

# Believe in Bayes

*Værktøjer til arktisk forvaltning af  
naturressourcer og  
lokalsamfundsbaseret co-management*

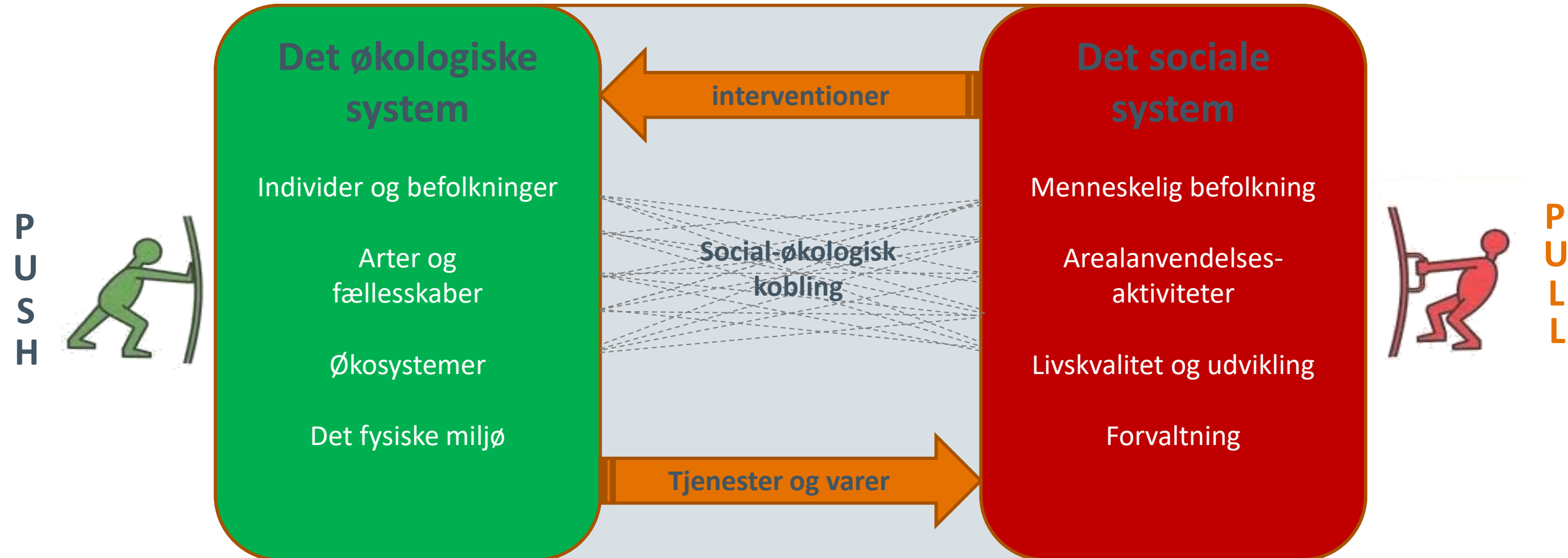


# Udfordringer i forhold til naturressourcer

- Arktis i hastig forandring
- 'Greening af Arktis'
- Samfundsmæssige tilpasninger
- Lokal og videnskabelig viden er til tider stødt sammen
- Behov for holistisk forvaltning af naturressourcer

