

2.4.2 Identifying the sampling frame and selecting respondents for the questionnaire

Using a case-control approach (Schlesselman 1982), two groups of private landowners were selected who received a mail questionnaire. The first group (case) included landowners on Tromsø Island who had Tromsøpalme on their parcel (Tromsøpalme was visible, TP-parcel) in the vegetation period 2012. The second group (control) consisted of the neighbors of these landowners who had no Tromsøpalme on their parcel (or regulated it so much that it was not visible, non-TP-parcel) in the vegetation period 2012. This was done to investigate how these two landowner groups differ in their values, normative beliefs, regulation behaviors, socio-demographic characteristics, and parcel characteristics.

For the sample, it was aimed for a more or less even distribution of parcels where Tromsøpalme was visible (TP-parcel) and not visible (non-TP-parcel). The plant was mapped with air photos but it turned out, as the plant was so widely spread in Tromsø, that many parcels which were identified as not having *H. laciniatum* (and were considered to be controls) in air photos, turned out to have it during field work (and appeared to be cases). This is called a “contaminated sampling scheme” if there is the danger that some controls are cases in case-control-studies (Lancaster & Imbens 1996: 145). Therefore, the classification of the parcels was done by using three methods: identifying and classifying the parcels into those with and without (visible) Tromsøpalme by using air photos and pictures from Google Maps[®] and Google Street View[®], then checking and adapting the classification of parcels by field visits,

and finally verifying the classification again by respondents' (landowners') information in the questionnaire.

The parcels and their landowners (questionnaire respondents) were identified in five steps:

- 1) Mapping Tromsøpalme by using air photos of Google Maps[®] and photos of Google Street View[®],
- 2) Classifying private parcels into parcels with visible Tromsøpalme and without visible Tromsøpalme in ArcGIS,
- 3) Verifying the classification of the private parcels during field visits,
- 4) Selecting landowners as questionnaire respondents,
- 5) Verifying the classification of parcels with questionnaire respondents' (landowners') answers.

In the following, these steps are described in more detail.

2.4.2.1 Mapping of Tromsøpalme by using air photos of Google Maps[®] and photos of Google Street View[®] (Step 1)

To identify parcels with Tromsøpalme, 1:5000 scale air photos from Google Maps[®] (date: August 2007) and ground-based photographs from Google Street View[®] (date: April and August 2010) were used. In the air photos in Google Maps[®], the plant stands were visible (from a height of 500 meters) due to the relatively unique color of the leaves. The leaves were a yellow/light shade of green which distinguished the plant from other vegetation. It was aimed to identify as many locations with Tromsøpalme on the whole island as possible (see Endnote #2, for a former study mapping Tromsøpalme on Tromsø Island, p. 153). The Google Street View[®] photos (taken in 2010, three years after the Google Maps[®] air photos) were used to check if plant stands near roads found in the air photos from 2007 were still present in 2010 (see Endnote #3 for more details about using Google Street View[®], p. 153). Using ESRI ArcGIS 10 software, the plant stands were drawn by hand on screen as a digital geographically-referenced polygon map layer on air photos of Tromsø Island, taken from an archive from the Norwegian Forest and Landscape Institute (Figure 10, p. 108).

2.4.2.2 *Classifying parcels with and without Tromsøpalme in ArcGIS® (Step 2)*

A cadastral map and an address file were obtained from the Norwegian Mapping authority (Kartverket). The Tromsøpalme polygon map layer was overlaid with the cadastral map containing all parcels on Tromsø Island. All parcels were linked to the address file containing the relevant address and the landowners' names. In that way, parcels with private owners could be extracted (see Endnote #4 for more information about selection criteria of parcels, p. 153). Finally, 202 private parcels (cases) that were identified by Google Maps® and Google Street View® as having one or more Tromsøpalme plants were classified as “TP-parcels” (see also definition in Endnote #1, p. 152).

The sampling of private parcels without visible Tromsøpalme (non-TP-parcels, control) followed a case-control approach which is often used in medical studies where households with a case of disease are sampled and compared to controls of neighboring households that do not have the disease (for example Agerbo et al. 2001; Schlesselman 1982). Also, ecological studies use case-control methods to determine habitat selection of species (for example Gillies et al. 2011). For each TP-parcel a neighboring non-TP-parcel as control was selected; this should result in the same number of TP-parcel (202 cases) and nearby non-TP-parcels (202 controls) in the final selection (Figure 4, p. 26), which is called “frequency matching” (Schlesselman 1982: 112). These “non-TP-parcels” included private parcels where the plant was not visible in Google Maps® and Google Street View® amongst others maybe because the plant might have never been there or the plant had just been cut before the air photos were taken.

Non-TP-parcels were chosen in a 20-meter radius around each of the selected TP-parcels by using a generator of random numbers in Microsoft Excel (for more detail, see Endnote #5, p. 154). By using a radius, only parcels nearby were chosen as controls which had a higher “risk” of invasion of the plant compared to parcels that were farther away; this is a so called nested case-control approach (Biesheuvel et al. 2008). Most of the parcels chosen for the study contained residences, yet some did not (see Endnote #6 for more information about selection of private parcels, p. 155).

Case-control sampling of parcels on Tromsø Island



0 100 200 400 Meters



Legend




-  Tromsøpalme seen in Google Maps/Google Street View
-  Private parcels with Tromsøpalme
-  Private parcels without Tromsøpalme

Figure 4: Case-control sampling of private parcels on Tromsø Island. Section of the map of Tromsø Island which shows the Southern area of the city center (Map source: Norwegian Forest and Landscape Institute). The map shows the status of classification of parcels with Tromsøpalme and without Tromsøpalme after ArcGIS classification according to Google Maps® and Google Street View® (step 2, p. 25). Mapped Tromsøpalme stands are shown in green. Parcels with Tromsøpalme (TP-parcel) are red (cases), parcels without Tromsøpalme (non-TP-parcel), chosen in a 20 m radius, are blue (controls). This map was used for field visits to verify the classification of the parcels.

2.4.2.3 *Reclassifying selected parcels during field visits (Step 3)*

After the selection of parcels in ArcGIS, fieldwork was conducted to check if the parcels were correctly categorized into TP-parcels (Tromsøpalme visible) and non-TP-parcels (Tromsøpalme not visible). This was done because the air photos and pictures used for the study were not up to date (as they were two to five years old) and because it was not known how many respondents of the questionnaire were aware of the plant on their parcel.

Some parcels were reclassified during field visits. If, for example, a parcel originally classified as not having Tromsøpalme, was found to have the plant via fieldwork (which was the case with 25%, $n=50$, $n_{\text{total}}=202$, of the non-TP-parcels), it was reclassified to a TP-parcel and two other non-TP parcels needed to be chosen in the field (see Figure 5, p. 28). Also, if a TP-parcel turned out to be a non-TP-parcel and was reclassified, two new TP-parcels needed to be found (which was the case with 14%, $n=28$, $n_{\text{total}}=202$, of the TP-parcels). In that way, the number of selected parcels in the sample had increased after field visits (from 404 to 453 parcels). In situations when both a TP-parcel and its neighboring non-TP parcel were wrongly classified, their classifications were just switched, but no new parcels were selected in that case.

It was not possible in the field to determine a 20 meters radius, as it was done in ArcGIS, and to fully inspect all nearby parcels from the road. Therefore, the new parcels that were chosen in the field were arbitrarily selected among those plots which were closest to the corresponding TP-parcel or non-TP-parcel. For these newly selected parcels it was clearly verifiable if Tromsøpalme could be seen on the plot or not.

For 45 parcels that were selected in ArcGIS, it was not possible to determine in the field if Tromsøpalme was on the parcel or not, for example if the parcel could not be viewed completely, or when Tromsøpalme was growing at parcel borders. These parcels were categorized as “unproven” and kept in the sample to maintain a larger sample size (percentage of unproven parcels among TP-parcels: 10.0%, $n=20$, $n_{\text{total}}=202$, among non-TP-parcels: 12.4%, $n=25$, $n_{\text{total}}=202$). But there were no new parcels selected in the field to replace those unproven parcels. Because some parcels were unproven, the number of cases and controls in the final sample was not even. The unproven parcels were classified later according to the landowners’ answers regarding the presence or absence of Tromsøpalme. After field work, the sampling of parcels was completed.

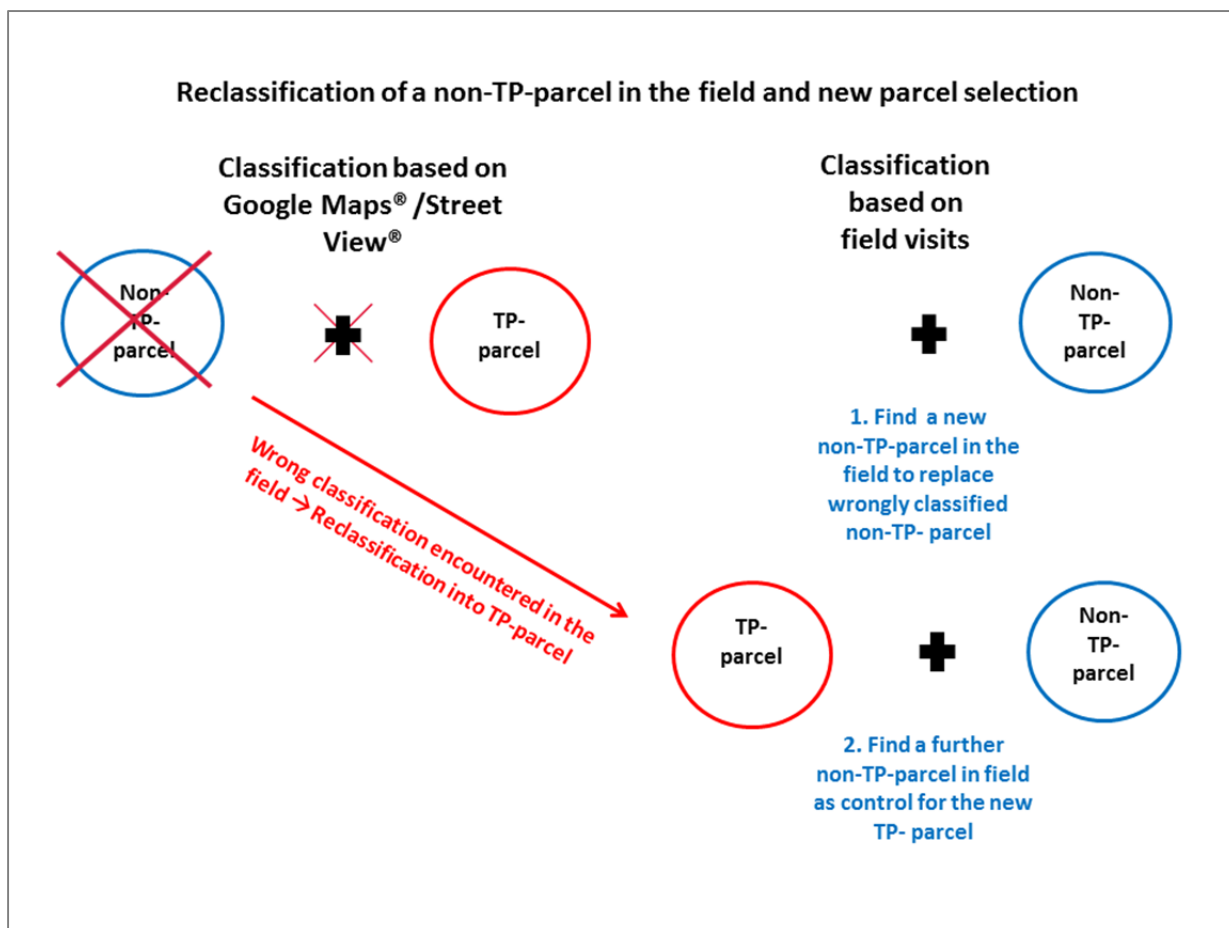


Figure 5: Example of a parcel pair (case-and control) consisting of a TP-parcel (Tromsøpalme visible in Google Maps® and Google Street View®, case) and a non-TP-parcel (Tromsøpalme not visible in Google Maps® and Google Street View®, control). According to field check of the parcel, the TP-parcel is correctly classified; however, the non-TP-parcel is wrongly classified. Therefore, latter is reclassified as a TP-parcel. In this situation, two new neighboring non-TP-parcels need to be selected in the field: 1) one non-TP-parcel close to the corresponding TP-parcel, to replace the wrongly classified non-TP-parcel, and 2) one non-TP-parcel close to wrongly classified non-TP parcel which has been reclassified to a TP-parcel to have (more or less) the same amount of TP-parcels and non-TP-parcels in the final sample. The same procedure is done if a wrongly classified TP-parcel is found.

2.4.2.4 Selection of questionnaire respondents (Step 4)

The parcel landowners' addresses were extracted from the address file and most of the landowners that were chosen as respondents were living in Tromsø (see Endnote #7 for selection of addressees, p. 155). Every respondent should only answer for one parcel, but some chosen respondents owned several parcels in the sample. If these parcels owned by one person were not neighboring parcels and could therefore not be combined into one parcel which the respondent could answer for, it was checked if there were alternative owners in the address file for these parcels. If that was not the case, the redundant parcels were removed from the sample (randomly) so that only one parcel was left for which the respondent was asked to answer the

questionnaire. This method led also to an uneven number of cases and controls in the final sample.

441 questionnaire respondents (landowners) were selected. From those, 193 respondents owned parcels with (visible) Tromsøpalme and 203 owned parcels without (visible) Tromsøpalme. For 45 respondents it was not clear at the time of sending out the questionnaire if Tromsøpalme grew on their parcel or not (unproven) (Table 2, p. 29).

Table 2: Number of selected parcels on Tromsø Island where Tromsøpalme was visible and not visible identified by Google Maps®, Google Street View®, and by field visits. Sometimes the plant grew on the border between two parcels or it was not possible to get a look into the parcels from the road. For these parcels it was not possible to determine if Tromsøpalme was on the plot or not (unproven). The questionnaire was sent to 441 landowners.

Parcel type	No. of parcels with (visible) Tromsøpalme	No. of parcels without (visible) Tromsøpalme	No. of unproven parcels	Total
Parcels with residence(s)	176	200	44	420
Parcels without residence(s)	17	3	1	21
Total	193	203	45	441

2.4.2.5 Verifying the classification of parcels with respondents' answers (Step 5)

The respondents' answers (which referred to the regulation status of Tromsøpalme between May and September 2012) were used to verify if the presence or absence of Tromsøpalme had been correctly identified by Google Maps®/Google Street View® and field work. 199 returned questionnaires were included into the statistical analyses (results of the respondents' answers regarding presence and absence of Tromsøpalme compared to the field classification can be seen in Endnote #8, p. 155). Regarding non-TP-parcels, more landowners reported to have Tromsøpalme on their parcel (between May and September 2012) than the author had observed in the field (47 parcels out of 95). From these 47 parcels, 43 were fully regulated according to the respondents (regulated so that it did not flower). So, these plants might not have been visible on the parcels because the plant had been cut at the time the field work was conducted.

A parcel was finally considered as having Tromsøpalme if either the author or the respondent indicated that the plant was on the parcel (as long as it was sure that the respondents had not confused Tromsøpalme with Sibirian hogweed which had been noted in the field). When the author had seen the plant on a parcel but the respondent had not, the parcel was nevertheless classified as having Tromsøpalme (see Endnote #9 for reasons why the respondents' answers were not considered, p. 156). When the presence or absence of the plant on the parcel was unproven, according to field visits, the respondents' answers were considered as valid. If the owner did not know if Tromsøpalme was on the parcel, the parcel was classified according to the observations in the field.

After adjusting the classification of the parcels with the help of the respondents' answers, 150 parcels were finally classified as TP-parcels and 48 parcels were classified as non-TP-parcels. Only for one parcel, the status of Tromsøpalme could not be clarified by any of the information sources (the parcel borders were unclear in Google Maps[®]/Google Street View[®], the parcel could not be accessed during field work, and the owner did not know if the plant was present or absent). If the respondents were aware of the presence of Tromsøpalme on their parcel, these parcels were classified into different regulation categories according to the respondents' answers (no regulation: Tromsøpalme was not regulated between May and September 2012, partly regulation: at least one plant flowered in that time period, full regulation: no plant flowered in that time period).

Although all three methods (mapping, fieldwork, and the respondents' answers) had their limitations (which are discussed in Endnote #10, p. 156), their combination helped to establish a relatively even distribution of parcels with different regulation degrees of Tromsøpalme, including parcels where the plant was absent: Google Maps[®] and Google Street View[®] helped to identify the parcels; fieldwork helped to correct the sample so that it included more parcels that were fully regulated or where Tromsøpalme was absent; finally, the questionnaire respondents' answers were useful to verify the classification of the parcels again, to attach different degrees of regulation of Tromsøpalme to the parcels, and to estimate the landowners' awareness of Tromsøpalme on their parcel.

2.4.3 Questionnaire

2.4.3.1 Development and administration

For sampling the landowners, a self-administered questionnaire was developed and sent out by mail (Appendix 6.4.3, p. 121; Appendix 6.4.4, p. 129). The door-to-door pretest of the questionnaire showed that approximately one in four landowners opened the door and from those every other landowner refused to participate, often because of lack of time. Therefore, it was thought that a mail questionnaire would be more suitable for this study than contacting the respondents personally. Furthermore, according to Williams (2003), mail-surveys are cost-efficient, because it is possible to reach a high amount of respondents in a large geographical area (even if only a fraction will answer) and respondents can stay anonymous. The latter was likely not a big issue in this questionnaire because the questions were not sensitive.

General recommendations about the layout and design of a questionnaire were obtained from Fowler (2009). The questionnaire used in this study was an eight-page brochure (size A5) and included 45 closed questions where the respondents could choose from a range of possible answers. In the multiple-answer questions there was an “others” option available where the respondents could write in. The questionnaire was created in English first and was translated into Norwegian afterwards.

The questions were developed based on the information received from the interviews with key informants and from conversations with landowners (see Chapter 2.4.1, p. 20-22), as well as from literature (for example Andreu et al. 2009; Fowler 2009; Nielsen et al. 2005; Steele et al. 2008; Williams 2003). The questionnaire dealt with: 1) parcel characteristics and the vegetation-covered area of the parcel; 2) awareness about Tromsøpalme and the presence/absence of Tromsøpalme on the respondent's parcel between May and September 2012; 3) regulation of Tromsøpalme on the parcel between May and September 2012; 4) evaluation of different values of Tromsøpalme: aesthetical value, health value, and symbolical value; 5) normative beliefs about the regulation of Tromsøpalme on Tromsø Island, justifications of normative beliefs; and 6) socio-demographic information of the respondents. One question concerning the source of the respondents' awareness of Tromsøpalme was derived from a study of Steele et al. (2008) who conducted a survey about forest landowners' awareness of invasive plants.

In the questionnaire, care was taken that the questions were not carrying any positive or negative connotations (as suggested by Fowler 2009). Based on the interviews with key informants from Tromsø Arts Association and Tromsø Municipality, it could be assumed that most of the landowners in Tromsø knew about the plant and had an opinion about it. Therefore, the questionnaire included many detailed questions about the plant. Nevertheless, the questionnaire also considered respondents who did not know the plant; they were encouraged to fill in any appropriate information they could provide. The questionnaire referred only to the vegetation period in 2012 (May to September) because the respondents were likely to remember that period best, and also may not have owned or lived on the parcel in the previous years. By providing a specific period, these answers also fit better to the field observation period.

The respondents were requested to refer to the whole parcel in their answers even if they only owned parts of it and shared it with other owners. All addresses associated with the parcel and the official property number of the parcel were written at the top of each questionnaire together with a respondent's ID-number. Parcels that did not have an address were indicated by their "use name" ("bruksnavn" in Norwegian) instead, which is an official designation of parcels in Norwegian law (Stadnamnlova §2c 1990). To avoid confusion, owners of parcels that had no residence and owners who had to answer for combined parcels (see Step 4 in Chapter 2.4.2.4, p. 28) additionally received a small map showing the borders and locations of the parcels. On the cover letter of the survey, a web link was provided to an online version of the survey which was given as an alternative option for the respondents. However, the online version of the survey was not tested on Tromsø landowners, only on willing volunteers to check if the operation of the online survey worked.

Landowners were visited at their homes in a pre-test - while the parcel classification was checked - and were asked to fill out the questionnaire. According to Williams (2003), this is necessary to find out if the questions and the layout are understandable, and to improve the validity of the questionnaire. Validity describes if the questions really measure the opinion of the respondent (Bryman 2008). To test the validity, as recommended by Williams (2003), immediately after the test-respondents filled out the questionnaire, the author asked these respondents (see also Chapter 2.4.1.2, p. 22) about the same topics in a modified formulation to see if the respondents' answers in the questionnaire fitted to their real opinion. The author also asked how respondents thought about the questionnaire. The questions for the landowners can be found in Chapter 6.3.4 (p. 114). In addition, the author checked the parcel to verify that the

landowners' questionnaire responses regarding Tromsøpalme's presence and absence and regulation degree were correct. According to the feedback of the test-respondents; the questionnaire was revised several times. The English version was tested on six landowners and on one renter and the Norwegian version was tested on eleven landowners and on two renters.

Finally, together with a cover letter (Appendix 6.4.1, p. 115; Appendix 6.4.2, p. 118) and a pre-paid envelope, the questionnaires were sent to 441 landowners twice. The first mailing was sent out in late December 2012 (during Christmas holidays); the reminder mail was sent six weeks later, in late January 2013, to those who had not yet responded. The response rate was 47% (201 questionnaires were sent back) and 199 questionnaires were included in the analysis (see Endnote #11 for the calculation of the response rate, p. 157). However, in many returned questionnaires not all of the questions were answered.

2.4.3.2 Limitations of a mail questionnaire

Mail surveys have several drawbacks in relation to how many respondents answer and which respondents answer relative to contacting the respondent personally at their homes or phoning them and asking them to fill out the questionnaire. For example, mail surveys have a larger rejection rate; research showed that even less than 50% of the questionnaires might return (Kaplowitz et al. 2004). Therefore, it is important to keep mail questionnaires as simple and short as possible (White et al. 2005). Furthermore, in mail surveys the researcher has also less control which respondents answer the questionnaire. Therefore, the sample of questionnaires which is sent back is more biased, due to self-selection by the respondents (Williams 2003). For instance higher educated and non-foreign respondents showed a higher response rate in mail surveys (Cartwright 1986) as well as respondents who have more time (Williams 2003). Also, respondents who are interested in these aspects (Groves et al. 2006), such as ecological issues and gardening might answer more frequently, as well as landowners that know about Tromsøpalme (see also Chapter 3.6, p. 85). A further drawback is that the researcher cannot help the respondents to figure out who is most appropriate to fill in the questionnaire (Williams 2003). Some selected respondents were not living on the parcels themselves or not even in Tromsø. It might be that in these cases, the renters who live on the parcel might know more about the issue.

Furthermore, in mail surveys the researcher has also less control over how the questionnaires are filled out. The respondents do not have the possibility to ask the researcher for help to interpret the questions (unless the respondents contacted the author whose email address and

telephone number were provided in the cover letter of the mail survey) (Williams 2003). Furthermore, when the researcher is not filling out the questionnaire for the respondents, the risk is high that respondents forget to answer some questions (Williams 2003). A general drawback in all forms of questionnaires is that there is a “social desirability bias” that respondents tend to answer in that way they think is appropriate (Ganster et al. 1983), for example indicate that Tromsøpalme was regulated, although it was not.

2.4.3.3 Statistical analysis

The questionnaire data, including information about parcels containing and not containing Tromsøpalme, were analyzed with the statistics program IBM SPSS Statistics 20 (all variables used in bivariate and multivariate analysis are listed in Table 3, p. 37-38). To address the research questions, univariate, bivariate and multivariate analyses were conducted. Univariate summary statistics were produced to understand the sampled population of respondents. In bivariate tests, the associations between different sets of variables were tested according to Figure 6 (p. 35). Bivariate statistics included socio-demographic variables and parcel characteristics (independent variables), values and normative beliefs (independent and outcome variables) and the regulation behavior (outcome variable) (different sets of variables, see Table 3, p. 37).

In bivariate analyses, for normal distributed continuous variables, t-tests (dependent variable has two levels) and ANOVAs (analysis of variance, dependent variable with more than two levels) were applied. For non-normal distributed continuous variables and ordinal variables, Mann-Whitney-U tests (dependent variable has two levels), and Kruskal-Wallis tests (dependent variable has more than two levels) were applied. When both independent and outcome variables were non-normal distributed continuous variables or ordinal variables, Spearman correlation was used. When both independent and outcome variables were independent, Chi-square tests for significance were used.

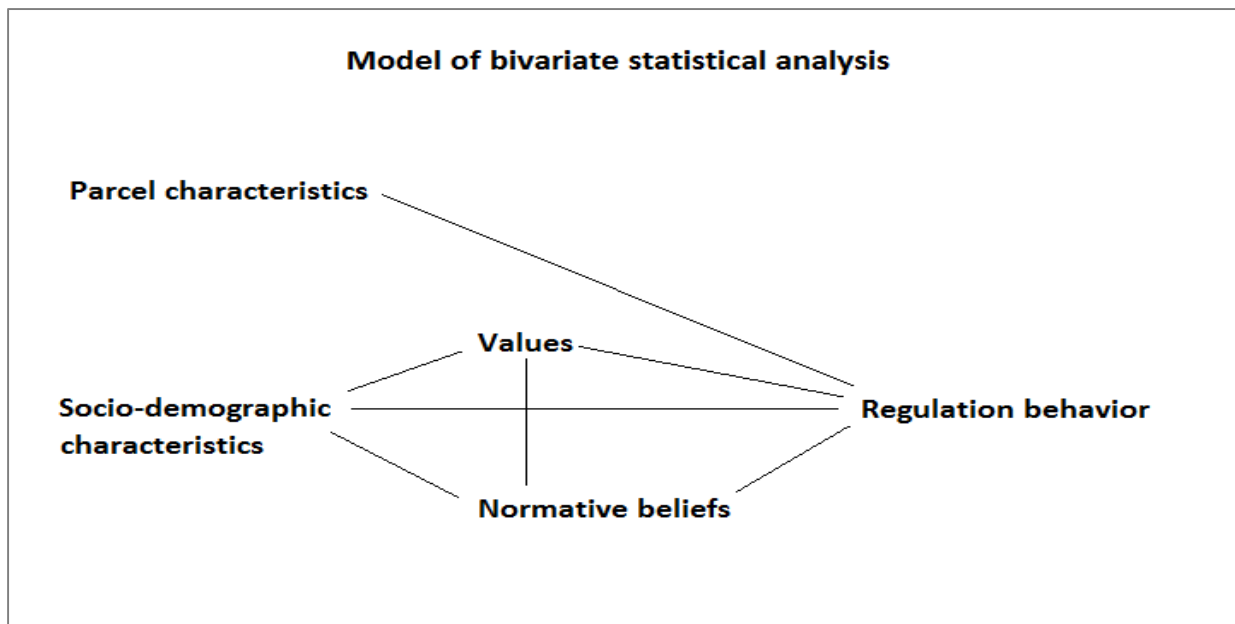


Figure 6: Model of bivariate statistical analyses (the lines symbolize the analyses of the associations between different sets of variables). To identify predictors for the regulation behavior also multivariate analyses (regressions) were conducted.

Logistic regressions (binary and multinomial) were used to determine which independent variables (values, normative beliefs, socio-demographic variables, and parcel characteristics) were associated most strongly with an outcome variable (regulation behavior) (Singh 2007). In multinomial logistic regression the categorical outcome variable can have more than two levels (Field 2009) which in this study was the regulation status of *Tromsøpalme* on the respondents' parcels between May and September 2012 (three levels: non-regulation, partial regulation, full regulation, see Endnote #1 for definitions of the different regulation levels, p. 152). In the binary logistic regression, the outcome variable is categorical and can only have two levels (Field 2009). In the binary regression, it was examined how parcels that contributed to the spread of *Tromsøpalme* (plant not or partly regulated) differed from parcels that did not (plant absent or fully regulated) (see also Endnote #12, p. 157).

While the multinomial regressions were carried out only with the parcels where the owners were aware of the presence of the plant on their parcels (and therefore could indicate the regulation degree), the binary regression analyses included the whole dataset of all parcels including the parcels where the plant was absent and the parcels whose owners were not aware of the presence of the plant on their parcels.

Four regression models were developed: two multinomial logistic regression models and two binary logistic regression models. One multinomial regression model (Model I, Table 9, p. 82)

included the independent variable “degree of tending vegetation area on the parcel” while the other (Model III, Table 21, p. 150) included the independent variable “residence status: owners lived on parcels vs. renters vs. no residence on parcels”. The two binary regression models each contained the same variables (Model II, Table 10, p. 83; Model IV, Table 22, p. 151).

Two models each were run because when both the variables “frequency of tending vegetation area” and “residence status” were included in the same model, the significances of the other variables were substantially reduced. This may be due to the relatively small sample size compared to the numbers of variables in the models. But according to field visits and literature (Fischer & Charnley 2012; Nielsen et al. 2005), the “frequency of tending vegetation area” and “residence status” seemed to have a considerable impact on the degree of regulation of Tromsøpalme. Therefore, these variables were seen as scientifically important and were kept in separate models. With these two variables as a starting point in the models, other significant variables were added (according to Tabachnick & Fidell 2013); these additional variables were (almost) the same in both versions of the models.

To identify outliers which affected the regression models, the Cook’s Distance, Leverage Values and Studentized Deleted Residuals for all four models were plotted in boxplots according to Field (2009). The Cook’s distance showed outliers in all four models, according to Pallant (2011) (see Endnote #13 for justification of outlier removal, p. 158).

Table 3: Type and attributes of variables that were used in bivariate and multivariate statistical analyses: socio-demographic characteristics of questionnaire respondents (landowners), parcel characteristics, values and normative beliefs of respondents, and regulation of Tromsøpalme on respondents' parcels. Variables that were used in binary logistic and multinomial logistic regression are indicated by an asterisk (*). The definitions of terms can be found in Endnote #1 (p. 152).

Socio-demographic characteristics of respondents	Type	Attribute
Age (<i>Question 39, p. 127</i>)	Continuous	Years
Gender (<i>Question 40, p. 127</i>)	Categorical	0: Male 1: Female
Education (<i>Question 41, p. 127</i>)	Categorical	0: Without higher education: completed elementary school or high school (≤ 13 years of education); 1: With higher education: university or polytechnic degree
Household Income in 2011 (<i>Question 45, p. 128</i>)	Ordinal	1: Less than 300,000 Norwegian kroner (NOK) 2: 300,000 – 450,000 NOK 3: 450,000 – 600,000 NOK 4: 600,000 – 1,000,000 NOK 5: More than 1,000,000 NOK
*Number of persons living in respondents' household (<i>Question 43, p. 128</i>)	Continuous	Number of persons
Residence time: years living in Tromsø (<i>Question 42, p. 127</i>)	Continuous	Years
Respondent experienced permanent injuries from Tromsøpalme and/or knew somebody who did (<i>Question 37 and 38, p. 127</i>)	Categorical	0: Having received permanent injuries and/or knowing somebody who did 1: Not having received permanent injuries and/or not knowing somebody who did
Parcel characteristics of respondents' parcels	Type	Attribute
*Residence status: owners living on parcels vs. only renters vs. no residence on parcels (<i>Question 6, p. 121; Question 9, p. 122</i>)	Categorical	0: Only renters lived on parcels (Reference category) 1: Owners lived on parcels 2: No residence on parcel
*Years of parcel ownership (<i>Question 3, p. 121</i>)	Continuous	Years
*Amount of households sharing parcel (<i>Question 14, p. 123, and data from address file, see Endnote #14, p. 159</i>)	Categorical	0: Several households were associated with the parcel (Reference category in binary regression) 1: One household was associated with the parcel (Reference category in multinomial regression)
Presence of children (under 10 years) on parcels with residence (<i>Question 11, p. 122</i>)	Categorical	0: Yes 1: No
*Frequency of tending vegetation-covered area on parcel between May – September 2012 (for example mowing, cutting hedges, weeding) (<i>Question 16, p. 123</i>)	Ordinal (analyzed as continuous variable)	1: Never 2: Less than once per month 3: Once per month 4: Several times per month 5: Once per week 6: Several times per week

<i>Evaluation of values and normative beliefs by respondents</i>	Type	Attribute
Aesthetical value: Appearance of Tromsøpalme (Question 31, p. 126)	Ordinal (analyzed as continuous variable)	1: Ugly 2 3: Neutral 4 5: Nice
Health value: Health impact of Tromsøpalme (Question 30, p. 126)	Ordinal (analyzed as continuous variable)	1: Positive impact 2 3: Neutral 4 5: Negative impact
Symbolical value: Symbolic importance of Tromsøpalme for Tromsø (Question 32, p. 126)	Ordinal (analyzed as continuous variable)	1: Not important 2 3: Neutral 4 5: Very important
*Normative belief of occurrence of Tromsøpalme on Tromsø Island (Question 34, p. 126)	Ordinal (analyzed as continuous variable)	1: Do not perceive Tromsøpalme as a problem on Tromsø Island 2 3 4 5: Perceive Tromsøpalme as a problem on Tromsø Island
*Normative belief of necessity of regulation measures (done by institutions) against Tromsøpalme on Tromsø Island (Question 33, p. 126)	Ordinal (analyzed as continuous variable)	1: Not necessary 2 3: Neutral 4 5: Necessary
Normative belief of degree Tromsøpalme should be removed (by institutions) on Tromsø Island (Question 35a and 36a, p. 126 - 127)	Cate- gorical	1: No removal of Tromsøpalme on Tromsø Island at all 2: Partial removal of Tromsøpalme (from some areas) 3: Full removal of Tromsøpalme
<i>Regulation of Tromsøpalme on respondents' parcel between May-September 2012</i>	Type	Attribute
*Degree of regulation of Tromsøpalme on respondents' parcels between May- September 2012 (Question 22, p. 124) (Regulation includes amongst others cutting, mowing, weeding, grazing, digging, use of herbicides, oil, salt, etc.)	Cate- gorical	0: No regulation, Tromsøpalme grew freely on the parcels (Reference category) 1: Partial regulation, Tromsøpalme was regulated but at least one plant was flowering on the parcels 2: Full regulation; Tromsøpalme was regulated so that no plant was flowering on the parcels
*Parcels' contribution to Tromsøpalme's spread between May and September 2012 (Question 19, p. 123 and Question 22, p. 124 + field visits)	Cate- gorical	0: Tromsøpalme was partly or not regulated on the parcels (see above) (Reference category) 1: Tromsøpalme was absent or fully regulated on parcels (see above)

3 Results and discussion

This chapter presents and discusses the landowners'/locals' awareness of Tromsøpalme and their evaluation of Tromsøpalme's values. Furthermore, it deals with the landowners'/locals' view on Tromsøpalme's regulation by local institutions on Tromsø Island (normative beliefs). Finally, this chapter deals with the landowners' regulation behaviors on their own parcels between May and September 2012 (definition regulation: see Endnote #1, p. 152). The results of the questionnaires, interviews with key informants, landowner conversations, field observations, and literature are presented and discussed together. All these results complement each other and therefore are not separated. Finally, bias in the questionnaire design and analysis are discussed.

