

# High resilience in the Yamal-Nenets social-ecological system, West Siberian Arctic, Russia

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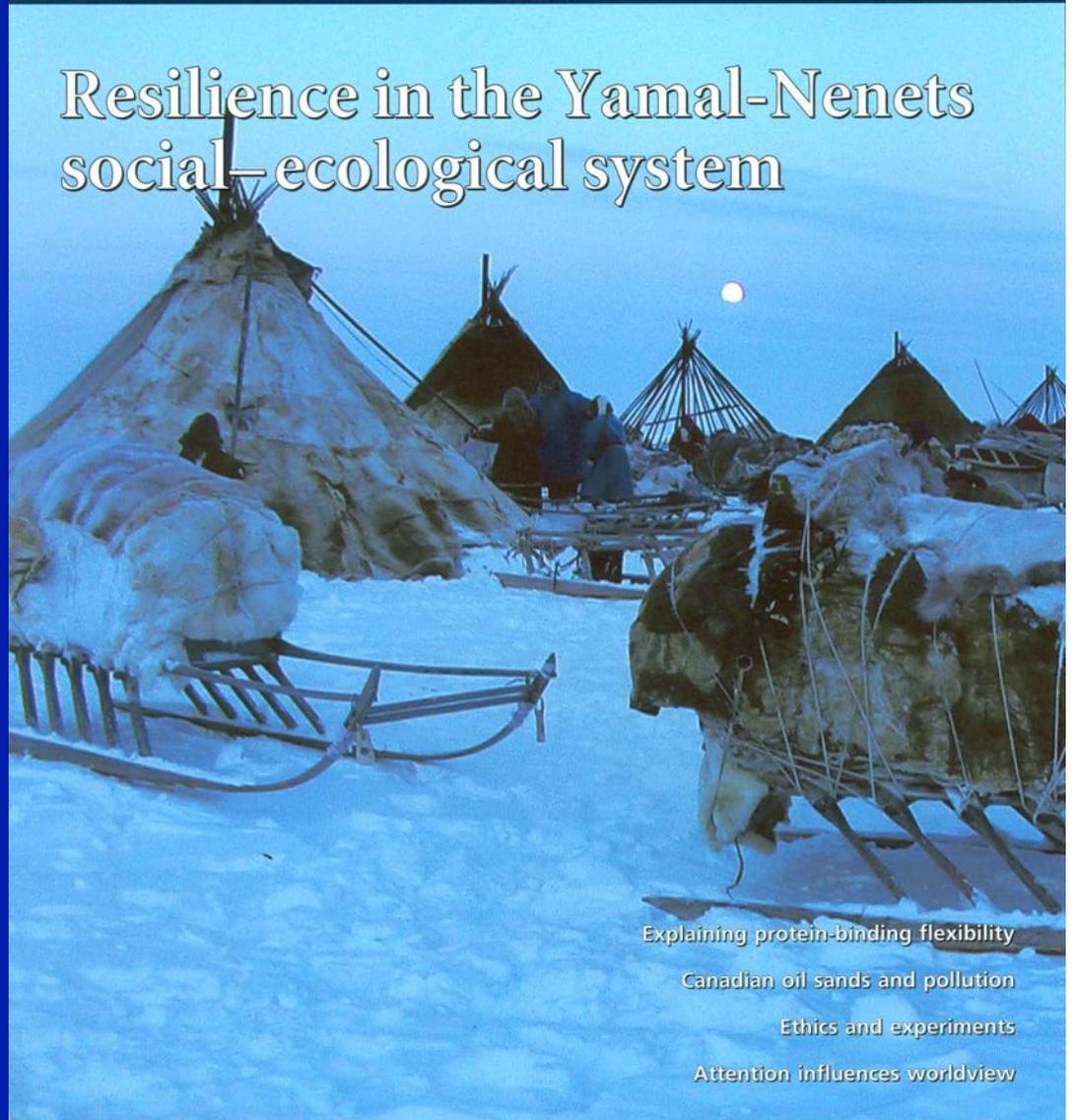
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## Resilience in the Yamal-Nenets social-ecological system



Explaining protein-binding flexibility

Canadian oil sands and pollution

Ethics and experiments

Attention influences worldview

# What do we mean by 'resilience'?

- Ecosystem resilience is the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes.
- A resilient ecosystem can withstand shocks and rebuild or reorganize itself when necessary.
- Resilience in social systems has the added capacity of humans to anticipate and plan for the future.
- Humans are part of the natural world. We depend on ecological systems for our survival and we continuously impact the ecosystems in which we live from the local to global scale.
- Resilience is a property of these linked social-ecological systems (SES).