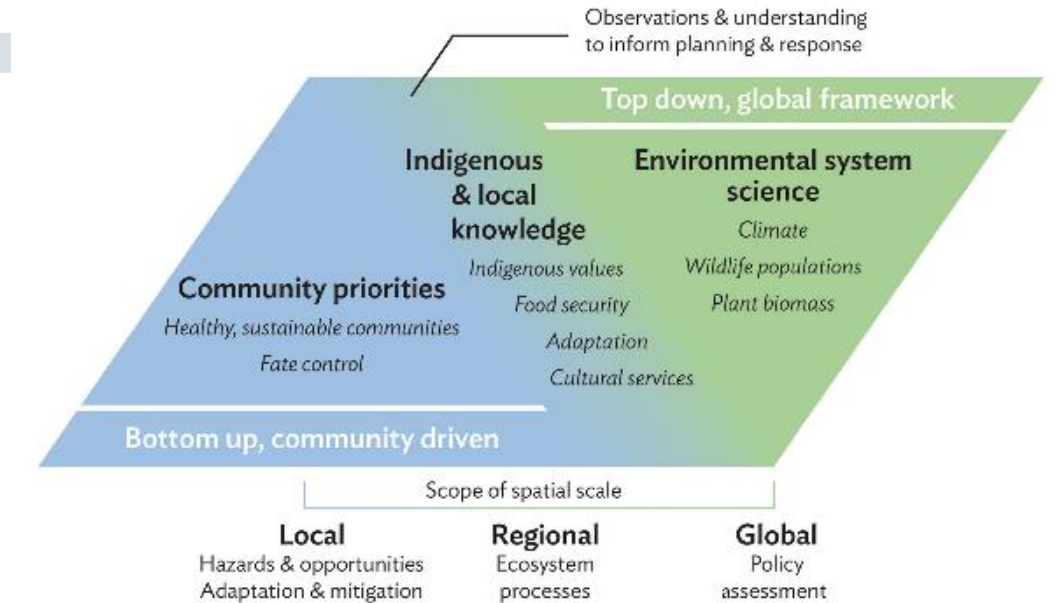


# Det socio-økologiske system



# Oprindelige folks og lokalsamfunds rolle

- Mange steder er økosystemerne i praksis styret af oprindelige folk og lokalsamfund
- Lokale videnssystemer og praksisser er lige så forskellige som de steder og grupper, de kommer fra
- Transformativ styring:
  - ▶ Integreret
  - ▶ Inkluderende
  - ▶ Informeret
  - ▶ Tilpasningsdygtig

