

Low arctic study design Varanger

INTENSIVE DESIGN AT VARANGER-REGION

The intensive design at Varanger-region has currently two localities; Vestre Jakobselv and Komagdalen.

SECTION TYPES IN THE INTENSIVE DESIGN: RIVER VALLEY SECTIONS

River valley sections are either separate side-valleys or sections along the main river. The sections differ in the degree of thicket areal extent and fragmentation, ranging from no willow thickets to relatively large and little fragmented thickets. The main contrast of fragmentation is between the sections; within section willow thickets have a roughly similar fragmentation degree. The sections are approximately between 1 and 4 km from the nearest neighboring section.

River valley sections have two main habitat types; riparian plains and dwarf shrub heaths.

In Komag, the sections currently included in the study design are Komagdalen øvre, Komagdalen midtre and Sandfjorddalen. At Vestre Jakobselv, the sections currently included in the study design are Torvhaugdalen and Bearalveaijohka.

Site type in river valley sections – heath and meadow sites

Heath and meadow sites come in three variants; i) meadow sites, ii) heath sites near the productive meadow/thicket habitats, and iii) heath sites that are at least ca. 1km from productive habitats.

Meadow sites are on mineral soils on riparian sediments flats and the nearby willows are imbedded in lush meadow vegetation. They have less than 30% flooded areas, stony areas or mires. When the sites were established (2004), no camping sites were present.

Both types of heath sites are in mesic heath with varied microtopography (hummocks and/or stones). The heaths have dominance of dwarf shrubs, including *Vaccinium* sp and *Betula nana*. Heaths with *Empetrum nigrum* dominance are excluded. In addition to shrubs, also other food plants of small rodents, notably palatable grasses and forbs (such as *Avenella flexuosa*, *Bistorta vivipara*, *Rumex acetosa*, and *Chamaepericlymenum suecica*) are present.

Each section has an equal number (4-5) of sites in all three types of habitats. Sites belonging to meadow habitats and heaths close to these are spatially aggregated in pairs. The distance between adjacent sites (within the same habitat type) is at minimum 160 m. Distance between paired sites (i.e. different habitat) can be down to 30 m.

Sites are named with a code representing “locality_section_habitat_site”; e.g. vj_to_m_a for meadow site “A” in Torvhaugdalen at Vestre Jakobselv. Abbreviation “m” is used for meadow, “hn” for heath near productive habitats and “hf” for heath far from productive habitats.