‘Resilience’ as applied to social-ecological systems, or to integrated systems of people and the natural environment, has three defining characteristics:

- The amount of change the system can undergo and still retain the same controls on function and structure
- The degree to which the system is capable of self-organization
- The ability to build and increase the capacity for learning and adaptation

# What is a social-ecological system?

- Social-ecological systems (or SESs) are complex adaptive systems where social and biophysical agents are interacting at multiple temporal and spatial scales
- SESs emphasize the concept of humans in nature and that the delineation between social and ecological systems is artificial and arbitrary
- SESs require integrated approaches to analysis, combining the natural and social sciences
- SESs are also sometimes called coupled human-environment systems (CHENS) and coupled human-natural systems (CHANS)



# 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.

Besides extensive oil & gas development, the Yamal has experienced profound pressures in the past 20-30 years from the Soviet Union's collapse and extreme weather scientists attribute to climate warming.

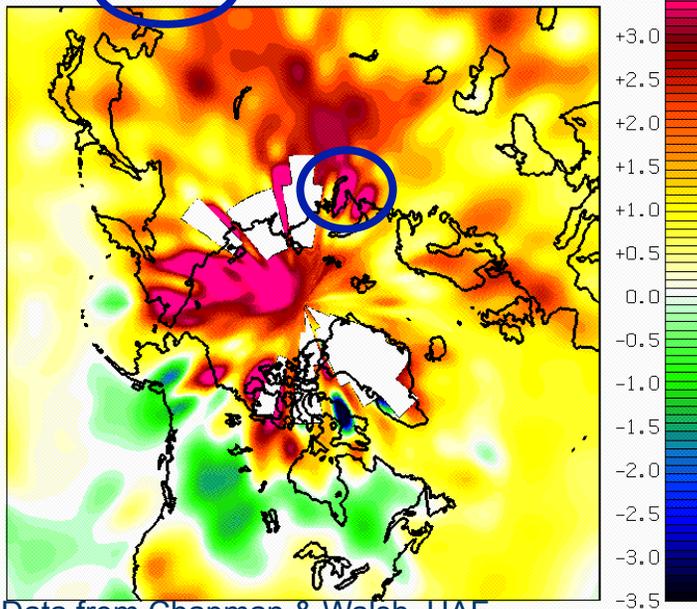




The ENSINOR project was designed to consider primarily oil & gas activities because these were what herders themselves cited as the most important factors affecting them. However, spring and summer air temperatures in YNAO (and NAO) have warmed over the past 25 to 30 years some 2 to 3°C. This has major 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.

Surface Air Temperature Trend

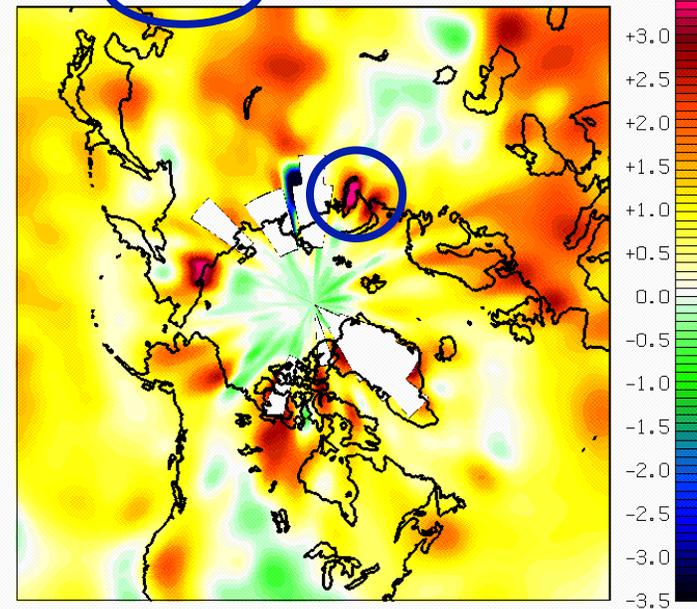
Spring (MAM) (1979–2005)