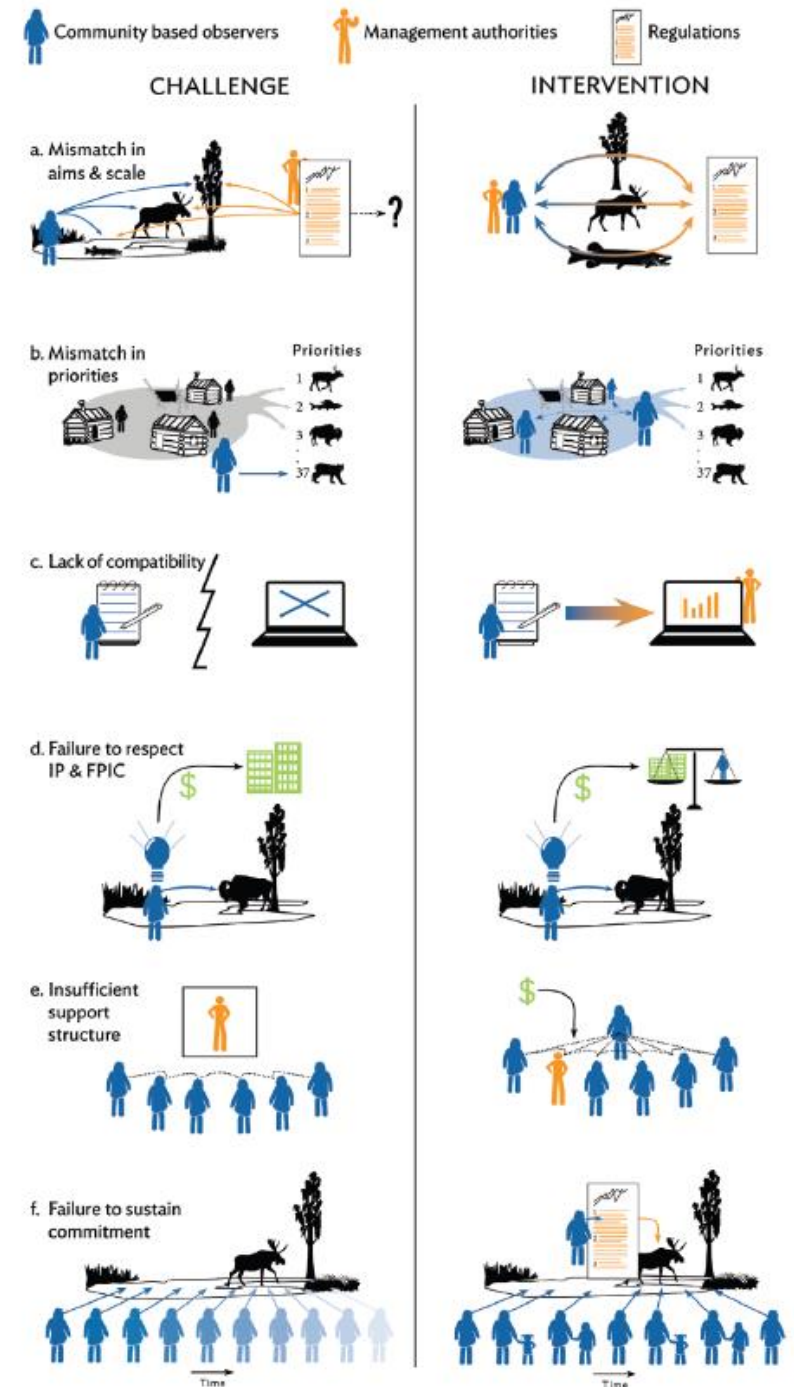


# Afvejning af forskellige interesser

Nye værktøjer er vigtige for:

- at indsamle og integrere datakilder
- at udvikle inkluderende processer
- at understøtte informeret og adaptiv beslutningstagning

	Traditionel viden	Empirisk viden
Metode	Intuitiv og erfaringsdrevet (subjektiv)	Hypotese and data-drevet (objektiv)
Skala	Lokal men holistisk (integreret)	Global men specifik (forudsigende)



# Bayesian Belief Networks (BBN)

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- BBN er en måde at strukturere komplekse problemer og udforske 'hvad nu hvis'-scenarier
- BBN hjælper med at forstå interaktioner og virkningerne af forvaltningsaktiviteter på miljøet
- Visualisering hjælper med at forstå planlægningens kompleksitet
- Det stimulerer også samfundsengagementet





