



Environmental and Social Impacts of Industrialization in Northern Russia (ENSINOR)

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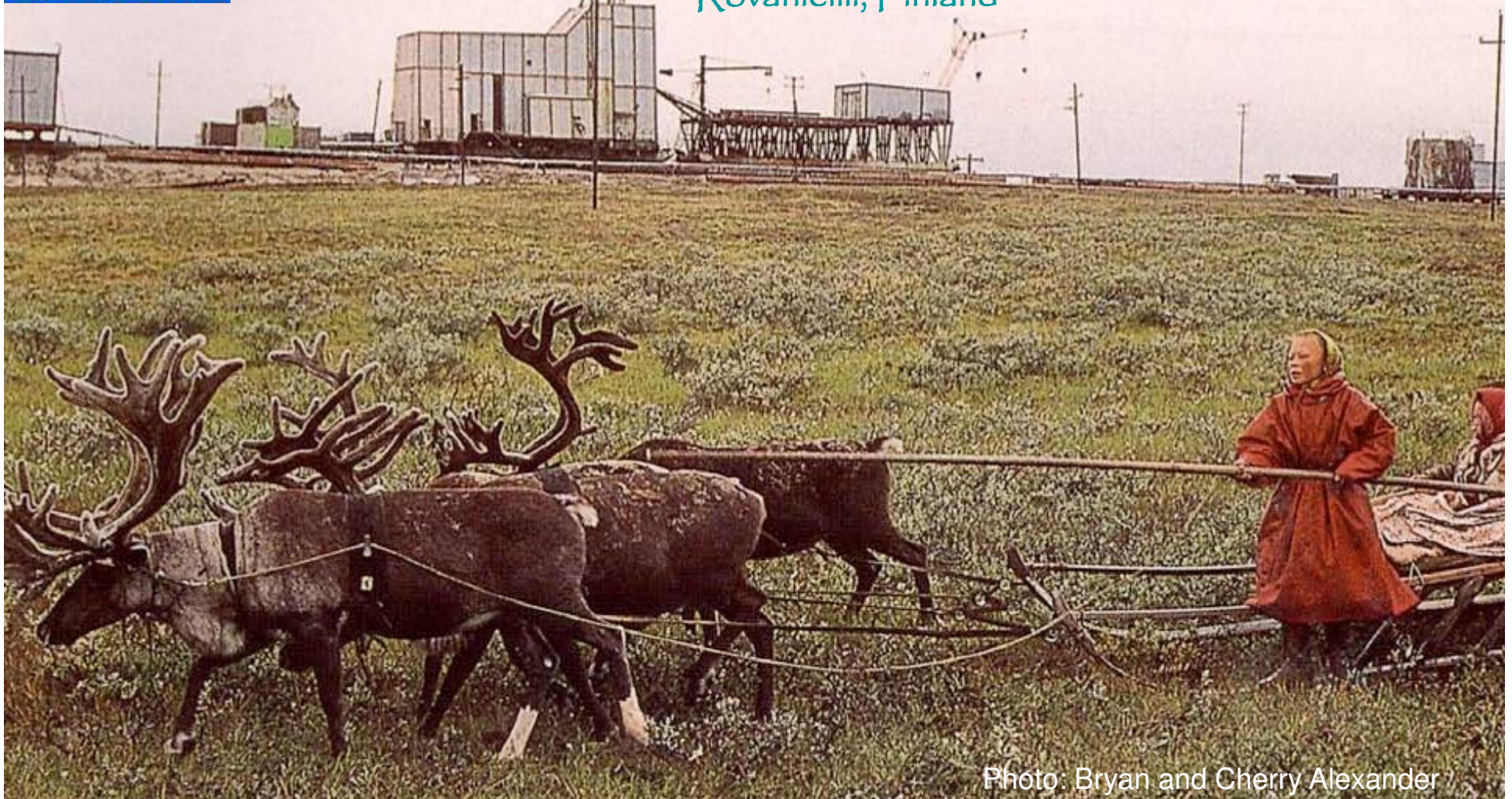


Photo: Bryan and Cherry Alexander

Tundra ecosystems are often considered vulnerable or 'fragile' in the face of large-scale hydrocarbon development, in part because even relatively small-scale, low-intensity impacts can accumulate in space and time.

- Scaling up to include human residents, combined arctic social-ecological systems are believed similarly susceptible to industrial impacts, as well as climate change
- In contrast to North America, virtually all terrestrial and aquatic components of oil and gas fields in Russia's Yamal-Nenets and Nenets Okrugs are seasonally exploited by migratory herders, hunters, fishers and domesticated reindeer (*Rangifer tarandus*)
- The amount of area directly disturbed in Russia is typically greater than in North America, in some cases by an order of magnitude
- The key issue in Russia is *coexistence* since the shared territories for hydrocarbon development and indigenous peoples overlap so completely

Oil & gas fields in the Barents Region and Yamal

World class deposits: most of them not yet tapped or in full production



Primary Russian oil & gas pipelines supplying Europe

The new Baltic 'Nord Stream' gas pipeline will be supplied in large part with gas from the Yamal Peninsula, West Siberia. It is currently delayed pending permission from e.g. Finland