3.1 Characteristics of the questionnaire respondents and their parcels

In the following, the socio-demographic variables of the questionnaire respondents and the characteristics of their parcels are summarized (for ordinal and continuous variables, see Table 4, p. 41; for categorical variables, see Table 5, p. 42-44). Although the total number of questionnaires used in this analysis was 199, some respondents did not answer all the questions. Therefore, the total number of the samples was different for each variable.

Concerning the socio-demographic characteristics of the sample of questionnaire respondents, the average age of the respondents was 58 years ($n_{\text{total}}=194$). There were as many female as male respondents (50.0%, $n=96$, $n_{\text{total}}=192$). More than two thirds of the respondents had graduated from university or polytechnic (69.4%, $n=134$, $n_{\text{total}}=193$). The median of the respondents' household incomes was between 600,001 and 1,000,000 Norwegian Kroner in 2011 ($n_{\text{total}}=146$), one year before the study was carried out. The average number of people living in the respondents' households was 2.69 (including the respondent) ($n_{\text{total}}=194$). The average time the respondents had lived in Tromsø was 41 years ($n_{\text{total}}=196$). Approximately one fifth of the respondents had received (and/or knew about someone who received) permanent injuries from contact with Tromsøpalme (19.5%, $n=38$, $n_{\text{total}}=195$).

Regarding parcel characteristics, almost all the respondents were owners of the parcel; only one respondent was a renter/leaseholder. Therefore, in the following text, the word "landowner" is used as a synonym for respondent. According to the respondents' information, 83.3% ($n=160$, $n_{\text{total}}=191$) of the parcels were inhabited by owners (in some cases together with

renters/leaseholders), but on a tenth of the parcels (9.9%, n=19) only renters/leaseholders (in the following only referred to as renters) lived. 6.3% (n=12) of the parcels had no residence. The average amount of years the respondent owned (and in one case rented) the parcel was approximately 22 years ($n_{\text{total}}=192$). Children (under 10 years) were living on almost a fourth of the parcels with a residence (23.5%, n=42, $n_{\text{total}}=179$). Approximately two thirds of the parcels were associated with one household (65.8%, n=125, $n_{\text{total}}=190$); one third of the plots were shared by several households (34.2%, n=65). The median of the frequency of tending of the vegetation-covered area between May and September 2012 on the parcel (for example cutting hedges, mowing, weeding) was once per month ($n_{\text{total}}=192$). Six of the 199 answered questionnaires had been addressed to owners who were not living in Tromsø themselves (however it was not known if the actual person who had answered the questionnaire lived in Tromsø or somewhere else).

Table 4: Important ordinal and continuous variables used in the study: respondents' (landowners') socio-demographic characteristics, parcel characteristics, values, and normative beliefs. The total amount of respondents included into the study was 199, but the total number of samples varies for each variable because of non-answered questions. The attributes of the ordinal variables are listed in Table 3 (p. 37).

Variable	Min	Max	Mean	Median	Standard deviation	n (total)
Socio-demographic variables:						
Age (years)	20	93	57.16	59	14.715	194
Household incomes in 2011	1	5	3.64	4.0	1.179	146
Number of persons living in respondents' households	1	14	2.69	2.0	1.519	194
Years respondents lived in Tromsø (Residence time)	0	85	40.91	40	19.317	196
Parcel characteristics:						
Years of parcel ownership	1	96	21.58	18.0	16.003	192
Frequency of tending vegetation-covered area on the parcels (for example cutting hedges, mowing, weeding)	1	6	3.97	4.0	1.463	192
Evaluation of values and normative beliefs:						
Aesthetical value (appearance) of Tromsøpalme	1	5	3.19	3.0	1.351	195
Health value (health impact) of Tromsøpalme	2	5	3.62	3.0	0.766	195
Symbolical value (symbolical importance) of Tromsøpalme for Tromsø	1	5	2.8	3.0	1.415	194
Occurrence of Tromsøpalme on Tromsø Island	1	5	3.66	4.0	1.170	195
Necessity of control measures against Tromsøpalme on Tromsø Island	1	5	4.25	5.0	1.020	194

Table 5: Important categorical variables used in the study: respondents' (landowners') socio-demographic characteristics, parcel characteristics, normative beliefs and regulation behaviors. The total amount of respondents included into the study was 199, but the total number of samples varies within each variable because of non-answered questions.

	Variable	Proportion (%)	n	n (total)
Socio-demographic characteristics	Gender			192
	Male	50.0	96	
	Female	50.0	96	
	Education			193
	Without higher education (fulfilled elementary school/highschool)	30.6	59	
	With higher education (fulfilled university/polytechnical highschool)	69.4	134	
	Permanent injuries			195
Experiencing permanent injuries or knowing somebody personally who did	19.5	38		
Not experiencing permanent injuries or not knowing somebody personally who did	80.5	157		
Parcel characteristics	Respondent status			199
	Respondent was owner	99.5	198	
	Respondent was renter/leaseholder	0.5	1	
	Residence status			191
	Owners (in some cases with renters) lived on parcels	83.8	160	
	Only renters lived on parcels	9.9	19	
	No residence on parcels	6.3	12	
	Children (under 10 years) present on parcels with residence			179
	Yes	23.5	42	
	No	76.5	137	

	Variable	Proportion (%)	n	n (total)
Parcel characteristics	Amount of households associated with parcels			190
	Parcel associated with single households	65.8	125	
	Parcel associated with several households	34.2	65	
Awareness	Respondents had heard about Tromsøpalme (knew what it is)			199
	Yes	99.5	198*	
	No	0.5	1	
	Respondents' awareness of Tromsøpalme on their parcels			199
	Respondents aware about the presence and absence of Tromsøpalme on their parcels	92.5	184	
	Respondents not aware about presence or absence of Tromsøpalme on their parcels	7.5	15	
Normative belief	Degree Tromsøpalme should be removed (by local authorities) on Tromsø Island			182
	Full removal (eradication)	33.0	60	
	Partial removal (from some areas)	64.3	117	
	No removal anywhere	2.7	5	
Regulation behavior	Change of amount of Tromsøpalme on the respondents' parcels from the first regulation ever done, until 2012 (answered by respondents that partly or fully regulated Tromsøpalme)			108
	Amount had decreased	56.5	61	
	Amount had not changed	25.9	28	
	Amount had increased	17.6	19	

	Variable	Proportion (%)	n	n (total)
Regulation behavior	Regulation degree on parcels between May and September 2012 (<i>outcome variable for multinomial logistic regression</i>)			140**
	Full regulation (so that no plant flowered on the parcel)	44.3	62	
	Partial regulation (at least one plant flowered on the parcel)	35.7	50	
	No regulation (there were no measures against Tromsøpalme in that period)	20.0	28	
	Contribution of parcels to Tromsøpalme's spread between May and September 2012 (<i>outcome variable for binary logistic regression</i>)			198***
	Plant fully regulated or absent	55.6	110	
	Plant partly or not regulated	44.4	88	

*Only 191 respondents answered "yes" regarding this question. Seven respondents forgot to answer this question but they were still considered being aware of Tromsøpalme because they were answering the subsequent questions about the plant in the questionnaire.

**The multinomial logistic regression analyses included only parcels from those landowners who knew that they had Tromsøpalme on their parcel between May and September 2012.

***For one parcel, the status of Tromsøpalme on the parcel was not known, therefore the binary regression included 198 parcels instead of 199. The binary logistic regression included the whole dataset. Endnote #12 (p. 157) shows which parcels were categorized into the group of parcels where Tromsøpalme was partly or not regulated and into the group where Tromsøpalme was absent or fully regulated.

3.2 Landowners'/locals' awareness of Tromsøpalme

This section describes and discusses locals'/landowners' awareness of Tromsøpalme (Question 17, p. 123). One respondent commented in the questionnaire: "*Everybody knows what a Tromsøpalme is, at least people from Tromsø!*" and in fact all the respondents had heard about Tromsøpalme except for one (Table 5, p. 43). Seven respondents forgot to answer the question, but it is assumed that they knew about Tromsøpalme because they answered the subsequent questions about the plant. But it has to be kept in mind that probably landowners who did not know the plant tended not to answer the questionnaire even though they were encouraged to do so, so this result might be biased. Also Alm (2013) found that the awareness among the locals in Tromsø towards Tromsøpalme was very high.

Newspapers and magazines were the most frequently mentioned sources of information among those landowners who had heard of Tromsøpalme (51.3%, n= 98, n_{total}=191, see Figure 7, p. 46, Question 18, p. 123). One key informant from the Tromsø Municipality stated that most of the locals were well informed about Tromsøpalme by the municipality: namely that it is an introduced plant and that it has negative impacts on biodiversity and on health. Furthermore, landowners were informed about how to remove Tromsøpalme from the property and about the health problems caused by the plant. This information is published by the municipality on its homepage (Tromsø Municipality 2010) and regularly in local newspapers. Additionally, Tromsøpalme had been a favorite topic of local newspapers with stories about landowners who tried to remove the plant or received skin injuries from contact with the plant (for example Alexandersen 2012; Hansen 2011). Also, Tromsø University published a magazine about the origin of the plant and its introduction to Tromsø (Alm et al. 2006). As a consequence of these measures, citizens in Tromsø are well informed about Tromsøpalme and the problems involved. It has been shown that information efforts from official institutions can result in a high public awareness towards invasive species (Garcia-Llorente et al. 2008).

Key informants from the NPRA and the Tromsø Arts Association stated that they learned as children from their parents about the plant and its health risk. The questionnaire respondents mentioned parents and relatives (46.2%, n=92, see Figure 7, p. 46) as the second most frequent information source, followed by friends and neighbors (41.2%, n=82). Key informants from Tromsø University, from NPRA, and landowners who were encountered in the field mentioned also that many locals who grew up in Tromsø probably had experience with the plant since childhood. A questionnaire respondent wrote into the questionnaire that s/he liked to play “hide-and-peek” in the “Tromsøpalme-jungles”. Alm (2013) reported about various ways in which children in Tromsø played with Tromsøpalme, for example, they used the hollow stems as blowing pipes and toy weapons. Even though this was not given as an option in the survey, a considerable number of respondents reported to have grown up with the plant being around (12.1%, n=24) and indicated this as their way of learning about the plant. Probably, more landowners would have indicated this aspect in the questionnaire if it had been an answer option. The plant is part of the locals’/landowners’ every day experience and therefore something they know about and are used to, which is also specified by the key informant from the Tromsø Arts Association: “[Tromsøpalme] *has such a presence in the cityscape, it is our daily environment [...]. Not everybody has that much to say about [Tromsøpalme], but I think everybody has an opinion about it.*”

Landowners were asked in the survey if Tromsøpalme was on their land or not between May and September 2012 (Question 19, p. 123). Nine respondents did not know if Tromsøpalme was on their plot or not, including the landowner who had never heard about the plant. Six landowners reported not having the plant on their plot even though in field visits the author saw that it was there. In total there were 15 respondents out of 199 (7.5%) who were not aware of the plant on their parcel (Table 5, p. 43). So, a relatively high percentage of landowners on Tromsø Island were aware of the presence or absence of Tromsøpalme on their parcel.

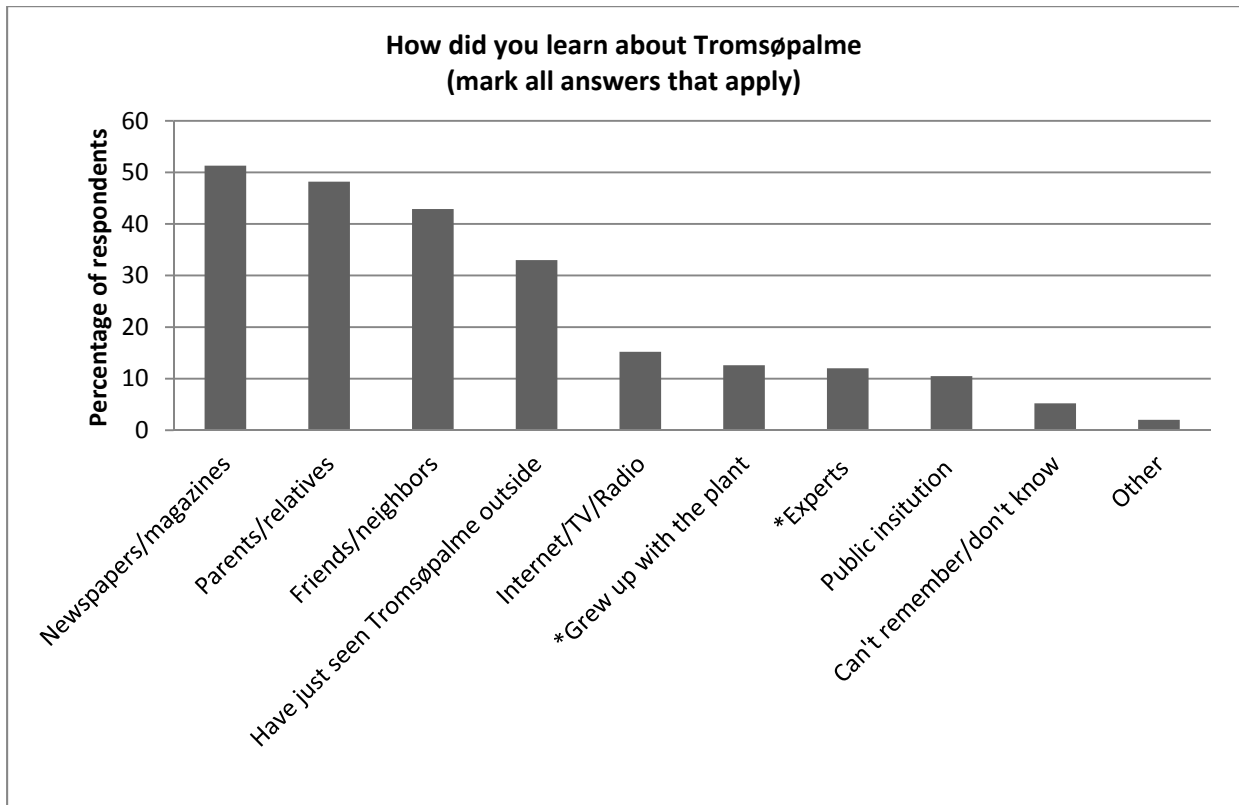


Figure 7: Sources of awareness of Tromsøpalme indicated by the respondents (n=191). *The option “grew up with the plant” was created after a considerable amount of respondents mentioned this as their way of learning about the plant in the “others” option of the questionnaire. *Experts refer to for example employees from authorities, the Tromsø University, the botanical garden in Tromsø, and environmental organizations like GWN (Question 18, p. 123).

Past studies dealt with the awareness of landowners, namely if landowners knew about invasive plants. They found that awareness translates into regulation measures against invasive plants (Daab & Flint 2010; Fischer & Charnley 2012). However in these studies, the invasive plants were not as well-known among the respondents as Tromsøpalme was known among landowners in the study on hand, in which all the respondents knew the plant (except for one). Therefore, in this study on hand there was no difference in the awareness which could have

been used as a variable to measure its contribution to values, normative beliefs, and regulation behaviors.

According to an literature review by Kollmuss and Agyeman (2002), more awareness (in their paper referred to as “knowledge”) about environmental issues does not necessarily lead to more environmentally friendly behavior, however it could have an indirect influence. In a further study, different degrees of landowners’ awareness of Tromsøpalme could be measured, for example, what landowners know about the ecological and health impacts of *H. laciniatum* and if they know how to conduct regulation measures correctly. Furthermore, it could be examined how the awareness about different aspects of Tromsøpalme can influence landowners’ values, normative beliefs, and regulation behaviors.

3.3 Landowners’/locals’ perceptions of Tromsøpalme

The perception, namely the evaluation of values and normative beliefs towards Tromsøpalme and its regulation on Tromsø Island were investigated and how different socio-demographic variables determined these variables in bivariate analyses. Furthermore, it was studied how values and normative beliefs were related to each other in bivariate analyses. In the questionnaire, the respondents had to evaluate the values and normative beliefs on a 5-point Likert-scale (see Questionnaire, p. 126). The descriptive statistics of values and normative beliefs are listed in Table 4 (p. 41) and Table 5 (p. 42).

3.3.1 Values concerning Tromsøpalme

The questionnaire asked the landowners about their evaluation of three values of Tromsøpalme: aesthetical value (appearance: ugly or nice, Question 31, p. 126), health value (good for health vs. dangerous, Question 30, p. 126), and symbolical value (importance as a symbol of Tromsø: important or not important, Question 32, p. 126). These attributes of Tromsøpalme were extracted as important values from key informant interviews and landowner conversations. Furthermore, studies showed that aesthetical and symbolical aspects as well as health issues can influence normative beliefs about how invasive species and wildlife in general should be managed (Aitken et al. 2009; Kellert 1996; Loker et al. 1999; Schüttler et al. 2011; van Wilgen 2012).

3.3.1.1 Evaluation of aesthetical value (appearance) of Tromsøpalme and its association with socio-demographic variables

The decorative and exotic look of the plant was the main reason why Tromsøpalme was introduced to Tromsø (Alm 2013). Almost half of the respondents thought Tromsøpalme looked nice (46.7%, $n=91$, $n_{total}=195$), while more than a quarter considered it as ugly (29.2%, $n=57$), and the rest considered the plant to be neither nice nor ugly (24.1%, $n=47$). This shows that more landowners regarded the plant as nice rather than ugly (median=3; mean=3.19; 1: ugly, 3: neutral, 5: nice; Table 4, p. 41). The words that were used by key informants regarding Tromsøpalme's appearance ranged from negative to positive ("disgusting", "massive", "exotic", "nice" and "beautiful"). However, these evaluations were not found to be dependent on the professional affiliation of the key informants.

Association between the aesthetical value and socio-demographic values were found. Women significantly tended to evaluate the appearance of the plant more positively than men (Mann-Whitney-U test: $p<0.001$, Table 13, p. 143). Also, the factor of time seems to play a role in evaluating the plant's appearance. There was a significant association between a positive evaluation of the plant's appearance and older respondents (Spearman correlation: $p<0.001$, Spearman's $r=0.30$), respondents with a longer period of ownership (Spearman correlation: $p<0.001$, Spearman's $r=0.29$), and respondents living in Tromsø for a longer time (Spearman correlation: $p=0.001$, Spearman's $r=0.23$).

This association could be explained by the fact that these landowners might have grown up at a time when the plant was still seen as a decorative garden plant. Meanwhile the "taste" has changed and Tromsøpalme is not perceived as a fashionable garden plant anymore, according to a key informant from Tromsø University and Tromsø Municipality. This change of the perception could be related to the increasing public concern about Tromsøpalme's ecological impacts which developed, according to key informants from Troms County Governor and GWN, since the end of the 1990s (see Chapter 1.1.2, p. 5). Also only one respondent indicated that Tromsøpalme was planted on his or her parcel (0.9%, $n_{total}=122$) regarding the question how Tromsøpalme had ended up on the landowners' parcels (mark all answers that apply, Question 21, p. 124). However, there might be exceptions, as one key informant from NPRA reported about a landowner who recently planted Tromsøpalme. Also Alm (2013) indicated that at some graveyards in Troms County, Tromsøpalme had been planted around the year 2007. Also, it is possible that more respondents had planted Tromsøpalme but thought they

should not have indicated this in the questionnaire (social desirability bias, according to Ganster et al. 1983). The study also showed that over a fourth of landowners who were not or only partly regulating Tromsøpalme still tolerated it on their plot (even if they had not planted it) because they thought it is nice (see Chapter 3.5.2, p. 71).

3.3.1.2 Evaluation of the health value (health impact) of Tromsøpalme and its association with socio-demographic variables

As mentioned in Chapter 1.2 (p. 6), Tromsøpalme has a phototoxic sap that in combination with UV-radiation leads to injuries and/or allergic reactions (Kavli & Volden 1984). Half of the respondents ranked the health impact of Tromsøpalme neither as positive nor as negative (neutral: 52.3%, n= 102, n_{total}=195) while the other half ranked it as dangerous (46.7%, n=91). Two respondents thought the plant was good for health (1.0%). The reason for the positive evaluation of the health impact might be that a closely related *Heracleum* species, Persian hogweed, is used for medication in Iran (Hemati et al. 2010). However, more respondents considered the plant to have a bad influence on health, relative to the respondents who considered it to have a positive influence (median=3; mean=3.62; 1: good for health, 3: neutral, 5: dangerous; see Table 4, p. 41).

Two key informants (NPRA and Tromsø Arts Association) and two landowners, who were met during the questionnaire pre-test, talked about allergic reactions when they came in contact with the plant. In the questionnaire a respondent reported a permanent wound. The newspapers published an article about a landowner mowing the plant on a sunny day without wearing a T-shirt. After he had taken a sun bath, he found burns on his skin where the sap had been sprayed during the work (Alexandersen 2012). Also Kavli et al. (1983b) reported an incident of a child playing in the Tromsøpalme stands and a gardener who was weeding during a sunny day. Both wore shorts and received blisters from contact with Tromsøpalme and the injuries remained visible for several months (hyperpigmentation). In this study, nineteen percent (19.5%, n=38, n_{total}=195) of the questionnaire respondents reported to have experienced (or to know someone who experienced) permanent injuries from getting in contact with Tromsøpalme (the formulation “permanent injuries” in the questionnaire probably might have led to confusion, which is discussed in Chapter 3.6, p. 85). In the following, “experiencing permanent injuries” will refer to as both having experienced permanent injuries and/or knowing about somebody who did.

The majority of the questionnaire respondents considered the plant neither as dangerous nor as good for health. Also, the key informants from Tromsø University and from the GWN saw the health impact of *H. laciniatum* as a minor problem compared to the ecological impacts of Tromsøpalme. According to the key informant from Tromsø University, the risk of getting burns is reduced in Tromsø due to lower temperatures compared to Southern Norway or other areas in Europe. Cooler summers induce locals to wear clothes that cover most of their skin. Additionally, even if the sap gets in contact with the skin, more cloudy summers with less UV-radiation lead to a lower risk of receiving injuries in Tromsø. Furthermore, Tromsøpalme might be not as noxious as Giant hogweed (Alm 2013), which is more common in South Norway (Fremstad & Elven 2006) and the rest of Europe (Nielsen et al. 2005).

Among the questionnaire respondents, there was a significant association between the experience of permanent injuries and considering Tromsøpalme as dangerous to health (Mann-Whitney-U test: $p=0.021$, Table 12, p. 142). Another study showed as well that negative experience with wildlife (deer) leads to more concern about problems related to wildlife (Loker et al. 1999). There were no significant (at the $\alpha=0.1$ level) differences between men and women or between landowners with and without children (in the Mann-Whitney-U test) concerning the evaluation of the health impact. However, a key informant from the Tromsø Municipality assumed that there might be a connection between locals having children and worrying about Tromsøpalme's health impact. Also in a study from Zinn and Pierce (2002) it was shown that women and respondents with children tended to have greater concern about potentially dangerous wildlife (mountain lions) near a residence zone, compared to men and respondents without children. However, in this study on hand, children lived only on a fourth of the parcels with a residence; so the sample size was relatively small (23.5%, $n=42$, $n_{\text{total}}=179$). Furthermore, the respondents needed to answer for the whole parcel and the answer might be different depending on if the parents answered the questionnaire or if their neighbors without children (who lived on the same parcel) answered (and indicated that their neighbors have a child).

3.3.1.3 Evaluation of the symbolical value (importance as a symbol) of Tromsøpalme for Tromsø and its association with socio-demographic variables

As mentioned in Chapter 1.3 (p. 7), Tromsøpalme is used as a symbol of Tromsø. Tromsøpalme is embroidered on the local folk costume; in Tromsø, pictures of the plant are used in local logos, on photos and on postcards (Alm 2013). The questionnaire showed that about a third of the respondents rated Tromsøpalme to be important as a symbol for Tromsø (36.6%, n=71, n_{total}=194). However, a somewhat larger percentage of the respondents did not consider the plant as a symbol (39.7%, n=77), while the rest did not have any opinion on this issue (23.7%, n=46). Overall, a slightly higher percentage of respondents thought that Tromsøpalme is not important as a symbol of Tromsø, compared to the percentage that considered it to be important as a symbol (median=3; mean=2.8, 1: not important, 3: neutral, 5: important; see Table 4, p. 41).

The fact that a non-native plant is seen as a local symbol by around a third of the respondents is remarkable. This could be related to the fact that despite information campaigns a few locals still might consider Tromsøpalme as a native and local plant according to key informants (Tromsø Tromsø Arts Association and GWN). Regarding Tromsøpalme, the long time period the plant has been in Tromsø (more than 150 years) might be an important reason why some locals accept Tromsøpalme as a natural part of the local vegetation and the landscape. Garcia-Llorente et al. (2008) found in their study that most respondents identified species as alien which were introduced to Spain at the end of the 20th century, while fewer respondents perceived those species as alien which were introduced to Spain at the beginning of the 20th century or earlier. Furthermore, in cities there is an high occurrence of numerous alien species which invaded there or were planted there (Pyšek 1998). As a consequence, city inhabitants might be more used to see exotic species and might consider them to belong to this area. Therefore, city inhabitants might have a different idea about what is local nature than inhabitants of rural areas and nature conservationists (Rotherham & Lambert 2011; Staples 2001).

The key informants from the Tromsø Arts Association and GWN also mentioned that some locals consider the plant even then as a part of Tromsø, when they actually know that the plant naturally does not belong to Tromsø. Schüttler et al. (2011) assume that the longer invasive species exist at a place, the higher the chances that these species receive special values, such as a symbolical meaning and local importance.

Key informant interviews showed that specific aspects of Tromsø could be represented by the plant. For example, for a key informant of the Tromsø Arts Association, the plant represented the beginning of the industrialization of Northern Norway when Tromsøpalme was cultivated in the gardens of rich families who owned the mines. Furthermore, for this key informant, the plant represents an alternative attitude towards the regulation of green areas in cities. This key informant favored Tromsø's relatively insufficient green space management which lets vegetation - including Tromsøpalme - grow out of ditches and holes in the asphalt, unlike the management in other European cities where green areas are managed more thoroughly. Tromsøpalme's growth was especially important for this key informant because the "explosive vegetation growth" of the urban alien vegetation contrasts the generally sparse plant growth in the subarctic.

Locals might base their evaluation of Tromsøpalme's local importance also on crucial experiences with the plant in Tromsø. A key informant of the Troms County Governor reported that she could still remember the first time when she came to Tromsø and how impressed she was by the size of Tromsøpalme relative to the other vegetation. Today, the plant's anise smell still reminds her of her first years living in Tromsø. Furthermore, some locals may connect the plant with the time when they grew up in this place and played exciting games in the plant stands (Alm 2013), which had also been mentioned in Chapter 3.2 (p. 45). So, all these individual aspects might indicate why the locals might accept the plant as a part of Tromsø and their life and why they can identify themselves with the plant.

Especially women (Mann-Whitney-U test: $p=0.009$, Table 13, p. 143) and respondents with higher education (Mann-Whitney-U test: $p=0.019$, Table 12, p. 142) significantly tended to consider Tromsøpalme as having a symbolic importance for Tromsø, according to the questionnaire analyses. These results might be explainable by a study of Vaske et al. (2001) who investigated how socio-demographic characteristics played a role in Colorado state residents' value orientations towards forest management. Vaske et al. (2001) used the concept of anthropocentric and ecocentric (biocentric) values from Thompson and Barton (1994). An ecocentric value orientation puts nature into the focus of perception and assumes that nature has a value in itself (intrinsic value) (Thompson & Barton 1994), for example: "*forests have as much right to exist as people*" (Vaske et al. 2001: 768). The anthropocentric viewpoint is human-centered and sees nature's value of existence depending on its material use for humans (Thompson & Barton 1994), such as "*forests are valuable if they produce jobs and income for people*" (Vaske et al. 2001: 768). Vaske et al. (2001) found that women, respondents with

higher education, and respondents with a shorter residence time in Colorado tend to have an ecocentric value orientation (Table 6, p. 60).

Similar to the ecocentric value orientation, the symbolic value of the Tromsøpalme can also be seen as intrinsic as it is not connected to a material use for humans. If this is assumed, the results of association between considering Tromsøpalme to have symbolical importance and respondents with higher education and female respondents could be explained by the ecocentric value orientation these population groups tend to have.

When looking at the relationships between different socio-demographic characteristics, higher education was associated (though near significant) with younger respondents (t-test: $p=0.086$, Table 18, p. 147) as well as significantly associated with fewer years of ownership (t-test: $p=0.012$, Table 18, p. 147) and to a shorter residence time in Tromsø (t-test: $p<0.001$, Table 18, p. 147). As already mentioned, Vaske et al. (2001) found an association between an ecocentric value orientation and shorter residence time. Although, residence time was not directly associated with the symbolic value in this study on hand, the results might point at an indirect effect of the length of residence on the landowners' evaluation of the symbolical importance of Tromsøpalme.

Bivariate analysis showed further that there was a near significance that respondents who had experienced permanent injuries were associated with seeing Tromsøpalme as not important as a symbol of Tromsø (Mann-Whitney-U test: $p=0.099$, Table 12, p. 142). Personal unpleasant experiences with Tromsøpalme seem to overshadow the symbolic value. This result corresponds to Fischer et al. (2011) who found that species, seen as dangerous, are also perceived as having less worth. However, the association between injuries and symbolic importance was only close to significance, probably due to the low number of respondents who reported to have experienced permanent injuries (only a fifth of the respondents).

The variable of having incurred injuries, was (conversely to the variable education) significantly related to advanced age (t-test: $p=0.011$, Table 18, p. 147), increasing years of parcel ownership (t-test: $p=0.013$, Table 18, p. 147), and longer residence time in Tromsø (t-test: $p=0.028$, Table 18, p.147). This finding could lead to the assumption that the longer someone stays in Tromsø, the higher is their risk to experience permanent injuries. A longer residence time (including higher age and longer ownership) could also mean that respondents have more negative experience with the plant when they found how difficult it is to control. This might have made them regard the plant as a nuisance which also overshadows the

symbolic importance of the plant. Furthermore, longer residence was found to be associated with anthropocentric values (Vaske et al. 2001); which could also relate to seeing Tromsøpalme not important as a symbol. In Chapter 3.3.2.2 (p. 57 - 62) it is discussed further how experiencing permanent injuries from Tromsøpalme, different educational levels and professional experiences with Tromsøpalme may play a role in the evaluation of normative beliefs regarding regulation of Tromsøpalme on Tromsø Island.

3.3.2 Landowners'/locals' normative beliefs regarding the regulation of Tromsøpalme on Tromsø Island by local institutions

This chapter deals with the respondents' normative beliefs regarding regulation of Tromsøpalme (for definitions, see also Endnote #1, p. 152) on Tromsø Island by local institutions and the reasons respondents gave for removing or keeping *H. laciniatum* on Tromsø Island. Furthermore, this chapter discusses the associations of normative beliefs with socio-demographic variables. The normative beliefs were “evaluating the necessity of regulation measures on Tromsø Island” (not necessary or necessary, Question 33, p. 126), “evaluating Tromsøpalme's occurrence on Tromsø Island” (not problematic or problematic, Question 34, p. 126), and “degree Tromsøpalme should be removed on Tromsø Island” (full removal from Tromsø Island; partial removal which implies removal from some areas; no removal from Tromsø Island, Question 35a/b and 36a/b, p. 126 - 127). The normative belief “evaluating Tromsøpalme's occurrence on Tromsø Island” is not a normative belief according to Fishbein and Ajzen (1975). But in this study it is treated as a normative belief as judging over Tromsøpalme as a problematic plant on Tromsø Island refers to the need of regulation of Tromsøpalme (see also Endnote #1, p. 152).

3.3.2.1 Evaluation of normative beliefs regarding regulation of Tromsøpalme (by local institutions) on Tromsø Island and reasons for the normative beliefs

Three out of four respondents saw regulation measures on Tromsø Island as necessary (78.4%, $n=152$, $n_{total}=194$), a small percentage did not consider it as necessary (7.2%, $n=14$), and 14.4% ($n=28$) had no opinion (median=5; mean=4.25; 1: not necessary, 3: neutral, 5: necessary; see Table 4, p. 41). More than half (55.9%, $n=109$, $n_{total}=195$) of the respondents saw Tromsøpalme as a problem on Tromsø Island, 16.4% ($n=32$) of the respondents thought that Tromsøpalme is not a problem, while around a third (27.7%, $n=54$) had no opinion on this (median=4; mean=3.66, 1: do not perceive it as a problem, 3: neutral, 5: perceive it as a problem on Tromsø

Island; see Table 4, p. 41). Two thirds of all the respondents preferred that Tromsøpalme should only be **partly removed** from some areas from Tromsø Island (64.3%, n=117, n_{total}=182), while one third of the respondents wanted Tromsøpalme to be **completely removed** from Tromsø Island (33.0%, n=60). A small amount of respondents indicated that Tromsøpalme should **not be removed anywhere** (2.7%, n=5, see Table 5, p. 43).