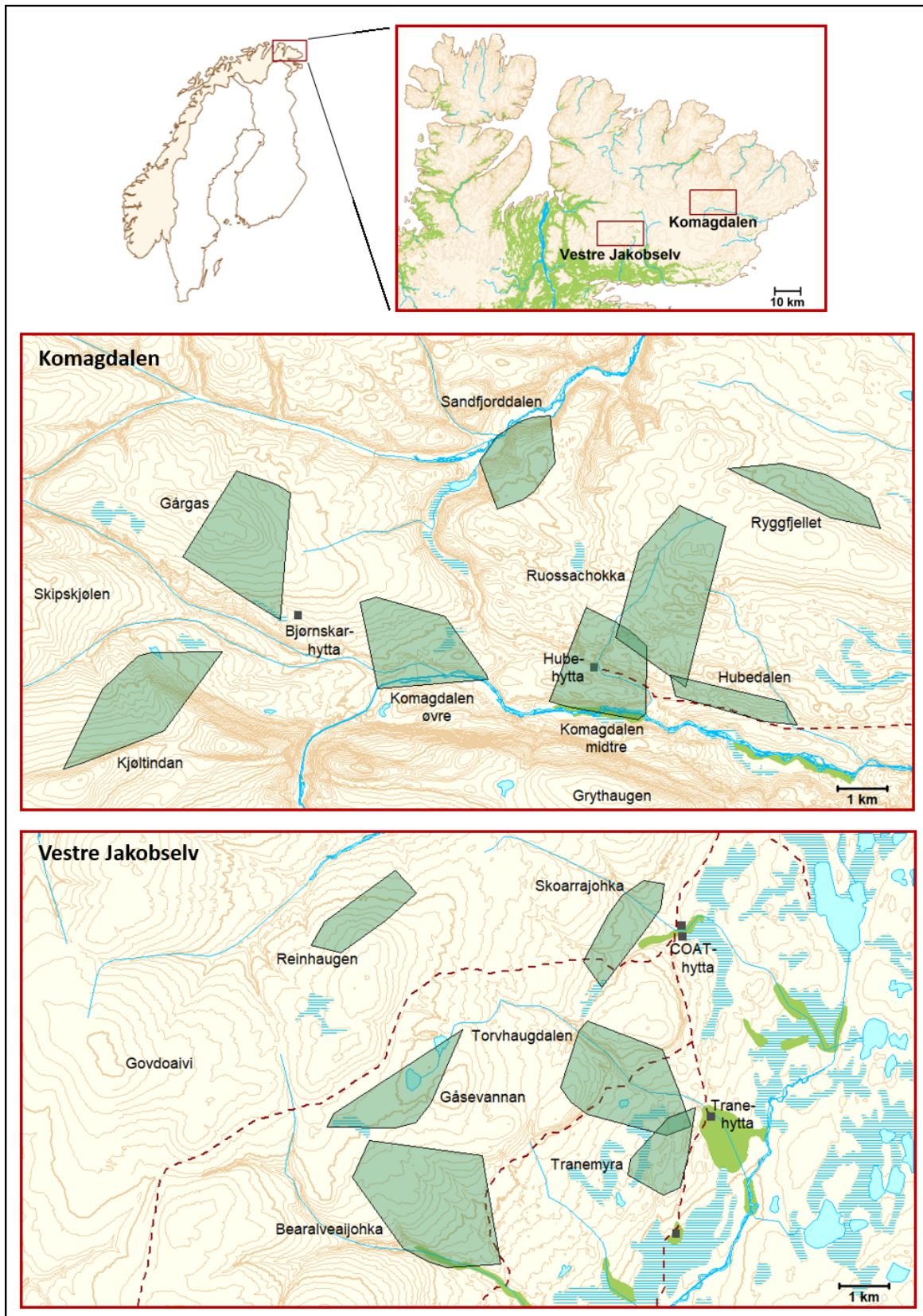


Figure 1: Overview of the intensive study design at Varanger-region with the two localities, Komagdalen and Vestre Jakobselv on the Varanger-peninsula (top) and the different section in Komagdalen (middle) and Vestre Jakobselv (bottom). (Map data from www.kartkatalog.geonorge.no)

Each site has a 15*15m sampling quadrat that is used as a frame for placing various plots. In the meadow habitat, one of the quadrat edges is aligned with the thicket edge and the rest extends into the meadow (Figure 2). The innermost corners of the meadow quadrat were originally set 1 m into/below the thicket (thicket canopy where this reaches further out into the meadow). In all quadrats without thicket (heath habitat, sites without thickets), the quadrat edge closest to river valley corresponds to the “thicket edge” (i.e. all plots etc. are numbered as if this edge was the thicket edge). Various additional plots and sampling instruments are placed in the vicinity of the quadrat (Figure 2).

The quadrat corners are marked with aluminium poles, or wooden sticks in the corners. Where aluminium poles are used, these are placed in the corners along the thicket edge, and painted with orange/yellow (NB the paint may sometimes be worn out). Other permanent markings within the sites are: pellet count plots (nails) and small rodent trap localities (plastic straps/painted rocks).