A flood of Russian natural gas

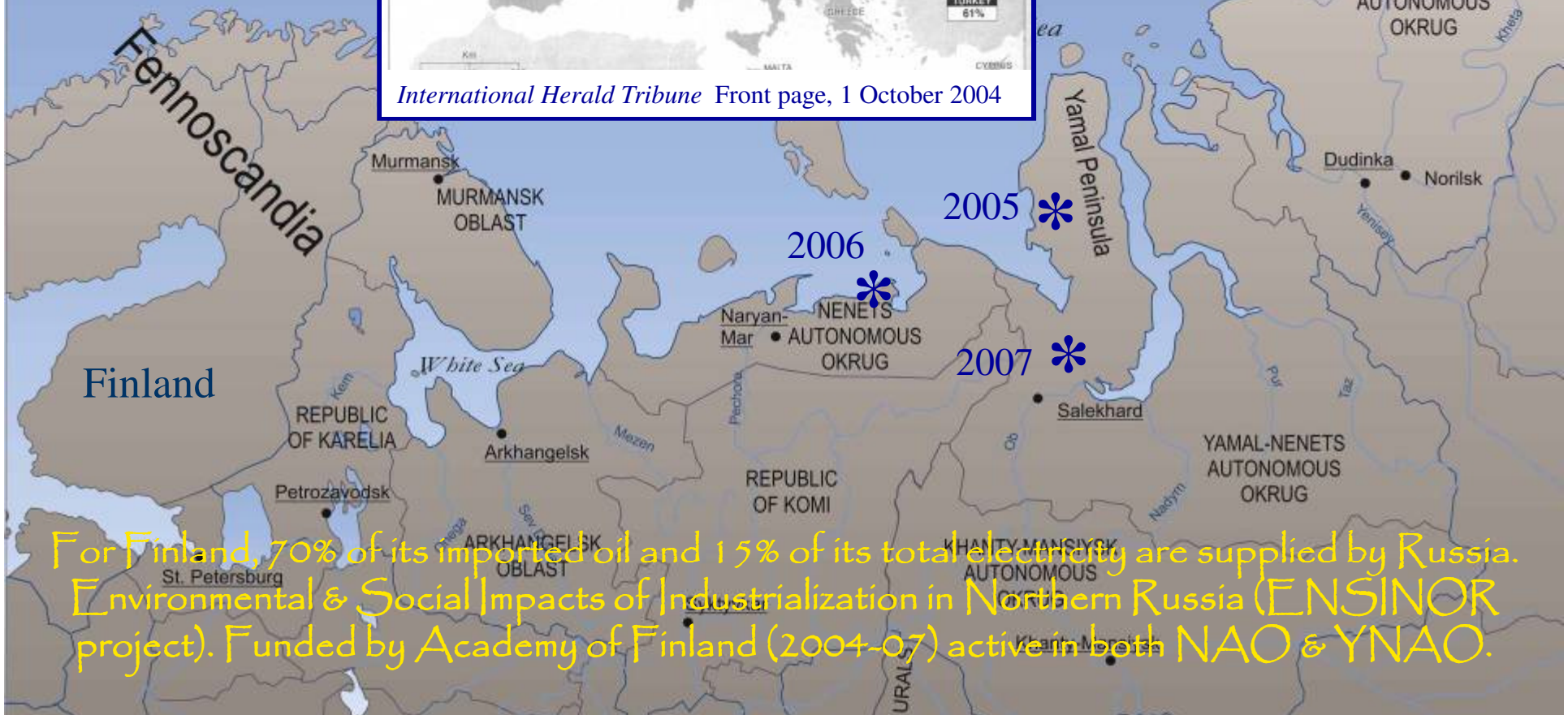
Russia's Gazprom, the world's largest natural gas producer, has remained a dominant supplier to eastern Europe and the Baltics even as countries in the region broke free of the Soviet orbit and entered the European Union.

Natural gas imported from Russia as a percent of total natural gas imports in 2003.

Note: Figure for Austria from 2001, latest year available.



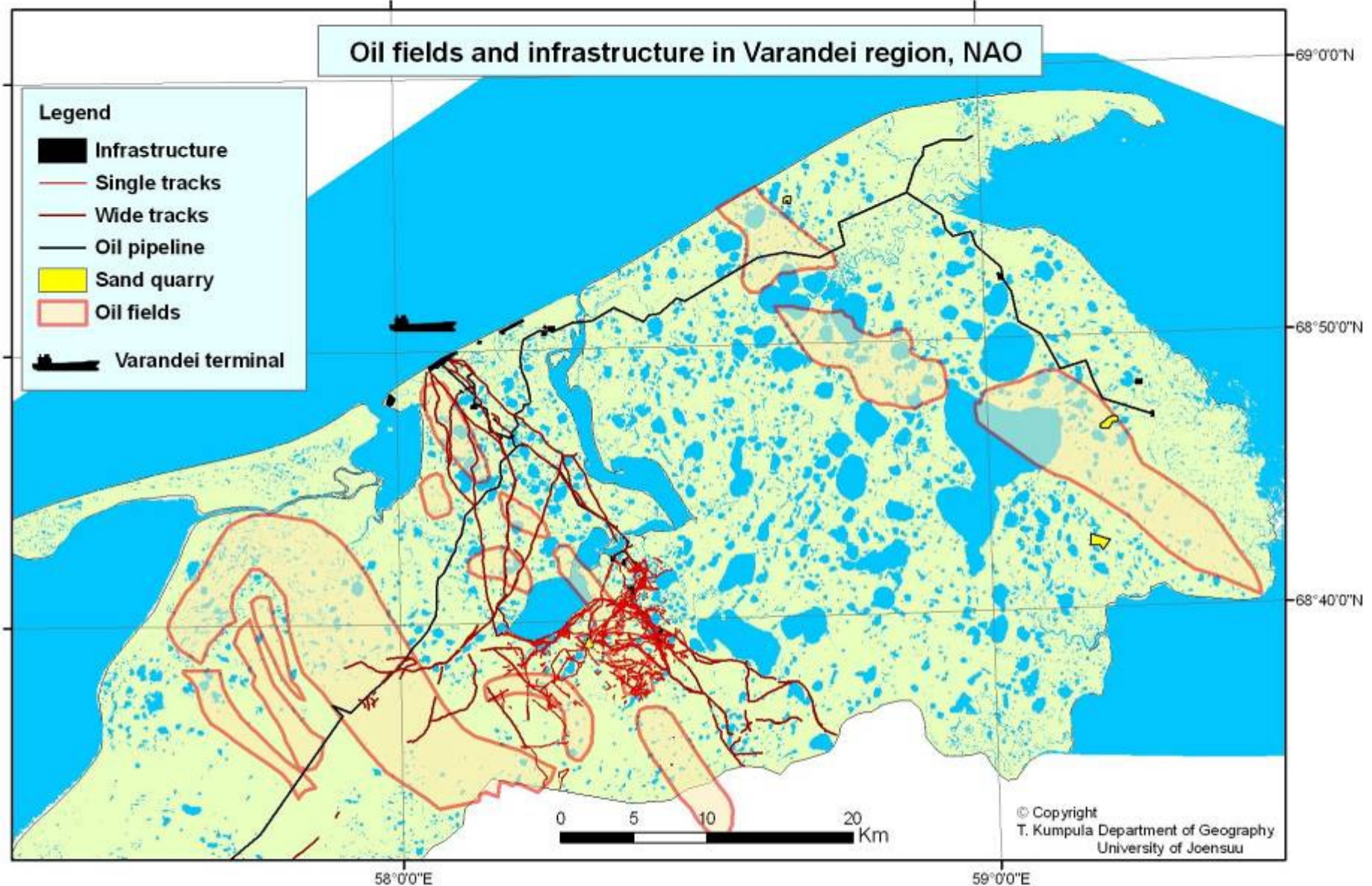
International Herald Tribune Front page, 1 October 2004



For Finland, 70% of its imported oil and 15% of its total electricity are supplied by Russia. Environmental & Social Impacts of Industrialization in Northern Russia (ENSINOR project). Funded by Academy of Finland (2004-07) active in both NAO & YNAO.