Foto. A. Staverløkk

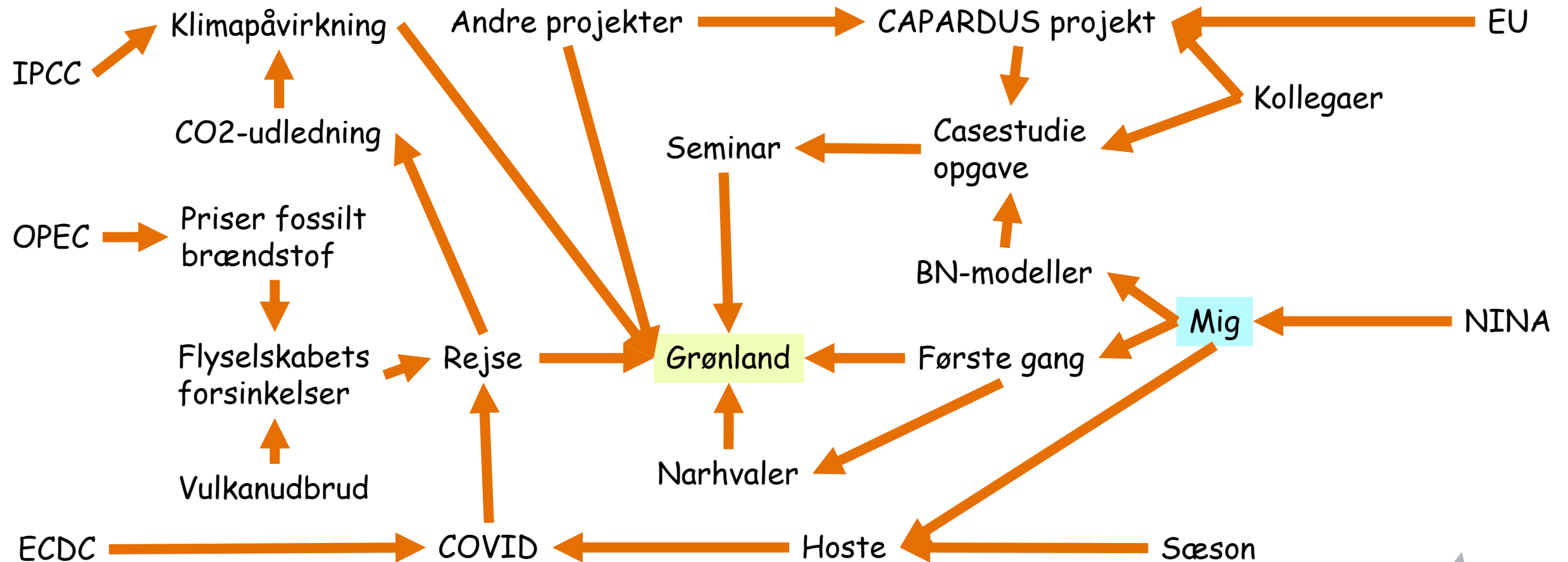
# Hvordan man udvikler en BBN

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1. Konstruer netværket med vigtige sociale og miljømæssige faktorer (nodes/knuder) og deres interaktioner (edges/kanter)
2. Tildel mulige alternative tilstande for de forskellige faktorer
3. Undersøgelsesoverbevisninger (survey beliefs) eller data
4. Visualiser modeloutput
5. Vurder konsekvenser af scenarier




# Hvorfor er jeg her?





# Indenskærs hellefiskefiskeri i Grønland

- 
- Vis en sådan BBN-tilgang
  - Gennem udvikling af en "legetøjsmodel". Visualiser et eksempel fra det virkelige liv: kystfiskeri af hellefisk
  - Udvikl online-appen surBayes