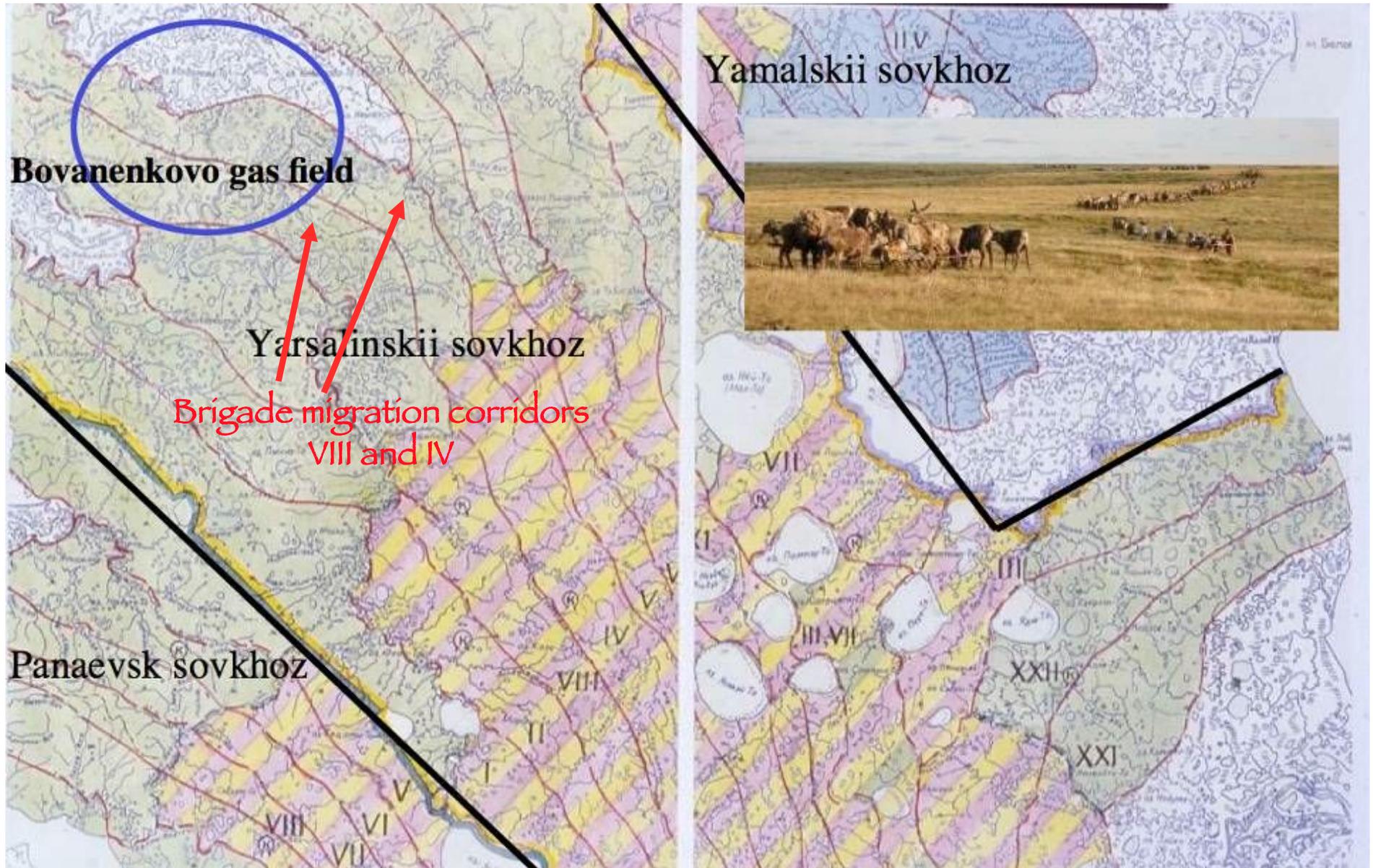


Data from Chapman & Walsh, UAF

Surface Air Temperature Trend

Summer (JJA) (1979–2005)





A mixture of private and state owned animals share lands, rivers and lakes that are divided according to different sovkhov units and migration corridors, none of which are fenced. The territory of Yamal Peninsula seems large, but all available pastures are under seasonal exploitation. Still, the system remains flexible enough to handle many different pressures which arise, such as 'rain-on-snow' or icing events. However, fixed infrastructure - such as new pipelines, roads and railways - and associated pasture and lake/river degradation presents challenges specific to certain brigades.