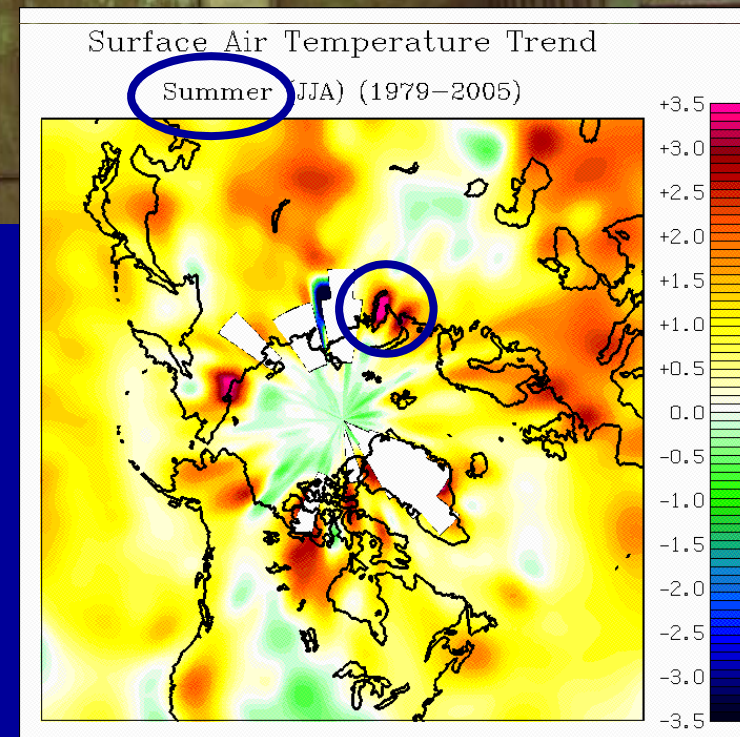
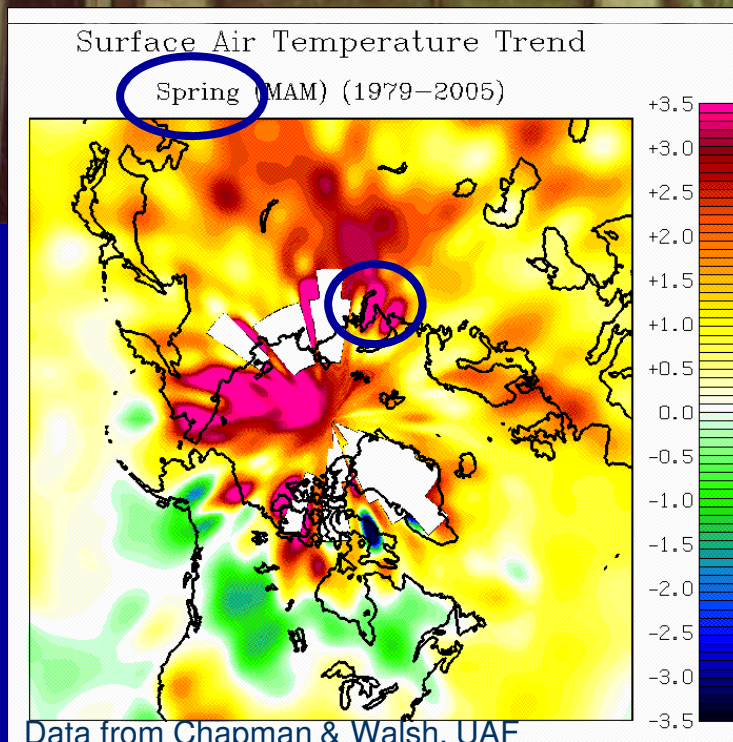
Onshore deposits in the vicinity of the Varandei terminal, NAO

First ice-class tanker was loaded in June 2008 and sailed for Canada





The ENSINOR project was designed to consider primarily oil & gas activities because these were what herders themselves cited as the most important factors affecting them. However, spring and summer air temperatures in NAO and YNAO have warmed over the past 25 to 30 years some 2 to 3°C. This has major implications for both oil & gas infrastructure and the future of reindeer herding since it means that people and reindeer are potentially exposed to multiple stressors.





Dmitri Khorolya, President, Association of World Reindeer Herders (WRH)

The first year of the project was devoted mainly to consultation, permissions, and field reconnaissance. Study areas were jointly selected in cooperation with the different stakeholders, including reindeer herders, during spring/summer 2004.



A. Azarnov, Minister of Natural Resources



PhD students Timo Kumpula & Anu Pajunen discuss migrations with Roman Okotetto



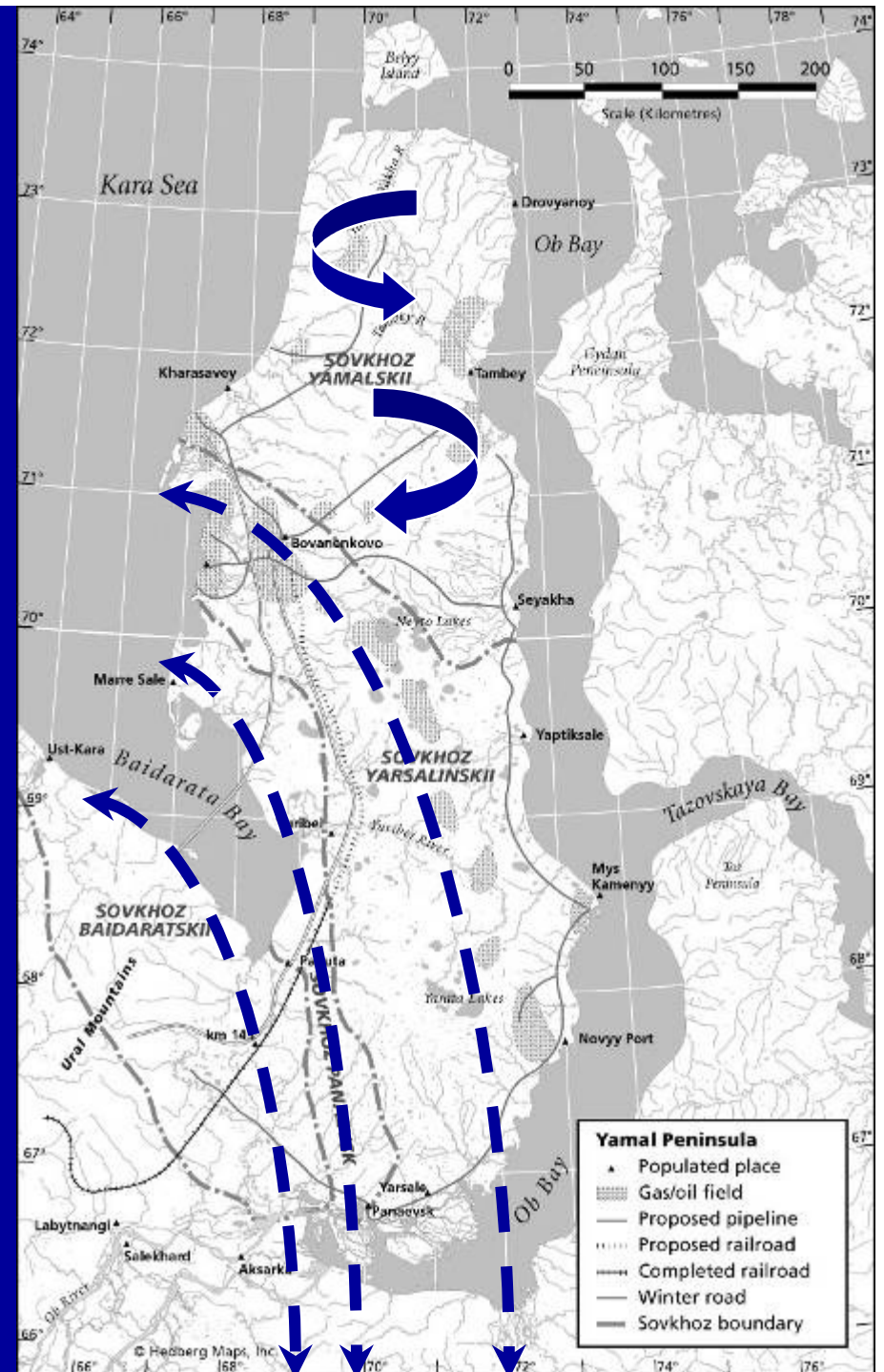
Dr. Nina Meschtyb discusses migration with Taichi Khudi at Bovanenkovo