As shown in the previous paragraph, three quarters of the respondents regarded regulation measures as important on Tromsø Island but half of them indicated that Tromsøpalme was a problem on Tromsø Island. This discrepancy could be explained by the respondents' interpretation of the questions. The normative belief of "seeing Tromsøpalme as a problem on Tromsø Island" expresses a stronger aversion towards Tromsøpalme than the "necessity of regulation measures". The latter does not necessarily imply that the mere occurrence of the plant is seen as problematic, but rather that the amount of the plant on Tromsø Island is a problem. So, most of the landowners saw the importance of regulation measures regarding Tromsøpalme but fewer respondents considered the plant's existence on Tromsø Island to be a problem. Also, more respondents indicated that Tromsøpalme should only be partly removed, compared to respondents who indicated that Tromsøpalme should be completely removed from Tromsø Island. So, the acceptance of removal measures against Tromsøpalme seemed to be generally high among the questionnaire respondents, however most of the respondents would not like to see the plant completely eradicated from the island.

Respondents who preferred full or partial removal of the plant from Tromsø Island gave different reasons for favoring a removal of Tromsøpalme (Question 35b, p. 126). The three most frequent reasons respondents named who preferred a **partial removal** of Tromsøpalme (from some areas) were: (1) "the plant spreads too much" (70.9% n=83, n_{total}=117), (2) "it suppresses other vegetation" (60.7%, n=71), and (3) because it has a "poisonous sap" (51.3%, n=60) (Figure 17, p. 138). Respondents who would like to have **full eradication** of the plant from Tromsø Island gave the same reasons most frequently, but in a different order ((1) "spreads too much: 90.0%, n=54, n_{total}=60, (2) "poisonous sap": 80.0%, n=48, (3) "suppresses other vegetation": 71.7%, n=43, Figure 18, p. 138). The questionnaire did not have as an answer option "because the plant is not native", though one respondent wrote this in as a reason.

Respondents who preferred a **partial removal** of Tromsøpalme on Tromsø Island indicated specific areas for removal (Figure 15, p. 137). They stated most frequently that the plant should

be removed from public areas, such as parks, graveyards, and playing grounds (90.6%, n=106, n_{total}=117), followed by roads (52.1%, n=61), and private parcels (37.6%, n=44). Two respondents wrote that the plant should be removed in frequently-used areas where many people might come in contact with the plant and mentioned recreation areas, playing grounds, and walking paths. Three respondents were concerned about safety of traffic as they wrote in the questionnaire that the plant should be removed along roads to allow a better view for car drivers. One respondent wrote into the questionnaire that it is a hopeless task for private persons to regulate Tromsøpalme on their own parcel.

The respondents who preferred partial or no removal of Tromsøpalme were asked about their reasons for keeping Tromsøpalme on Tromsø Island (Question 36b, p. 127). The three most frequent reasons respondents (**partial removal**) indicated were: (1) “cultural meaning” (63.2%, n=74, n_{total}=117), because it (2) “looked nice in the landscape” (49.6%, n=58), and that (3) “resources should not be used for regulation” (21.4%, n=25) (Figure 19, p. 139). Respondents who objected to any regulation measures (**no removal anywhere**) named the same three reasons most frequently: (1) “cultural meaning”: 60.0%, n=3, n_{total}=5, (2) “looks nice in the landscape”: 40.0%, n=2, (3) “resources should not be used for that”: 40.0%, n=2 (Figure 20, p. 139).

Respondents who favored a **partial removal** (Figure 16, p. 137) indicated most frequently that Tromsøpalme should be left growing mainly along the shore (53.8%, n=63, n_{total}=117), on private land (29.9%, n=35), and along roads (27.4%, n=32). A key informant from the Troms County Governor and Tromsø University stated that many locals like the view of Tromsøpalme especially at the shore. Two landowners and two renters specified in conversations that they liked to look at Tromsøpalme at the shore and along the roads. Regarding private areas, one respondent wrote in the questionnaire that owners should decide for themselves if they let Tromsøpalme grow on their own parcel or not. However, among the respondents who favored a partial removal, the number of respondents who indicated a desire to keep the plant along roads and in private areas was smaller than the number of respondents who indicated that they favored a removal from these areas.

Four respondents wrote in the “others” option of the questionnaire that, because of cultural reasons, Tromsøpalme should be kept in some specific areas on Tromsø Island that are well-controlled. One respondent even proposed to establish a “park with Tromsøpalme” where the locals or tourists could go and look at it. However, one respondent commented in the questionnaire that leaving the plant in some areas on Tromsø Island would not solve the

problem, as the plant would continue to spread. However, a full removal of Tromsøpalme from Tromsø Island might be difficult to achieve which is discussed in Chapter 4.2.2 (p. 94).

The previous paragraphs show that a third of the respondents wanted Tromsøpalme to be completely removed from Tromsø Island (for ecological and health reasons), while around two thirds wanted to have it partly removed (compromising ecological and health reasons with cultural and aesthetical reasons). Overall, there is a clear tendency that most of the landowners support the removal or regulation of Tromsøpalme in some areas. However, there are landowners who would not agree with the removal of Tromsøpalme at the shore, along roads, or on their parcel. The results of this section must be handled carefully as there were drawbacks in the question design and analysis regarding the normative belief “degree Tromsøpalme should be removed from Tromsø Island” which is further discussed in Chapter 3.6 (p. 85).

3.3.2.2 Association between normative beliefs regarding the regulation of Tromsøpalme on Tromsø Island and socio-demographic variables

Similar to the symbolical value, the normative beliefs were associated with the socio-demographic variables “experiencing permanent injuries” and “education”. The questionnaire results showed that landowners who experienced permanent injuries were significantly associated with a stronger notion that Tromsøpalme is a problem on Tromsø Island (Mann-Whitney-U test: $p=0.043$, Table 12, p. 142) and significantly tended to see regulation measures as necessary (Mann-Whitney-U test: $p=0.005$, Table 12, p. 142). Furthermore, these respondents significantly tended to a complete removal of Tromsøpalme from Tromsø Island, while respondents who received no permanent injuries significantly tended to support a partial removal (Chi-square test: $p=0.004$, Table 19, p. 148, for the Chi-square test, respondents favoring “no removal” had to be excluded because the sample size was below five).

These results show that safety is an important factor for the respondents’ evaluation of Tromsøpalme’s regulation on Tromsø Island. This corresponds to the results of Stout et al. (1993) who showed in their study that respondents who experienced a deer-involved car accident tended to support lethal methods to reduce deer herd size. Furthermore, as shown in Chapter 3.3.1.3 (p. 53), respondents who experienced injuries from Tromsøpalme disregarded the symbolical value of the plant. As this value did not play such an important role for these respondents, they supported more radical regulation measures.

As shown before (Chapter 3.3.1.3, p. 53), experiencing injuries was also associated to time-related variables, such as respondents with a longer residence time in Tromsø, respondents of advanced age, and longer parcel ownership. Fitzgerald et al. (2007) found in a literature review that older respondents are generally more skeptical towards invasive animals than younger respondents. Probably, a longer ownership or longer residence time in Tromsø implies that respondents needed to deal with Tromsøpalme for a longer time (on their parcel) and therefore tend to favor regulation measures on the island by authorities. Also, Manfredo et al. (2003) found that respondents with a longer residence time within one of six American states tend to support more strongly human management of wildlife (materialistic belief). Furthermore, Vaske et al. (2001) found that respondents with longer residence time tend to evaluate wildlife regarding its use for humans (anthropocentric value orientation), see also Table 6 (p. 60). So, even though no significant association of the time-related socio-demographic characteristics (“length of ownership”, “residence time”, “age”) and the evaluation of regulation measures could be found, results of former research might show that these characteristics played an indirect role.

Contrary to the respondents who experienced permanent injuries, there was also a significant tendency of respondents with higher education to see the presence of Tromsøpalme on Tromsø Island as less problematic (Mann-Whitney-U test: $p=0.019$, Table 12, p. 142) and to think less that regulation measures on Tromsø Island are necessary (Mann-Whitney-U test: $p=0.013$, Table 12, p. 142), compared to respondents without higher education. In the same way, there was a significant tendency (Chi-square test: $p=0.016$, Table 19, p. 148) of respondents with higher education to favor more strongly the partial removal of the plant from Tromsø Island, compared to respondents without higher education. Among respondents without higher education a higher percentage tended significantly to favor the full removal, compared to the respondents with higher education (for the Chi-square test, respondents favoring “no removal” were removed because the sample size was below five).

The fact that higher educated respondents are more critical towards regulation measures might be related to the aspect that these respondents considered Tromsøpalme important as a symbol for Tromsø (see Chapter 3.3.1.3, p. 53). As shown before (Chapter 3.3.1.3, p. 53), higher educated respondents in this study were associated with a shorter residence time in Tromsø, younger age, and shorter ownership. So, also here the time-related variables might play a role in the evaluation of regulation measures which has also be shown in former research: Manfredo et al. (2003) found that respondents with higher education and shorter residence time within

one of six American states tended to object management of wildlife (protectionist belief, see also Table 6, p. 60). Also Teel et al. (2002) found that in the state Utah newcomers and respondents with higher education tend to oppose bear and cougar hunt compared to long-term residence and residents without higher education. A similar pattern has been found in landscape management research as van der Berg and Koole (2006) found that higher educated respondents favored unmanaged and wild sceneries over managed and developed landscapes. Furthermore, former research showed that both higher education and shorter residence time is related to an ecocentric value orientation (Vaske et al. 2001).

These associations of higher education and being more skeptical towards human management of wildlife could be related to the fact that higher educated respondents (also often urban respondents) less often have firsthand experience of wildlife and related conflicts. They tend to have an abstract knowledge about wildlife they gained from science and media (Skogen 2001). Furthermore, increasing mobility (which leads to shorter residence time) means that people become more open towards new perceptions (cf. Jandt 2001). In that way, traditional local perceptions that are held towards wildlife (materialistic beliefs) are increasingly mixed with alternative perceptions (protective beliefs) of newcomers from other areas (Manfredo et al. 2003). In the specific case of Tromsøpalme this could also imply that landowners who lived not so long in Tromsø and owned their land for a shorter time might have less experience with the plant and therefore considered it less to be a problem.

As shown before, two thirds of the respondents favored a partial removal of Tromsøpalme while one third favored a full removal of the plant from Tromsø Island. This might be related to the fact that generally the sample could be biased towards higher educated respondents who tend to answer more frequently to mail surveys, according to Cartwright (1986). Furthermore, a higher percentage of well-educated people, who tend to disregard regulation measures (Manfredo et al. 2003), lives in urban areas, compared to rural areas (Statistics Norway 2013b). Additionally, urban residents showed to perceive invasive species less as an issue relative to rural residents, as Fitzgerald et al. (2007) found in a literature review. Other studies showed that urban respondents, like higher educated respondents, show a more protectionist belief with a tendency to object management of wildlife, relative to rural residents (Manfredo et al. 2003; Teel et al. 2002), see also Table 6 (p. 60). However, Bremner and Park (2007) found no differences of values/normative beliefs towards invasive species between respondents from rural and from urban areas in their study. Instead Bremner and Park (2007) and also Fitzgerald

et al. (2007) found men favoring more strongly regulation measures towards invasive species than women. This association has not been measured in this study, though.

Table 6: A selection of the results of two studies regarding associations between socio-demographic characteristics and values (Vaske et al. 2001) and normative beliefs (Manfredo et al. 2003) regarding to wildlife management.

Study of Vaske et al. (2001)		Study of Manfredo et al. (2003)	
Values	Associated socio-demographic variables	Normative beliefs*	Associated socio-demographic variables
<i>Ecocentric value orientation towards forest</i> (evaluating forest as having a value in its own)	<ul style="list-style-type: none"> • Women • Higher education • Shorter residence time in Colorado 	<i>Protective beliefs towards wildlife management</i> (disregarding human use of /management of wildlife)	<ul style="list-style-type: none"> • Urban residents • Higher education • Shorter residence time within one of six American states
<i>Anthropocentric value orientation towards forest</i> (evaluating forest on basis of its human use)	<ul style="list-style-type: none"> • Men • Without higher education • Longer residence time in Colorado 	<i>Materialistic beliefs towards wildlife management</i> (favoring human use of / management of wildlife)	<ul style="list-style-type: none"> • Rural residents • Without higher education • Longer residence time within one of six American states

*Manfredo et al. (2003) use the terms “values” in their study. But as these values refer to the way how respondents think nature should be managed, they are defined in this study on hand as “normative beliefs”.

Garcia-Llorente et al. (2008) found that higher educated respondents actually supported the regulation and eradication programs of invasive species, relative to respondents without higher education. But in their study, the respondents with higher education were mostly conservation experts. Those respondents probably have different knowledge and perceptions on this issue, compared to people with higher education who are not environmental specialists. Similarly, in this study on hand, key informants with expert knowledge on environmental conservation (such as the staff at the authorities and the employee at GWN) supported strongly the regulation of Tromsøpalme.

Specific knowledge and experiences that people have with nature also seem to play a role in their evaluation of wildlife. Skogen (2001) carried out a study in a rural area about young

respondents' perceptions of wolves in Norway. He found that respondents with an academic background (middle class), who often do not work directly in natural surroundings had a more positive view towards wolves. However, respondents dealing with hunting and fishing have a view on wildlife that developed from their own experience and is oriented towards the use of nature (working class). These respondents have more direct experience with wolves and emphasize therefore more the negative aspects as they experience that wolves kill their hunting dogs, and fear that wolves could come closer to human settlements. The first group of respondents might be more disconnected from wildlife conflicts. They gain their knowledge about nature primarily from external sources, such as science and media which leads to an abstract view of nature which is often detached from the local circumstances. Therefore, people who are not directly concerned by wildlife conflicts might see them not as problematic compared to people who have more direct experience with wildlife.

In this study on hand, the interviews with key informants also showed a relationship between (professional) experience and a persons' view on wildlife. A key informant from Tromsø Arts Association who grew up on a farm on a neighbor island of Tromsø Island assumed that farmers do not like *H. laciniatum* since it is a lot of work to remove it from the fields. So, the plant is seen as a nuisance during work: *"My mother, when she saw [Tromsøpalme] on the fields: 'Oh, there are Tromsøpalme on the field, we have to remove them, they are so ugly. We don't want them here.' Like some kind of a plant enemy in some ways. [...] Her grandparents had the same attitude to this plant, that you remove it and that's how it is. And that it is a threat against the other plants in the fields. So, if you see it, you take it away, immediately before the seeds get spread"*. Fitzgerald et al. (2007) found in a literature review that rural residents, as they are often associated with farming, consider invasive animals as dangerous and favor regulation measures, for example when they have an influence on the productivity of the farm.

One key informant from Tromsø Municipality working as a landscaper in the parks and other green areas in Tromsø had also an aversion to the plant as she had to regulate the plant on public areas. Another key informant from Tromsø Municipality specified that also landowners with interest in gardening and plants are likely to be more concerned about the presence of Tromsøpalme on their plot. The key informant from the roads department described how her perception of *H. laciniatum* had changed after encountering the problem of the plant spreading along the roads: *"It is very interesting to work with Tromsøpalme, because I have never considered it as a problem, before I started to work [at NPRA]"*. Key informants from Tromsø

Municipality, Troms County Governor, and GWN had a similarly critical attitude towards Tromsøpalme because they were responsible for nature protection.

In contrast to the key informants mentioned above, the artists (excluding the one who grew up on a farm) and the Tromsøpalme enthusiast were not concerned professionally with the problems caused by Tromsøpalme. This might also be a reason why they felt uneasiness against the common predominantly negative perceptions of Tromsøpalme presented in the local media (see also Chapter 4.2.1, p. 92). In the interviews, they emphasized its cultural and historical value to show that the plant has also positive aspects. The Tromsøpalme enthusiast mentioned: *“Tromsøpalme has significant cultural impact in Tromsø. The Tromsø festdrakt [folk costume with Tromsøpalme] has Tromsøpalme as symbol. We have an elderly home building for older people called Heracleum. This dried flower is used as an ornamental symbol in jewels and drawings. So, it would be a catastrophe if Tromsøpalme was eradicated”*.

Even though these key informants (Tromsø Arts Association and Tromsøpalme enthusiast) were thinking rather positive about the plant they nevertheless saw the need of regulation measures on Tromsø Island - as long as the plant was not eradicated. The key informant from the Tromsø Arts Association explained: *“I think I do not really mind [regulation measures against Tromsøpalme] as long as [authorities] do not get completely rid of it [...]. That [authorities] have started to take it away is probably a good way and that they are restricting it [...]. It does not have to grow everywhere”*. A key informant from Tromsø Municipality, explicitly critical towards Tromsøpalme, specified regarding regulation measures: *“I wouldn't mind Tromsøpalme growing on some places as a plant, but not as [widespread] as this”*. So, this key informant who generally had a negative perception of the plant and found regulation measures important nevertheless accepted the growth of the plant in some areas. So, even though these different key informants had a relatively positive or a relatively negative view about the plant, they did not have extreme views regarding regulation of the plant on Tromsø Island, such as no regulation at all or full eradication.

3.3.3 Associations between values and normative beliefs

The questionnaire results showed that values and normative beliefs were significantly correlated with each other: a negative evaluation of the plant's attributes led to a higher support for its regulation (Spearman correlation: $p < 0.001$, Table 7, p. 64). For example, seeing Tromsøpalme as dangerous to health was positively correlated with the necessity of regulation measures (Spearman's $r = 0.407$), and perceiving Tromsøpalme as a problematic plant

(Spearman's $r = 0.373$). Further, thinking that the plant is dangerous was negatively correlated with thinking that the plant is important as a symbol of Tromsø (Spearman's $r = -0.384$) and seeing Tromsøpalme as nice (Spearman's $r = -0.282$). Conversely, respondents who considered the plant symbolically important agreed less with regulation measures (Spearman's $r = -0.519$), less that Tromsøpalme is a problem (Spearman's $r = -0.548$) and believed less that Tromsøpalme had a negative health impact (Spearman's $r = -0.384$). The aesthetical value showed the same direction of correlation with the values and normative beliefs as the symbolical value. Furthermore, those respondents who emphasized the negative aspects of *H. laciniatum* also tended to accept its full removal from Tromsø Island while those who tended to rank the attributes of Tromsøpalme as more positive preferred a partial or no removal from Tromsø Island (Kruskal-Wallis test: $p < 0.001$, see Table 15, p. 144). These results show that the more positive Tromsøpalme is perceived, the less its regulation or removal is wanted.

Table 7: Results of Spearman correlations (significant at the alpha = 0.1 level) between evaluations of values of Tromsøpalme and evaluations of normative beliefs concerning Tromsøpalme's regulation on Tromsø Island.

		Evaluating the impact on health (health value)	Evaluating the appearance (aesthetical value)	Evaluating the importance as a symbol for Tromsø (symbolical value)	Evaluating the necessity of reg. measures on Tromsø Island (normative belief)	Evaluating Tromsøpalme's occurrence on Tromsø Island (normative belief)
Evaluating the impact on health (health value)	Spearman's r	1.000	-0.282***	-0.384***	0.407***	0.373***
	p-value	.	<0.001	<0.001	<0.001	<0.001
	n	195	195	194	194	195
Evaluating the appearance (aesthetical value)	Spearman's r	-0.282***	1.000	0.569***	-0.370***	-0.374***
	p-value	<0.001	.	<0.001	<0.001	<0.001
	n	195	195	194	194	195
Evaluating the importance as a symbol for Tromsø (symbolical value)	Spearman's r	-0.384***	0.569***	1.000	-0.519***	-0.548***
	p-value	<0.001	<0.001	.	<0.001	<0.001
	n	194	194	194	193	194
Evaluating the necessity of reg. measures on Tromsø Island (normative belief)	Spearman's r	0.407***	-0.370***	-0.519***	1.000	0.673***
	p-value	<0.001	<0.001	<0.001	.	<0.001
	n	194	194	193	194	194
Evaluating Tromsøpalme's occurrence on Tromsø Island (normative belief)	Spearman's r	0.373***	-0.374***	-0.548***	0.673***	1.000
	p-value	<0.001	<0.001	<0.001	<0.001	.
	n	195	195	194	194	195

*** Correlation is significant at the alpha= 0.01 level (p-value)

3.4 Summary of locals'/landowners' awareness and perception of Tromsøpalme

Tromsøpalme was known by most of the locals, according to key informants from Tromsø Arts Association and Tromsø Municipality. Also all the landowners answering the questionnaire, except for one, had heard about Tromsøpalme. Only 15 out of 199 landowners were not aware of the presence or absence of Tromsøpalme on their parcel. Tromsøpalme was perceived as nice by more respondents, compared to those who perceived it as ugly. The health impact of *H. laciniatum* was considered as dangerous by almost half of the respondents. However, more than half of the respondents had a neutral position towards the health impact, and also key informants from Tromsø University and GWN saw the health risk not as problematic. These key informants found the ecological impacts of the plant more worrying. A fifth of the respondents indicated to have received permanent injuries from the plant (or knew about somebody who did). A slightly higher amount of the respondents did not consider Tromsøpalme important as a local symbol, compared to the amount of respondents who did. Key informants from GWN and Tromsø Arts Association mentioned that many locals were informed about Tromsøpalme not being native in Tromsø, but that these locals nevertheless regarded Tromsøpalme as a part of Tromsø.

Regarding an association of socio-demographic variables and values or normative beliefs, women were evaluating Tromsøpalme's aesthetical value significantly more positively (nice) than men. Also, higher age, longer residence time, and longer ownership were significantly related to a positive evaluation of Tromsøpalme's appearance. Respondents who received permanent injuries (or knowing somebody who did) due to contact with *H. laciniatum* significantly tended to consider Tromsøpalme as dangerous to health, to disregard the plant's symbolical value (almost significant), to think that regulation measures are necessary, and to see Tromsøpalme's occurrence on Tromsø Island as a problem. Furthermore, these respondents significantly favored a full removal of Tromsøpalme from Tromsø Island over a partial removal. Respondents who experienced injuries from the plant were also significantly related to longer residence time in Tromsø, advanced age, and longer parcel ownership. Possibly, these respondents had to deal longer with the plant and therefore tend to favor its regulation. Furthermore, respondents with longer residence time have shown to evaluate nature according to its use for humans (Vaske et al. 2001) and to favor human regulation of wildlife (Manfredo et al. 2003; Teel et al. 2002).

Respondents with higher education and women significantly tended to see Tromsøpalme as a symbol of Tromsø. Furthermore, they significantly tended to think that regulation measures are not necessary, and to see Tromsøpalme's occurrence on Tromsø Island not so much as a problem. Furthermore, these respondents significantly preferred a partial removal of Tromsøpalme from Tromsø Island over a full removal. Higher educated respondents were associated with a shorter residence time in Tromsø, younger age, and shorter parcel ownership. A shorter residence time in Tromsø and parcel ownership time might imply that these respondents might not have so much negative experience with the plant. Former research showed that respondents with shorter residence time and higher educated respondents have a tendency to reject human regulation of wildlife (Manfredo et al. 2003) and to emphasize the intrinsic value of nature (Vaske et al. 2001). All associations between values, normative beliefs and socio-demographic variables (significant at the $\alpha=0.1$ level) are shown in Table 8 (p. 67). A depreciative evaluation of the plants' values (not nice, not important as a symbol for Tromsø, dangerous to health) was correlated with a stronger support (higher ranking of normative beliefs) of regulation measures towards the plant on Tromsø Island.

Almost all respondents wished regulation of Tromsøpalme on Tromsø Island because of the negative impact of *H. laciniatum* on other vegetation and on human health. However, most of the respondents favored a partial removal of Tromsøpalme (only in some areas on Tromsø Island) because of its cultural meaning. Key informants who were more concerned professionally about the ecological impacts of Tromsøpalme had a more critical view on the plant (such as key informants from GWN, NPRA, Troms County Governor, Tromsø Municipality), compared to key informants from Tromsø Arts Association and the Tromsøpalme enthusiast.

Table 8: Results of bivariate analyses (significant at alpha = 0.1 level) showing how different population groups tended to evaluate different values and normative beliefs towards Tromsøpalme.

Values / normative beliefs	Evaluation	Associated socio-demographic variables
Aesthetical value	Nice	<ul style="list-style-type: none"> • Women • Higher age • Longer parcel ownership time • Longer residence time in Tromsø
	Ugly	<ul style="list-style-type: none"> • Men • Lower age • Shorter parcel ownership time • Shorter residence time in Tromsø
Health value	Dangerous	<ul style="list-style-type: none"> • Experienced permanent injuries from contact with Tromsøpalme
	Not dangerous	<ul style="list-style-type: none"> • Did not experience permanent injuries from contact with Tromsøpalme
Symbolical value	Important	<ul style="list-style-type: none"> • Women • *Higher education • Did not experience permanent injuries from contact with Tromsøpalme
	Not important	<ul style="list-style-type: none"> • Men • Without higher education • **Experienced permanent injuries from contact with Tromsøpalme
Evaluation of the necessity of regulation measures on Tromsø Island (normative belief)	Necessary	<ul style="list-style-type: none"> • Without higher education • Experienced permanent injuries from contact with Tromsøpalme
	Not necessary	<ul style="list-style-type: none"> • Higher education • Did not experience permanent injuries from contact with Tromsøpalme
Evaluation of the occurrence of Tromsøpalme on Tromsø Island (normative belief)	Problematic	<ul style="list-style-type: none"> • Without higher education • Experienced permanent injuries from contact with Tromsøpalme
	Not problematic	<ul style="list-style-type: none"> • Higher education • Did not experience permanent injuries from contact with Tromsøpalme
***Evaluation of the degree Tromsøpalme should be removed from Tromsø Island (normative belief)	Full removal	<ul style="list-style-type: none"> • Without higher education • Experienced permanent injuries from contact with Tromsøpalme
	Partial removal	<ul style="list-style-type: none"> • Higher education • Did not experience permanent injuries from contact with Tromsøpalme

*Respondents with higher education were associated with shorter residence time in Tromsø, younger age, and owning their parcel on Tromsø Island for a shorter time.

**Respondents who experienced permanent injuries from Tromsøpalme were significantly associated with longer residence time in Tromsø, higher age, and owning their parcel on Tromsø Island for a longer time.

*** The number of respondents indicating Tromsøpalme should not be removed anywhere from Tromsø Island was below five, therefore these respondents were excluded from the Chi-square test.

3.5 Regulation of Tromsøpalme on the landowners' parcels on Tromsø Island between

This chapter focuses on the regulation measures (Definition: regulation, see Endnote #1, p. 152) carried out by landowners (questionnaire respondents) who (knew that they) had Tromsøpalme on their land between May and September 2012. Full regulation” means *H. laciniatum* was regulated to a degree that it was not flowering on the landowner’s parcel (so it might not be able to spread) while “partial regulation” means the plant was regulated on the parcel, but there were still some plants flowering (so the plant might be able to spread). “No regulation” refers to the fact that the plant was growing unhindered on the parcel. It was examined in multinomial logistic regression how landowners’ socio-demographic characteristics, parcel characteristics, values, and normative beliefs were associated with the landowners’ regulation behaviors (full regulation, partial regulation, or no regulation). Furthermore, in binary logistic regression, it was investigated how socio-demographic characteristics, parcel characteristics, values, normative beliefs, were associated with the parcels’ contribution of Tromsøpalme’s spread (plant not or partially regulated vs. plant fully regulated or absent).

3.5.1 Regulation practices of the landowners between May and September 2012

This section presents to what extent the landowners regulated Tromsøpalme on their parcels (Question 22, p. 124), what regulation measures landowners used (Question 25, p. 125), and how they handled the plant waste (Question 26, p. 125). Among those respondents who knew that they had Tromsøpalme on their land, 44.3% (n=62, n_{total}=140) indicated full regulation while around a third (35.7%, n=50) indicated that the plant was partly regulated. The rest (20%, n=28) reported that *H. laciniatum* was not regulated on their parcels at all (see also Table 5, p. 44).

The three most indicated regulation methods (Figure 8, p. 69) the landowners (including both the landowners who partially or fully regulated the plant) used were ”cutting the stems” (73.2%, n=82, n_{total}=112), followed by “digging out the root” (50.0%, n=56) and “mowing” (31.3%, n=35). If only looking on the respondents who partially regulated Tromsøpalme, it can be seen that they indicated the same three methods most frequently. Respondents who were fully regulating Tromsøpalme mentioned “filling salt in cut stem” as the third frequent measure

instead of mowing (see Footnote #1). Three respondents indicated in the questionnaire that they even applied chlorine and cement to eliminate the plant. During conversations, one landowner mentioned that he filled gasoline into the stems.

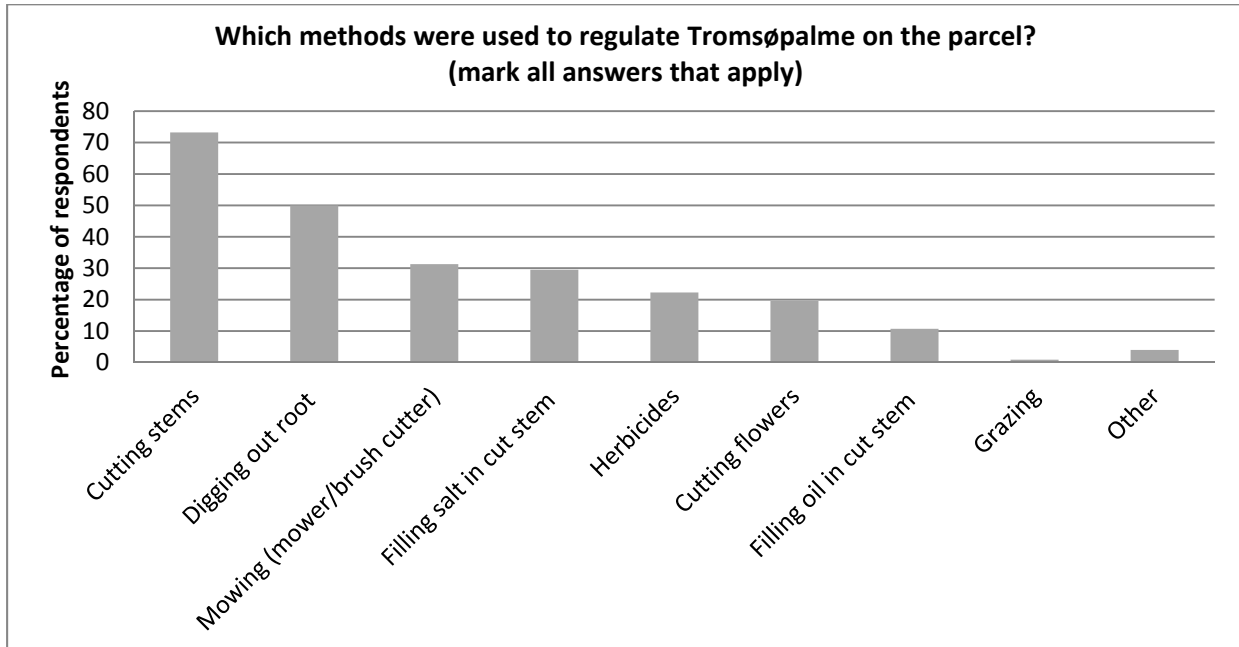


Figure 8: Regulation methods indicated by landowners (n=112) who regulated Tromsøpalme on their parcel (partly or fully) between May and September 2012 (Question 25, p. 125).

Most respondents (including both those who partially or fully regulated Tromsøpalme) indicated that the plant waste was disposed on the parcel, i.e. in a compost heap (43.8%, n=49, n_{total}=112) and/or on the ground (32.1%, n=36). Fewer respondents indicated that the plant waste was taken away from the parcel and deposited in the garbage/biowaste container (24.1%, n=27) and/or the municipal waste disposal site (10.7%, n=12) (Figure 9, p. 70). Leaving most of the plant waste on the parcel has shown in the case of Giant hogweed to contribute to the unobstructed distribution of the plant (Pyšek et al. 2007a). If looking on the two regulation groups separately (either fully regulating or partly), both groups leave the plant waste more frequently on the parcel (ground or compost) than bring it away (waste disposal site or

Footnote #1: Regulation measures used by landowners of different regulation degrees between May and September 2012:

Partial regulation (n_{total}=50):

(1) cutting stems: 70.0% (n=35); (2) digging out the roots: 46.0% (n=23); (3) mowing: 42.0% (n=23); (4) filling salt into cut stem: 26.0% (n=13); (5) herbicides: 20.0% (n=10); (6) filling oil in cut stem: 16% (n=8); (7) cutting flowers: 14.0% (n=7); (8) grazing: 2.0% (n=1); (9) other: 2.0% (n=1);

Full regulation (n_{total}=62):

(1) cutting stems: 75.8% (n=47); (2) digging out the roots: 53.2% (n=33); (3) filling salt in cut stem: 32.3% (n=20); (4) cutting flowers: 24.2% (n=15); (5) herbicides: 24.2% (n=15); (6) mowing: 22.6% (n=14); (7) filling oil in cut stem: 6.5% (n=4); (8) grazing: 0% (n=0); (9) other: 4.8% (n=3)

garbage). However, respondents who were fully regulating the plant used the municipal waste disposal site more frequently, and indicated less frequently deposition of the plant waste into the compost on the parcel or on the ground, compared to those landowners indicating partial regulation (see Footnote #2).