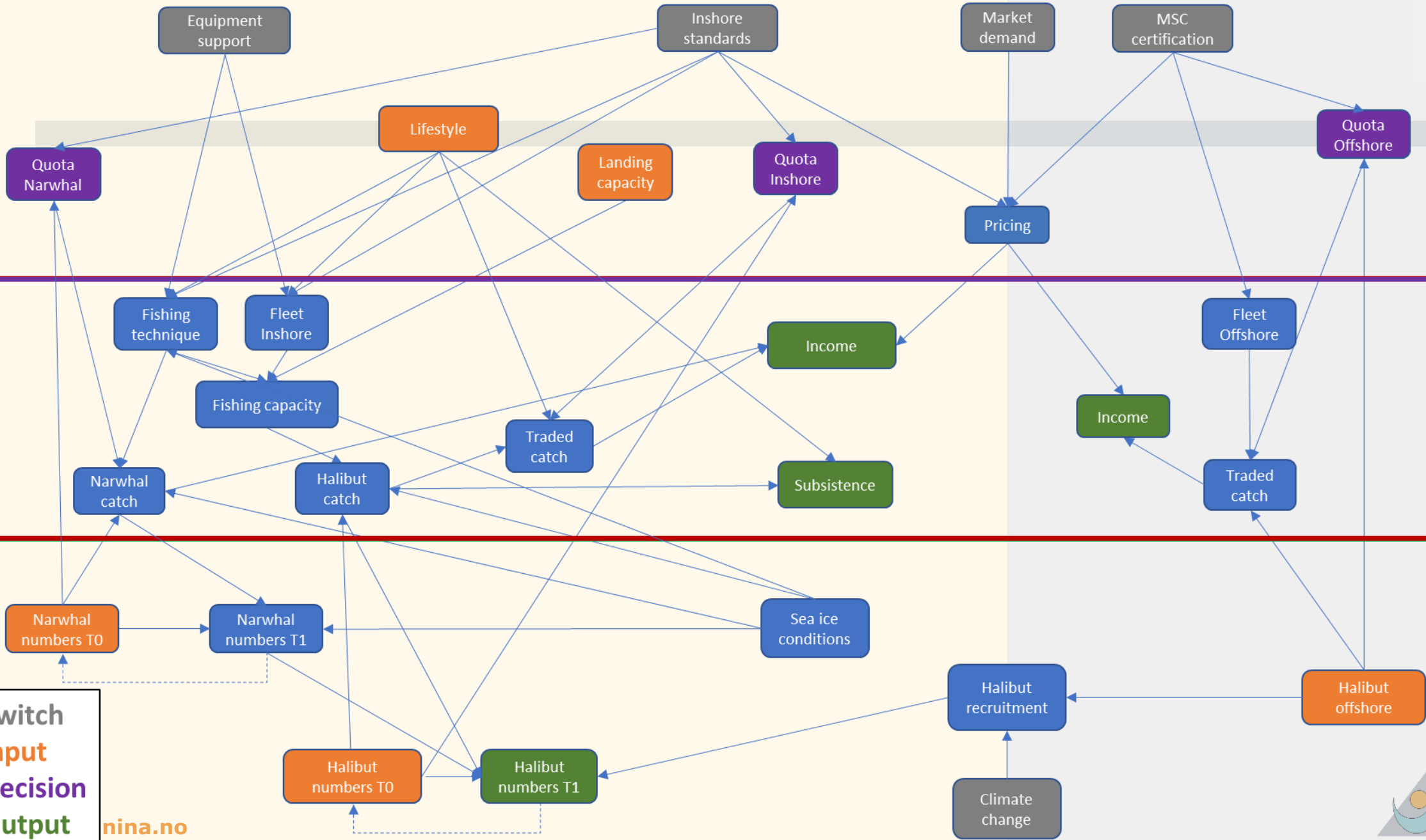
# INSHORE SUBSYSTEM

# OFFSHORE SUBSYSTEM

Governance

Socioeconomics

Environment



**Switch**  
**Input**  
**Decision**  
**Output**

nina.no



### Dashboard

- Home
- Instructions
- Construct network
- Define nodes
- Enter data
- Inference

### Network input

- Create new model
- Load existing model

#### Choose a file

Halibut

#### Password:

.....

Load!

Network correctly loaded...

Save!

### Construct model structure

View/Edit

Show groups

#### Nodes in the network:

Climate\_change

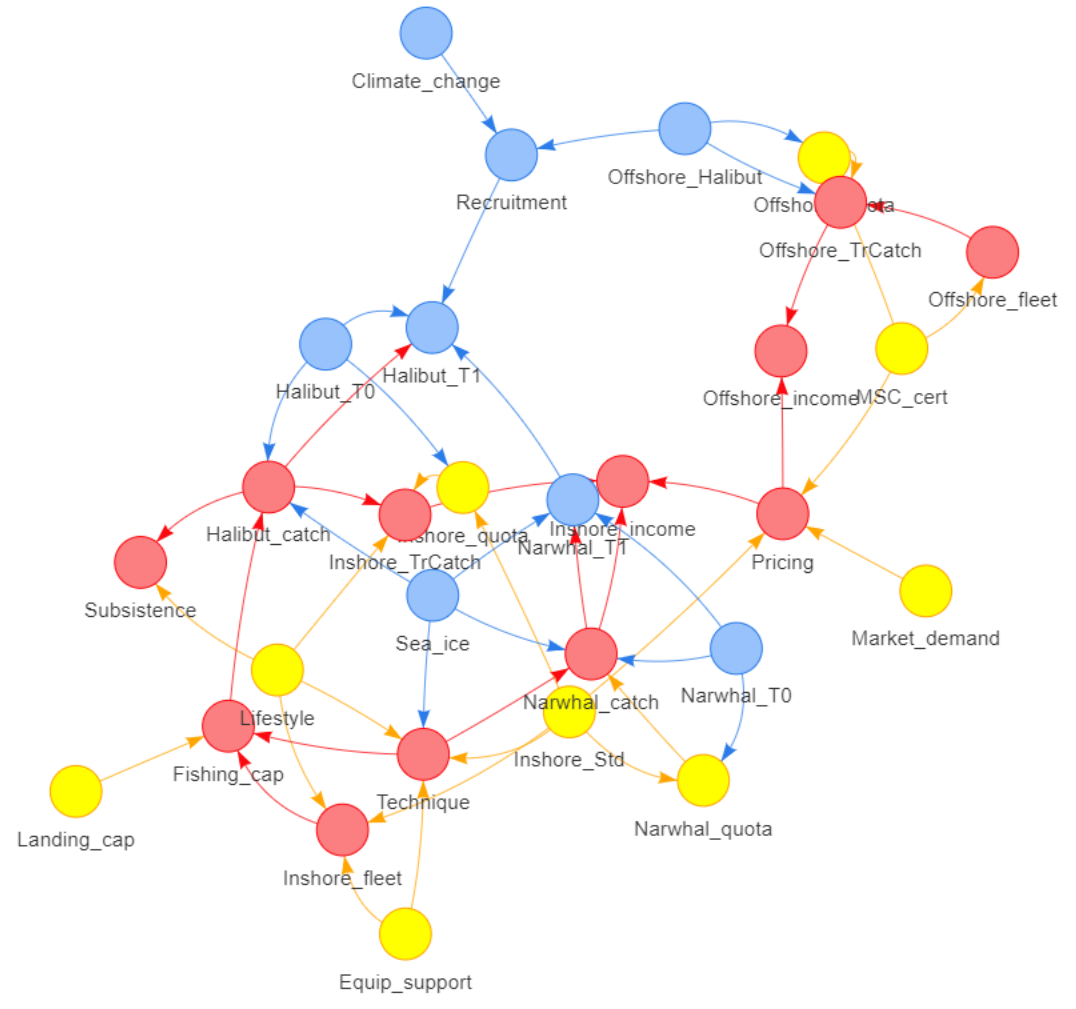
#### Edges in the network:

Equip\_support --> Technique

Save edits

Finalize!

- Environment
- Governance
- Socioeconomics



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.....

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Save!

### Define node characteristics

#### Enter groups:

Semicolon separated

View / Edit

Save edits

Finalize!

ProjID	Group	Name	Description	States	N_states	N_parent	N_child
0	Environment	Climate_change	the long-term effect of climate change to halibut populations	Negative;Negligible;Positive	3	0	1
0	Governance	Equip_support	the company-based subsidies and public loans	No;Yes	2	0	2
0	Socioeconomics	Fishing_cap	the total catch capacity	Low;Medium;High	3	3	1
0	Socioeconomics	Halibut_catch	the total weight of halibut caught inshore	Low;Medium;High	3	3	3
0	Environment	Halibut_T0	the population size of the catchable stock (fish >40cm) at the start of a 7-year period	Low;Medium;High	3	0	3
0	Environment	Halibut_T1	the population size of the catchable stock (fish >40cm) at the end of a 7-year period	Low;Medium;High	3	4	0
0	Socioeconomics	Inshore_fleet	the number of people engaged in fishing/hunting	Low;Medium;High	3	3	1
0	Socioeconomics	Inshore_income	the household income derived from fishing, hunting or other (undefined activities)	Fishing;Hunting;Other	3	3	0
0	Governance	Inshore_quota	the total weight of halibut allowed to be caught inshore	Low;Medium;High	3	2	1
0	Governance	Inshore_Std	the political balance between sustainability and income and provision self-sufficiency	No;Yes	2	0	5
0	Socioeconomics	Inshore_TrCatch	the total weight of inshore halibut traded	Low;Medium;High	3	3	1
0	Governance	Landing_cap	the presence of landing facilities in the community	No;Yes	2	0	1
0	Governance	Lifestyle	the proportion of the households engaged as occupational or recreational fishermen	Occupational;Recreational;Non-resource	3	0	4
0	Governance	Market_demand	the external market influence on pricing	Low;Medium;High	3	0	1
0	Governance	MSC_cert	the MSC certification practice, where sustainable harvest and no environmental damage is required	No;Yes	2	0	3
0	Socioeconomics	Narwhal_catch	the number of narwhal caught	Low;Medium;High	3	4	2
0	Governance	Narwhal_quota	the total number of narwhal allowed to be caught inshore	Low;Medium;High	3	2	1
0	Environment	Narwhal_T0	the number of narwhal in the population at start of a 7-year period	Low;Medium;High	3	0	3
0	Environment	Narwhal_T1	the number of narwhal in the population at the end of the 7-year period	Low;Medium;High	3	3	1
0	Socioeconomics	Offshore_fleet	the total tonnage of trawlers	Low;Medium;High	3	1	1
0	Environment	Offshore_Halibut	the population size of the catchable stock (fish >40cm)	Low;Medium;High	3	0	3
0	Socioeconomics	Offshore_income	the number of household incomes that are derived from offshore fisheries	Low;Medium;High	3	2	0
0	Governance	Offshore_quota	the total weight of halibut allowed to be caught offshore	Low;Medium;High	3	2	1
0	Socioeconomics	Offshore_TrCatch	the total weight of offshore halibut traded	Low;Medium;High	3	3	1
0	Socioeconomics	Pricing	the per weight prices agreed upon through international negotiations	Low;Medium;High	3	3	2
0	Environment	Recruitment	the effect of 1-year old offshore survival to the inshore catchable stock seven years later	Low;Medium;High	3	2	1
0	Environment	Sea_ice	the sea ice conditions, measured in number of months covered per year	Fixed_ice;Slush_ice;Ice_free	3	0	4
0	Socioeconomics	Subsistence	the contribution to the household subsistence	Low;Medium;High	3	2	0
0	Socioeconomics	Technique	the distribution of harvest techniques/vehicles used in fishing/hunting activities	Ice-based;Dinghy;Cutter	3	4	2

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Save!