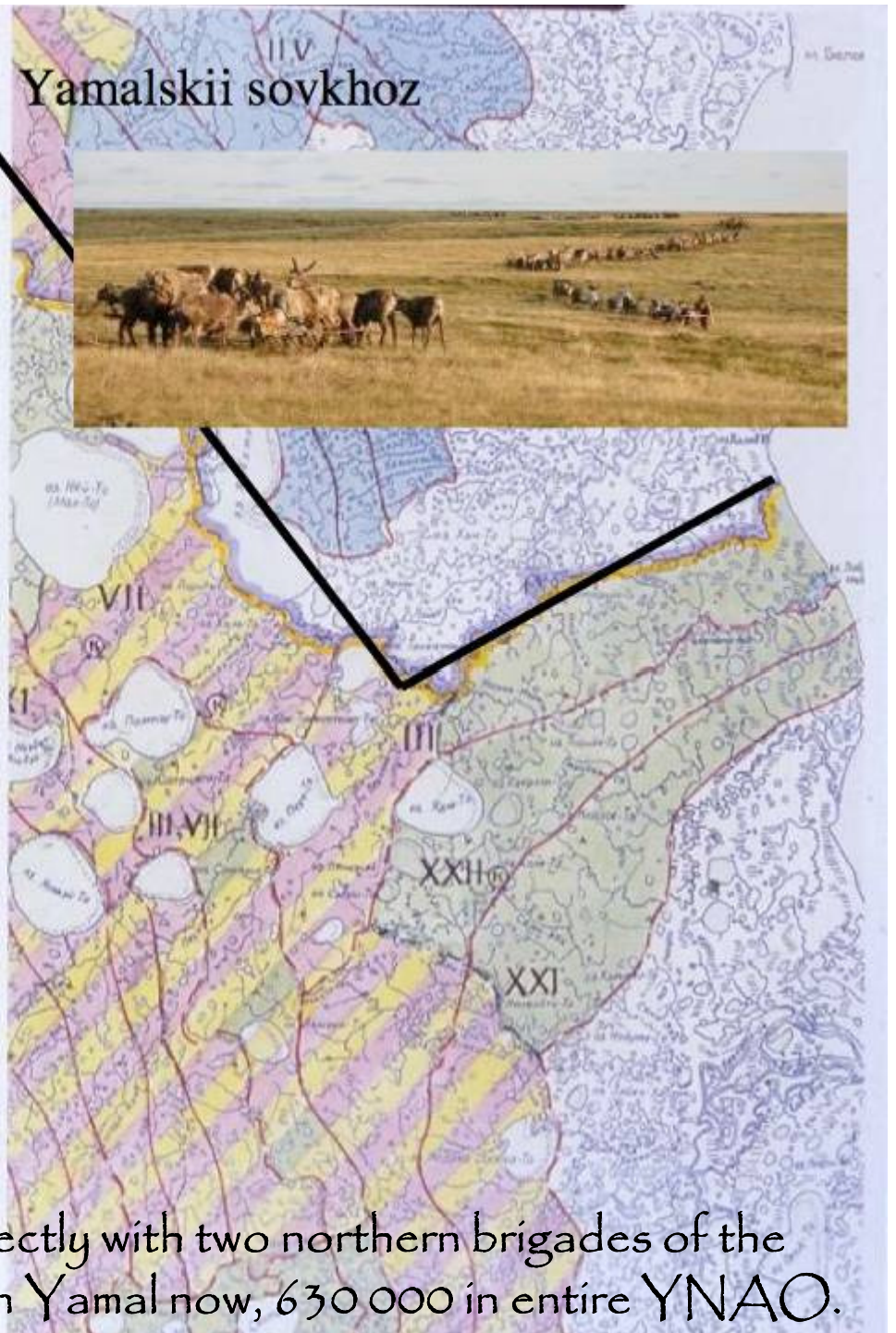
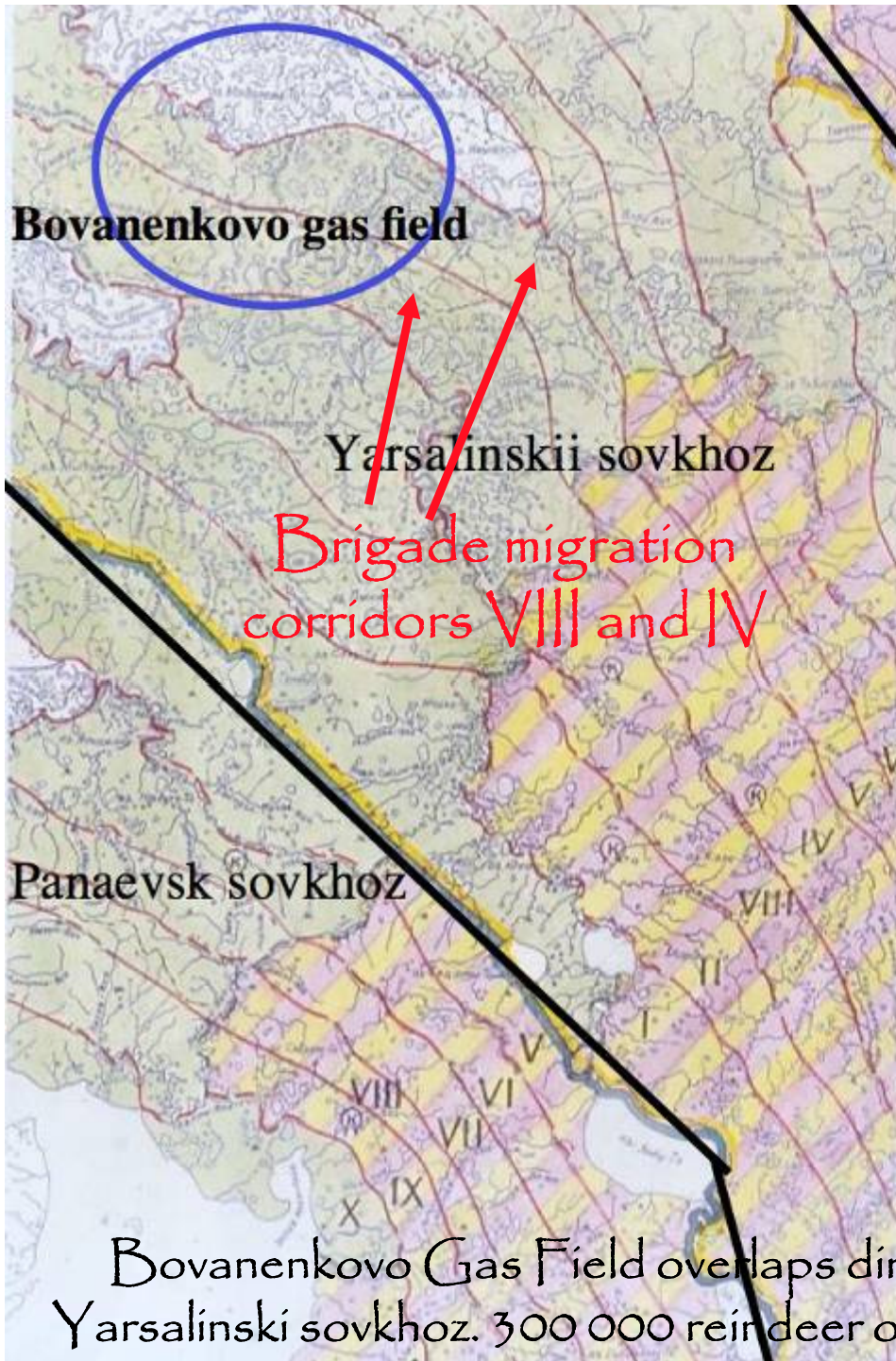