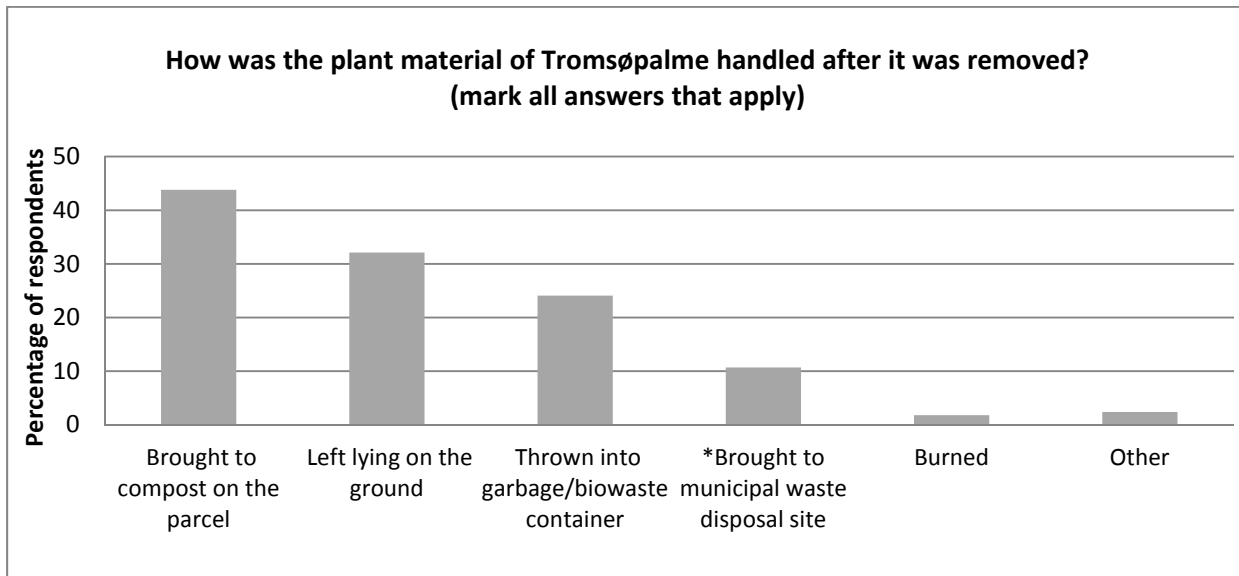


Figure 9: Handling of the plant waste by respondents (landowners) who regulated Tromsøpalme (partly or fully) on their parcel between May and September 2012 (n=112). *The option “municipal waste disposal site” was mentioned by several respondents in the “others” category, and was then made into an own category (Question 26, p. 125).

3.5.2 Reasons given by landowners for regulating or not regulating Tromsøpalme on their parcels between May and September 2012

The following section is about the three most frequent reasons (Question 23, p. 124) landowners gave who partly or fully regulated the plant on their parcel (see Figure 21, p. 140 and Figure 22, p. 140). Respondents who **partly regulated** Tromsøpalme indicated as reasons for regulating (1) “spreads itself” (76.0%, n=38, n_{total}=50), (2) “prevents other plants from growing” (56.0%, n=28), followed by (3) “dangerous when you get in contact, allergic reactions” (46.0%, n=23). Landowners who were **fully regulating** Tromsøpalme on their parcel indicated the following reasons most frequently: ((1) “spreads itself” (88.7%, n=55, n_{total}=62),

Footnote #2: Handling of the plant waste by landowners regulating Tromsøpalme to different degrees between May and September 2012:

Partial regulation (n_{total}=50): (1) brought to the compost on the parcel: 50.0% (n=25); (2) left lying on the ground: 38.0% (n=19); (3) thrown into garbage/biowaste container: 24.0% (n=12); (4) burned: 0.0% (n=0); (5) brought to municipal waste disposal site: 4.0% (n=2);

Full regulation (n_{total}=62): (1) brought to compost on parcel: 38.7% (n=24); (2) left lying on the ground: 27.4% (n=17); (3) thrown into garbage/biowaste container: 22.6% (n=14); (4) brought to municipal waste disposal site: 12.9% (n=8); (5) burned: 3.2% (n=2)

(2) “doesn’t look nice on the parcel” (66.1%, n=41), and (3) “prevents other plants from growing” (50.0%, n=31). So, the reasons landowners gave most frequently for partly and fully removing *Tromsøpalme* was the invasive character of the plant: the risk of spreading and the suppression of other vegetation on their plot.

In this paragraph the three most frequent reasons questionnaire respondents gave for regulating *H. laciniatum* only partially or not at all (Question 29, p. 125) are presented (Figure 23, p. 141 and Figure 24, p. 141): the **partially regulating** landowners indicated as a reason (for not fully regulating the plant) that they had (1) “no time to regulate” the plant (32.0%, n=16, n_{total}=50); the same percentage indicated that they had (2) “tried to regulate it but gave up” (32.0%, n=16); followed by (3) “looks nice” (26.0%, n=13). Respondents who did **not do any regulation** indicated mostly that they (1) “do not care/mind to have it on the parcel” (42.9%, n=12, n_{total}=28), followed by (2) “looks nice” (32.1%, n=9), and (3) “have no time to regulate it” (25.0%, n=7). This shows that practical issues (time consuming and difficult work) but also not minding the plant were the main reasons for not (fully) regulating the plant, followed by the aesthetical reason that *Tromsøpalme* looks nice. The option “cultural reason” for not regulating the plant on the parcel was not given in the questionnaire. However, one respondent wrote that he did not remove *Tromsøpalme* completely because for this respondent the plant was a “part of Tromsø’s cultural landscape”.

For all three regulation groups (no, partial and full), the look of *Tromsøpalme* on their parcels was an important motivation for regulating or not regulating *H. laciniatum*. Two thirds of the landowners who fully regulated the plant did this because they found that the plant did not look nice on their parcels. It was mentioned before that *Tromsøpalme* is not considered as a fashionable garden plant these days and that only one questionnaire respondent indicated (or knew) that *Tromsøpalme* was planted on his/her parcel (Chapter 3.3.1.1, p. 48). In the question asking the landowners in which year *Tromsøpalme* had reached their parcel (Question 20, p. 123), most of the landowners indicated that *Tromsøpalme* had already been there when they bought the land or moved there (78.3%, n=108, n_{total}=138); this percentage was almost the same for the different regulation groups (no regulation: 77.8% n= 21, n_{total}=28; partial regulation: 82.0%, n=41, n_{total}=50; full regulation: 75.4%, n=46, n_{total}=62). Even though the plant was not planted by the respondents themselves more than a fourth of those landowners regulating *Tromsøpalme* partly or not at all (28.2%, n=22, n_{total}=78) seem to like or tolerate *H. laciniatum* on their parcel as an ornamental plant. Two landowners were encountered during field work who said that they kept *Tromsøpalme* on their parcels for ornamental reasons (Figure 13, p.

110). One of those landowners mentioned that she had not planted Tromsøpalme, but that she found it on her plot when she moved there. However, she cut the stems of the plant regularly after flowering before the plant set seeds; by doing this she was trying to prevent further spread. This shows that there are also landowners who regulate the plant only partly (which means they let it flower) but still try to prevent spreading of the plant. During field work, two parcels were found where the plant looked as if it was tended and kept in good shape. But, even after several tries, the residents could not be met at home.

Even more important for not (fully) regulating the plant was the difficult task to control Tromsøpalme on the plot, as respondents regulating the plant only partly or not at all indicated frequently that they tried to remove it and gave up, that they had no time, or that they did not care. In the question “How did/does Tromsøpalme end up your parcel?” (mark all answers that apply, Question 21, p. 124), 37.9% (n=53, n_{total}=140) of all respondents who had Tromsøpalme on their parcel indicated that it spread from the neighbor parcels while one fourth thought it spread from road sides (26.4%, n=37). However, most of the respondents did not know exactly how the plant reached their parcel (9.3%, n=13) or it happened before their time (65.7%, n=92). This shows that a number of respondents felt they had to deal with a constant intrusion of plants from adjacent areas. Also field observations showed that if Tromsøpalme existed on a parcel, it could often be found on the neighboring parcels as well.

Respondents who regulated the plant fully indicated even more frequently that Tromsøpalme spread from road sides and neighboring parcels onto their parcels, compared to those landowners who did not regulate or only partially regulated the plant (Footnote #3). This could be related to the fact that respondents who fully regulate the plant dealt more often with it and therefore know better where the plant spreads from. During field work it was observed that Tromsøpalme was often growing along parcel borders - maybe because the responsibilities for these areas were not clear (see also Figure 14, p. 110) - and in inaccessible or steep areas on parcels. The spreading of Tromsøpalme from neighboring parcels, inaccessible areas on the

Footnote #3: Source of Tromsøpalme indicated by respondents with different regulation degrees:

No regulation (n_{total}=28): before my time: 64.3% (n=18); neighboring parcels: 25.0% (n=7); road sides: 25.0% (n=7); cannot remember: 17.9% (n=5);

Partial regulation (n_{total}=50): before my time: 70.0% (n=35); neighboring parcels: 28.0% (n=14); road sides: 22.0% (n=11); cannot remember: 6.0% (n=3);

Full regulation (n_{total}= 62): before my time: 62.9% (n=39); neighboring parcels: 51.6% (n=32); road sides: 30.9% (n=19); cannot remember: 8.1% (n=5)

parcels, and lack of responsibility for border areas might be important reasons why it is difficult to regulate Tromsøpalme on private parcels.

The respondents with parcels where the plant was regulated (fully or partly) between May and September 2012 were asked “who was regulating Tromsøpalme on the parcel?” (mark all answers that apply, Question 24, p. 124). On 9 in 10 parcels the respondents were responsible, amongst others (89.3%, n=100, n_{total}=112), on 8.9% (n=10) of the parcels other owners had regulated Tromsøpalme, and on one parcel only renters were regulating it. No private organizations or companies were involved in any regulation measures of Tromsøpalme on the parcels according to the respondents. Two respondents indicated that employees from a public institution were helping to regulate the plant. But that were probably exceptions because both key informants from Tromsø Municipality mentioned that there is no official help from the authorities in Tromsø for the private landowners to regulate Tromsøpalme on their parcel. Possibly, this lack of external help was another reason why many landowners had difficulties to regulate the plant. Respondents who were partially regulating the plant were more frequently indicating that other owners were responsible for the regulation, compared to those respondents who indicated full regulation (see Footnote #4). If respondents were not regulating the plant themselves they might feel unsure what to answer regarding the degree of regulation. Therefore, they might have indicated partial rather than full regulation.

In spite of the difficulties to regulate Tromsøpalme mentioned in the previous paragraphs, there were also signs that some landowners had the plant under control. 56.0% (n=61, n_{total}=109) of the respondents (who fully or partly regulated Tromsøpalme) reported that the amount of Tromsøpalme had been reduced since the first regulation measure that was ever done until the study year 2012. One fourth reported (25.9%, n=28) the amount had not changed while 17.6% (n=19) of the landowners indicated that the amount of Tromsøpalme on their parcel had increased (Question 28, p. 125). So, it seems that even though the landowners had to regulate the plant on their own more than three in four landowners managed to keep the amount of Tromsøpalme on their parcel at the same level or even to reduce it. Respondents who indicated

Footnote #4: Responsible persons for regulation of Tromsøpalme within different regulation degrees:

Partial regulation (n_{total}=50): (1) respondent: 84.0% (n=42); (2) other owner: 26.0% (n=13); (3) renter: 0% (n=0); (4) public institution/company: 2.0% (n=1);

Full regulation (n_{total}=62): (1) respondent: 93.5% (n=58); (2) other owner: 11.3% (n=7); (3) renter: 1.6% (n=1); (4) public institution/company: 2.0% (n=1)

full regulation of the plant indicated more frequently that the amount had been reduced, compared to the respondents partially regulating the plant (see Footnote #5).

3.5.3 Socio-demographic characteristics, parcel characteristics, values, and normative beliefs as predictors for the degree of regulation of Tromsøpalme on the landowners' parcels and as predictors for the contribution of the parcels regarding Tromsøpalme's spread

This chapter presents and discusses how socio-demographic characteristics, parcel characteristics, values, and normative beliefs were associated (at the $\alpha=0.1$ level) with the regulation degree of Tromsøpalme on the landowners' parcels (no, partial or full regulation) in multinomial logistic regression analyses. Furthermore, this chapter shows which variables were associated (at the $\alpha=0.1$ level) with parcels that contributed to the spread of Tromsøpalme on Tromsø Island (no or partial regulation of Tromsøpalme) and parcels that did not contribute (full regulation of Tromsøpalme or plant absent) in binary logistic regression analyses. While 55.6% ($n=110$) of the parcels did not contribute to Tromsøpalme's spread (plant was fully regulated or absent on the parcel), on 44.4% ($n=88$) there was the risk that Tromsøpalme could spread (plant was partially regulated or not regulated at all) (see also Table 5, p. 44). For more details about the logistic regression analysis, see Chapter 2.4.3.3 (p. 35 - 36) and Endnote #12 (p. 157).

Four regression models were developed: A multinomial logistic regression model (Model I, Table 9, p. 82) and a binary logistic regression model (Model II Table 10, p. 83), each including the variable "frequency of tending the vegetation-covered area on parcel"; further, a multinomial (Model III, Table 21, p. 150) and binary regression model (Model IV, Table 22, p. 151), each including the variable "residence status: owners lived on the parcels vs. only renters lived on the parcels vs. no residence on the parcels". Two models of both the binary and the multinomial regression were developed because the variables "frequency of tending the vegetation covered area on the parcels" and "residence status" could not be included into one model as the other variables in the model became insignificant in that case (see also Chapter 2.4.3.3, p. 36).

Footnote #5: Change of the amount of Tromsøpalme on the parcel from the first measure ever done until 2012:

Partial regulation ($n_{\text{total}}=48$): (1) amount has been reduced: 39.6% ($n=19$); (2) amount has not changed: 39.6% ($n=19$); (3) amount has increased: 20.8% ($n=10$);

Full regulation ($n_{\text{total}}=60$): (1) amount has been reduced: 70.0% ($n=42$); (2) amount has not changed: 15.0% ($n=9$); (3) amount has increased: 15.0% ($n=9$)

Mainly the multinomial Model I and binary Model II including the “frequency of tending the vegetation-covered area on the parcels” are discussed because more variables were significant in these models and are presented at the end of this chapter. The results of the other two models, multinomial Model III and the binary Model IV (Table 9 and Table 10, p. 82 - 83), including the “residence status” are only discussed if they deviate concerning significance or direction of associations relative to Model I and II; therefore they are shown in the appendix section. Additionally, the results of bivariate analyses are presented. The statistical results are discussed together with findings from key informant interviews, landowner conversations, and literature.

The pseudo-Nagelkerke- R^2 values were 0.365 in the multinomial Model I (n=120, p. 82) and 0.260 in the multinomial Model III (n=120, p. 150) while the values in the binary models were 0.194 for Model II (n=176, p. 83) and 0.145 for Model IV (n=178, p. 151). This shows a poor to moderate fit of the variables to the regression line for studies in social sciences. So, the variables included into the regression models are moderately useful to predict the degree of Tromsøpalme’s regulation, and the parcels’ contribution to Tromsøpalme’s spread. The R^2 -values are somewhat higher in the multinomial Models I and III which means that the variables in these models fit better the regression line, compared to the binary Models II and IV. However, this might not be related to the fact that the variables in the multinomial models explain the outcome better, compared to the binary models, but that the data set used for the multinomial models is smaller, compared to the one used for the binary models (Pallant 2011).

3.5.3.1 The effect of “frequency of tending vegetation-covered area on parcel between May and September 2012”

The multinomial Model I (n=120, Table 9, p. 82) showed that parcels with a higher frequency of tending the vegetation-covered area had significantly higher odds of both partial regulation of Tromsøpalme (p=0.001, odds=2.501) and full regulation (p<0.001, odds=2.881), relative to no regulation of Tromsøpalme. This association was also significant in the bivariate analysis (Kruskal-Wallis test: p<0.001, Table 16, p. 145). The binary Model II (n=176, Table 10, p. 83) showed that parcels where the vegetation-covered area was tended more frequently had significantly higher odds that Tromsøpalme was absent or fully regulated (p=0.003, odds=1.416), relative to parcels where the plant was not or partly regulated. The bivariate analysis showed the same significant association (Mann-Whitney-U test: p<0.001, Table 14, p.

143). Also field visits showed that parcels with mowed lawn and cut hedges had often less *H. laciniatum*.

3.5.3.2 *The effect of “residence status: owners living on the parcels vs. only renters living on the parcels vs. no residence on the parcels”*

The multinomial Model III (n=120, Table 21, p. 150) showed that parcels where only renters lived, compared to parcels without any residence (nobody living there), had significantly higher odds for partial regulation (p=0.031, odds=35.714, see footnote #6) and full regulation (p=0.035, odds=28.571, see footnote #7), relative to no regulation of Tromsøpalme. The binary Model IV showed no significant difference between parcels that were inhabited by only renters and parcels where nobody lived. The binary and multinomial regression models were run with the variable “no residence on parcel” as a reference level (same outliers removed as for Model III or IV). These models showed that parcels where owners lived, relative to parcels without residence, had significantly higher odds to have partly regulated (p=0.076, odds= 8.525) and fully regulated Tromsøpalme (p=0.026, odds=15.130), relative to not regulated Tromsøpalme. Furthermore, parcels where an owner lived, relative to parcels without a residence, had significantly higher odds that Tromsøpalme was fully regulated or absent, relative to not or partly regulated (p=0.029, odds=4.823). In bivariate statistics (Chi-square test), significant differences (at the alpha=0.1 level) in the regulation degree between parcels with and without residence could not be tested because the sample size of the parcels without residents was below five. However, bivariate analysis showed that having a resident on the parcel was significantly associated with tending the vegetation-covered area more frequently (Kruskal-Wallis test: p<0.001, Table 17, p. 146).

In field visits, it could be seen that on parcels without residents (no buildings or empty buildings for sale), Tromsøpalme often spread unchecked. On an unbuilt area at the shore, for example, a lot of Tromsøpalme was found. The landowner had not been at the plot for many years and therefore did not know if Tromsøpalme was there or not. The owner did not tend the vegetation on the plot because she planned to sell the parcel to the municipality. Similarly, Fischer and Charnley (2012) found that forest landowners who are living on the parcel have a higher probability to regulate invasive plants on their plot, and assumed that living on the

Footnote #6: as the parcels where only renters lived were the reference level, the inverse of the odds for the parcels without residence corresponded to the odds of the parcels with only renters: $35.714=1/0.028$

Footnote #7: $28.571 = 1/0.035$

parcel makes it easier for the landowners to tend their property and to regulate the growth of invasive plants.

Also, a difference between parcels where owners lived and parcels where only renters lived could be found. The binary Model IV (n=178, Table 22, p. 151) showed an almost significant association that on parcels where owners lived, relative to only renters, the odds were higher that Tromsøpalme was absent or fully regulated, relative to not regulated or partly regulated (p=0.081, odds=3.121). In bivariate statistics (Chi-square test: p=0.096, Table 20, p. 149), there was an almost significant association that on parcels where owners lived, Tromsøpalme tended to be fully regulated or to be absent while on parcels with only renters living there Tromsøpalme tended to be partly or not regulated; however, the parcels without residence had to be removed from the Chi-square test because the sample size was below five. In fact, one owner in the questionnaire mentioned as a reason why Tromsøpalme was not tended that the renter was responsible for the vegetation on the parcel but not doing anything. However, no difference between owners and renters regarding the regulation behaviors could be found in the multinomial regression Model III (p. 150) and the bivariate analysis.

3.5.3.3 The effect of “one household vs. several households sharing the parcel”

In the multinomial Model I (p. 82), parcels that were shared between several households, compared to parcels that belonged only to one household, had significantly higher odds of partial regulation of Tromsøpalme relative to no regulation (p=0.020, odds=5.068). However, there was no difference between non-regulated parcels and fully regulated parcels concerning the number of households sharing the parcel. In the multinomial Model III (Table 21, p. 150), which included the residence status, this variable showed no significance for any form of regulation. Also, in bivariate analysis (Chi-square test), there was no significant association between the number of households and the regulation degree.

The result that parcels with several households had a higher chance to be partially regulated is surprising because the concept of “diffusion of responsibility” states that the more people are present in a problematic situation, the less the individual feels responsible to solve the problem (Bell et al. 2001: 343). However, the common effort of householders in shared parcels might have had some effect towards controlling the plant because there might have been regular community work on shared parcels (Norw.: *Dugnad*) - which had been indicated by one respondent from a parcel shared among several households.

The binary Model II (p. 83) showed that parcels associated with one household, compared to parcels which refer to several households, had significantly higher odds of fully regulated Tromsøpalme, or not having Tromsøpalme ($p=0.020$, $odds=2.294$), compared to not or partially regulated Tromsøpalme. Also, there was a significant tendency that a higher percentage of one-household parcels were associated with having fully regulated Tromsøpalme or not having Tromsøpalme, relative to parcels that were shared between several households in bivariate analysis (Chi-square test: $p=0.004$, Table 20, p. 149).

To summarize, parcels related to one household tended to have Tromsøpalme which is not regulated. However, the binary Model II showed that parcel which belonged to one household also tended to have either fully regulated Tromsøpalme or to have no Tromsøpalme. So, to some degree on shared parcels it is easier to regulate the plant (partially), but to regulate Tromsøpalme so thoroughly that it does not spread one-household parcels seem to obtain better results. Furthermore, on shared parcels, landowners might not know which part they are responsible for and therefore regulate Tromsøpalme only partially. Another reason for better results in one-household parcels might be that these parcels are smaller than shared parcels and easier to manage. Although Fischer and Charnley (2012) found no impact of parcel size on the regulation behavior of forest landowners, the effect of the parcel size on the regulation of Tromsøpalme could be examined in a further study.

3.5.3.4 The effect of "length of parcel ownership"

The multinomial Model I (p. 82) showed that with increasing years of ownership, the odds for partial regulation of Tromsøpalme increased significantly ($p=0.029$, $odds=1.059$), relative to no regulation of Tromsøpalme. The other multinomial Model III (p. 150) showed even that increasing years of ownership increased the odds significantly for both partial ($p=0.009$, $odds=1.073$) and full regulation ($p=0.042$, $odds=1.055$), relative to no regulation. In bivariate analysis, this relationship was only close to significance (ANOVA: $p=0.089$, $F(2, 133) = 2.464$, $n_{total}=135$). A reason for a better regulation status of parcels that are owned longer could be that it takes several years of consistent regulation measures to remove hogweed (Nielsen et al. 2005) (see also Chapter 1.4, p. 8). Also, it could be that respondents who have owned land for a longer time are more interested in taking care of the land.

3.5.3.5 *The effect of “presence of children under 10 years on the parcels vs. absence of children”*

Bivariate analysis showed a significant tendency (Chi-square test: $p=0.041$, Table 19, p. 148) of a higher percentage of residential parcels with children (younger than 10 years) belonging to the category of non-regulated parcels, compared to (residential) parcels without. This result was unexpected as it was thought that parents might control Tromsøpalme better on their parcel to protect their children. However, the same percentage of parcels with children (45.8%, $n=11$) and parcels without children (44.6%, $n=45$) belonged to the group of fully regulated parcels, so here no difference could be found. Inclusion of the variable “children’s presence or absence on the parcels” into the regression models led to insignificance of other included variables and therefore the variable was kept out.

3.5.3.6 *The effect of “number of people in the respondent’s household”*

The binary Model II (p. 83) showed that the more persons were living in the respondent’s household, the significantly higher were the odds to have no or fully regulated Tromsøpalme on the parcel, relative to not or partly regulated Tromsøpalme ($p=0.006$, odds=1.460). The bivariate test showed the same significant association (Mann-Whitney-U test: $p=0.002$, Table 14, p. 143). A larger number of people living in the household may offer more labor force to take care of Tromsøpalme. The inclusion of this variable in the other binary Model IV (p. 151) made other variables insignificant and therefore it was left out.

Other socio-demographic variables, such as age, gender, income, residence time, education, or incurring injuries were not found to be significantly related (at the $\alpha=0.1$ level) to the regulation degree of Tromsøpalme or to the contribution of the parcels to Tromsøpalme’s spread. As shown in previous chapters, experiencing injuries (or knowing somebody who did) had an effect on values and normative beliefs, namely that respondents perceived Tromsøpalme as dangerous, considered it less to be a symbol of Tromsø, and saw regulation measures as important on Tromsø Island (Chapter 3.3.1.2, p. 50; Chapter 3.3.1.3, p. 53; Chapter 3.3.2.2, p. 57). But seemingly, experiencing injuries did not have an influence on landowners’ regulation behaviors, according to the logistic regression analyses.

3.5.3.7 *The effects of “normative beliefs” and “values”*

The multinomial Model I (p. 82) showed that respondents who found regulation measures for Tromsøpalme on Tromsø Island necessary had also significantly higher odds for partial regulation ($p=0.002$, odds=2.796) or full regulation ($p<0.001$, odds=3.531) on their land, relative to no regulation. Also, the bivariate test showed that a higher regulation degree was significantly associated with considering regulation measures on Tromsø Island as necessary (Kruskal-Wallis test: $p=0.027$, Table 16, p. 145). Additionally, bivariate analysis showed that seeing Tromsøpalme's occurrence on Tromsø Island as more problematic was significantly associated with a higher regulation degree (Kruskal-Wallis test: $p=0.007$, Table 16, p. 145).

The binary Model II (p. 83) showed that respondents who regarded Tromsøpalme as a problem had significantly higher odds to own parcels with no Tromsøpalme or fully regulated Tromsøpalme, relative to non- or partly regulated Tromsøpalme ($p=0.001$, odds= 1.626). Also in the bivariate test, this association was significant (Mann-Whitney-U test: $p=0.002$, Table 14, p. 143) and the bivariate test also showed that respondents who thought that regulation measures are necessary had a significantly higher tendency to own parcels where the plant was fully regulated or absent, relative to not or partly regulated (Mann-Whitney-U test: $p=0.031$, Table 14, p. 143). Both Daab and Flint (2010) and Fischer and Charnley (2012) found that being concerned about invasive species is related to landowners taking action against invasive species on the own property.

As discussed before, the normative belief “seeing Tromsøpalme as a problem on Tromsø Island” seemed to relate more to respondents who thought Tromsøpalme is a problem in itself. However, the normative belief “necessity of regulation measures on Tromsø Island” might imply that rather the amount of Tromsøpalme is seen as the main problem and therefore regulation measures are considered as necessary (see Chapter 3.3.2.1, p. 55). So, the former normative belief represents a stronger antipathy towards the plant. The regression analysis seemed to show a similar pattern, because seeing Tromsøpalme's occurrence as a problem was related to landowners whose parcels did not contribute to the spread of Tromsøpalme.

Contrary to the normative beliefs, none of the values investigated in this study (aesthetical, health-related, and symbolical) were significant in any of the four regression models. The normative beliefs are more directly associated with the topic “regulation of Tromsøpalme”, and have therefore more influence on the regulation behaviors of landowners than general values of the plant (cf. Ajzen & Fishbein 1977). It is remarkable that, although landowners

mentioned the ornamental aspect of the plant as a reason for not removing Tromsøpalme, the aesthetical value was not associated with the regulation status of Tromsøpalme on the parcel in the regression analyses. A reason for this discrepancy could be that the question related to the aesthetical value addressed the plant's appearance in general but not the specific plant on the respondents' parcels. This aspect might show that *H. laciniatum* in general is evaluated differently depending on if the question refers to the specific Tromsøpalme on the landowners' parcels or if the question refers to the plant in general.

There was no significant association (in both the regression analyses and the Chi-square test at the $\alpha = 0.1$ level) of landowners' normative beliefs towards the degree Tromsøpalme should be removed from Tromsø Island by institutions and the landowners' regulation behaviors on their parcel (however, for the Chi-square tests, the number of respondents favoring no removal was below 5 so that they were excluded from this test, and it was therefore not possible to make a statement about these respondents). These results might show again that Tromsøpalme is evaluated differently, depending on if the question refers to the plant that grows on the landowners' parcels or if the question refers to Tromsøpalme in general. This aspect could also be found during a conversation with a landowner who mentioned that she had removed the plant completely from her parcel, but at the same time she appreciated it along the roads and the shore. However, a deviation in the questionnaire answers between perception and actual behavior can also be related to bias in the analyses, as in 20 cases the respondents who answered were not the persons who regulated Tromsøpalme. Furthermore, results referring to the normative belief about the removal of Tromsøpalme from Tromsø Island might be biased because the question design had some drawbacks (see also discussion about bias in Chapter 3.6, p. 86 - 87).

Nevertheless, the fact that a duality of the locals' evaluations of Tromsøpalme exists was mentioned by all key informants. For example a key informant from Tromsø Municipality said: "*[Tromsøpalme] is a symbol of Tromsø and they are nice plants if you do not have them in the garden*". The key informant from Tromsø University mentioned the following regarding this idea: "*It is not easy to put [the relationship between locals and Tromsøpalme] into words because people have mixed feelings I think. Sometimes they like it and think it is a bit impressive in a way because it is so large and they like to take pictures of it in the winter when the dry stems are decorative and so forth. But they do not want to have [Tromsøpalme] in their own garden, or their own back yard.*" So, key informant interviews suggested an ambivalent perception as well.

Table 9: Model I - Multinomial logistic regression of the outcome variable “regulation degree of Tromsøpalme on respondents’ (landowners’) parcels: no regulation (reference category), partial regulation, full regulation” with parcel characteristics and normative beliefs as independent variables (bold). All data refer to vegetation period May-September 2012 (n=120). Two outliers were removed (see Endnote #13, p. 158). The multinomial Model III is the alternative model (Table 21, p. 150).

<u>Outcome variable:</u> Degree of regulation of Tromsøpalme on the parcels in the time period May - September 2012		B	std. Error	p-value	odds
<i>Partial regulation of Tromsøpalme on the respondents' parcels; at least one plant flowered on the parcels</i>	Intercept	-8.761	2.250	0.000	
	Frequency vegetation-covered area on parcels was tended between May and September 2012 (1: never, 6: several times per week)	0.917	0.265	0.001	2.501 ^{***}
	Parcels associated with several households each <u>Reference:</u> Parcels associated with one household each	1.623	0.697	0.020	5.068 ^{**}
	Length of parcel ownership	0.057	0.026	0.029	1.059 ^{**}
	Normative belief: Evaluating the necessity of regulation measures of Tromsøpalme on Tromsø Island (1: not necessary, 5: necessary)	1.028	0.332	0.002	2.796 ^{***}
<i>Full regulation of Tromsøpalme on the respondents' parcels; no plant flowered on the parcels</i>	Intercept	-9.258	2.271	0.000	
	Frequency vegetation-covered area on parcels was tended between May and September 2012 (1: never, 6: several times per week)	1.058	0.264	<0.001	2.881 ^{***}
	Parcels associated with several households each <u>Reference:</u> Parcels associated with one household each	0.702	0.686	0.307	2.017
	Length of parcel ownership	0.037	0.026	0.147	1.038
	Normative belief: Evaluating the necessity of regulation measures of Tromsøpalme on Tromsø Island (1: not necessary, 3: neutral, 5: necessary)	1.262	0.340	<0.001	3.531 ^{***}

Reference category: no regulation of Tromsøpalme on parcels

Nagelkerke-pseudo-R² = 0.365 (maximum 1.0)

*** Significant at 0.01, ** Significant at 0.05, * Significant at 0.1

Table 10: Model II - Binary logistic regression of the outcome variable “contribution of the respondents’ (landowners’) parcels to the spread of Tromsøpalme: no or partial regulation (reference category) vs. full regulation of Tromsøpalme or plant absent” with socio-demographic variables, parcel characteristics, and normative beliefs as independent variables (bold). All data refer to vegetation period May-September 2012 (n=176). No outlier removed. This Model II includes one significant variable (number of persons living in the respondent’s household) more than the alternative binary Model IV (Table 22, p. 151).

<i>Outcome variable: Tromsøpalme was fully regulated/ absent on the parcels or Tromsøpalme was partly regulated/not regulated on the parcels</i>	B	std. Error	p-value	odds
Frequency vegetation-covered area on parcels was tended between May and September 2012 (1: never, 6: several times per week)	0.348	0.119	0.003	1.416 ^{***}
Parcels associated with one household each (Reference: Parcels associated with several households each)	0.831	0.357	0.020	2.294 ^{**}
Number of persons who lived in the household of the respondent	0.378	0.138	0.006	1.460 ^{***}
Normative belief: Evaluating Tromsøpalme’s occurrence on Tromsø Island (1: did not perceive it as a problem, 5: perceived it as a problem)	0.486	0.151	0.001	1.626 ^{***}
Constant	-4.461	0.908	0.000	0.012

Reference category: *no or only partial regulation of Tromsøpalme on the parcels*

Nagelkerke-pseudo-R² = 0.194 (maximum: 1.0)

*** Significant at 0.01, ** Significant at 0.05, * Significant at 0.1

3.5.4 Summary of landowners’ regulation of Tromsøpalme on their parcel

This section summarizes the findings of the landowners’ regulation behaviors towards Tromsøpalme on their parcels between May and September 2012. On half of the parcels (whose landowners knew about the presence of the plant on their parcel), Tromsøpalme was fully regulated so that the plant did not flower and spread while on a third Tromsøpalme was only partly regulated so that at least one plant flowered. On a fifth of the parcels, the plant was not regulated at all. The most frequent measures of those respondents fully or partly regulating Tromsøpalme were cutting of the stems and digging out the roots. A higher percentage of landowners deposited the plant waste on the parcel compared to the percentage of landowners putting it into the garbage or to the municipal waste disposal site. This behavior might contribute to the spread of Tromsøpalme on the parcels according to findings from Pyšek et al.

(2007a). Most of the landowners who were regulating the plant (fully or partly) did this because it spread and suppressed other plants on their parcels. Most of the landowners who were not (fully) regulating Tromsøpalme (partly or not regulating) had given up or did not care about having it on their parcels.