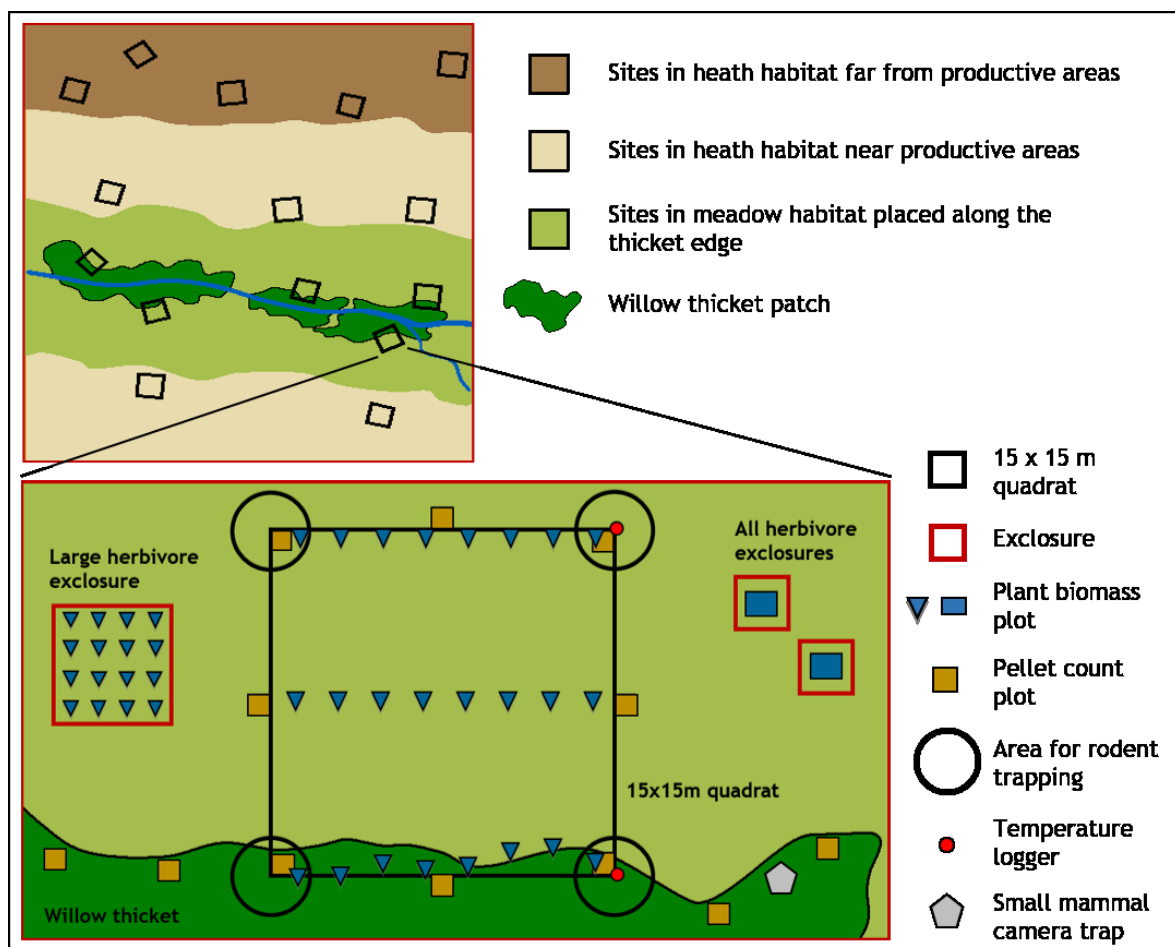


Figure 2: Schematic presentation of a river valley section with sampling sites in heath habitat far from productive areas, heath habitat near productive areas and meadow habitat (top). Schematic presentation of a sampling site with related measurement plots and instruments. Not all sites have all plots/instruments (bottom).

SECTION TYPES IN THE INTENSIVE DESIGN: MOUNTAIN SLOPES

Mountain slope sections are stretches of sloping terrain that stretch from the river valleys to nearby hilltops. Each section covers an altitudinal gradient, with a range of 138 to 204 m within the section. At the lowest section reaches down to 170 m.a.s.l. and the highest up to 483 m.a.s.l.