Sergei N. Khariuchi, RAIPON

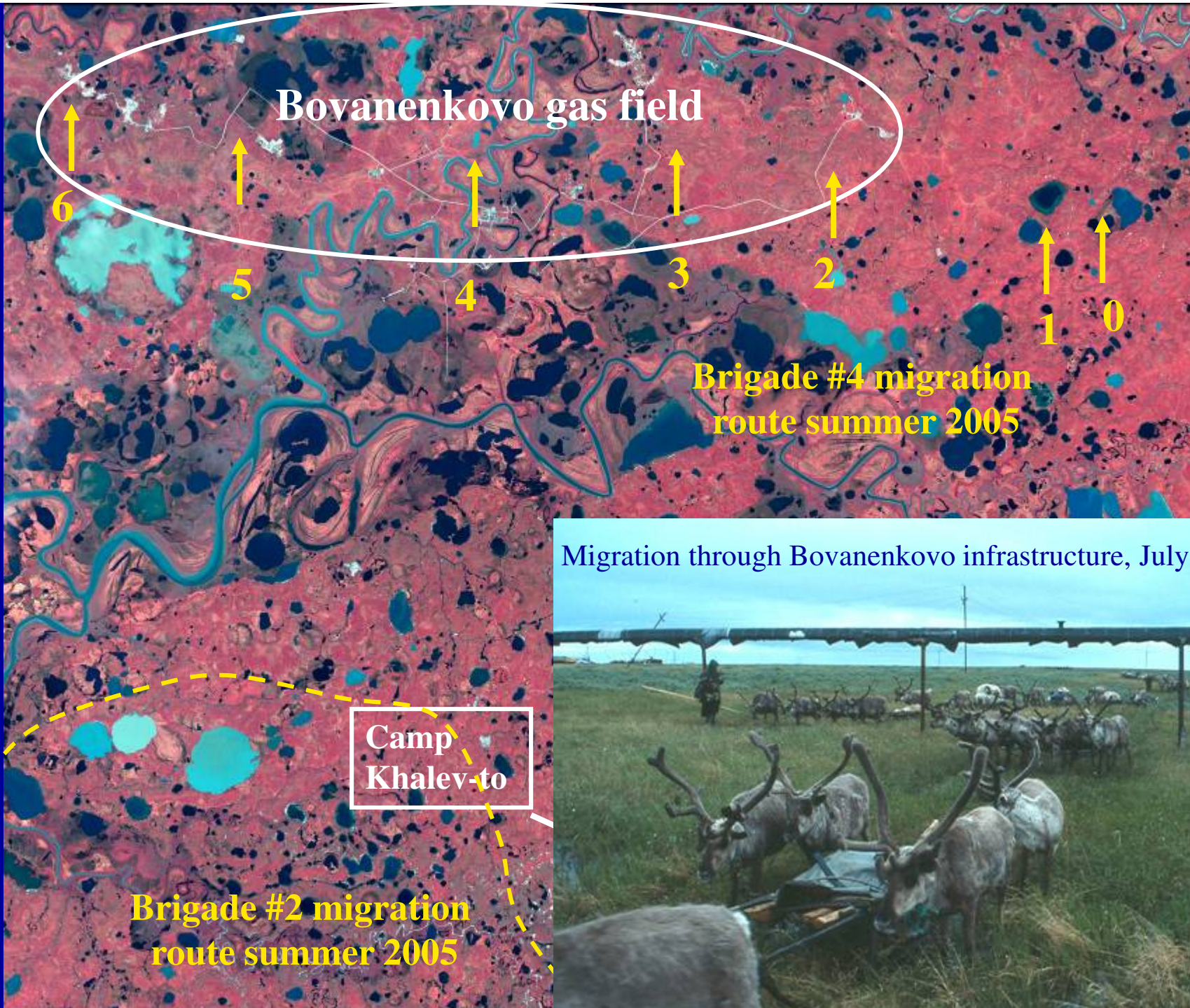
Map of the Yamal Peninsula gas and oil deposits showing the degree of overlap with modern reindeer herding territories (sovkhozi)

Land cover on the peninsula consists primarily of arctic tundra. Treeline is at the Arctic Circle, near Salekhard. For nomadic Nenets, the longest annual migrations are ≈ 1400 km from the winter ranges south of Ob River, north to the Kara Sea, and back.