### Survey events and beliefs

Load overview

Survey events

Upload

csv (;)

#### Choose a (group and) node

Environment

Offshore\_Halibut

Survey beliefs

View / Edit

Save Edits

### Offshore\_Halibut [1/1]

Given the following conditions, how would you score the relative likelihood of obtaining the following outcomes for Offshore\_Halibut? All other aspects that might somehow affect Offshore\_Halibut may be considered to be able to vary unlimitedly; there are no inherent assumptions.

Recruitment	Halibut_catch	Narwhal_T1	Halibut_T0
Low	Medium	Low	Medium

*What will be most likely state of the population size of the catchable stock (fish >40cm), and how much more so?*

Choose which outcome is most likely:

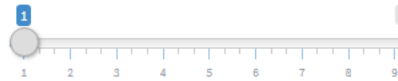
Low  Medium



1=equal importance, 9=much more important

Choose which outcome is most likely:

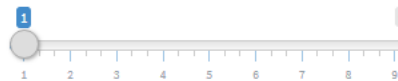
Low  High



1=equal importance, 9=much more important

Choose which outcome is most likely:

Medium  High



1=equal importance, 9=much more important

Submit

*Capture stakeholder knowledge and beliefs through node-specific online surveys*



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Network input

- Create new model
- Load existing model

Choose a file

Halibut

Password:

\*\*\*\*\*

Load!

Network correctly loaded...

Save!

Inference of the model

Display network

Display nodes

Choose node(s) of interest

Choose focal node

Include influencer

Display probability

Display influencers

Add evidence

Choose temporal nodes

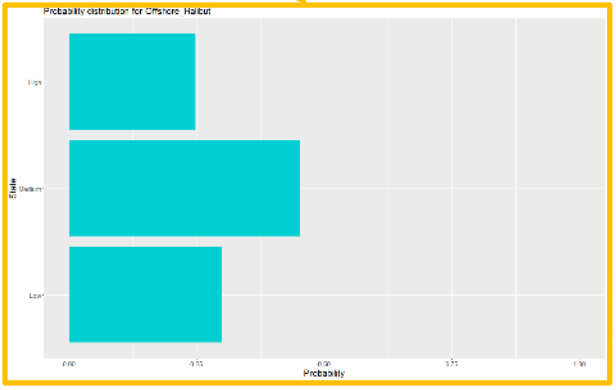
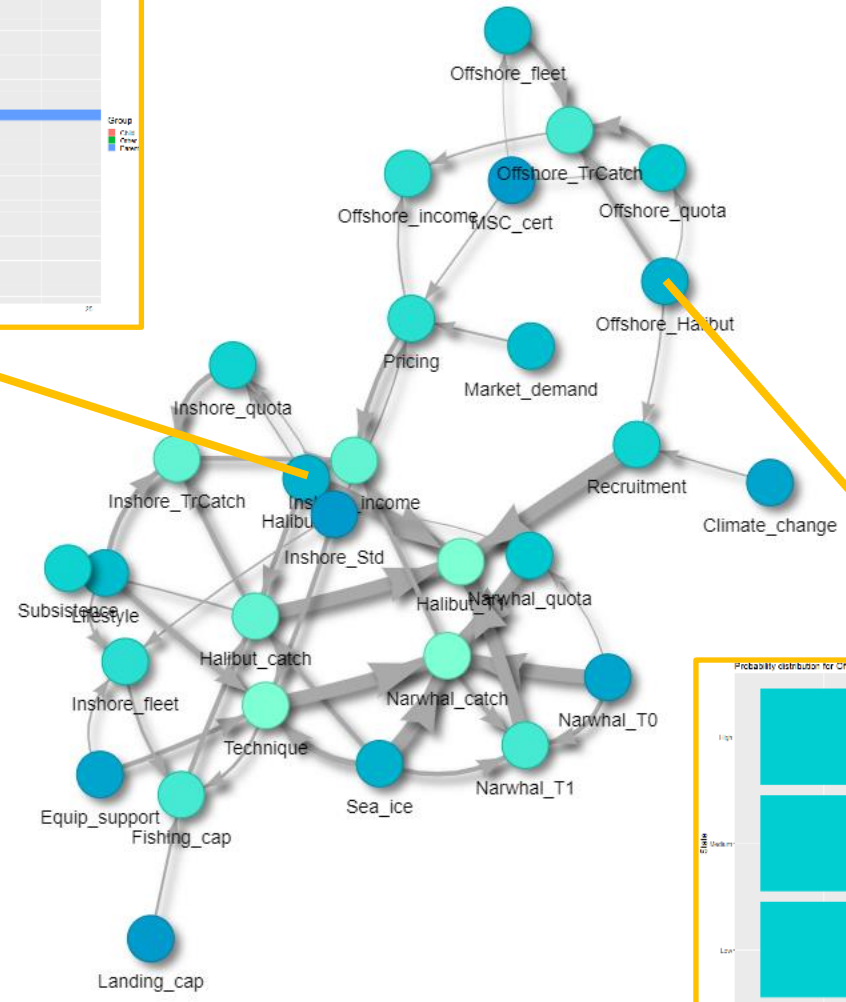
Choose input node