According to the regression analyses, the regulation behaviors were associated with socio-demographic characteristics, parcel characteristics, and normative beliefs. As multinomial logistic regression showed, parcels where Tromsøpalme was regulated (partly or fully between May and September 2012), compared to parcels where Tromsøpalme was not regulated, seemed to be related (significant at the $\alpha=0.1$ level) to: a vegetation-covered area which was tended more often, to residents (owners or renters) living on the parcel (which often also means that the vegetation was more tended), to several households associated with the parcel, to longer parcel ownership, and to a landowner agreeing with regulation measures on Tromsø Island. Binary logistic regression showed that parcels which did not contribute to Tromsøpalme's spread (full regulation or absence of Tromsøpalme on the parcel between May and September 2012), compared to parcels that contributed to the spread (no or only partial regulation), were related (significant at the $\alpha=0.1$ level) to: a vegetation-covered area that was tended more frequently, to owners living on the parcel, to only one household that is associated with the parcel, to landowners with a higher amount of persons in the household, and to landowners who tended to think that the occurrence of Tromsøpalme is a problem on Tromsø Island. Additionally, bivariate analyses showed that on residential parcels where children (below the age of 10 years) lived Tromsøpalme tended to be less regulated, compared to residential parcels without children.

The results from the two types of logistic regression analyses showed that parcels which belonged only to one household seemed to be associated with the two extremes of having either no Tromsøpalme or to have not regulated Tromsøpalme. Parcels belonging to several households seemed to be associated to partial regulation of Tromsøpalme. All results of variables that were associated with the regulation degree are summarized in Table 11 (p. 85). However, according to the low R^2 -values, the normative beliefs and parcel characteristics mentioned in the previous paragraph were only moderately predictors for the regulation degree and the contribution of parcels to Tromsøpalme's spread. The questionnaire and interview results reflected an ambivalent perception of the locals towards Tromsøpalme as many landowners considered Tromsøpalme as tolerable or even favorable on Tromsø Island as long as they did not need to deal with the plant on their own parcel.

Table 11: Predictors for parcels where Tromsøpalme was regulated between May and September 2012 (partially or fully, left column) and for parcels that did not contribute to the spread of Tromsøpalme on Tromsø Island between May and September 2012 (full regulation/absence of Tromsøpalme, right column), significant in regression analysis at the alpha=0.1 level.

Characteristics of parcels where Tromsøpalme was regulated (partially or full) compared to parcels where Tromsøpalme was not regulated	Characteristics of parcels with full regulation / absence of Tromsøpalme compared to parcels with no regulation or partial regulation of Tromsøpalme
<ul style="list-style-type: none"> • Higher frequency of tending vegetation-covered area on parcels • Somebody lived on parcels (landowners or only renters) • *Parcels associated with several households each • Landowners owned the parcels longer • **No children (below 10 years) lived on parcels • Landowners of parcels considered regulation measures as important on Tromsø Island 	<ul style="list-style-type: none"> • Higher frequency of tending vegetation-covered area on parcels • Landowners lived on parcels • *Parcels associated with one household each • More persons in the households of the landowners of the parcels • Landowners of parcels considered Tromsøpalme's occurrence as problematic on Tromsø Island

*Parcels which belonged only to one household each were associated with both no regulation of Tromsøpalme and the full regulation/absence of Tromsøpalme.

**The variable "presence vs. absence of children below 10 years on parcels" was only significant in the bivariate analysis but not in the regression analyses.

3.6 Bias in the questionnaire design and in the analysis

The potential bias of the research design was discussed before: mixed methods studies have drawbacks concerning legitimation (Chapter 2.3, p. 19). Furthermore, limitations in the qualitative data gathering (Chapter 2.4.1, p. 21), the sampling of the parcels (see Endnote # 10, p. 156), and in the use of mail questionnaires (Chapter 2.4.3.2, p. 33) might have led to biased conclusions. In the following section, it is discussed how the formulation of questions in the questionnaire, the questionnaire design, and the analysis of the questionnaire could have led to potential bias.

The questions related to physical injuries which respondents might have suffered from contact with the phototoxic sap of Tromsøpalme were asking only about permanent injuries (Question

37 and 38, p. 127) and were probably formulated in a confusing way. Hyperpigmentation, which can develop from the burned skin part, might disappear after some months and also allergic reactions might be only temporary (Kavli & Volden 1984). If the questionnaire had asked if respondents experienced “health problems” from Tromsøpalme instead of “permanent injuries”, more respondents might have indicated health impacts in the questionnaire.

There were also drawbacks in the question formulation relating to the normative belief “degree Tromsøpalme should be removed from Tromsø Island” which was developed out of the two questions: “In which areas do you think it is good to remove Tromsøpalme?” (Question 35a, p. 126) and “In which areas do you think it is good to keep Tromsøpalme?” (Question 36a, p. 127). In the questionnaire, the respondents could only mark “should be removed completely from Tromsø Island” or “should grow on all these given areas”. Landowners who ticked the first option were categorized as respondents who wished “full removal” while those choosing the second option were categorized as “favoring no removal at all”. Respondents who had ticked neither of these two answers were categorized during analysis as preferring “partial removal from some areas on Tromsø Island”. This categorizing was therefore somehow artificial as the respondents could not directly answer “partial removal”. Respondents who ticked “should grow on all these given areas (private parcels, road sides, along the shore, on agricultural areas, on public areas)” were regarded as not wishing a regulation at all on Tromsø Island although the question actually referred only to those specific areas.

It is possible that the results would have been different if the questions had been formulated differently. There should have been three questions. One question should have asked about the respondents’ preferences regarding the removal of Tromsøpalme on Tromsø Island with these optional answers: 1) complete eradication on Tromsø Island, 2) partial removal from some areas 3) no removal of the plant anywhere. The subsequent two questions should have asked the respondents who preferred partial removal in which areas 1) the plant should be removed and 2) where it should not be removed.

There were further drawbacks concerning answer options and the questionnaire design. Some questions in the survey which related to the regulation of the plant on the parcel did not have a “don’t know” option (for example Question 24 – 26, p. 124 - 125). This could have led to biased results because the respondents might just have guessed without knowing the correct answer (Hawkins & Coney 1981). However, providing “don’t know” options could also prevent the respondents from reflecting longer on alternative answers that would provide more substantial information (Poe et al. 1988). Due to the brochure format of the questionnaire,

seven respondents had even overlooked whole pages of the questionnaire. Generally, there were a lot of unanswered questions in the questionnaire which led to missing data.

Some inaccuracy in the analysis procedure should be mentioned: the analysis assumed a connection of the landowners' characteristics (values, normative beliefs, socio-demographic characteristics, and parcel characteristics) with the landowners' regulation behaviors. However these relationships are to some extent theoretical and it is not clear to what extent values, normative beliefs, and behavior determine each other and how large the impact of other, not measured factors (for example knowledge, parcel topography, inaccessible areas on the parcel, or parcel size) are on the regulation behaviors (cf. Kollmuss & Agyeman 2002). These aspects were not in the focus of the study but could be studied in future research. Furthermore, the fact that the plant tends to grow on one parcel but not on the neighboring parcel might have - besides the landowners' characteristics and perceptions - also other reasons which had not been investigated in the study: for example, soil conditions as *Heracleum laciniatum* prefers nutritious soil (Fröberg 2010) or competition for light with other plant species as Tromsøpalme does not flower under shadow of trees (Fremstad 2006).

In the analysis, there was a mismatch between perceptions and regulation behavior in the case of some parcels. 20 respondents answered that they had not regulated the plant themselves. This could have impacted the validity of the results as in these cases values and normative beliefs from the respondent were compared to the behavior of another person. Furthermore, those respondents not regulating *H. laciniatum* themselves might not have enough information about the status and the regulation of the plant on the parcel. But generally, answers in mail questionnaires tend to be a mix of different opinions in the household (Williams 2003); it was indicated on four questionnaires that several persons filled in the questionnaire. This could have evened out the mismatch between perceptions and regulation behavior. Perceptions and regulation status of the plant might also not be comparable if the respondent had moved to or bought the parcel just recently and so the regulation status of Tromsøpalme on the parcel refers actually to the previous resident. The problems mentioned above were potential sources of inaccuracies and might have influenced the results; however, some deviations related to the problems mentioned in this paragraph might be mitigated when outliers were removed from the regression models (see Endnote #13, p. 158).

There may have also been a selection bias because sampling was done with a mail questionnaire. Respondents that are more interested in invasive species might answer more frequently (Groves et al. 2006). Also, respondents who have more time available might answer

more frequently to mail surveys (Williams 2003). Research has also shown that mail questionnaires are biased towards respondents with higher education (Cartwright 1986). In this study here, 70% of the respondents had higher education while the general level of higher education was around 35% in Tromsø in 2012 (Statistics Norway 2013b). Although the percentage of higher educated people specifically among landowners in Tromsø is not known, the high percentage of higher educated respondents in the sample might indicate to a selection bias towards higher educated respondents. A distortion of results might also be caused by the social desirability bias when respondents answered in a way they considered as appropriate instead of answering what they were really thinking (Ganster et al. 1983). Furthermore, the questionnaire was sent out in late autumn 2012. A lot of landowners might have forgotten how and to what degree they regulated the plant five months before, and their answers might not be as accurate as if they had been asked during the vegetation period. In the following section, the most important results of the study are summarized.

4 Conclusion: Summary and management implications

This chapter summarizes the findings of the study, and discusses potential implications of the findings and further literature for the management of Tromsøpalme on Tromsø Island and for further research.

4.1 Summary

Invasive Tromsøpalme (*Heracleum laciniatum*) is regarded as a problem by locals in the city of Tromsø in Northern Norway because of its continuous spread, its suppression of other plant species, and because the plant's phototoxic sap can lead to injuries. Simultaneously, *H. laciniatum* is appreciated by many locals as a symbol of Tromsø (key informants Tromsø Municipality, Tromsø University, pers. comm. 2012). This study investigated locals'/landowners' awareness, and their evaluation of values and normative beliefs regarding invasive Tromsøpalme as well as the landowners' regulation behavior towards the plant on their parcel.

Concerning awareness of landowners/locals towards Tromsøpalme (*Research question 1*), the questionnaire results showed that except for one, all landowners were aware of Tromsøpalme, and 184 out of 199 landowners knew if Tromsøpalme was on their parcel or not. Also, key informants from Tromsø Municipality and Tromsø Arts Association suggested that almost everybody in Tromsø knows what Tromsøpalme is.

The evaluation of Tromsøpalme's values by the landowners/locals and the association of these evaluations with different population groups was investigated (*Research question 2*). The aesthetical value of Tromsøpalme was generally evaluated positively (considered as nice) by the landowners. A positive evaluation of the aesthetical value was significantly associated with landowners who were: female, older, owned their parcel longer, or lived longer in Tromsø. The health value of the plant was generally ranked as negative (was seen as dangerous to health) and this evaluation was significantly associated with landowners who experienced permanent injuries from contact with the plant's sap (or knew somebody who did). Among all the landowners, a slightly higher amount evaluated the symbolical value of Tromsøpalme as negative (considered it not important as a symbol of Tromsø), compared to the number of landowners who evaluated it as positive. Specifically, landowners who received permanent injuries (or knew somebody who did) tended to disregard Tromsøpalme's symbolical meaning almost significantly. Contrary, there was a significant association that female landowners and

landowners with higher education considered Tromsøpalme important as a symbol of Tromsø. Respondents with higher education, and women tend to emphasize the intrinsic values of wildlife (Vaske et al. 2001) which might explain why higher educated and female landowners emphasized the importance of Tromsøpalme as a symbol for Tromsø.

It was investigated how landowners/locals evaluated normative beliefs concerning regulation of Tromsøpalme on Tromsø Island (by local authorities) and it was examined how these beliefs were associated with different population groups (*Research question 3*). More than three in four landowners thought regulation measures towards Tromsøpalme on Tromsø Island were necessary, but most of the respondents preferred partial removal (from some areas) over full or no removal of the plant from Tromsø Island. The respondents favoring partial removal were concerned about Tromsøpalme's spread and its impact on other vegetation however found its cultural value also important. Even a key informant from Tromsø Municipality with a strong negative opinion towards the plant was willing to allow it to be kept in some areas, while a key informant from the Tromsø Arts Association and the Tromsøpalme enthusiast who both had a generally positive opinion towards the plants were accepting some regulation measures.

Respondents with higher education significantly tended to favor a partial removal of the plant, to see regulation measures as less important, and to consider the occurrence of the plant less as a problem. Higher educated people view human-wildlife conflicts from a more distanced position (Skogen 2001), furthermore, as they were related to a shorter residence time in Tromsø and ownership time, so they might not have so much negative experience with the plant yet. Higher educated respondents and respondents with a shorter residence time are also known to disregard management of wildlife (Manfredo et al. 2003). To the contrary, respondents who experienced injuries (or knew somebody who did), significantly tended to favor a full removal of the plant from Tromsø Island, saw regulation measures as important, and considered the occurrence of the plant on Tromsø Island as problematic. This might be related to the negative health impact of the plant but also that these landowners might have to deal longer with the plant as these landowners were also associated with a longer residence time and longer ownership. Key informants (from Tromsø Municipality or from Tromsø Arts Association with a farming background) who encountered the negative issues of Tromsøpalme in their daily life tended to regard the plant more negatively than other key informants from the Tromsø Arts Association and the Tromsøpalme enthusiast. These results could show that personal experience of the negative aspects of the plant (its impact on health or the difficulties to control it) leads to stronger antipathy towards the plant. The high amount of landowners who favored

only a partial removal in the study might also be related to the fact that the respondents lived in an urban area. Urban citizens are known to see invasive species as less problematic, relative to people living in rural areas (Fitzgerald et al. 2007). Nevertheless, the percentage of respondents who preferred only a partial removal of Tromsøpalme might be overestimated as probably a disproportionately large amount of higher educated respondents answers to the mail questionnaires, according to Cartwright (1986).

The regulation behavior of the landowners between May and September 2012 was investigated (*Research question 4*). Half of the landowners indicated that the plant was fully regulated on their parcel; this means that no plant flowered and so did not seed or spread. The remaining respondents were not regulating it or regulating it only partly, which might enable the plant to flower and to spread further. The most common reasons the landowners indicated for regulation (full or partial) of Tromsøpalme on their parcel was the invasive character of Tromsøpalme. The most common reason for not fully regulating Tromsøpalme (partial or no regulation) was that the landowners were overwhelmed by the task or did not care. Some kept Tromsøpalme on their plot for ornamental purpose even though almost no landowners in the study had planted it.

The results of the multinomial regression analyses (significant at the $\alpha=0.1$ level) showed that parcels where Tromsøpalme was regulated (partly or fully between May and September 2012), relative to parcels where it was not, tended to have the vegetation-covered area tended more frequently, to have a residence (owners or only renters living there), to be associated with several households, to be owned by the landowners for a longer time, and to belong to an owner who thought that regulation measures towards Tromsøpalme on Tromsø Island are necessary (*Research question 5*). Concerning parcels that did not contribute to the spread of Tromsøpalme (Tromsøpalme was absent or was fully regulated between May and September 2012), compared to parcels where there was a risk that the plant could spread from (not or partly regulated), the results of binary regression (significant at the $\alpha=0.1$ level) showed that these parcels tended to: have a vegetation-covered area that was tended more often, have owners living on the parcels, be associated with only one household, and to belong to landowners who perceived Tromsøpalme as a problematic plant on Tromsø Island (*Research question 6*). Questionnaire data, landowner conversations, and all key informant interviews showed that although many landowners did not want to have Tromsøpalme on their own land, they seemed to accept or even appreciate its general occurrence on Tromsø Island.

Even if the respondents see the necessity of official regulation measures in some areas on Tromsø Island, a lot of them find the general occurrence of Tromsøpalme on Tromsø Island as acceptable or even important. However, many landowners do not like to have the plant on their parcel. Based on the findings of this study some recommendation can be made which could be helpful for further regulation of Tromsøpalme on Tromsø Island.

4.2 Management implications

This chapter evaluates how results of the interviews and the questionnaire could be translated into new information for media and authorities about dealing with Tromsøpalme on Tromsø Island.

4.2.1 Considering objectivity in information campaigns

The information spread by media and authorities seems to be sufficient for propagating awareness of Tromsøpalme because almost all the landowners knew about the plant. According to the key informants from Tromsø Municipality, many locals seem to know also about problematic aspects of *H. laciniatum*, such as the negative health impact and the fact that it replaces other vegetation and changes the cultural landscape. However, the way information about invasive species is communicated can be emotional, biased (Gobster 2005), and therefore might not consider all the different perceptions of Tromsøpalme the locals have.

According to the study and former research, the reason that Tromsøpalme is perceived so differently seems to arise from different experiences the locals have regarding the plant and their different ways of learning about wildlife in general. Many locals have never had a bad experience with *H. laciniatum* and consider the plant's cultural value as important while for other locals Tromsøpalme is mainly an ecological and health problem or an uncontrollable plant that replaces their garden vegetation. Generally, urban residents tend to be skeptical towards management of nature, compared to rural residents (Manfredo et al. 2003), and might have a different opinion of what is native and should grow in the green areas compared to conservationists, scientists and politicians (Rotherham & Lambert 2011; Staples 2001). All these aspects need to be considered by authorities and scientists in the management of invasive species (Rotherham & Lambert 2011).

Tromsøpalme has become a “native” in the eyes of many locals. This view is to some extent legitimate because the concept of invasive species is discussed by many scientists. For

example, Warren (2007) criticizes that the point in time that indicates if a species is non-native or native is arbitrary. While older theories in ecology are based on a static concept of nature, newer theories in ecology describe nature as a chaotic system that changes all the time. Therefore, the theories of invasion biology, which automatically see introduced species as problematic and unnatural, are increasingly questioned (Peretti 1998). As the concept of invasive species is so controversial, it is important to consider different opinions concerning the regulation of Tromsøpalme on Tromsø Island.

Environmental managers might think that the perceptions of invasive species should be influenced until locals agree on the regulation of invasive species (Gobster 2005; Schüttler et al. 2011; van Wilgen 2012). To inform the public about invasive species, conservationists, scientists and media often stress the negative aspects of invasive species and stigmatize them as evil in order to emphasize the importance of the problem (Gobster 2005). Some articles in local newspapers in Tromsø follow the connotation of the evil invasive Tromsøpalme. An article mentions the “*hateful Tromsøpalme*” that landowners had to “*fight*” in a “*palm-murder operation*” (Hansen 2011). Another article called the measures a “*war*” against Tromsøpalme (Lysvold 2008). However, there have also been newspaper articles where more differentiated opinions were expressed (for example Sveen 2007).

Informing the public about invasive species by only emphasizing the negative aspects might be critical. It creates unnecessary fear among the locals or can even lead to declining credibility of the authorities and scientists who seem to lose their objectivity when disregarding the positive values of invasive species (Gobster 2005; Larson 2005). If the locals’ values are not included as part of the management plans this can lead to an opposing reaction of the locals against regulation measures of invasive species (Blossey 1999; Gobster 2005; Schüttler et al. 2011). Furthermore, changing values towards wildlife in a desired direction could be very difficult because they are embedded in a societal context that has developed over several decades (Manfredo et al. 2003).

Key informants from the Tromsø Arts Association and the local Tromsøpalme enthusiast showed concern about the one-sided information about Tromsøpalme spread by the media in Tromsø. Therefore, the Tromsø Arts Association organized an exhibition in autumn 2012 which was meant to show more differentiated views about Tromsøpalme. This seems to be a promising approach because it creates a debate about Tromsøpalme in the media and contributes to a balanced view of Tromsøpalme in the public. Even though the negative aspects of Tromsøpalme should not be trivialized, the different perceptions of locals should not be

neglected. Therefore media (as they have an important role in the public debate about Tromsøpalme) and officials should not only emphasize the negative aspects of the plant to raise the awareness, but should also respect its aesthetical value and cultural meaning (Gobster 2005; Schüttler et al. 2011). This could also make regulation measures of Tromsøpalme more acceptable for locals.

4.2.2 Approaches to a management of Tromsøpalme on Tromsø Island

The results of the study showed that Tromsøpalme's occurrence in some areas on Tromsø Island is preferred by many respondents. Two thirds of the landowners wished only a partial removal of Tromsøpalme from some places on Tromsø Island. Of these respondents more than a half stated that the plant should be left at the shore. More than a fourth of these landowners indicated this for roads, although in these areas the plant has a high potential to spread. Almost a third of these landowners indicated that they would prefer to keep the plant on private parcels. Four landowners wished to keep Tromsøpalme in well-managed areas, such as a "park", where the locals can go and look at the plant. Two respondents suggested leaving the plant in areas where the plant cannot spread so easily and few people would come in contact with the plant. This partial removal, however, would require professionals who prevent the plant from "escaping", which was also a concern of a questionnaire respondent; these areas should be very well-managed as wind, water, and people will continue to spread the seeds. So, partial controlling might be an unsatisfactory way of regulating Tromsøpalme.

However, key informants from Tromsø Municipality, Tromsø University and from GWN did not believe that the Tromsøpalme could ever be removed from Tromsø Island and the key informant from the Tromsø University as well as questionnaire respondents were concerned that measures would require a lot of resources. If invasive plants are spread too far and have been too long in their established areas, eradication might not be possible anymore, according to the experiences of Gardener et al. (2010) who investigated the success of invasive plant eradication projects in Galapagos. This might also be the case with Tromsøpalme on Tromsø Island.

In these situations, Rotherham and Lambert (2011) believe that management of invasive species needs to be more pragmatic, not aiming at eradicating the species but controlling it, as invasive species management is an everlasting process. In their opinion, well-planned, organized, and consistent controlling is more financially sustainable in the long-run and more democratic than focusing on removing invasive species (which might be an unachievable goal).

So, even though this is not the optimal solution for conservationists in Tromsø, a partial removal and a partial keeping of Tromsøpalme on Tromsø Island seem to be the most realistic solution and might be most supported by the locals in Tromsø.

If not well-planned, trying to remove invasive plants might be a waste of time and resources (Gardener et al. 2010). If authorities plan further regulation, decisions about areas where Tromsøpalme should be managed should consider available resources and therefore focus on specific areas where the occurrence of the plant is considered to be most problematic and where the plant has high chances to spread further. Authorities could focus on public places and roads close to the future conservation area on the top of Tromsø Island to prevent Tromsøpalme from spreading there, and on public areas in the city center which are most visited by the locals. Also measures along the roads in areas where Tromsøpalme is very dense could be important, for example north of the city center close to the industrial zone as the plant can spread here over long distances. However, in the decision about areas that need regulation, also the probability of reinvasion should to be considered (Gardener et al. 2010). Authorities could also think about grazing in some areas at the beginning of the vegetation season as this measure had shown to be efficient on the neighboring island, according to key informants from Troms County Governor.

Furthermore, the management process should consider locals' preferences. In workshops with citizens, potential conflicting issues could be identified and discussed. The citizens could be informed about where and how regulation measures will be conducted and why they are important in areas where the plant has the chance to spread further, for example along roads and the shore. However, the authorities could consider allowing the plant in some well-managed areas on the island where not so many people would come in contact with the plant and where it is easier to prevent the plant from escaping. To find an agreement what areas regulation should focus on, authorities together with locals should discuss Tromsøpalme's values and weigh reasons for regulating and for keeping the plant. On the basis of locals' preferences, together with considerations about reinvasion and financial resources, specific areas on Tromsø Island could be identified where the plant could/should be kept or where it could/should be regulated.

Based on the experiences from Galapagos (Gardener et al. 2010), it might be difficult to regulate the plant on private areas on Tromsø Island, especially as so many landowners are involved and the plant has spread over a large area. There will always be landowners who do not regulate Tromsøpalme rigorously enough and there might be areas on the parcel where the

plant is more difficult to regulate and so the plant will always find places where it can grow and spread. In this study, almost half of the landowners with Tromsøpalme on their parcels seemed to have the plant under full control by preventing the spread of the plant. More than a third of the landowners with Tromsøpalme on their parcel were able to prevent the spread of the plant at least partially. However, every fifth landowner with Tromsøpalme did not regulate it and from those almost every other landowner did not mind having Tromsøpalme on the parcel. More than a third of the landowners with Tromsøpalme had to deal with Tromsøpalme's spreading from neighboring parcels and every fourth landowner with the spreading of the plant from road sides. Furthermore, many landowners go on vacation during the summer months, so this means that there are generally less people available to tend the private land at the time when Tromsøpalme flowers and seeds. Because of all these aspects, official help is necessary.

According to the results of this study, private owners who could be supported by authorities might be, for instance, those who own parcels without a residence or parcels where currently nobody lives. These parcels can present problems as the successful management of the plant demands active and permanent control. The owners of these parcels could receive financial incentives or active help by authorities. Furthermore, the municipality could target landowners that recently bought their parcel and help them in the first years to control the plant. Also parcels that are shared by several households could receive active or financial help because owners of these parcels have problems to regulate the plant fully or to remove it. Furthermore, the authorities could try to get permission from landowners to regulate the plant on private land close to public areas to prevent the plant spreading onto public land.

In addition, landowners could be better informed about how to regulate Tromsøpalme. If landowners deposit refuse from the plant on their plot instead of using the garbage bin or the municipal waste disposal site, the plant may spread further on their parcels, according to the findings of Pyšek et al. (2007a). Also, landowners often seem to neglect the tending of border areas, or spaces on the parcel that are hidden or inaccessible (for example behind garages or on steep slopes), which had been seen during field work (Figure 12 and Figure 14, p. 109 - 110). These facts seem to indicate that authorities should put more emphasis on these issues in their information campaigns. To improve landowners' regulating measures at parcel borders, the coordination among the landowners and their neighbors should be encouraged. Landowners together with their neighbors could learn how to manage the plants efficiently and safely. This approach could be a promising start, as having more households involved means at least a certain amount of regulation. Furthermore, landowners could be informed about not leaving the

refuse on the parcel or on the compost but disposing it in the garbage so that the seeds are not able to spread further on the parcel.

It was discussed at the beginning of this section (p. 94) that a partial removal of invasive species is more pragmatic than attempts of full eradication. Also Hobbs et al. (2006) believe that it might be impossible to bring ecosystems that are a mix of native and invasive species (“novel ecosystems”) back into the original state of including only native species. Therefore, they demand a stronger focus of conservationists on preserving the important services of those “novel” ecosystems instead. They also recommend more research about the ecological benefits of invasive species. In that sense, more research on the ecological impact of *Tromsøpalme* in Tromsø might help to find out which vegetation types, plant and animal species are impacted mostly by *Tromsøpalme* and how this impact should be evaluated. In this way, it can be defined which areas in Tromsø need to be kept free of *Tromsøpalme* and for which areas it might be tolerable to have the plant.

Apart from regulating the plant it could be an option to make use of *Tromsøpalme*. A key informant of the Tromsø Arts Association used the plants’ dry stems as building material for sculptures and was wondering why nobody thought of taking advantage of this natural and free resource. In areas where the plant is native, it is used as a spice (Golpar) and as herbal medicine (Hemati et al. 2010). *Tromsøpalme* might provide useful material for human use and possibly even useful ecosystem services that have not been investigated so far.

This study added new knowledge about human perceptions of invasive species. It gave insights into what different perceptions managers might encounter in an urban area when dealing with invasive species. Furthermore, the study gave insight into management priorities in areas where a lot of private owners are involved. The ambivalent relationship of the locals in Tromsø towards *Tromsøpalme* might be a unique case (Bryman 2008). The values/normative beliefs towards *Tromsøpalme* and other invasive *Heracleum* species might be different in other parts of Norway, such as rural areas (Fitzgerald et al. 2007; Manfredi et al. 2003) or in other countries (Bremner & Park 2007). However, there had been studies in which locals also had a positive relationship towards invasive species (for example Schüttler et al. 2011) similar to the situation in Tromsø and so Tromsø could be considered as a further typical case (Bryman 2008) among those cases.

4.3 Further research

In future research, the awareness of landowners could be examined in more detail to find out what the landowners know about Tromsøpalme's environmental impacts, its ways of spreading, and methods of regulating the plant. Further, it could be studied how these different levels of awareness translate into values, normative beliefs, and regulation behaviors. This information would be helpful for informing campaigns of authorities. Also, it could be studied in a further questionnaire how respondents' professions play a role in evaluating the plant's attributes and the necessity of its regulation.

Future research could also investigate what kinds of regulation measures are preferred by locals in Tromsø. Instead of using herbicides and other potentially ecologically harmful measures against invasive plants, some locals might prefer less intrusive management methods as shown by Fischer and van der Wal (2007). Furthermore, the effect of other parcel characteristics on the regulation degree, such as the topography of the parcel and the parcel size, could be investigated as done by Fischer and Charnley (2012). Also it could be studied how the different density of *H. laciniatum* in different areas on Tromsø Island affects landowners' values, normative beliefs, regulation behaviors, and the risk of incurring injuries.

In a further study, values, normative beliefs, and regulation behavior of the respondents on Tromsø Island could be compared with respondents who live in the rural districts around Tromsø where the plant has spread as well. This would reveal if there is a difference in the perception of Tromsøpalme between rural and urban areas as found in the literature review of Fitzgerald et al. (2007).

Also, citizen research projects could be conducted, where volunteers monitor and map the plant with the help of landowners and at the same time encourage them to conduct regulation measures (Cooper et al. 2007). In that way the plant could be mapped exactly and a better awareness of Tromsøpalme and more knowledge about regulation measures among landowners could be developed. Research could also assess the most important spreading paths of the plant on Tromsø Island and help to structure regulation measures for different areas on Tromsø Island. Furthermore, the ecological impacts of Tromsøpalme need to be assessed further to decide which areas on Tromsø Island should be prioritized for the removal of Tromsøpalme.

5 References

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6 Appendix

6.1 Appendix A: Mapping of Tromsøpalme

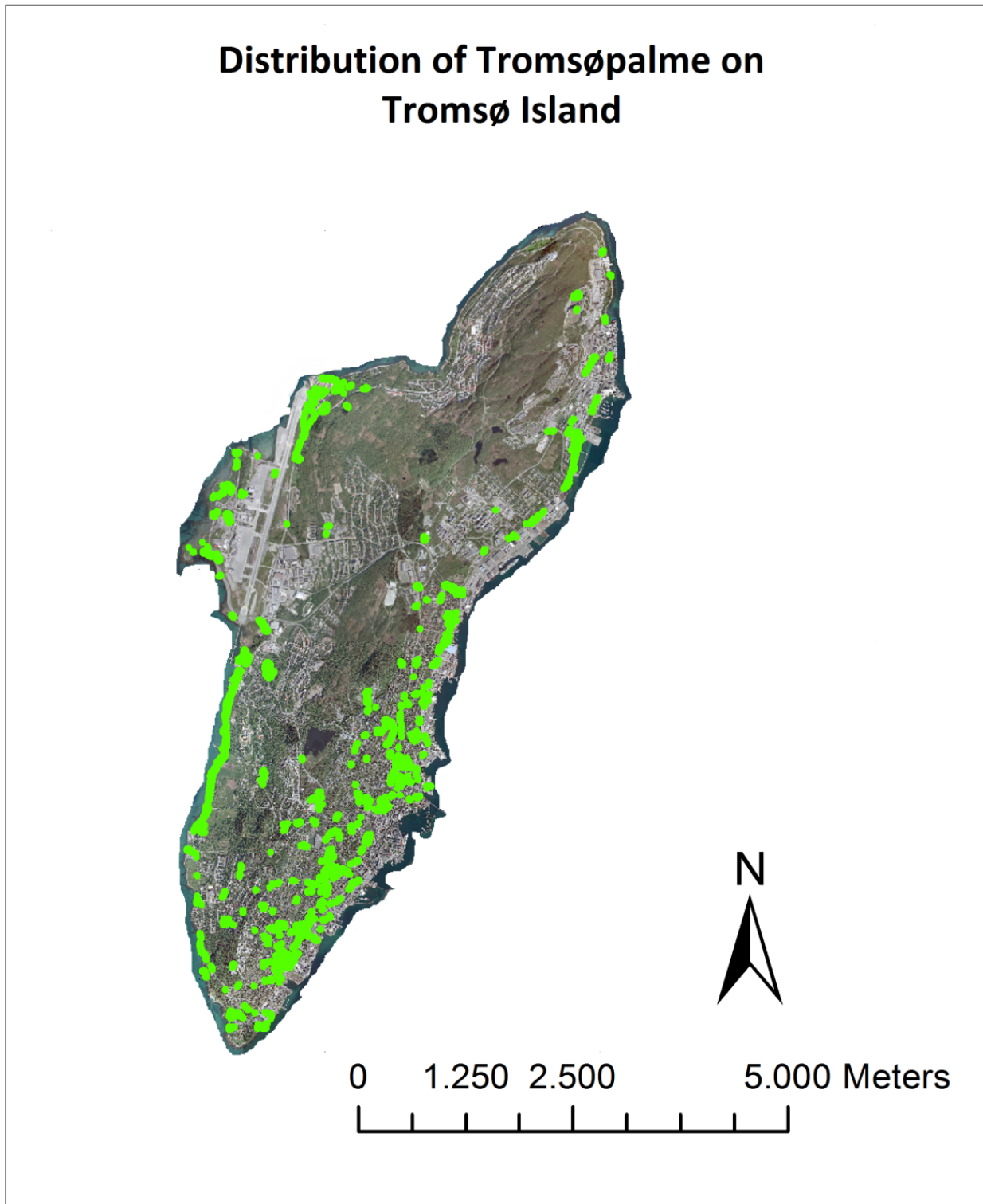


Figure 10: Tromsø Island with Tromsøpalme distribution (green) mapped after Google Maps® (year: 2007) and Google Street View® (year: 2010) drawn on air photos from the Norwegian Forest and Landscape Institute.

6.2 Appendix B: Photos



Figure 11: Tromsøpalme along house wall, middle of August (photo: author).



Figure 12: Tromsøpalme (right) along border of private parcel, middle of August 2012 (photo: author).