In Komagdalen, the sections currently included in the study design are Kjøltdindan and Ruossachokka. At Vestre Jakobselv, the sections currently included in the study design are Torvhaugdalen and Bearalveaijohka.

Site type in mountain slope sections – snowbeds

Snowbeds are dominated by mosses and other typical snowbed plants such as *Salix herbacea* (not grass or lichens). Their topography leads to accumulation of snow during winter (i.e. below ridges and lee sides). At the time of selecting, they contained lemming faeces and showed grazing signs from the previous lemming peak (2007). They are large enough to hold 4 paired plots with a minimum distance of 5 meters between pairs.

Snowbeds are distinct landscape elements. They can be discontinuous, but still form a distinct unit in the landscape. The snowbeds belonging to the the same mountain slope section are at least 60m from each other.

Sites are named with a code representing “locality_section_habitat_site”; e.g. vj_to_sn_1 for snowbed site number 1 in Torvhaugdalen at Vestre Jakobselv. Abbreviation “sn” is used for snowbeds.

Snowbed sites are not marked. However, plots that are within snowbeds are marked with paired wooden poles. In addition, some of the snowbed sites have herbivore exclosures (Figure 3).

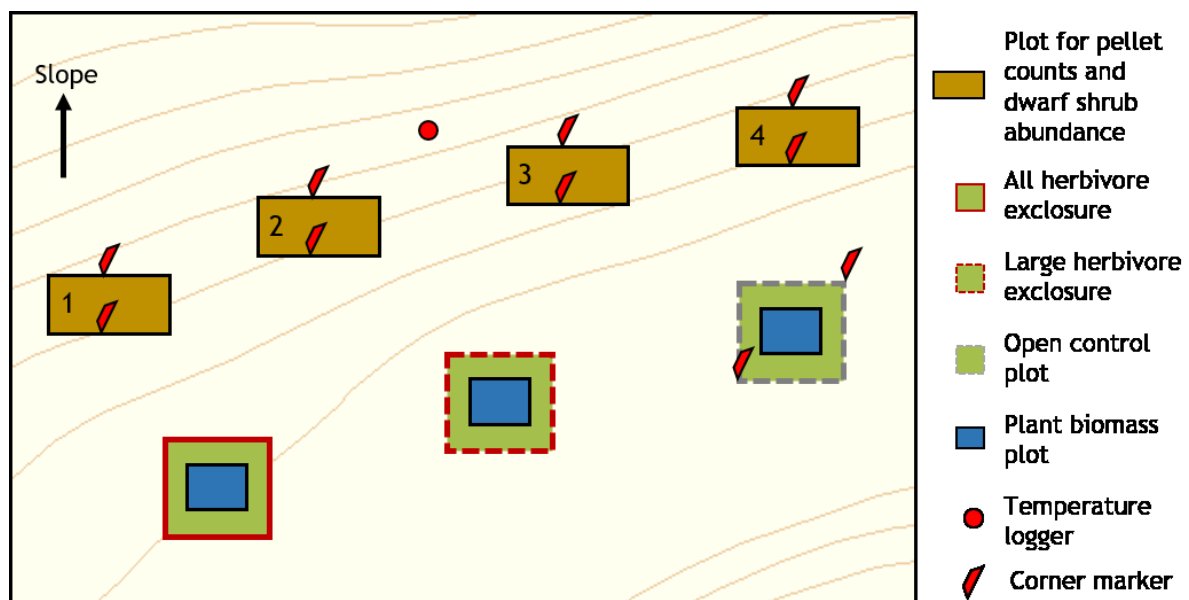


Figure 3: Schematic presentation of a snowbed site in the mountain slope sections. Not all sites have exclosures.