Migration along fixed brigade corridor, July 2005 - herds tend to move onto neighbouring corridors only if there is a serious problem, such as heavily crusted snow in winter



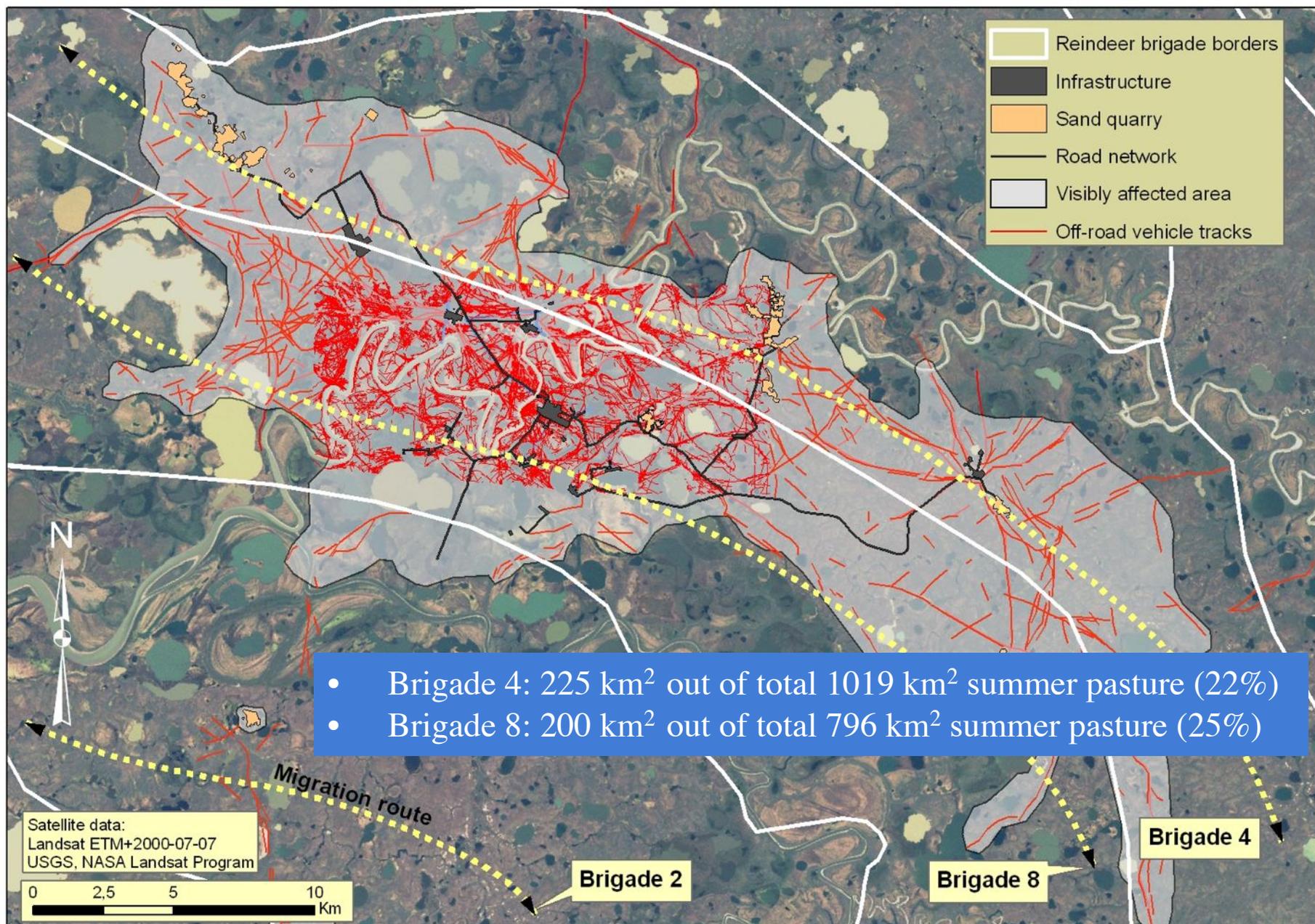
A modern gas field has many direct and indirect impacts on the ground that have implications for both ecological and social aspects of the system. Herders are forced to adapt to these.