Figure 13: Tromsøpalme kept in private garden for aesthetic reasons according to owner, middle of August 2012 (photo: author).



Figure 14: Tromsøpalme (red circle) at the border (between the white lines) between two private parcels, middle of August 2012 (photo: author).

6.3 Appendix C: Interviews and conversations

6.3.1 Informed consent key informants (English)

Hereby, the participant is informed about the purpose of the interview and procedures of handling the information s/he will provide. The study is notified by the personal security delegate for research, Norwegian Social Science Data Services (NSD)

My name is Sophie Meier and I am a Master's student at the Norwegian University of Life Sciences in Ås at the department of International Environment and Development Studies (Noragric). This study is my Master's thesis project which I am doing at the Norwegian Forest and Landscape Institute in Tromsø. It deals with studying the distribution of Tromsøpalme on Tromsø Island. The project is financially supported by Noragric (UMB).

Tromsøpalme is an invasive plant species and this study might contribute to understand its spread on Tromsø Island. I would appreciate if I could ask you some questions about your opinions/views concerning some of these issues.

You can withdraw the participation in the interview and for the duration of the project any time without giving any reason. The interview will not take more than 20 minutes and you can refuse to give an answer at any time.

If it is ok for you, I would like to record the interview. Only I and my supervisor Gregory Taff will have access to it. I might ask you for your permission, to quote the information you provide in the final report. For that you will get the quotes beforehand and you can decide if you would like to be quoted with your full name. Otherwise everything you say will be held completely anonymous, so no information can be traced back to you. The interview recording will be deleted after the study is finished in summer 2013.

In case you have more questions about the handling of your data or about the project you can send me an e-mail (...) or call me (tel. ...). You can also contact my supervisor Gregory Taff (project responsible) at the Norwegian Forest and Landscape Institute in Tromsø (tel. ...) or my supervisor Jens Aune at the department of International Environment and Development Studies (Noragric) (tel. ...).

Thank you for your contribution,

Date, Place

Signature of participant

6.3.2 Informed consent key informants (Norwegian)

Deltakeren er herved informert om hensikten med intervjuet og prosedyrer for å håndtere informasjonen han/hun gir.

Mitt navn er Sophie Meier og jeg er mastergradsstudent ved institutt for Internasjonale miljø- og utviklingsstudier (Noragric) ved Universitetet for Miljø- og biovitenskap (UMB) på Ås. Som del av min mastergradsoppgave gjør jeg en studie som ser på utbredelsen av tromsøpalme på Tromsøya. Dette prosjektet gjøres ved Institutt for Skog og Landskap sitt Nord-Norge Kontor i Tromsø. Prosjektet er finansiert med hjelp av Noragric (UMB).

Tromsøpalmen er en invaderende planteart, og denne studien vil forsøke å bidra til økt forståelsen av hvordan tromsøpalmen spreder seg på Tromsøya. Jeg vil sette stor pris på om jeg kunne spørre deg noen spørsmål om dine meninger/tanker rundt noen av disse problemene.

Intervjuet tar maksimalt 20 minutter. Du velger selv hvilke spørsmål du ønsker å besvare. Intervjuet eller din deltakelse i prosjektet kan avbrytes når som helst underveis uten begrunnelse.

Hvis det er greit for deg, vil jeg gjerne ta opp intervjuet. Bare jeg og min veileder, Gregory Taff, vil ha tilgang til opptaket. Jeg vil trenge din tillatelse for å sitere den informasjonen du oppgir i den endelige rapporten. Du vil få lese sitatene på forhånd slik at du kan selv bestemme om du ønsker å bli sitert med fullt navn. Ellers vil alt du sier bli holdt helt anonym, dvs. ingen informasjon kan spores tilbake til deg. Opptaket av intervjuet vil bli slettet etter at studien er ferdig, sommeren 2013.

Studiet er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste (NSD).

Ved ytterligere spørsmål om håndteringen av informasjonen du gir, eller om prosjektet generelt kan du sende meg en e-post (...) eller ring meg (tlf...). Du kan også kontakte min veileder Gregory Taff (prosjektansvarlig) ved Skog og Landskap sitt Nord-Norge Kontor i Tromsø (tlf...), eller min veileder Jens Aune ved Institutt for Internasjonale miljø- og utviklingsstudier (Noragric) i Ås (tlf. ...).

Takk for ditt bidrag,

Dato, sted

Signatur av deltaker

6.3.3 Interview guide key informants / general questions

Can you tell me a little bit about your work?

Did you grow up in Tromsø?

How do you feel about the awareness of local people in Tromsø concerning Tromsøpalme (what do people know about the plant, what are their perceptions of Tromsøpalme)?

What is the cultural meaning of Tromsøpalme for you /for the local people?

Do you feel Tromsø has problems with the Tromsøpalme and if so, what kind of problems? Do you know if people got hurt by Tromsøpalme? And if yes, can you estimate how many people per year?

What would you think about regulation/eradicating the plant on Tromsø Island?

Do you know any present official regulation measures of Tromsøpalme on Tromsø Island against Tromsøpalme?

What kind of locals might know about the plant and remove it, and what kind of locals do not know about the plant or do not remove it?

Do you know of any local landowners that are planting or protecting Tromsøpalme on their land?

Do you know somebody else that I could ask about Tromsøpalme?

6.3.4 Questions for landowners, pretesting of questionnaire

Was the question structuring of the survey confusing/ were there too many questions?

Did you understand the questions?

Do you feel that questions/answers are missing?

What do you think about the appearance, symbolic importance, and the health impact of Tromsøpalme?

Could you think of negative/positive aspects of Tromsøpalme?

Should Tromsøpalme be regulated or eradicated from Tromsø Island?

How often do you regulate Tromsøpalme per year?

Why do you regulate it, why not?

What type of measures do you use?

6.4 Appendix D: Questionnaire

6.4.1 Cover letter and reminder letter (English)

Survey: Tromsøpalme and use of parcel

To the owner of...

Address/or “use name” (Norw.: bruksnavn)

GNR: (...) BNR: (...)

Respondent ID-Number: (...)



Tromsøpalme (*Heracleum laciniatum*) is a plant species that was introduced to Tromsø in the 19th century. This is a survey on the distribution of Tromsøpalme on Tromsø Island and the way landowners in Tromsø relate to this plant. You have been chosen from the landowners on Tromsø Island and I would appreciate, if you could answer the questionnaire: Your answers will help to understand the distribution of this plant on Tromsø Island and how to deal with it. My name is Sophie Meier and I am a student at the Norwegian University of Life Sciences in Ås at the department of International Environment and Development Studies (Noragric). This study is my Master's thesis project which I am doing at the Norwegian Forest and Landscape Institute in Tromsø.

I hope that you will take some of your time to answer this questionnaire. It might take 10-15 minutes to answer. Even if you have never heard about this plant and do not know what it is, your answers will provide helpful results for this study. Just follow the instructions in the questionnaire. All questions in the questionnaire refer to the parcel which is indicated at the top of this sheet (address or bruksnavn, GNR, BNR). It is preferred that the respondent of the survey is the owner or one of the owners of the parcel, but if the owner is not available also other people (over the age of 18) can answer the questions.

You are not obliged to answer questions. You can withdraw the participation in the survey anytime during the project without giving any reason. All the information you provide will be held anonymous and it will not be possible for anyone to trace back information you give. No parcel numbers, addresses or names will appear in the end report. The data will be deleted as soon as the project has finished in summer 2013. This project is notified by Personal security delegate for research, Norwegian Social Science Data Services (NSD).

The answers in the survey you can choose from might not reflect your feelings/opinions/attitudes completely. Nevertheless, please tick the answer which you think comes closest to your opinion/ feeling. There is no right or wrong answer. To keep the answers authentic you are asked not to look up any information while filling in the questionnaire. Your answer will not have any influence on your relationship to an authority, private person, or institution.

Please fill in the questionnaire in the next few days and send it back by 10 January 2013 and use the attached prepaid envelope.

If the questionnaire is not sent back by the deadline, you will receive a reminder by telephone or mail. Alternatively, you can fill out the online questionnaire.

For questions regarding the handling of your data and the study, please contact me:

Email: ... Telephone: ...

Best regards,

Sophie Meier

Sophie Meier

Attachment:

Questionnaire

Answering envelope

(parcels without a residence: map)



Photos: Author

Instructions – only for use of online-questionnaire

The link to the online-questionnaire can you find here:

<https://www.surveymonkey.com/s/Tromsoepalme>

1. Maybe you need to activate Cookies and Java-Script in your browser, and open your firewall in order to answer the online-questionnaire.

Activate Java-Script: http://help.surveymonkey.com/app/answers/detail/a_id/358

Activate Cookies: http://help.surveymonkey.com/app/answers/detail/a_id/373

Open the firewall for Survey Monkey® (otherwise it can happen that the answering boxes are not displayed): http://help.surveymonkey.com/app/answers/detail/a_id/402

For more help: <http://help.surveymonkey.com/app/home/>

2. The first questions ask you to enter your unique Respondents-ID-Number (...) and the parcel to which the answer should refer to

GNR: (...)

BNR: (...)

3. Do not use the next/back button in the browser to go back and forth between questions. Only use the buttons at the end of every page or you will miss questions.

4. If you have finished with the questionnaire, press “finish” at the end of the last page.

Thank you

Respondent Address and ID-number



Reminder mail

Survey: Tromsøpalme and use of parcel

Four weeks ago, I sent you a mail asking you to take part in a short survey about land use and handling of Tromsøpalme on the land you own on Tromsø Island. I would be grateful if you could take the time to fill out this survey.

Could you spare 7 minutes to give me information about if Tromsøpalme is on your property and your attitudes towards Tromsøpalme?

Even if you do not use the area of land which is indicated on the survey, it is important that you answer because environmental conservation is a public issue and your knowledge and opinion are important to know for local institutions, so that they have a better understanding of the local's attitude towards introduced Tromsøpalme and the distribution of the plant on Tromsø Island.

If you feel, that you know somebody else that would have more knowledge to answer the questionnaire, please forward it to this person or inform me about this person.

Regardless if Tromsøpalme can be found or whether you know that Tromsøpalme is on the indicated property or not, your answer is a valuable source of information.

If you prefer you may fill out the survey online:

<https://www.surveymonkey.com/s/Tromsoepalme>

For the case you did not receive the first mail, this mail includes a new Cover letter, questionnaire, and prepaid envelope. Please send the questionnaire back by **15 February 2013**.

If you have already sent back your completed questionnaire, thank you very much for doing this and please accept my apologies for sending this reminder.

If you have any more questions or need help filling out the survey please contact me (tlf: ...) or write me an email (...).

Thank you!
Sophie Meier

6.4.2 Cover letter and reminder letter (Norwegian)

Spørreundersøkelse: Tromsøpalme og bruk av eiendom

Til Grunneiere fra ...

Adresse/eller bruksnavn

GNR: (...) BNR: (...)

Respondent ID-nummer: (...)



Tromsøpalme (*Heracleum laciniatum*) er en planteart som ble innført til Tromsø på 1800-tallet. Dette er en spørreundersøkelse om utbredelsen av planten Tromsøpalme på Tromsøya, og hvordan grunneiere i Tromsø forholder seg til denne planten. Du har blitt valgt ut til å delta i denne undersøkelsen, og dine svar vil bidra til en bedre forståelse av denne plantens utbredelse på Tromsøya, samt kunnskap om hvordan offentlige institusjoner skal forholde seg til Tromsøpalmen. Mitt navn er Sophie Meier og jeg er student ved Universitetet for miljø- og biovitenskap (UMB) på Ås, ved Institutt for internasjonale miljø- og utviklingsstudier (Noragric). Denne undersøkelsen er en del av min Masteroppgave som jeg gjennomfører i samarbeid med Norsk Institutt for Skog og landskap sitt kontor for Nord-Norge i Tromsø.

Jeg håper at du vil ta deg tid til å svare på denne undersøkelsen. Undersøkelsen vil kunne besvares i løpet av 10-15 minutter. **Selv om du aldri har hørt om denne planten, eller ikke vet hvilken plante det er snakk om, vil dine svar gi nyttig informasjon for denne undersøkelsen.** Bare følg instruksjonene underveis i skjemaet. Alle spørsmålene i undersøkelsen gjelder den eiendommen som står øverst på arket (adresse eller bruksnavn og GNR/BNR). Det sees helst at (en av) eiendommens grunneier(e) svarer på undersøkelsen, men dersom grunneier ikke har anledning til dette kan en annen person svare i stedet. **Personen som besvarer undersøkelsen må være fylt 18 år.**

Det er frivillig å være med og du har mulighet til å trekke deg når som helst underveis, uten å måtte begrunne dette nærmere. Opplysningene vil bli behandlet konfidensielt, og ingen enkeltpersoner, adresser, gårds- og bruksnummer (GNR/BNR) vil kunne gjenkjennes i den ferdige oppgaven. Opplysningene anonymiseres og spørreskjemaet makuleres når oppgaven er ferdig (i løpet av sommeren 2013). Dataene skal bli slettet når prosjektet bli ferdig i sommeren 2012. Prosjektet er godkjent av Personvernombudet for Forskning, Norsk Samfunnsvitenskapelig Datatjeneste (NSD).

Der svaralternativene i undersøkelsen eventuelt ikke stemmer helt overens med dine meninger, holdninger eller følelser bes du om å velge det svaralternativet som ligger nærmest. **Det er ingen riktige eller gale svar.** For at svarene skal være så nøytrale som mulig bes du om å ikke slå opp noe informasjon under utfylling av undersøkelsen. Uansett hvilke svar du gir i denne undersøkelsen vil det ikke påvirke ditt forhold til noen instans, verken privatpersoner eller institusjoner.

Vennligst svar på undersøkelsen innen 10. januar 2013 og bruk vedlagt returkonvolutt (frankert).

Alternativt kan du fylle ut spørreskjemaet online. Dersom du velger dette alternativet, vennligst følg instruksene på baksiden av dette brevet.

Hvis spørreskjemaet ikke blir sendt tilbake innen fristen vil du få en påminnelse per post og eventuelt per telefon. Ved spørsmål kan jeg kontaktes på e-post (...) eller telefon (...).

Med vennlig hilsen,

Sophie Meier

Sophie Meier
Vedlegg:
Spørreskjema
Returkonvolutt
Evt. kart



Fotos: Author

Retningslinjer – KUN for evt. bruk av nettbasert spørreskjema

Linken til det nettbaserte skjemaet finner du her:

<https://www.surveymonkey.com/s/Tromsoepalme>

1. Du må kanskje aktivisere Cookies og Java-Script i nettleseren din, og åpne din brannmur for Survey Monkey for å åpne og besvare undersøkelsen.

Slå på Java-Script: http://help.surveymonkey.com/app/answers/detail/a_id/358

Slå på Cookies: http://help.surveymonkey.com/app/answers/detail/a_id/373

Åpne brannmuren til Survey Monkey® (mulig årsak dersom svarboksene til å avgi svarene i ikke vises): http://help.surveymonkey.com/app/answers/detail/a_id/402

For mer hjelp se: <http://help.surveymonkey.com/app/home/>

2. De første spørsmålene ber deg om å oppgi ditt unike Respondent-ID-nummer: (...)

og eiendommen som jeg ønsker at besvarelsen skal gjelde

GNR: (...)

BNR: (...)

3. Ikke bruk frem/tilbake-knappene i nettleseren for å komme til neste spørsmål eller for å gå tilbake. Bruk kun «neste» og «forrige» knappen på slutten av hver side, ellers vil du kunne miste spørsmål.

4. Når du er ferdig med undersøkelsen, klikk på «ferdig» knappen nederst på siste side.

Takk for ditt bidrag.

28. januar 2013

Påminnelse

Spørreundersøkelse: Tromsøpalme og bruk av eiendom

For fire uker siden sendte jeg deg et spørreskjema.

Hvis du allerede har sendt tilbake spørreskjemaet, takk for at du gjorde dette, og du kan du se bort fra denne henvendelsen.

Dersom du ikke har sendt svar vil jeg gjerne be deg en gang til om din deltakelse. Jeg har fått mange svar, men jeg ønsker så stor oppslutning som mulig for at svarene skal være representative.

Kan du avse noen minutter for å gi meg informasjon om du kjenner til Tromsøpalme på din eiendom og dine evt. holdninger overfor denne planten?

Uansett om det er Tromsøpalme på eiendommen eller ikke, eller om du ikke vet om Tromsøpalmen vokser der, er svaret ditt viktig informasjon.

Hvis du foretrekker det kan du fylle ut en nettversjon av spørreskjemaet:

<https://www.surveymonkey.com/s/Tromsoepalme>

Hvis du ikke eier eiendommen setter jeg stor pris på å få beskjed om det.

I tilfelle du ikke mottok min opprinnelige henvendelse eller den har kommet på avveie, legger jeg ved et nytt sett dokumenter: forklaringsbrev, spørreskjema, og returkonvolutt. Vennligst send skjemaet tilbake innen 15. februar 2013.

Hvis du har flere spørsmål eller trenger hjelp til å fylle ut skjemaet kan du ringe (mob.: ...) eller sende meg en e-post (...).

Vennlig hilsen og mange takk!

Sophie Meier

6.4.3 Questionnaire (English)

ID: [...] **GNR: [...]** **BNR: [...]** **Adresse/"use name" (norw.: bruksnavn): [...]**

(indicated on each page of the questionnaire)

Tromsøpalme and parcel use



All your answers will be held anonymous. You are not obliged to take part into this study and can withdraw anytime without giving reasons.

PLEASE MARK (x) THE APPROPRIATE BOX NEXT TO THE ANSWER CHOICE. PLEASE GIVE ONLY ONE ANSWER TO ONE QUESTION AS LONG YOU CAN NOT FIND THE OPTION ("MARK ALL ANSWERS THAT APPLY"). YOU MAY SKIP QUESTIONS THAT YOU DO NOT FEEL COMFORTABLE ANSWERING

A) Information about the parcel*

***Parcel: Piece of land you own (on Tromsø Island) which address/location, GNR/BNR are specified at the top of the page (some questionnaires have an enclosed map)**

1. Who owns the parcel? (Mark all answers that apply)	<input type="checkbox"/> Private person(s) <input type="checkbox"/> Under public control <input type="checkbox"/> Company/(ies) <input type="checkbox"/> Other: _____
2. You are?	<input type="checkbox"/> Owner of the parcel <input type="checkbox"/> Renter/leaseholder of the parcel <input type="checkbox"/> Other: _____
3. In which year did you buy/rent/lease the parcel?	_____
4. Has the whole parcel or parts of it been bought by a public institution (municipality, etc.) within the last six months?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Is a public institution (municipality etc.) going to buy the parcel or parts of it?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6. Is there/Are there any building(s) on the parcel?	<input type="checkbox"/> Yes → Question 7 <input type="checkbox"/> No → Question 12
7. In which year(s) was/were the building(s) built?	_____

- 8a.** What kinds of building(s) are on the parcel?
(Mark all answers that apply)
- Residence
 - State-owned offices/buildings
 - Company-owned offices/buildings
 - Mixed use:
Combination of private residence and/or state-used and/or company-used
 - shed, storage
 - Boathouse
 - Others: _____

- 8b.** If there is a/are residence(s), what type?
(Mark all answers that apply)
- Single family house
 - Apartment building
 - Housing block
 - Cabin
 - Others: _____

- 9.** Who lives on the parcel?
(Mark all answers that apply)
- Owner(s)
 - Renter(s)/Leaseholder(s)
 - Other(s): _____

- 10.** How many people in total live on the parcel?

- 11.** Do children under 10 years live on the parcel?
- Yes
 - No
- ➔ Go to Question 13

- 12.** If there is/are no building(s) on the parcel, how is the parcel used?
(Mark all answers that apply)
- Parking place
 - Storage area
 - Agriculture/garden
 - Forest extraction (picking berries, collecting wood, etc.)
 - Mooring space
 - Pasture
 - Area which is accessible for everybody
(Norw.: Friområde)
 - Not used for anything
 - Other: _____

B) Refers to vegetation on the parcel in the time period May – September 2012

- 13.** What type of vegetation grew on the parcel in the period May – September 2012?
(Mark all answers that apply)
- Wild vegetation
 - Ornamental plants
 - Vegetables/berries/fruits
 - Lawn
 - sparse vegetation along the house
 - Pasture plants
 - Tree(s)/forest
 - Other: _____

14. How many households share the vegetation-covered area on the parcel? _____

15. Who took care of the vegetation in the period May-September 2012?

This includes mowing, cutting hedges, weeding, etc.

(Mark all answers that apply)

- I took care
- (other) owner(s)
- (other) renter(s)/leaseholder(s)
- External person (for example gardener)
- Other(s): _____

16. How often did you or others, manage the vegetation on the parcel in the time period May-September 2012?

This includes mowing, cutting hedges, weeding, etc.

- Several times per week
- Once a week
- Several times per month
- Once a month
- Less than once a month
- Never

C) Refers to Tromsøpalme on the parcel in the time period May – September 2012

17. Do you know the plant Tromsøpalme?

(check the picture on the enclosed information sheet)

- Yes → Question 18
- No → Question 39

18. How did you learn about Tromsøpalme?

(Mark all answers that apply)

- Newspapers/magazines
- Public institution (for example brochure)
- Internet/TV/Radio
- Parents/relatives
- Friends/neighbors
- Experts (employee of authority, university, botanical garden, Green Warriors of Norway GWN)
- Have just seen Tromsøpalme outside
- Cannot remember/Don't know
- Other: _____

19. Was there Tromsøpalme (even single plants) on the parcel in the period May – September 2012?

- Yes → Question 20
- No → Question 30
- Don't know → Question 30

20. In approximately which year did Tromsøpalme appear for the first time on the parcel?

(Please give a precise answer)

Year: _____

- it was already there, when I got the parcel/when I moved there,
- Cannot remember/ Don't know

21. How does/did Tromsøpalme end up on the parcel?
(Mark all answers that apply)
- Is/was planted
 - Spread/s from the neighbor parcel
 - Spread/s from the roadsides
 - Happened before my time
 - Cannot remember/Don` t know
 - Other: _____
-
22. To what degree was Tromsøpalme regulated on the parcel in the period May-September 2012? (Regulation includes amongst others *cutting, mowing, weeding, grazing, digging, use of herbicides, oil, salt, etc.*)
- A:** No regulation; Tromsøpalme grew free on the parcel → Question 29
 - B:** Partial regulation; at least one plant got flowers on the parcel → Question 23
 - C:** Total regulation; no plant got flowers on the parcel → Question 23
-
23. Why was Tromsøpalme regulated?
(Mark all answers that apply)
- Dangerous when you get in contact/allergic reactions
 - Children in household might come in contact with the plant
 - Neighbor(s) did not approve of the plant
 - Doesn` t look nice on the parcel
 - Takes too much space
 - Prevents other plants from growing
 - Spreads
 - Restricts view
 - Don` t know (for example because others regulated plant)
 - Other reasons: _____
-
24. Who was regulating Tromsøpalme on the parcel?
(Mark all answers that apply)
- I am/ was
 - (other) owner (s)
 - (other) Renter(s)/Leaseholder (s)
 - External person/gardener
 - Public institution (municipality, etc.):

 - Organization/company (Norges Miljøvernforbund, etc.):

 - Other: _____

25. Which methods were used to regulate Tromsøpalme on the parcel?
(Mark all answers that apply)

- Cutting of the stems
- Cutting of the flowers
- Digging out of the root
- Mowing with a mower/brush cutter
- Herbicides
- Oil
- Salt
- Grazing
- Other: _____

26. How was the plant material of Tromsøpalme handled after it was removed?
(Mark all answers that apply)

- Was left lying on the ground
- Was burned
- Was brought to the compost on the parcel
- Was thrown into the garbage/biowaste-container
- Other: _____

27. In approximately which year was Tromsøpalme regulated for the first time?
(Please give a precise answer)

- Year: _____
- measures started before I got the parcel/before I moved here
 - Cannot remember/ Don` t know

28. How has the amount (size and number) of Tromsøpalme changed when it was first regulated until 2012?

- Amount of Tromsøpalme has been reduced
- Amount of Tromsøpalme is the same
- Amount of Tromsøpalme has increased

Only answer the following question if you answered A or B in Question 22:

29. If Tromsøpalme was only partly regulated or not regulated on the parcel in the time period May – September 2012, what is the reason for that?
(Mark all answers that apply)

- Looks nice
- Have no time to regulate it
- Have no financial resources
- Have tried to regulate it, but gave up
- Uncomfortable/dangerous to handle
- Health and age restrictions
- Neighbor(s) do(es) not regulate it
- I do not care/do not mind
- I wish to regulate it, but it is not worth the trouble
- Don` t know – for example because it grows on a part of the parcel somebody else has responsibility for
- Other reasons: _____

D) Tromsøpalme in Tromsø (please give your own opinion)

PLEASE PUT A CIRCLE AROUND THE NUMBER BETWEEN 1 AND 7 THAT REFLECTS YOUR OPINION

30. How would you evaluate the impact of Tromsøpalme on health?

Good for the health			Neutral		Dangerous to the health
1	2	3	4	5	

31. What do you think about Tromsøpalme`s appearance?

Ugly			Neutral		Nice
1	2	3	4	5	

32. How would you evaluate Tromsøpalme`s importance as a symbol for Tromsø?

Not important			Neutral	important	Very
1	2	3	4	5	

33. How would you evaluate regulation measures against Tromsøpalme on Tromsø Island?

Not necessary			Neutral		Very necessary
1	2	3	4	5	

34. What is your personal attitude to Tromsøpalme`s occurrence on Tromsø Island?

Do not perceive Tromsøpalme as a problem at all	1	2	3	4	5	Perceive Tromsøpalme as a big problem
---	---	---	---	---	---	---------------------------------------

A department/institution removes Tromsøpalme from Tromsø Island:

35a. In which areas do you think it is good to remove Tromsøpalme?
(Mark all answers that apply)

- On private parcels
- Along roads
- In public green areas (parks, grave yards, play grounds, etc.)
- Along the seashore
- On Agricultural areas
- Should grow in all these areas
- Should be completely removed from Tromsø Island
- Other: _____

35b. Why do you think it is good to remove Tromsøpalme from these areas?
(Mark all answers that apply)

- Poisonous sap
- Suppresses other vegetation
- Too much spreading
- Doesn`t look nice in the area/ landscape
- Smells strong
- Other: _____

36a. In which areas on Tromsø Island do you think Tromsøpalme should grow?
(Mark all answers that apply)

- On private parcels
- Along roads
- In public green areas (parks, grave yards, play grounds, etc.)
- Along the seashore
- On agricultural areas
- Should grow on all these areas
- Should be completely removed from Tromsø Island
- Other: _____

36b. Why do you think it should grow in these areas?
(Mark all answers that apply)

- Cultural meaning
- We should not kill plants without good reasons
- Looks nice in the area/landscape
- Smells good
- We should not waste resources on removal
- Other: _____

37. Have you received permanent injuries (for example scar or allergic reaction) from getting in contact with Tromsøpalme?

- Yes
- No

38. Do you know of anyone (acquaintance, friend, relative) that received permanent injuries from getting in contact with Tromsøpalme?

- Yes
- No

E) Information about you and your household

39. Year of birth? _____

40. Gender?

- Male
- Female

41. What is the highest level of education you completed?

- Elementary school (10 years)
- Highschool (13 years)
- University/college up to 4 years
- University/college over 4 years

42. How many years have you lived in Tromsø? _____

43. Number of people in your household
(including yourself) _____

44. Number of people in your household
that contribute to the household
income _____

45. Total pre-tax household income in
2011 (voluntary to answer the
question)

- Up to 300,000 NOK
- 300,001 – 450,000 NOK
- 450,001 – 600,000 NOK
- 600,001 – 1,000,000 NOK
- More than 1,000,000 NOK

Thank you for your contribution to this study

Do you want to have the results about the study sent to you? Yes No

If yes, you may provide your email address here: _____

6.4.4 Questionnaire (Norwegian)

Spørreundersøkelse

Tromsøpalme og bruk av eiendommen

Taushetsplikt: Alle svarene, adresser og eiendommer vil anonymiseres og benyttes utelukkende i forbindelse med denne undersøkelsen.

SETT KRYSS I BOKSEN VED SVARET. KUN ETT SVAR FOR HVERT SPØRSMÅL, SÅ LENGE DET IKKE STÅR "FLERE SVAR MULIG". HOPP OVER SPØRSMÅL DU IKKE ØNSKER Å SVARE PÅ.

A) Opplysninger om eiendommen*

*Eiendom: Spørsmålene om eiendom refererer til Landområde (på Tromsøya) som tilhører adresse/sted og GNR/BNR skrevet øverst på dette skjemaet (noen spørreskjema har også et vedlagt kart)

1. Hvem eier eiendommen? (Flere svar mulig)	<input type="checkbox"/> Privatperson(er) <input type="checkbox"/> Offentlig eiendom/kommune <input type="checkbox"/> Bedrift <input type="checkbox"/> Annet: _____
2. Du er?	<input type="checkbox"/> Grunneier på eiendommen <input type="checkbox"/> Leietaker/Fester på eiendommen <input type="checkbox"/> Annet: _____
3. I hvilket år kjøpte/leide/festet du eiendommen?	_____
4. Har hele eller deler av eiendommen blitt kjøpt opp av en offentlig institusjon (kommune etc.) i løpet av de siste seks månedene?	<input type="checkbox"/> Ja <input type="checkbox"/> Nei
5. Har en offentlig institusjon (kommune etc.) planlagt å kjøpe hele eller deler av eiendommen?	<input type="checkbox"/> Ja <input type="checkbox"/> Nei
6. Finnes det bygning(er) på eiendommen?	<input type="checkbox"/> Ja → spørsmål 7 <input type="checkbox"/> Nei → spørsmål 12
7. Hvilke(t) år ble bygningen(e) oppført?	_____

8a. Hvilken type bygning(er) er dette?
(Flere svar mulig)

- Bolig
- Offentlig lokale/bygning
- Bedriftslokale/-bygning
- Kombinert bruk:
Privat bolig og/eller offentlig lokale og/eller bedriftslokale
- Lagerbygning
- Naust
- Annet: _____

8b. Dersom dette er en bolig, hvilken type bolig er det?
(Flere svar mulig)

- Enebolig
- Rekkehus/Tomannsbolig
- Boligblokk
- Hytte/fritidsbolig
- Annet: _____

9. Hvem bor på eiendommen?
(Flere svar mulig)

- Grunneier(e)
- Leietaker(e)/Fester(e)
- Andre: _____

10. Hvor mange mennesker bor på eiendommen totalt?

11. Bor det barn under 10 år på eiendommen?

- Ja
- Nei → gå til spørsmål 13

12. Dersom det IKKE er noen bygning på eiendommen, hva brukes eiendommen til?
(Flere svar mulig)

- Parkeringsplass
- Lager
- Jordbruk/hagebruk
- Skog som det høstes av (bærplukking, sanking av ved etc.)
- Båtplass
- Husdyrbeite
- Friområde
- Ikke i bruk
- Annet: _____

B) Refererer til vegetasjon på eiendommen i tidsrommet mai – september 2012

13. Hvilken vegetasjon vokste på eiendommen i tidsrommet mai – september 2012?
(Flere svar mulig)

- Viltvoksende vegetasjon
- Prydvekster
- Grønnsaker/bær/frukter
- Gressplen
- Kantvegetasjon/ugress langs husvegger
- Beiteplanter
- Trær/Skog
- Annet: _____

14. Hvor mange husstander deler det vegetasjonsdekte arealet på eiendommen? _____

15. Hvem stelte vegetasjonen på eiendommen i tidsrommet mai-september 2012? Dette innebærer klipping av plen/hekk, lusing, raking, etc.
(Flere svar mulig)

Meg selv
 (annen) Grunneier (en eller flere)
 (annen) leietaker/fester (en eller flere)
 Utenforstående (f.eks. gartner)
 Andre: _____

16. Hvor ofte ble det, av deg eller andre, utført stell/skjøtsel av vegetasjonen på eiendommen i tidsrommet mai-september 2012? Dette innebærer klipping av plen/hekk, lusing, raking, etc.