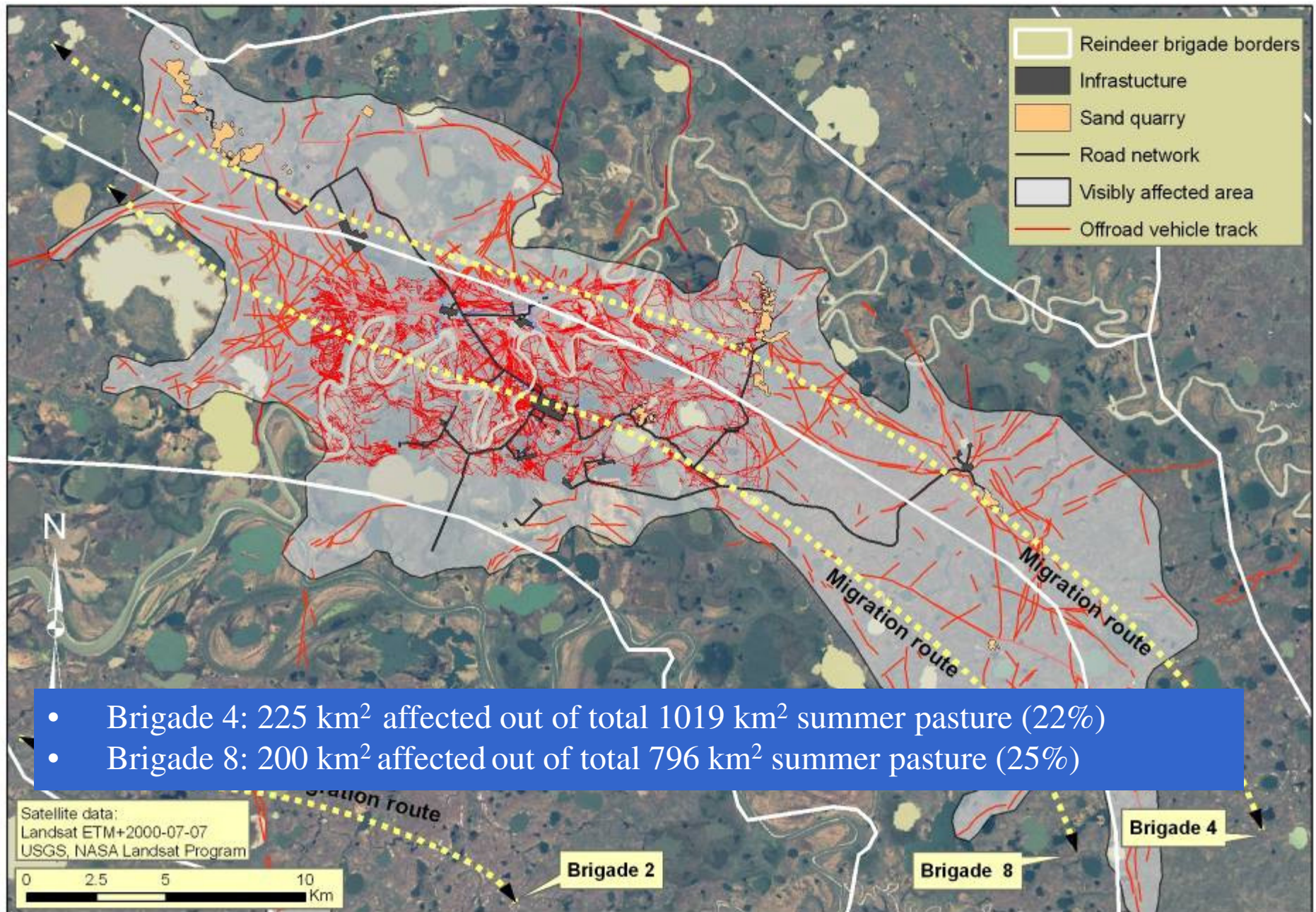
Bovanenkovo Gas Field overlaps directly with two northern brigades of the Yarsalinski sovkhoz. 300 000 reindeer on Yamal now, 630 000 in entire YNAO.