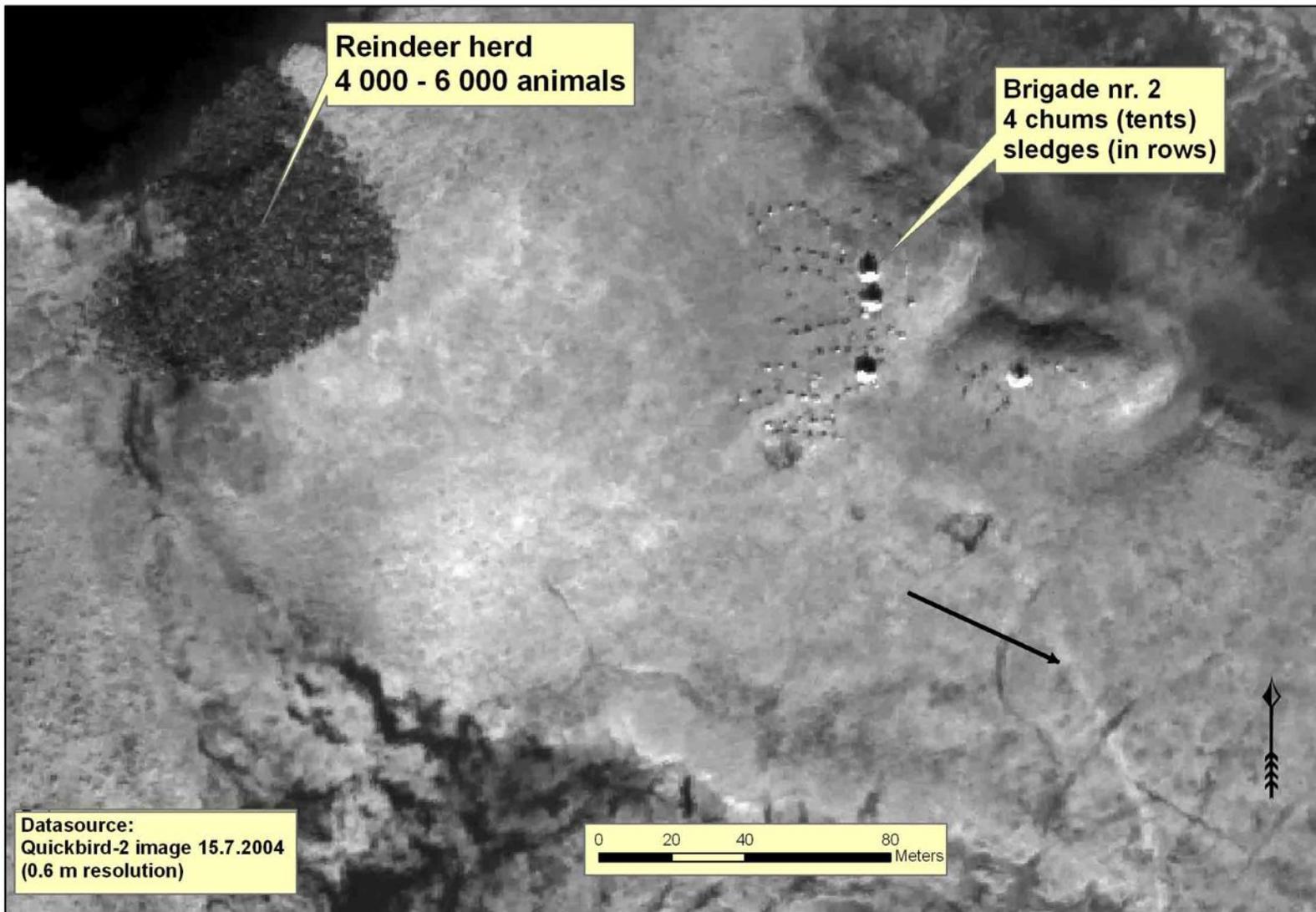
Some impacts accumulate in space & time, e.g. vehicle tracks, road dust & hydrological changes.



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



Very high-resolution satellite imagery aids in discussions of spatial aspects of change as informants were able to recognize virtually all locations on the ground. Social as well as ecological matters raised.



Two aspects of a warmer climate are: (1) earlier thawing of rivers in spring, and (2) later freeze-up in autumn. Crossing the Seyakha River in the Bovanenkovo Gas Field, July 2005, about 2 weeks earlier than average. People and animals must migrate faster!



Another factor is warmer winters, with an increase in the frequency and severity of 'rain-on-snow' events (Bartsch et al. *Ecological Applications* in press)



The relatively free use of space according to herders' own needs is a critical factor at present. However, if too much oil & gas infrastructure encroaches on their migration routes, this adaptive capacity will be greatly reduced. Responses so far appear dynamic and non-linear. Mid-winter events used to be extremely rare.

# Conclusions

- The Yamal-Nenets SES has recently been subject to anthropogenic fragmentation and transformation of a large proportion of the environment, socio-economic upheaval, and pronounced warming
- The system has successfully reorganized in response to these shocks
- Institutional constraints and drivers were as important as the documented ecological changes
- Particularly crucial to success is the unfettered movement of people and animals in space and time
- Despite several instances of extreme weather, people remain much more concerned about gas development than ‘climate change’
- Synergies between terrestrial and freshwater ecosystem degradation, climate change, and a massive influx of workers underway present a looming threat to future resilience
- Herders feel they understand what is needed to achieve coexistence

**Thank  
you!**