Flere ganger i uken
 Én gang i uken
 Flere ganger i måneden
 Én gang i måneden
 Sjeldnere enn én gang i måneden
 Aldri

C) Refererer til Tromsøpalme på eiendommen i tidsrommet mai – september 2012

17. Kjenner du til planten *Tromsøpalme*?
(se bilder på vedlagt informasjonsark)

Ja ➔ spørsmål 18
 Nei ➔ spørsmål 39

18. Hvordan har du fått kjennskap til Tromsøpalme?
(Flere svar mulig)

Avis/tidsskrift
 Offentlig institusjon (f. eks. brosjyre)
 Internett/TV/radio
 Foreldre/slektninger
 Venner/naboer
 Fagperson (offentlig ansatt, universitet, botanisk hage, Norges miljøvernforbund, etc.)
 Har bare sett Tromsøpalmen ute
 Husker ikke/Vet ikke
 Annet: _____

19. Har det vært Tromsøpalme (også enkelt planter) på eiendommen i tidsrommet mai – september 2012?

Ja ➔ spørsmål 20
 Nei ➔ spørsmål 30
 Vet ikke ➔ spørsmål 30

20. I ca. hvilket år dukket Tromsøpalme opp for første gang på eiendommen?
(Vennligst gi et mest mulig presist svar)

År: _____

Var allerede til stede på eiendommen ved overtakelse/ved tilflytting
 Husker ikke/ Vet ikke

21. Hvordan kom/kommer Tromsøpalme til eiendommen?

(Flere svar mulig)

- Ble/blir plantet
- Sprer seg fra naboeiendom
- Sprer seg fra vegkanten
- Før min tid
- Husker ikke/Vet ikke
- Annet: _____

22. I hvor stor grad ble Tromsøpalme regulert på eiendommen i tidsrommet mai-september 2012? (Regulering

innebærer blant annet *beskjæring, slåing, lusing, beiting, opprykking, bruk av ugressmidler, olje, salt, etc.*)

- A:** Ingen regulering; Tromsøpalme har fått vokse fritt på eiendommen → spørsmål 29
- B:** Delvis regulering; minst én plante har fått blomstre på eiendommen → spørsmål 23
- C:** Total regulering; ingen planter har fått blomstre på eiendommen → spørsmål 23

23. Hvorfor ble Tromsøpalme regulert på eiendommen?

(Flere svar mulig)

- Ubehagelig/farlig ved kontakt/allergiske reaksjoner
- Barn i husstanden som kan komme nær
- Naboen(e) misliker at den er der
- Ser ikke bra ut/sjenerende på eiendommen
- Tar for mye plass
- Til hinder for andre planter
- Sprer seg
- Sperrer utsikt
- Vet ikke (f.eks. fordi andre gjorde det)
- Andre grunner: _____

24. Hvem har utført regulering av Tromsøpalme på eiendommen?

(Flere svar mulig)

- Meg selv
- (Annen) Grunneier (en eller flere)
- (Annen) Leietaker/Fester (en eller flere)
- Utenforstående/gartner
- Offentlig institusjon (kommune, etc.): _____
- Organisasjon/firma (Norges Miljøvernforbund, etc.): _____
- Annet: _____

25. Hvilke metoder har blitt brukt for å regulere Tromsøpalme på eiendommen?
(Flere svar mulig)

- Beskjæring av stengler
 - Beskjæring av blomster
 - Opprykking med rot
 - Slåing med gressklipper/kantklipper
 - Ugressmidler
 - Olje
 - Salting
 - Beiting
 - Annet: _____
-

26. Hvordan har planterester av Tromsøpalme blitt håndtert etter fjerning?
(Flere svar mulig)

- Blitt liggende på stedet
 - Blitt brent
 - Blitt kompostert på stedet
 - Blitt kastet i matavfall/bioavfall
 - Annet: _____
-

27. I ca. hvilket år ble Tromsøpalme for første gang regulert på eiendommen?
(Vennligst gi et mest mulig presist svar)

- År: _____
- Var allerede regulert på eiendommen ved overtakelse/ved tilflytting
 - Husker ikke/ Vet ikke
-

28. Har mengden (størrelse og antall) Tromsøpalme forandret seg fra den første reguleringen til 2012?

- Mengden Tromsøpalme har blitt redusert
 - Mengden Tromsøpalme er den samme
 - Mengden Tromsøpalme har økt
-

Bare besvar dette spørsmålet om du svarte

A eller B i spørsmål 22:

29. Hvis Tromsøpalme ble regulert bare delvis eller ikke i det hele tatt på eiendommen i tidsrommet mai – september 2012, hva var grunnen(e) til det?
(Flere svar mulig)

- Ser bra ut
 - Har ikke tid til å regulere
 - Har ikke finansielle ressurser
 - Har prøvd å regulere, men har gitt opp
 - Ubehagelig/farlig å håndtere
 - Helse- eller aldersbegrensninger
 - Nabo(er) regulerer ikke
 - Jeg bryr meg ikke/det gjør meg ikke noe
 - Jeg ønsker å regulere den, men det er ikke verdt bryet
 - Vet ikke - f.eks. fordi den vokser på en del av eiendommen som andre har ansvar for
 - Andre grunner: _____
-

D) Tromsøpalme i Tromsø (Ta utgangspunkt i din egen oppfatning)

SETT RING RUNDT TALLET (1 TIL 5) SOM NÆRMEST BESKRIVER HVA DU MENER.

30. Hva slags påvirkning mener du Tromsøpalme har på helsa?

Bra for helsa			Nøytral		Farlig for helsa
1	2	3	4	5	

31. Hva mener du om Tromsøpalmens utseende?

Stygg			Nøytral		Vakker
1	2	3	4	5	

32. Hvor viktig mener du Tromsøpalme er som et symbol for Tromsø?

Ikke viktig			Nøytral		Svært viktig
1	2	3	4	5	

33. Hva mener du om regulering av Tromsøpalme på Tromsøya?

Ikke nødvendig			Nøytral		Helt nødvendig
1	2	3	4	5	

34. Hva mener du personlig om Tromsøpalmens tilstedeværelse på Tromsøya?

Anser ikke Tromsøpalme som et problem på Tromsøya i det hele tatt	1	2	3	4	5	Anser Tromsøpalme som et stort problem på Tromsøya
---	---	---	---	---	---	--

En del etater/institusjoner jobber med å fjerne Tromsøpalme:

35a. Fra hvilke arealer på Tromsøya mener du det er bra at Tromsøpalme FJERNES?

(Flere svar mulig)

- Privat eiendom
- Langs veg
- Offentlige grøntområder (parker, kirkegårder, lekeplasser, etc.)
- Langs fjæra/strand
- Landbruksområder
- Bør få vokse på alle disse arealene
- Bør fjernes helt fra Tromsøya
- Annet _____

35b. HVORFOR synes du at det er bra å fjerne Tromsøpalme fra disse arealene?

(Flere svar mulig)

- Giftig plantesaft
- Hindrer annen vegetasjon
- For stor utbredelse
- Ser ikke bra ut i området/ landskapet
- Lukter sterkt
- Annet: _____

- 36a.** På hvilke arealer på Tromsøya synes du at institusjoner skal la Tromsøpalme FÅ VOKSE?
(Flere svar mulig)
- Privat eiendom
 - Langs veg
 - Offentlige grøntområder (parker, kirkegårder, lekeplasser etc.)
 - Langs fjære/strand
 - Landbruksområder
 - Bør få vokse på alle disse arealene
 - Bør fjernes helt fra Tromsøya
 - Annet _____
- 36b.** HVORFOR synes du at Tromsøpalme skal få vokse på disse arealene?
(Flere svar mulig)
- Kulturell betydning
 - Man bør ikke drepe planter unødig
 - Ser bra ut i området/landskapet
 - Lukter godt
 - Bør ikke bruker ressurser på fjerning
 - Annet: _____
-
- 37.** Har du noen gang fått varige skader (for eksempel arr eller allergisk reaksjon) av kontakt med Tromsøpalme?
- Ja
 - Nei
-
- 38.** Vet du om noen (bekjent, venn, slekt) som har fått varige skader av kontakt med Tromsøpalme?
- Ja
 - Nei

E) Opplysninger om deg og husstanden din

39. Fødselsår? _____

40. Kjønn?

- Mann
- Kvinne

41. Hva er din høyeste fullførte utdanning?

- Grunnskole
- Videregående Skolenivå
- Høyskole-/Universitetsutdanning til og med 4 år
- Høyskole-/Universitetsutdanning over 4 år

42. Hvor mange år har du vært bosatt i Tromsø til sammen? _____

43. Antall personer i din husstand (inkludert deg selv) _____

44. Antall personer i din husstand som bidrar til husstandens inntekt _____

-
45. Samlet bruttoinntekt for din husstand i 2011 (det er frivillig å svare på dette spørsmålet)
- Inntil 300.000 NOK
 - 300.001 – 450.000 NOK
 - 450.001 – 600.000 NOK
 - 600.001 – 1.000.000 NOK
 - Mer enn 1.000.000 NOK
-

Takk for ditt bidrag til denne undersøkelsen!

Her kan du oppgi din e-postadresse for eventuelle spørsmål i etterkant av undersøkelsen (dette er helt frivillig). _____

Ønsker du å få resultatene av denne undersøkelsen tilsendt? Ja Nei

6.5 Appendix E: Results

6.5.1 Preferred areas for removal and non-removal of Tromsøpalme

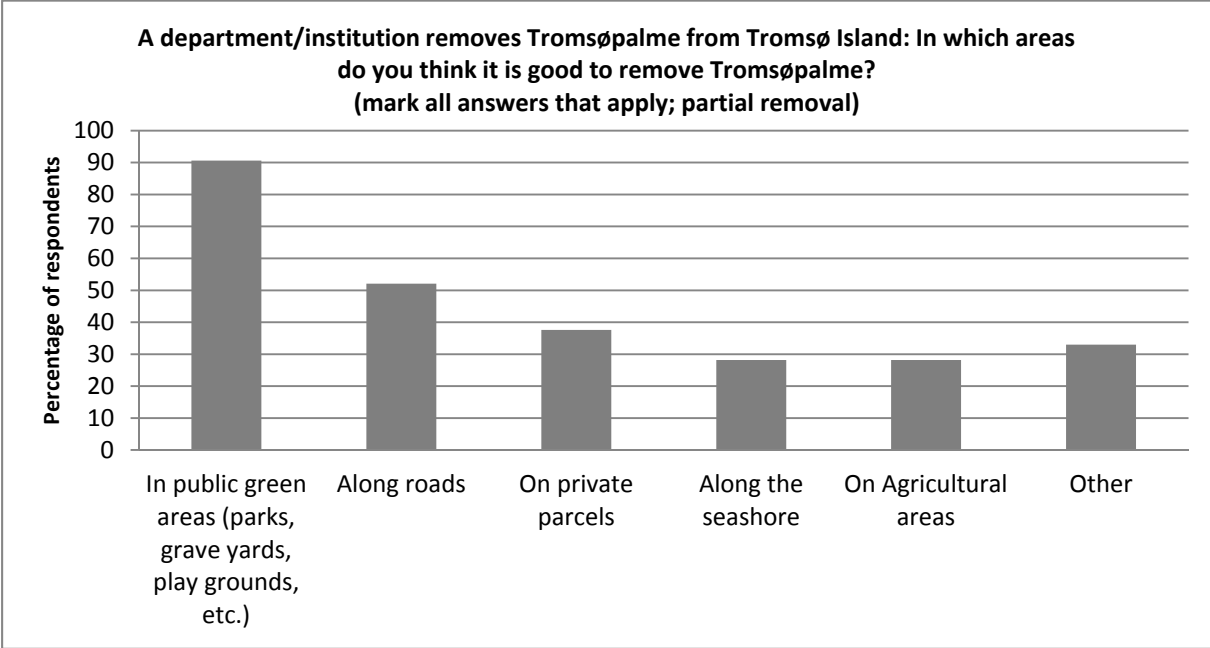


Figure 15: Areas on Tromsø Island where Tromsøpalme should be removed, according to respondents who preferred a partial removal which means from some areas on Tromsø Island (n=117).

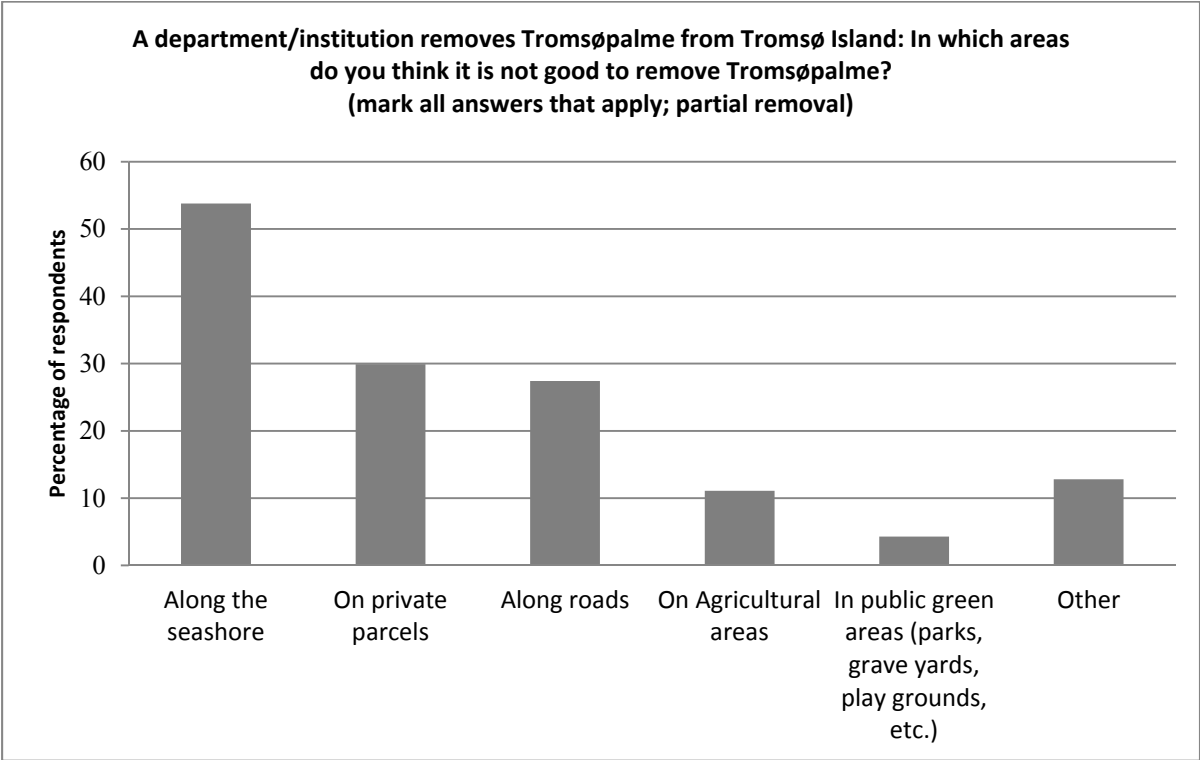


Figure 16: Areas on Tromsø Island where Tromsøpalme should not be removed, according to respondents who favored a partial removal which means from some areas on Tromsø Island (n=117). Three respondents mentioned in the “others” option that Tromsøpalme should be kept in specific areas that are well managed.

6.5.2 Reasons for removal or non-removal of Tromsøpalme on Tromsø Island

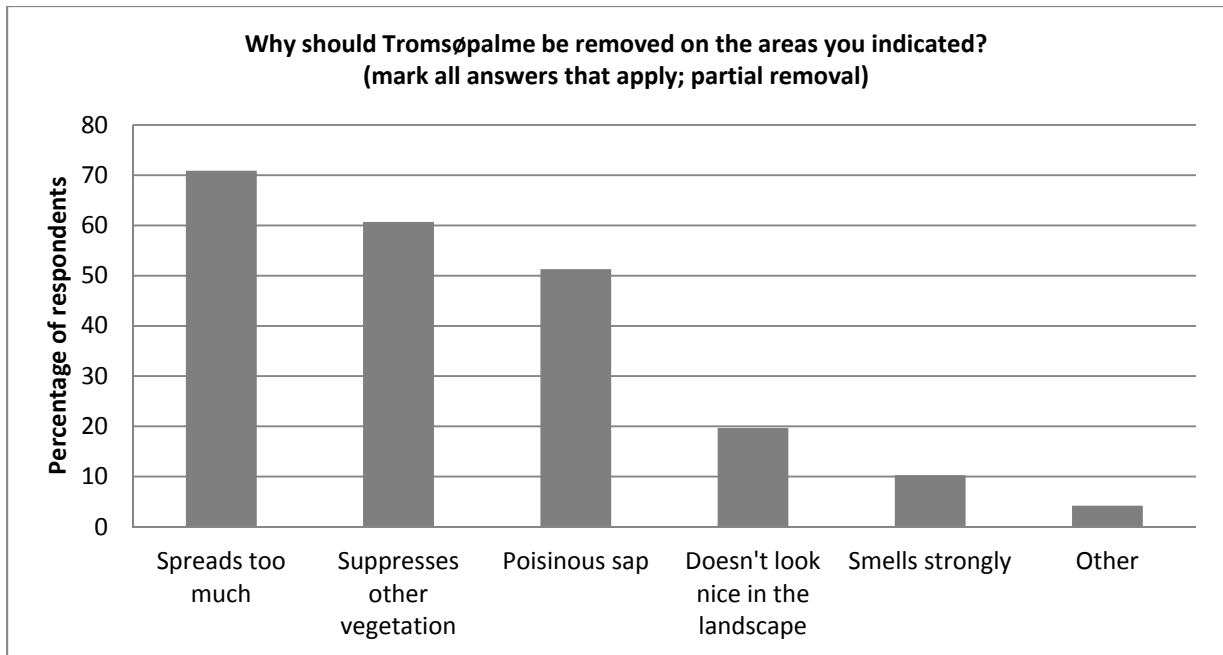


Figure 17: Reasons given by respondents that want Tromsøpalme to be partly removed (from some areas) from Tromsø Island (n=117).

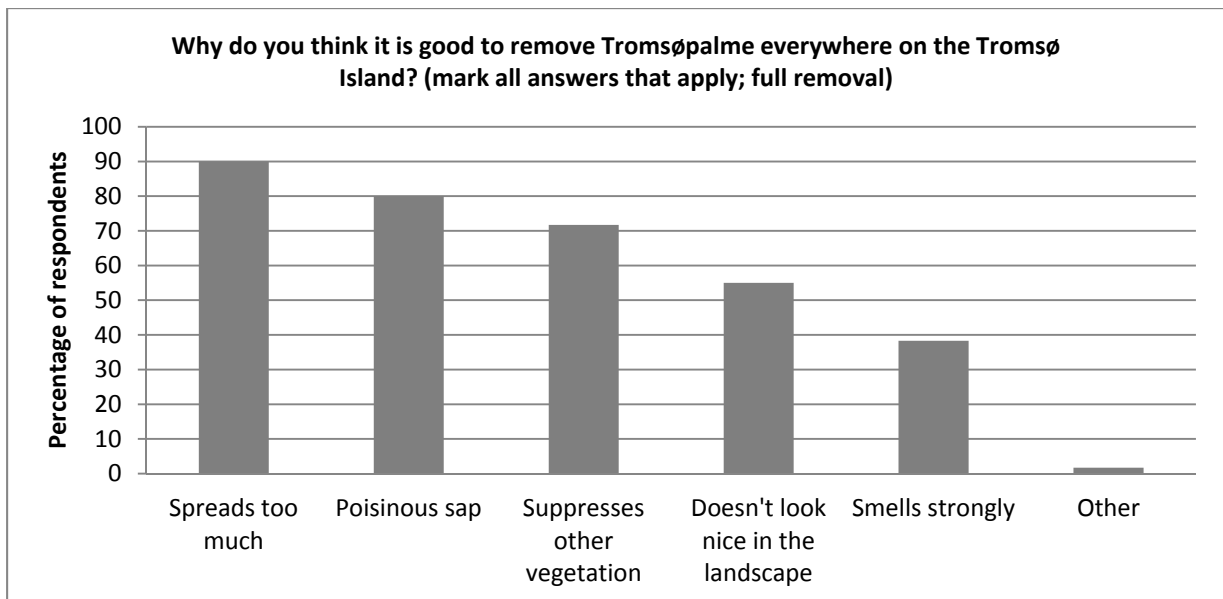


Figure 18: Reasons given by respondents that want an eradication (full removal) of Tromsøpalme on Tromsø Island (n=60).

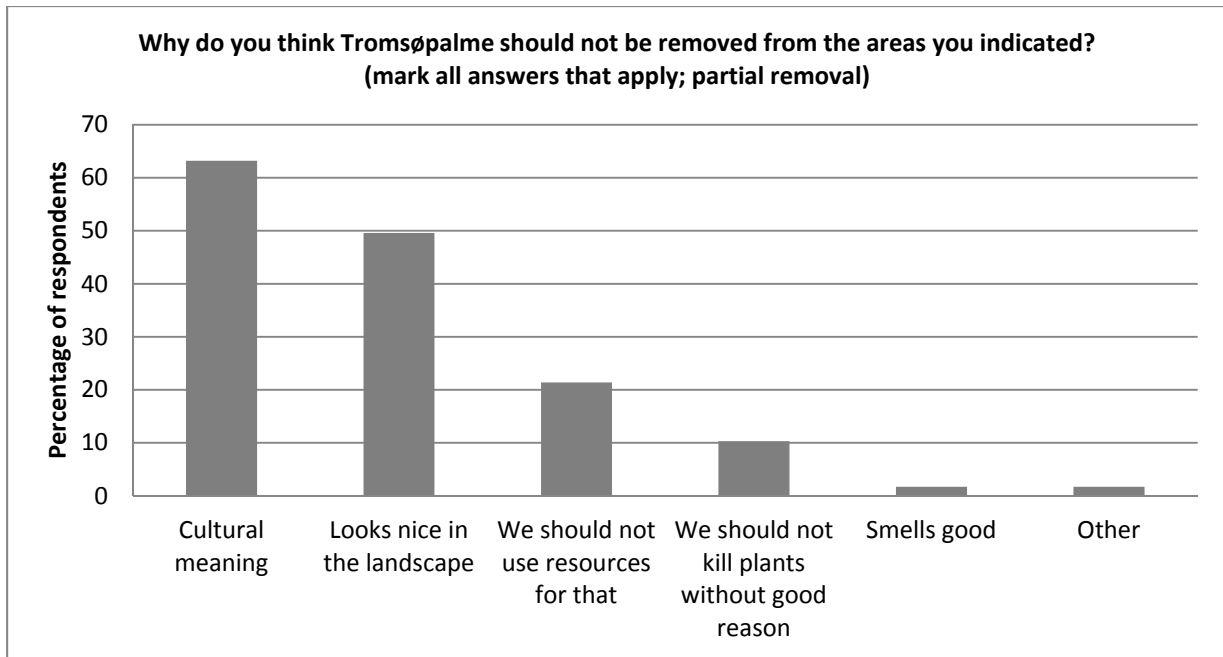


Figure 19: Reasons given by respondents that want Tromsøpalme only to be partly removed (from some areas) on Tromsø Island for keeping the plant in some areas (n=117).

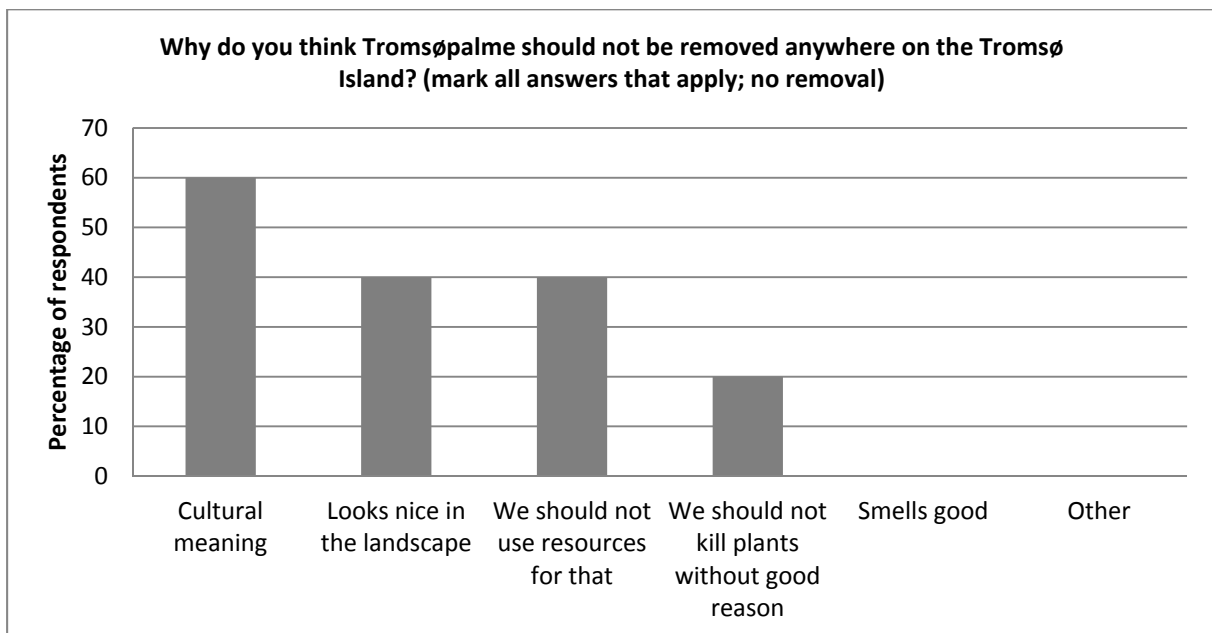


Figure 20: Reasons given by respondents that want Tromsøpalme not to be removed anywhere on Tromsø Island (n=5). No answers given in the option “smells good” and “others”.

6.5.3 Reasons for regulation or non-regulation of Tromsøpalme on the respondents' parcels

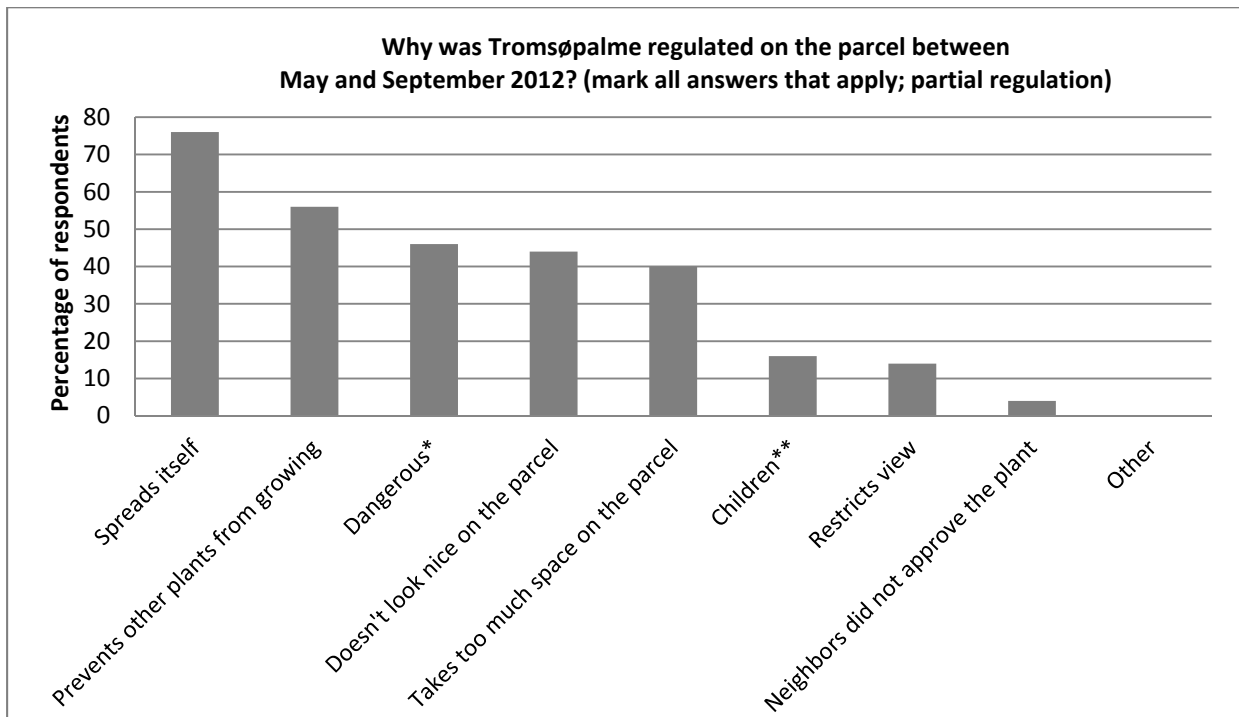


Figure 21: Reasons given by respondents for regulating Tromsøpalme at least partially (at least one plant flowered on the parcel) between May and September 2012 (n=50). *Dangerous when you get in contact/allergic reactions, **Children in the household might come in contact with the plant.

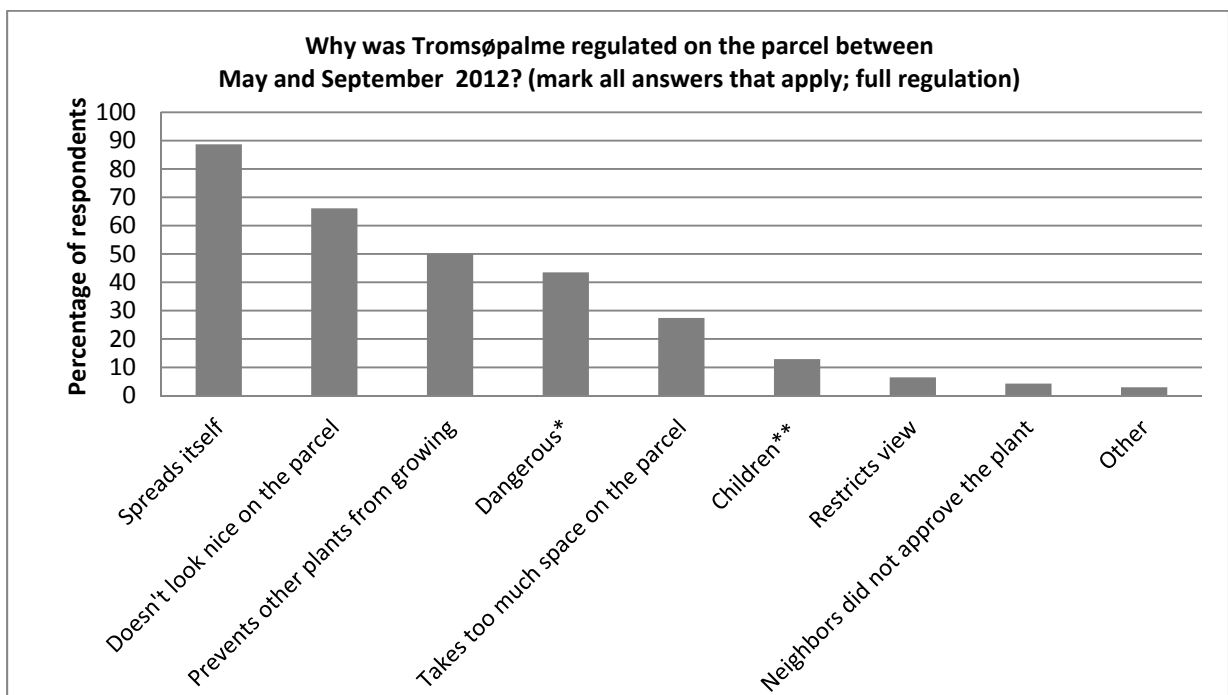


Figure 22: Reasons given by respondents for fully regulating Tromsøpalme (no plant flowered on the parcel) between May and September 2012 (n=62). *Dangerous when you get in contact/allergic reactions, **Children in the household might come in contact with the plant.

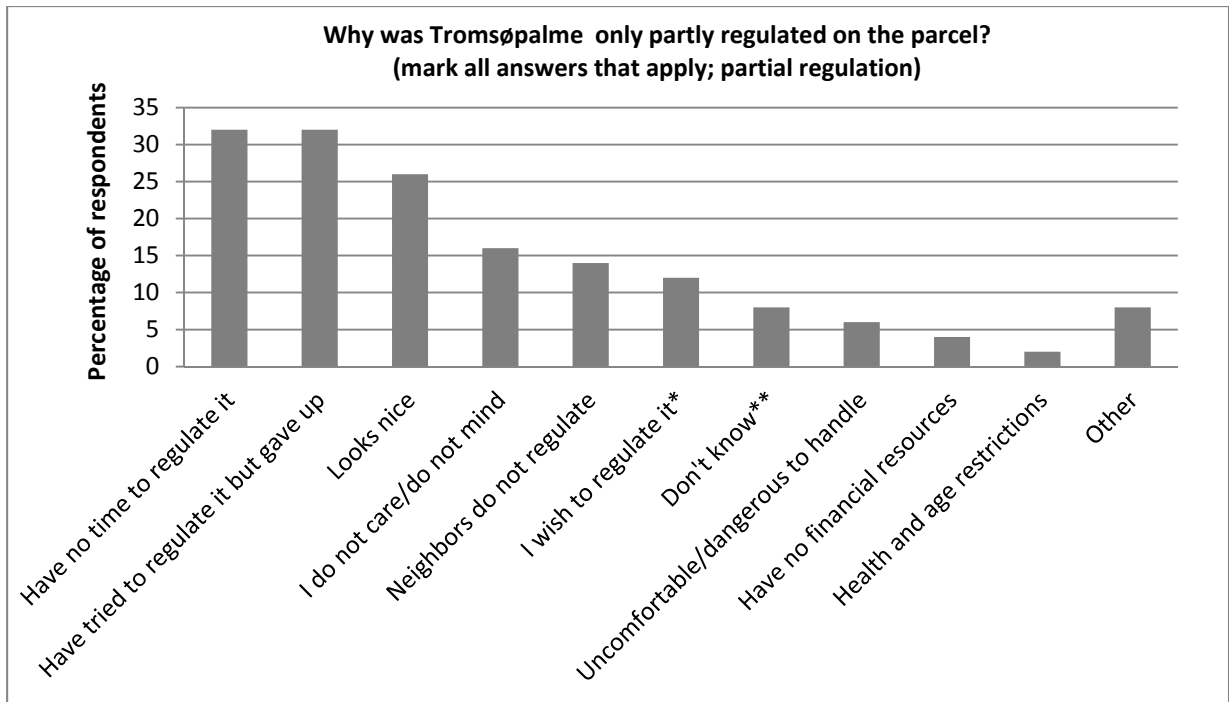


Figure 23: Reasons given by respondents for regulating Tromsøpalme only partly on their parcel (at least one plant flowered on the parcel) between May and September 2012 (n=50). *I wish to regulate it but it is not worth the trouble, **for example because it grows on a part of the parcel somebody else has responsibility for.