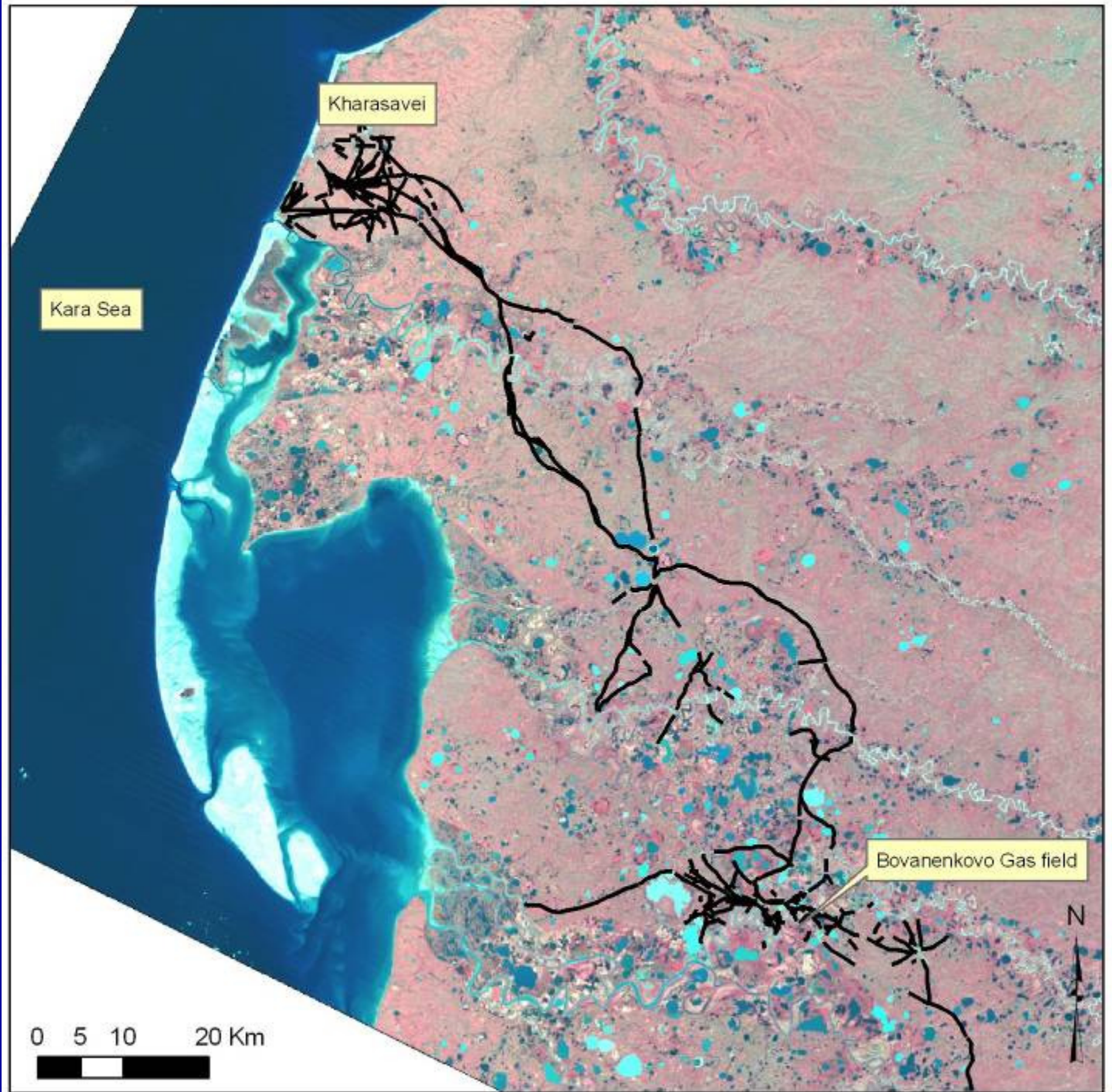
Migration through Bovanenkovo infrastructure, July 2005



Visible impacts of Bovanenkovo gas field on summer pastures as of 2005



Transport corridor under development between the main gas field at Bovanenkovo and the coastal port of Kharasavei
Impacts along the route include the damming of rivers and streams for bridge construction during the spawning season, which Nenets report negatively affects fish populations.



Among the negative effects of development, there can be direct impacts on the plant-soil cover over substantial areas. Sand and gravel quarries, for example, sometimes cover several hectares.



Abandoned sand quarry near Obskaya, southern Yamal

Single passage of 'vezdekhod' on mesic tundra



Visible changes in land cover over time include a widespread shift from shrub- to graminoid-dominated tundra. Examples of impacts include off-road vehicle traffic and thermal erosion of ice-rich permafrost.



Ice-rich permafrost at Bovanenkovo Gas Field

Multi-pass tracks on wet tundra

Within and near oil & gas fields reindeer herders daily encounter a wide range of environmental impacts.



Debris left on Varandei tundra, NAO, July 2006



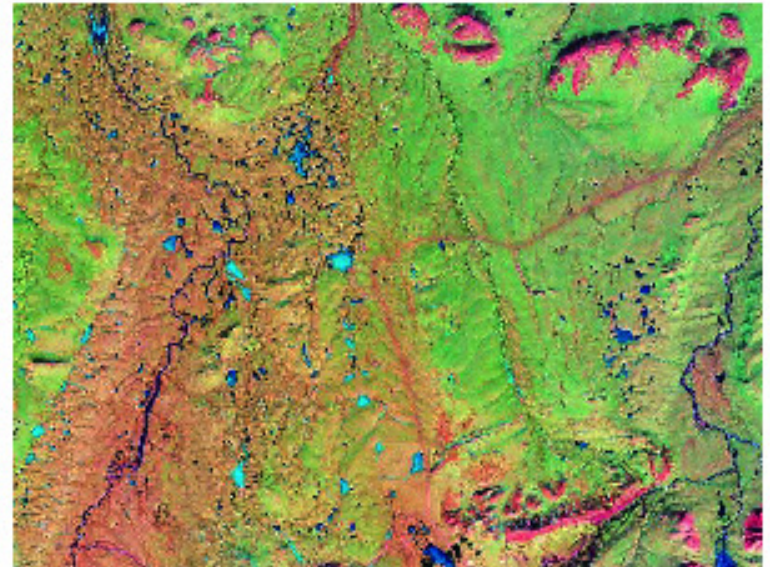
Abandoned drill rigs are strewn with trash (e.g. rusted metal, broken glass) and often toxic drill muds.