SECTION TYPES IN THE INTENSIVE DESIGN — LEMMING BLOCKS

“Lemming blocks” are sections of tundra at a given altitude (i.e. no altitudinal gradient within the section). That is, within sections the sites are at approximately similar altitude. Each section has both snowbed and hummock tundra sites. The lowest lemming blocks are close to willow thickets, the highest ones at the uppermost limit of vascular plants. Minimum distance between sections is 3 km; we therefore assume that the recordings of mustelids are independent between these sections.

In Komagdalen, the sections currently included in the study design are Kjøltindan, Gargas, Ryggfjellet, and Hubedalen. At Vestre Jakobselv, the sections currently included in the study design are Tranemyra, Skoarrajohka, Gåsevannan, and Reinhaugen. Lemming blocks overlap partly with mountain slope sections, but do not cover the same within-section altitudinal gradient as mountain slope sections (Figure 1).

Site type in lemming blocks – camera trapping sites for lemmings (snowbeds, hummock tundra)

Camera trapping sites for lemmings come in two variants; summer and winter habitat sites. Summer habitat sites are located in graminoid rich hummock tundra. Winter habitat sites are located in snowbeds with an adjacent rock field. Their vegetation is relatively rich; i.e. compared to all possible snowbeds within a given section. The sites were selected after surveying a larger selection of possible sites within the section, and selecting sites that: i) enabled a configuration of each site being ca. 300m from adjacent sites, ii) having best possibilities for establishing a camera trap without flooding the camera, and iii) having largest possible selection of lemming food plants.

Each section has in total 12 camera sites. The sites are distributed in equal numbers between snowbed habitat (presumed optimal lemming winter habitat) and hummock tundra habitat (presumed optimal lemming summer habitat). In most sections, the two habitats are so close to each other that we can assume lemmings to switch between the habitats. At Gargas this was not possible at transect level. However, all cameras in a given habitat have the other habitat relatively close. Thus, the available habitat complex always encompasses both types of habitats. Minimum interval between two sites is 300m; and we therefore assume that the same rodent is unlikely present at more than one site within a given day.

Sites are named with a code representing “locality_section_habitat_site”; e.g. ko_ga_hu_1 for hummock tundra site number 1 at Gargas at Komagdalen. Abbreviation “sn” is used for snowbed habitat and abbreviation “hu” for hummock tundra habitat.

Camera trapping sites are not marked. The only structures present are cameras below the rock construction.

HISTORY OF THE VARANGER INTENSIVE DESIGN

Localities: Three sections were originally established in 2005. From 2005 to 2017, we also sampled several data series at Ifjordfjellet. Ifjordfjellet was removed from the intensive design in 2017. The increased human presence due to the new road led to difficulties in distinguishing between changes of the ecosystem caused by human activity and climate-driven changes.

River valley sections: Originally established in 2005 in Komagdalen (3 sections), Vestre Jakobselv (3 sections) and Ifjordfjellet (4 sections), only in areas with willow thicket. In 2009, riparian areas without thickets were included in the design (Sandfjorddalen in Komagdalen, Iesjohka and Giksjoehka at Ifjordfjellet). At the same time the sections with largest thickets (i.e. Komagdalen nedre and

Jakobselv), as well as very small sections at Ifjordfjellet (Suolojavri and Gurrojohka) were removed from the study design.

Mountain slope sections: Originally established in 2009 in Komagdalen (2 sections), Vestre Jakobselv (2 sections) and Ifjordfjellet (2 sections). Originally each section had 20 snowbeds, except for Vestre Jakobselv where each section had 30 snowbeds. In 2013, some of the snowbed sites at Vestre Jakobselv were removed from the design, resulting in 20 snowbeds per section. 2016 was the last year when sections at Ifjordfjellet were included in the design.

Lemming block sections: Originally established in 2015 in Komagdalen (4 sections) and in 2018 at Vestre Jakobselv (4 sections).