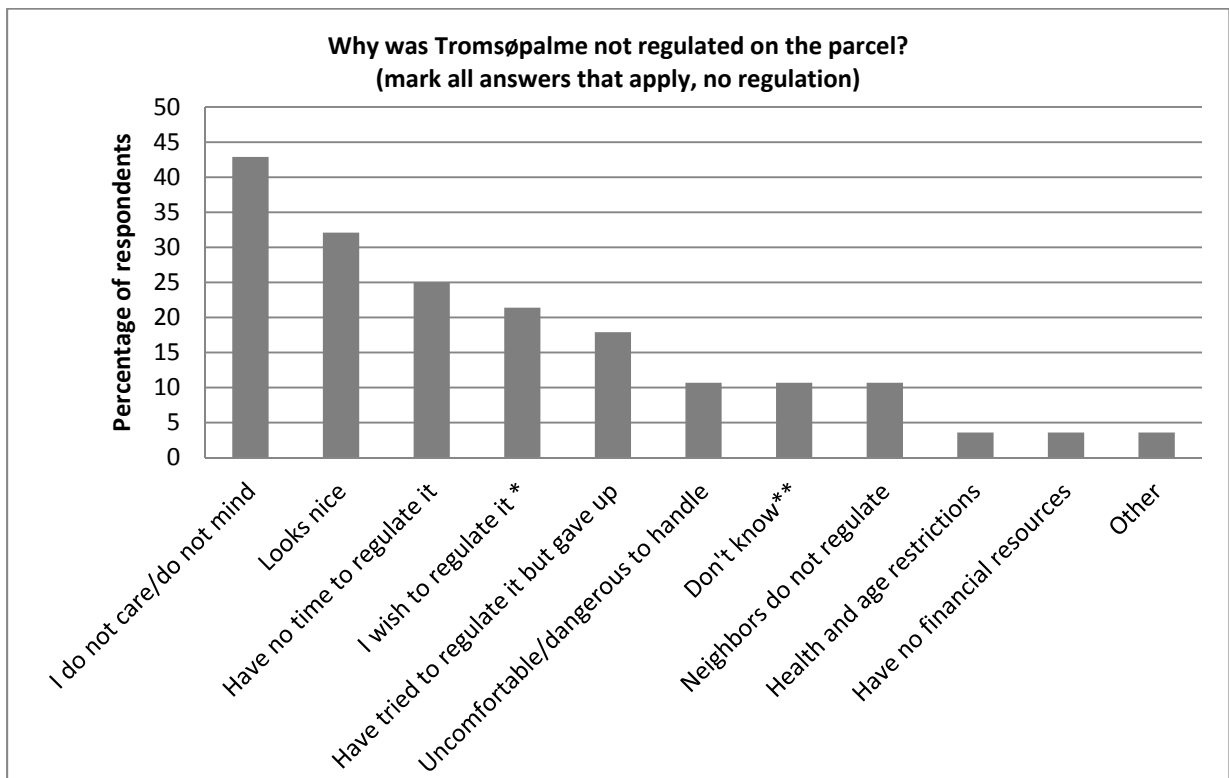


Figure 24: Reasons given by respondents for not regulating Tromsøpalme on their parcel between May and September 2012 (n=28). *I wish to regulate it but it is not worth the trouble, **for example because it grows on a part of the parcel somebody else has responsibility for.

6.5.4 Bivariate analysis

Table 12: Results of Mann-Whitney-U tests (part 1) found to be significant (at the alpha = 0.1 level) for different independent variables (*italic: socio-demographic variables*) and outcome variables written below each independent variable (**bold: values, normative beliefs, parcel characteristics**).

<i>Education</i>	n (total)	p-value	n (without higher education)	mean rank	mean	median	n (with higher education)	mean rank	mean	median
Evaluating Tromsøpalme's importance as a symbol for Tromsø: 1: not important, 5: important	188	0.019	58	80.91	2.47	3.0	130	100.56	2.89	3.0
Evaluating the occurrence of Tromsøpalme on Tromsø Island: 1: seeing Tromsøpalme not as a problem, 5: seeing Tromsøpalme as a problem	189	0.019	59	108.42	3.95	4.0	130	88.91	3.52	4.0
Evaluating the necessity of regulation measures on Tromsø Island towards Tromsøpalme: 1: not necessary, 5: necessary	188	0.013	59	107.7	4.49	5.0	129	88.46	4.12	4.0
<i>Having experienced injuries or knowing about somebody who did</i>	n (total)	p-value	n (injuries)	mean rank	mean	median	n (no injuries)	mean rank	mean	median
Evaluating Tromsøpalme's impact on health: 1: positive, 5: negative	195	0.021	38	115.22	3.89	4.0	157	93.83	3.55	3.0
Evaluating Tromsøpalme's importance as a symbol for Tromsø: 1: not important, 5: important	194	0.099	38	84.39	2.54	2.0	156	100.69	2.89	3.0
Evaluating the occurrence of Tromsøpalme on Tromsø Island: 1: seeing Tromsøpalme not as a problem, 5: seeing Tromsøpalme as a problem	195	0.043	38	114.04	3.97	4.0	157	94.12	3.59	4.0
Evaluating the necessity of regulation measures against Tromsøpalme on Tromsø Island: 1: not necessary, 5: necessary	194	0.005	37	118.70	4.62	5.0	157	92.50	4.17	5.0

Table 13: Results of Mann-Whitney-U tests (part 2) found to be significant (at the alpha = 0.1 level) for independent variable “gender” and outcome variables (bold: values).

<i>Gender</i>	n (total)	p-value	n (women)	mean rank	mean	median	n (men)	mean rank	mean	median
Evaluating Tromsøpalme’s appearance: 1: ugly, 5: nice	188	<0.001	94	110.26	3.55	4.0	94	78.74	2.79	3.0
Evaluating Tromsøpalme’s importance as a symbol for Tromsø: 1: not important, 5: important	187	0.009	93	104.17	3.08	3.0	94	83.94	2.53	3.0

Table 14: Results of Mann-Whitney-U tests (part 3) found to be significant (at the alpha = 0.1 level) for outcome variable “regulation status of Tromsøpalme on the parcel” (in bold) and independent variables (italic: value, normative beliefs, parcel characteristic).

Parcels’ contribution to the spread of Tromsøpalme (not or only partially regulated vs. full regulated or plant absent) (between May and September 2012)	n (total)	p-value	n (no or partial regulation)	mean rank	mean	median	n (plant absent or full regulation)	mean rank	mean	median
<i>Evaluating the occurrence of Tromsøpalme on Tromsø Island: 1: seeing Tromsøpalme not as a problem, 5: seeing Tromsøpalme as a problem</i>	194	0.002	87	84.01	3.34	3.0	107	108.47	3.92	4.0
<i>Evaluating the necessity of regulation measures on Tromsø Island: 1: not necessary, 5: necessary</i>	193	0.031	87	88.43	4.10	4.0	106	104.04	4.39	5.0
<i>Frequency vegetation-covered area on parcel was tended between May and September 2012: 1: never, 6: several times per week</i>	191	<0.001	85	80.28	3.54	4.0	106	109.04	4.33	4.0
<i>Number of persons living in respondent’s household (not normal distributed)</i>	193	0.002	88	84.23	2.33	2.0	105	107.70	2.99	3.0

Table 15: Results of Kruskal-Wallis tests (part 1) found to be significant (at the alpha = 0.1 level) with the outcome variable “normative belief of to what degree Tromsøpalme should be removed from Tromsø Island (no removal; partial removal from some areas, full removal)” and different independent variables (italic: values and normative beliefs).

Outcome variable: Normative belief - Degree Tromsøpalme should be removed from Tromsø Island	n (total)	p-value	n (no removal)	mean rank	mean	median	n (partial re- moval)	mean rank	mean	median	n (full removal)	mean rank	mean	median
<i>Evaluating appearance of Tromsøpalme, 1: ugly, 5: nice</i>	182	<0.001	5	98.50	3.40	4.0	117	106.38	4.0	3.63	60	61.91	2.37	2.0
<i>Evaluating Tromsøpalme’s impact on health, 1: good for health, 5: dangerous</i>	182	<0.001	5	79.80	3.40	3.0	117	75.91	3.0	3.37	60	122.88	4.15	4.0
<i>Evaluating importance of Tromsøpalme as a symbol for Tromsø, 1: not important, 5: important</i>	181	<0.001	5	147.10	4.40	5.0	116	110.81	4.0	3.39	60	48.03	1.62	1.0
<i>Evaluating the necessity of regulation measures on Tromsø Island: 1: not necessary, 5: necessary</i>	181	<0.001	5	39.90	2.80	3.0	116	75.78	4.0	3.96	60	124.68	4.87	5.0
<i>Evaluating the occur- rence of Tromsøpalme on Tromsø Island: 1: seeing Tromsøpalme not as a problem, 5: seeing Tromsøpalme as a problem</i>	182	<0.001	5	18.10	1.6	1.0	117	75.70	3.0	3.33	60	128.43	4.50	5.0

Table 16: Results of Kruskal-Wallis tests (part 2) found to be significant (at the alpha = 0.1 level) with the outcome variable “degree of regulating Tromsøpalme on the parcel between May and September 2012 (no regulation; partial regulation, at least one plant flowered; full regulation, no plant flowered)” and different independent variables (*italic: normative beliefs and parcel characteristic*).

Outcome variable: Degree of regulating Tromsøpalme on the parcel between May and September 2012	n (total)	p-value	n (no regula- tion)	mean rank	mean	median	n (partial regulation)	mean rank	mean	median	n (full regulation)	mean rank	mean	median
<i>Evaluating the necessity of regulation measures on Tromsø Island: 1: not necessary, 5: necessary</i>	136	0.027	28	54.68	3.75	4.0	49	66.90	5.0	4.24	59	76.39	4.46	5.0
<i>Evaluating the <u>occur- rence</u> of Tromsøpalme on Tromsø Island: 1: seeing Tromsøpalme not as a problem, 5: seeing Tromsøpalme as a problem</i>	137	0.007	28	55.71	3.21	3.0	49	62.60	3.0	3.43	60	80.43	4.05	4.0
<i>Frequency vegetation- covered area on parcel is tended between May and September 2012: 1: never, 6: several times per week</i>	134	<0.001	27	43.33	2.93	3.0	48	67.86	4.0	4.00	59	78.28	4.37	4.0

Table 17: Results of Kruskal-Wallis tests (part 3) found to be significant (at the alpha = 0.1 level) with the outcome variable “frequency of tending vegetation-covered area” for independent variable “residence status” (italic).

Outcome variable: Frequency vegetation- covered area on parcel was tended between May and September 2012: 1: never, 6: several times per week	n (total)	p-value	n (owner lives on parcel)	mean rank	mean	median	n (only renter lives on parcel)	mean rank	mean	median	n (no building on parcel)	mean rank	mean	medi an
<i>Residence status- owner lives on parcel, renter, no building on parcel</i>	190	<0.001	160	105.11	4.26	4.0	19	57.58	3.0	3.0	11	21.27	1.64	1.0

Table 18: Results of t-tests found to be significant (at the alpha=0.1 level), outcome variables (bold: socio-demographic variables) and independent variables (italic: socio-demographic variables).

Education	n (total)	p-value	n (without higher education)	mean	n (with higher education)	mean
<i>Age</i>	192	0.086	58	60.21	134	56.25
<i>Years of ownership</i>	187	0.012	56	25.84	131	19.62
<i>Years living in Tromsø/ Residence time</i>	193	<0.001	59	47.92	134	37.22
Experiencing injuries or knowing about somebody that did	n (total)	p-value	n (injuries)	mean	n (no injuries)	mean
<i>Age</i>	190	0.011	38	63.18	152	56.33
<i>Years of ownership</i>	188	0.013	150	29.16	38	20.01
<i>Years living in Tromsø/ Residence time</i>	192	0.028	38	47.26	154	39.57

Table 19: Results of Chi-square tests (part 1) found to be significant (at the alpha=0.1 level); rows: outcome variables in bold (normative belief towards removal of Tromsøpalme on Tromsø Island, regulation behavior between May and September 2012); columns: independent variables in italic (socio-demographic characteristics and parcel characteristics).

		Tromsøpalme should be removed everywhere from Tromsø Island	*should be removed partly (from some areas)	total	
<i>Without higher education</i>	n	26 46.4%	30 53.6%	56 100%	
<i>With higher education</i>	n	32 27.8%	83 72.2%	115 100.0%	
Total	n	58 33.9%	113 66.1%	171 100.0%	
p-value	0.016				
<i>Respondent received permanent injuries or knew sb. who did</i>	n	20 54.1%	17 45.9%	37 100%	
<i>No injuries</i>	n	40 28.6%	100 71.4%	140 100%	
Total	n	60 33.9%	117 66.1%	177 100%	
p-value	0.004				
		Regulation behavior: No regulation of Tromsøpalme on parcel	Partly regulation; at least one plant flowered on the parcel	Total regulation ; no plant flowered on the parcel	total
<i>Children (below 10 years) lived on parcel</i>	n	8 33.3%	5 20.8%	11 45.8%	24 100%
<i>No children (below 10 years) lived on parcel</i>	n	14 13.9%	42 41.6%	45 44.6%	101 100%
Total	n	22 17.6%	47 37.6%	56 44.8%	125 100.0%
p-value	0.041				

*The number of respondents favoring “should not be removed anywhere” was below 5 and therefore they were not included into the Chi-square test.

Table 20: Results of Chi-square tests (part 2) significant at the alpha=0.1 level; rows: outcome variable in bold (“contribution of parcel to Tromsøpalme’s spread”); columns: independent variables in italic (parcel characteristics).

		Parcels contributed to Tromsøpalme’s spread (plant not or partly regulated)	Parcels did not contribute to Tromsøpalme’s spread (plant fully regulated or absent)	total
<i>Parcels associated with several households each</i>	n	37 57.8%	27 42.2%	64 100.0%
<i>Parcels associated with one household each</i>	n	45 36.0%	80 64.0%	125 100.0%
Total	n	82 43.4%	107 56.6%	189 100.0%
p-value	0.004			
<i>Owners lived on parcel</i>	n	65 40.6%	95 59.4%	160 100.0%
<i>*Only renters lived on parcel</i>	n	11 61.1%	7 38.9%	18 100.0%
Total	n	76 42.7%	102 57.3%	178 100.0%
p-value	0.096			

*The parcels without residence were not included into Chi-square test because sample size was below 5.

6.5.5 Multinomial and binary logistic regressions

Table 21: Modell III - Multinomial logistic regression of the outcome variable “regulation degree of Tromsøpalme on respondents’ parcels: no regulation (reference category), partial regulation, full regulation” with parcel characteristics and normative beliefs as independent variables (bold) (n=120). All data refer to vegetation period May-September 2012. One outlier was removed (see Endnote #13, p. 158). Model I is the alternative model (Table 9, p. 82).

<i>Outcome variable: Degree of regulation of Tromsøpalme on the parcel in the time period May - September 2012</i>		B	std. error	p-value	odds
<i>Partial regulation on the respondents’ parcels; at least one plant flowered on the parcel</i>	Intercept	-2.413	1.740	0.166	
	Residence status: owners lived on parcels	-1.441	1.211	0.234	0.237
	No residence on parcels	-3.584	1.664	0.031	0.028**
	(Reference: Only renters lived on parcels)
	Parcels associated with several households each (Reference: Parcels associated with one household each)	0.824	0.613	0.179	2.279
	Length of parcel ownership	0.070	0.027	0.009	1.073***
<i>Total regulation on the respondents’ parcels; no plant flowered on the parcel</i>	Normative belief: Evaluating necessity of regulation measures of Tromsøpalme on Tromsø Island (1: not necessary, 5: necessary)	0.681	0.281	0.015	1.976**
	Intercept	-2.919	1.763	0.098	
	Owners lived on parcel	-0.639	1.232	0.604	0.528
	No residence on the parcel	-3.356	1.694	0.048	0.035**
	(Reference: only renters lived on the parcel)
	Parcels associated with several households each (Reference: Parcels associated with one household each)	-0.090	0.599	0.881	0.914
Length of parcel ownership	0.053	0.026	0.042	1.055**	
Normative belief: Evaluating necessity of regulation measures of Tromsøpalme on Tromsø Island (1: not necessary, 5: necessary)	0.872	0.284	0.002	2.392***	

Reference category: *no regulation of Tromsøpalme on the parcel*

Nagelkerke-Pseudo-R²=0.260 (maximum: 1.0)

***Significant at 0.01, **Significant at 0.05, *Significant at 0.1

Table 22: Model IV - Binary logistic regression of the outcome variable “contribution of the respondents’ (landowners’) parcels to the spread of Tromsøpalme: no or partial regulation (reference category) vs. full regulation of Tromsøpalme or plant absent” with parcel characteristics and normative beliefs as independent variables (bold). All data refer to vegetation period May-September 2012 (n=178). Two outliers were removed (see Endnote #13, p. 158). Model II is the alternative model (Table 10, p. 83).

<u>Outcome variable: Tromsøpalme was fully regulated/absent on the parcels vs. Tromsøpalme was partly regulated not regulated on the parcels</u>	B	std. error	p - value	odds
Residence status			0.025	
Owners lived on parcels	1.138	0.652	0.081	3.121*
No residence on parcels (Reference: only renters lived on parcels)	-0.435	0.944	0.645	0.647
Parcels associated with one household each (Reference: Parcels associated with several households each)	1.056	0.348	0.002	2.874***
Normative belief: Evaluating Tromsøpalme’s occurrence on Tromsø Island (1: did not perceive it as a problem, 5: perceived it as a problem)	0.463	0.146	0.002	1.589***
Constant	-3.065	0.877	0.000	0.047

Reference category: *no or only partial regulation of Tromsøpalme on the parcels*

Nagelkerke-Pseudo R²=0.145 (maximum: 1.0)

*** Significant at 0.01, ** Significant at 0.05, * Significant at 0.1

6.6 Appendix F: Endnotes

Endnote #1: Definitions of terms used in the thesis

The definition of “awareness” used by Steele et al. (2006: 248) is the way how landowners have received information about invasive plants, and if they know about invasive plants on their land. For this study, more or less the same definition is used, namely if landowners have heard about Tromsøpalme, where they got information from, and if they know if Tromsøpalme is on their parcel or not.

The term “value” describes a durable positive or negative feeling about something, such as “good or bad” or “ugly and beautiful” (Rokeach 1979: 16). Kellert (1996) determines different values which humans connect with nature. For the study at hand, the nature’s “aesthetical value” (appearance: ugly or nice) and “symbolical value” (symbolical importance: important or not important) are used defined by Kellert (1996: 14-20). The values were evaluated in a positive or a negative sense according to Rokeach (1979) and they were measured in a five-point Likert- scale. Another value is created for this study called “health value” (health impact: good or dangerous to health).

“Normative belief”, defined by (Fishbein & Ajzen 1975: 16), describes, what is believed by somebody about how another person should or should not act. In this study, the normative beliefs refer to the acceptance of study participants towards wildlife management measures in the way, Zinn et al. (1998) use the term in their study. Normative beliefs in this study on hand means if landowners/locals considered regulation of Tromsøpalme on Tromsø Island taken by local institutions as necessary and to what degree they thought Tromsøpalme should be removed from Tromsø Island. Also, it includes if Tromsøpalme’s occurrence is seen as problematic on Tromsø Island. Even though this latter is not a normative belief according to the definition, it is an evaluation that refers to the necessity of regulation of Tromsøpalme on Tromsø Island. Therefore it is treated here as a normative belief.

Other studies, which are cited in this thesis, use the terms “concerns” (Fischer & Charnley 2012; Loker et al. 1999), “attitudes” (Bremner & Park 2007) or “perceptions” (Fischer & van der Wal 2007) in a similar way as the definition of “values” and “normative beliefs” according to Rokeach (1979) and Fishbein and Ajzen (1975). Therefore, to be more consistent in this thesis the terms “values” and “normative beliefs” are used regarding other studies even though these other studies might actually not use these terms. The terms “values” and “normative beliefs” seemed to be most appropriate in this study to make a clear distinction between the locals’/landowners’ evaluations which refer to the plant itself (values), and

evaluations that refer to what should be done with the plant (normative beliefs). “Perception” in this study is used as a collective term for “values” and “normative beliefs”.

“Behaviors” are “observable acts” (Fishbein & Ajzen 1975: 13). In this study, regulation behavior of landowners refers to the degree to which the landowners regulated Tromsøpalme on their parcels between May and September 2012 (no regulation, Tromsøpalme could grow unhindered on the parcel; partial regulation, at least one plant flowered; full regulation so that no plant flowered). The term “regulation” describes any measure to prevent Tromsøpalme from spreading by the use of different methods, such as cutting of the stems or flowers, mowing, or digging out the roots. The terms “controlling” or “regulating” of Tromsøpalme on Tromsø Island means applying measures to keep the plant in check, while the term “eradication” describes the complete removal of the plant from Tromsø Island.

“Respondents” is used as a synonym for landowners who have answered the questionnaire. Landowners in this study were people owning a private property on Tromsø Island, in this study called “parcel”. A parcel is a piece of land that can be bought or sold and that has defined borders (Norwegian encyclopedia 2007). “Plot” and “land” are used as synonyms for parcel in this work. Landowners’ parcels where Tromsøpalme (at least one plant) was observed on the parcel during field visits are called “TP-parcels” while parcels where Tromsøpalme was not seen on the parcel are referred to as “non-TP-parcels”.

“Wildlife” in this thesis relates to both animals and plants. The term “authorities” refers to governmental organizations, such as the municipality of Tromsø, the Norwegian Public Road Administration, and the Troms County Governor. The socio-demographic variable “experiencing injuries” includes both that the respondent had experienced injuries and/or that the respondent knew about somebody who did.

Endnote #2: Sortland (1997) surveyed Tromsøpalme (among other plants) on Tromsø Island by field investigation, but did this only along roadsides.

Endnote #3: In Google Street View[®] more Tromsøpalme plants were visible (along roads) than in Google Maps[®] and therefore some stands were found and mapped based on Google Street View[®] only. Especially, in the city center (the south-eastern part of the island) and along larger roads, the plant was mapped by “walking” through all the roads with Google Street View[®].

Endnote #4: The address file showed that parcels on Tromsø Island belonged to three main types of owners: either to the public, to companies or industrial enterprises, or to private persons. Parcels owned by public institutions or companies were not included in the study because staff at an authority or a business were not considered as suitable respondents for the questionnaire. These respondents might not have been aware of how the vegetation on the

parcel was managed and they were probably not regulating the parcel themselves. So, the regulation status of Tromsøpalme on these parcels could not be compared to the respondents' characteristics and perceptions towards the plant (see Table 23, p. 154).

To double-check that only parcels with private owners were included in the study, the questionnaire explicitly asked the respondent if the parcel was owned by a public institution, belonged to a company, or if it was used by one of these (see Question 1, 4, 5 and 8a, p. 121-122). If the respondent answered “yes” to one of these questions, the questionnaire filled out by this respondent was not included in the analyses, which was the case with two respondents.

Table 23: Examples of landowners on Tromsø Island who were not considered as potential respondents for the questionnaire in the study.

Owner types	Different landowners
Public owners	Norwegian Public Road Administration, NPRA (Norw: Statens Vegvesen) Tromsø Municipality (Norw: Tromsø kommune) Troms County Administration (Norw.: Troms Fylkeskommune) Church University Student Housing Office (Norw.: Studentsamskipnaden i Tromsø) Hospital Community accommodation (Norw.: Kommunale boliger stiftelsen) Homes for the elderly (Norw.: Eldreboliger boligstifte)
Companies (identified by the abbreviation AS)	Shopping malls Factories Office buildings Hotels Airport Real estate companies
Mixed-ownership	Both private and public or company owners were registered as owners of the parcel

Endnote #5: This radius was chosen so that houses on the opposite side of roads could also be sampled. For some parcels (8 out of 404) a wider radius was chosen if no parcel without visible Tromsøpalme was within the 20-meter radius.

The radius was measured from the middle of the parcel. So, the method of selecting neighboring parcels did not consider that if Tromsøpalme was just on one edge of the parcel,

the probability for the plant to spread on adjacent parcels was higher for neighboring parcels closer to that edge relative to the other neighboring parcels.

Endnote #6: Some of the included parcels had no green area but were kept in the sample because Tromsøpalme can grow along house walls and in small openings in the pavement. If the address of a parcel was not registered in the address file or no living owner was indicated, the parcel was not included into the study. Small parcels with no buildings (that looked like residuals from once larger parcels) were not included in the study unless the same owner owned adjacent parcels; in that situation, all of the small parcels owned by the same owner were combined into one parcel (as long as all the parcels seemed to be utilized as one plot of land). The owners received a map of the combined parcels and were asked to refer in their answers to the combined parcels.

Endnote #7: One parcel was often associated with several owners so that one respondent had to be randomly selected among these. When one of these owners lived on the land/in the house him- or herself, s/he was chosen as a respondent (if there were several owners living on the parcel, the choice was made randomly among them). If the owners did not live on the parcel themselves (or if there was no building on the parcel), respondents were selected randomly out of those owners who lived in Tromsø. If none of the owners lived in Tromsø, the respondents were randomly chosen among all the owners of the parcel. If a parcel was selected that had a neighboring parcel belonging to the same owner, those parcels were combined (when they were utilized in the same way) so that the respondent had to answer for the combined parcels. If a parcel was linked to several houses/housing units with several addresses, one address was selected randomly. Then the respondent was chosen among those owners who were associated with that address.

Endnote #8: According to the respondents answers, in 140 of these 199 questionnaires respondents indicated that Tromsøpalme was present, 50 indicated that the plant was absent, while eight indicated they did not know the status of Tromsøpalme on their parcel, one owner had never heard of Tromsøpalme. The status of one parcel could not be verified by any information source. Of those 50 respondents who indicated not to have Tromsøpalme, 14 respondents wrote into the questionnaire that they had removed Tromsøpalme before summer 2012.

According to the field classification, 95 of these 199 answered questionnaires related to parcels where no Tromsøpalme was visible on the parcel in the field (47.7%), 83 related to parcels where Tromsøpalme was visible (41.7%), and 21 related to parcels where the status of Tromsøpalme was unproven (10.6%).

Endnote #9: Six respondents reported not to have Tromsøpalme, although Tromsøpalme was observed during field visits. Therefore, photos which were taken during field work from the parcels and parcel borders were checked again. These parcels were still considered as TP-parcels for different reasons: a) in three cases the respondents might not have considered the areas containing Tromsøpalme as part of their parcels, in spite of the description in the cadaster map, b) in two cases the plant grew in the “unused” area of the parcels (behind a garage or in a steep inaccessible part), so that the respondent might not have seen it, and c) in one case the respondent reported to have bought the house in the year of the field work, maybe therefore this respondent was not so familiar with the property yet and did not know that the plant was on the parcel.

Endnote #10: Evaluating the methods of classifying the parcels

In the following, the methods leading to the classification of the parcels are discussed which includes the mapping of Tromsøpalme (with air photos of Google Maps[®] and pictures of Google Street View[®]), the identification of private parcels with and without Tromsøpalme in ArcGIS, and finally the verification by field visits and respondents’ answers.

The air photos of Google Maps[®] showed only plants that flowered in 2007 (five years before the study). This means recently established plants (between 2007 and 2012) were not visible. Furthermore, plants under tree cover were not visible either, nor were plants that were cut just before the time when the photos were taken. The Google Street View[®] pictures were from 2010, so they were a little bit more up-to-date than the Google Maps[®] pictures (only two years before the study), however, it was often difficult to have a look into parcels from the road by using this tool. When Tromsøpalme grew on the border of parcels or when there was a mismatch between the map layer where Tromsøpalme was drawn in and the cadastral map layer, the parcels could not be classified easily with Google Maps[®]. It happened also that Siberian hogweed looked like Tromsøpalme in Google maps[®] because of similar color and therefore parcels with Siberian hogweed were mistakenly classified as TP- parcels.

The problems of using Google Maps[®]/Google Street View[®] were mitigated by field visits. 25% (n=50, n_{total}=202) of the classified non-TP-parcels could be identified by field visits as actually being TP-parcels and 14% (n=28, n_{total}=202) of the TP-parcels were reclassified as non-TP-parcels. In that way, the original sample based on the maps had more TP-parcels (cases) than non-TP- parcels (controls) and this was evened out by field work to a certain degree. Four of the mistakenly included Siberian hogweed parcels could be corrected by field checks, and these parcels with Siberian hogweed were re-classified as non-TP parcels.

To decide on which parcels Tromsøpalme grew in border cases was easier in the field than when using Google Maps[®] and Google Street View[®]. But there were still some parcels where

it was not possible to tell on which side of the border Tromsøpalme grew. Furthermore, in the field, only those parcels were selected which could be inspected from the road to check if Tromsøpalme was visible or not, so the selection could not be done randomly. In the field, no notes about the degree of regulation were taken; this idea came up later within the research and therefore respondents were asked about the degree of regulation in the questionnaire. Parcels where respondents were not aware of the presence of the plant could therefore not be categorized into different levels of regulation. For further studies interested in the different regulation degrees, it might be useful to check also the regulation statuses of the plant on the parcels by field visits.

To test the field verifications, the questionnaire respondents were asked about the presence and absence of Tromsøpalme on their parcel between May and September 2012. Furthermore, they were asked a) if the plant was not regulated at all, b) if it was partly regulated (if it flowered at least once in that period and therefore had a high chance to set seeds and reproduce) or c) if it was completely regulated by the landowner (so that plant did not flower). There are some challenges regarding the respondents' answers: it is uncertain to what extent the landowners can remember the situation of the plant on their parcel as they were asked in winter around three months after the vegetation season when the plant is hardly visible under the snow. Furthermore, the landowners might not have a clear notion about the borders of their parcels or the plant often grew in hidden areas of the parcel. Also, in 20 cases, the respondent was not the person who was responsible for the regulation of the plant. So, in these cases the respondents might not have been informed enough to answer the questionnaire adequately and their perceptions of the plant might not correspond to the regulation status of the plant on the parcel.

Endnote #11: After the first mailing of 441 questionnaires, 140 were sent back within four weeks and after the reminder mailing a further 61 questionnaires returned, which amounted to 201 responses altogether. 14 questionnaires could not be delivered, three questionnaires were sent back without being filled in and three respondents indicated they did not own the parcel anymore and therefore could not answer the questionnaire. Considering non-deliverable addresses (14) and non-appropriate respondents (3), the effective sample size, which means the amount of respondents that could potentially have answered to the questionnaire, had to be corrected to 424. Based on this figure, the response rate was 47%. Two of the returned 201 questionnaires were excluded because one parcel was partly owned by a public institution and a private person and one by a business and a private person. So, 199 questionnaires were used in the analysis.

Endnote #12: As already mentioned, for more than a half of the parcels where no Tromsøpalme had been observed, respondents reported that Tromsøpalme actually existed on the parcel, probably, because the plant was regulated on these parcels thoroughly. So, there

were more parcels with Tromsøpalme (75.4%, n=150) than parcels without Tromsøpalme (24.1%, n=48) in the sample of the returned questionnaires (the classification of one parcel was unknown). Therefore, parcels where Tromsøpalme was absent were combined with parcels where Tromsøpalme was fully regulated (fully regulated Tromsøpalme did not flower, would not spread and would eventually disappear). These parcels did not contribute to the spread of Tromsøpalme. In the same way, the parcels where Tromsøpalme was not regulated or partially regulated were combined as in those cases there was a risk that the plant would spread further. Thus, in the binary regression the group of parcels where the plant was absent/fully regulated (55.6%, n=110) was compared to the group of parcels where the plant was not or only partly regulated (44.4%, n=88) between May and September 2012.

The 110 parcels in the group “absence/fully regulated” included: 1) 62 parcels where the plant was fully regulated according to the respondents, 2) 44 parcels where Tromsøpalme was absent according to the questionnaire respondents and where the plant was not visible in field visits, and 3) four parcels where the owner did not know if the plant was present or not but in field visits the plant was not visible.

The 88 parcels in the group “not or partly regulated” included: 1) parcels where the plant was not regulated (28) or partly regulated (50) according to the respondents, 2) four parcels whose owners did not know if the plant was present or absent but field visits showed that the plant was visible, and 3) six parcels whose owners indicated that the plant was absent but field work showed that there was Tromsøpalme on the plot.

Endnote #13: Outliers were identified by developing boxplot diagrams out of Cooks distance, Studentized Standard, and Leverage Values of the regression models. Outliers that were removed lied three times the length of the box away from the upper or lower end of the box, and were shown by a star in SPSS (Pallant 2011).

In Model I, two outliers were taken out. One outlier was a parcel which was shared among a high number of households (16 apartments, which is far above the average, because most of the parcels were only associated with two to eight households). For the analysis, though, the continuous variable “number of households sharing the parcel” was changed to a two-level categorical variable “one household vs. several households”, so the actual number of 16 households did not make any difference for this categorical variable. But, the high number of households might be a reason that this respondent had characteristics which were considerably different from the other respondents in the dataset, which could unduly influence the regression line. The other outlier was a parcel of an owner who was actually not responsible for the tending of the vegetation area and the regulation of Tromsøpalme on the parcel. However, this owner answered that the vegetation-covered area was tended but not the Tromsøpalme. Here the respondent was possibly not informed enough because s/he did not

perform the regulation of the plant. Taking out these outliers changed the variable “amount of households that share the parcel” from “almost significant” to “significant” at the $\alpha = 0.1$ level.

For Model II, no outlier was removed.

In Model III, the outlier, which was taken out, was a parcel where renter(s) lived who had the responsibility of tending the vegetation-covered area on the parcel, according to the respondent (owner). However, the respondent also stated that neither the parcel nor Tromsøpalme was tended. Although the owner was not regulating Tromsøpalme because s/he did not live on the parcel, the owner considered regulation measures on Tromsø Island as important. As the renters were responsible for the vegetation on this parcel, the regulation of Tromsøpalme could not be directly comparable to the owner’s perceptions of Tromsøpalme. After taking out this outlier, the significance of “residence status” and “number of households sharing the parcel” was higher.

For Model IV, the outliers that were taken out were two parcels where only renters lived and where the vegetation-covered area was not tended frequently. However, the plant had not established there. These owners also considered Tromsøpalme not so much to be a problem on Tromsø Island. As the vegetation-covered area was not so often tended, Tromsøpalme actually could have a high chance to establish in the area. Taking out these outliers increased the significance of the variables “residence status” and “number of households sharing the parcel”.

Endnote #14: As there were so many missing answers for the question “how many households share the vegetation-covered area of the parcel” (Question 14, p. 123) - maybe because the question could have been overlooked easily as it was a short question - information about the amount of households that share the area was taken from the address file of the Norwegian Mapping Authority. Therefore, this variable refers here only to the number of households associated with the parcel.