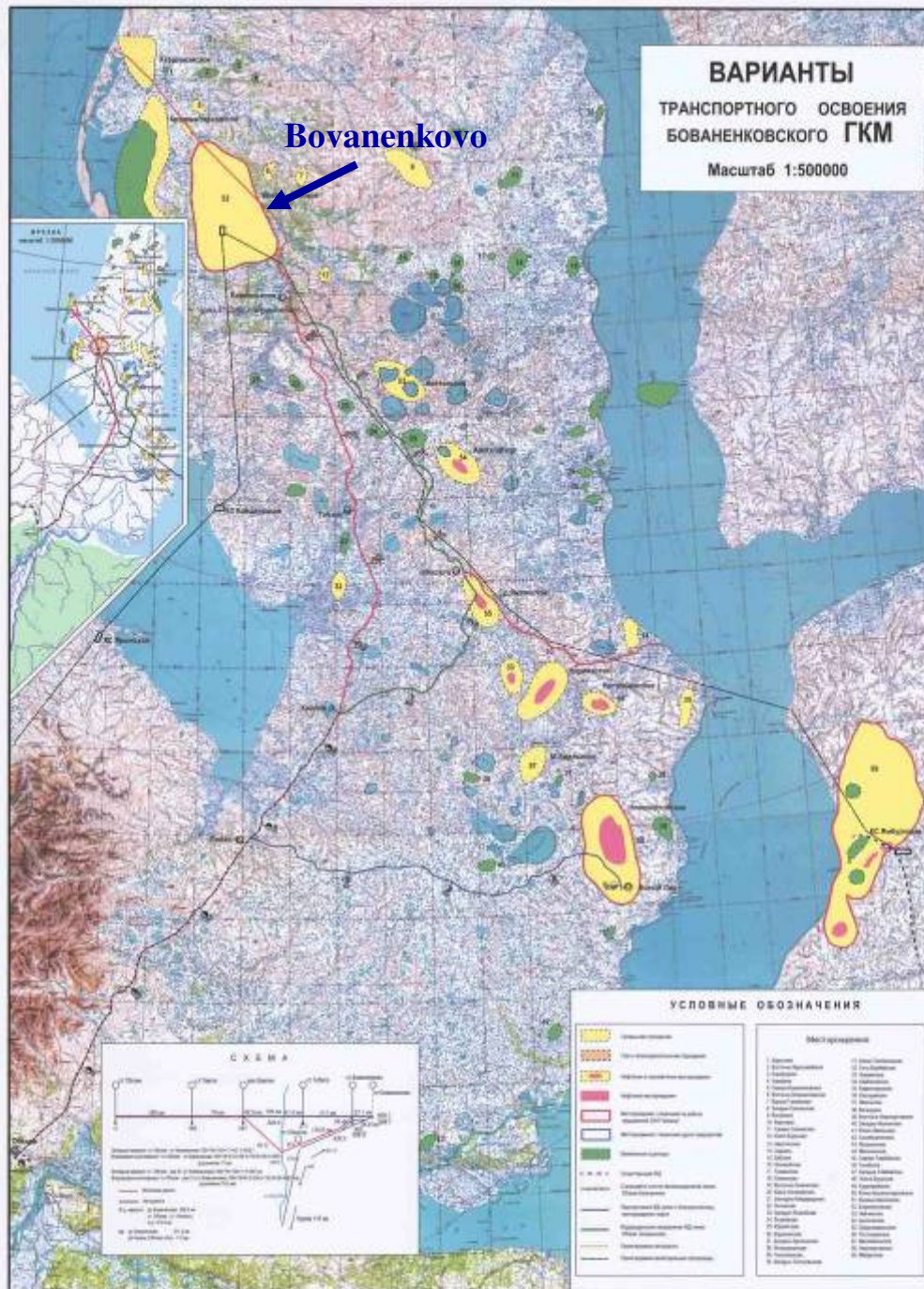


There can also be indirect impacts, including rapid transformation of the hydrological, chemical and nutrient regimes in otherwise intact vegetation. For example, alkaline dust affects moist acidic tundra ($\text{pH} \approx 4.0$) along roads in Northwest Siberia. Road dust with $\text{pH} \approx 8.0$ can travel hundreds of meters, affecting vegetation. Roads have the potential to improve access for poachers.

Truck traffic near Laborovaya, Baidaratski sovkhos, Yamal



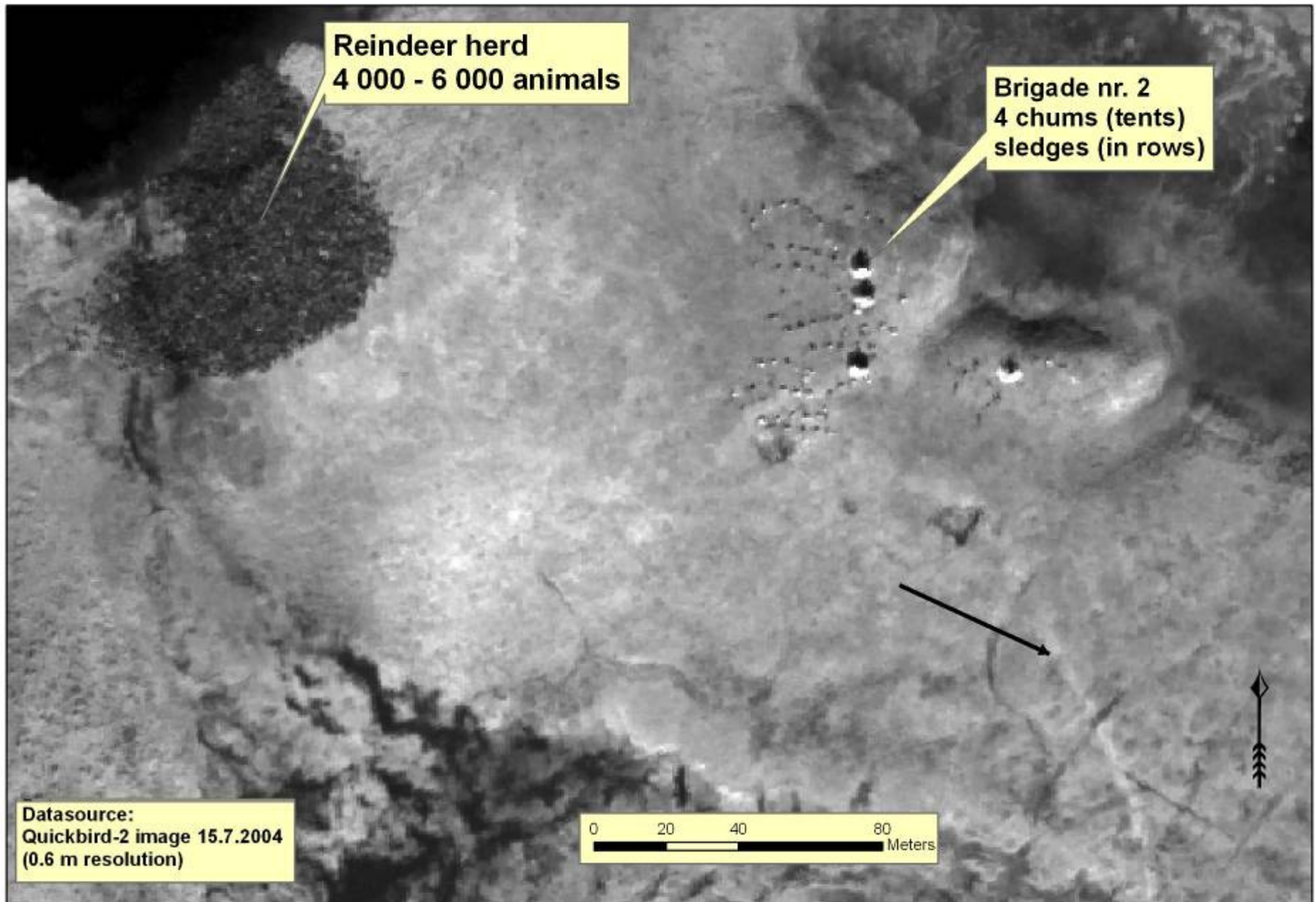
Toolik area from satellite



Yamal-Taz region,
 West Siberia. Gas
 deposits in yellow, oil
 deposits in red.

New road and railway corridors
 continue to improve access to the
 region, although the main gas field
 at Bovanenkovo is still accessible
 only by helicopter. Construction is
 difficult and costly due to extensive
 deposits of ice-rich permafrost and
 terrain that is potentially unstable
 with or without a warming climate.

Very high-resolution satellite imagery is readily interpreted with local Nenets



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