Choose output node

Choose node of interest

Time steps: 5

Display temporal



## Dashboard

Home

Instructions

Construct network

Define nodes

Enter data

Inference

### Network input

- View example model
- Create new model
- Load existing model

#### Choose a file

Halibut

View!

Network ready to view...

## Inference of the model

Display network

Display nodes

### Choose node(s) of interest

Halibut\_catch

Technique

Display probability

Display influencers

Add evidence

### Choose temporal nodes

Choose input node

Choose output node

Choose node of interest

Time steps:

1

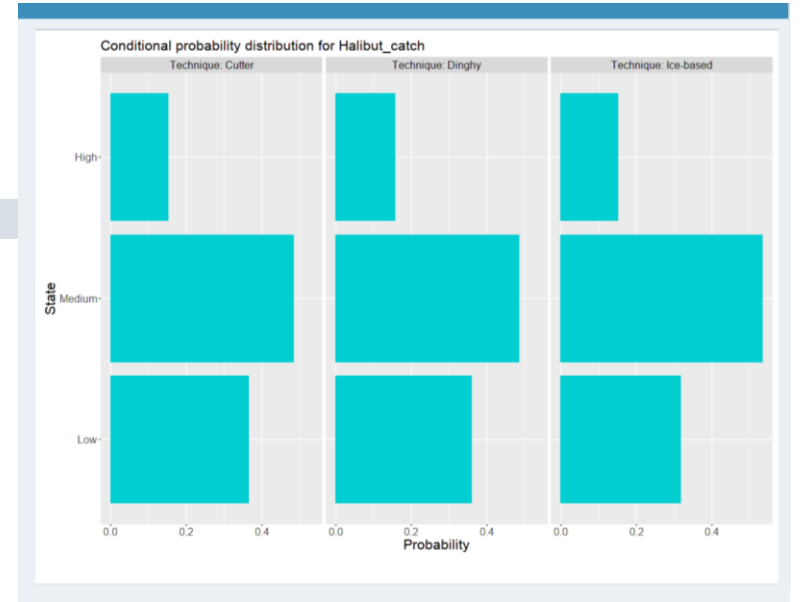
Display temporal

Submit

Reset

Node	Evidence
Climate_change	
Equip_support	No
Fishing_cap	Low
Halibut_catch	
Halibut_T0	
Halibut_T1	
Inshore_fleet	
Inshore_income	
Inshore_quota	Low
Inshore_Std	Yes
Inshore_TrCatch	
Landing_cap	Yes
Lifestyle	
Market_demand	High
MSC_cert	
Narwhal_catch	
Narwhal_quota	Low
Narwhal_T0	
Narwhal_T1	
Offshore_fleet	
Offshore_Halibut	
Offshore_income	
Offshore_quota	
Offshore_TrCatch	
Pricing	
Recruitment	
Sea_ice	
Subsistence	
Technique	

Precautionary



Globalization

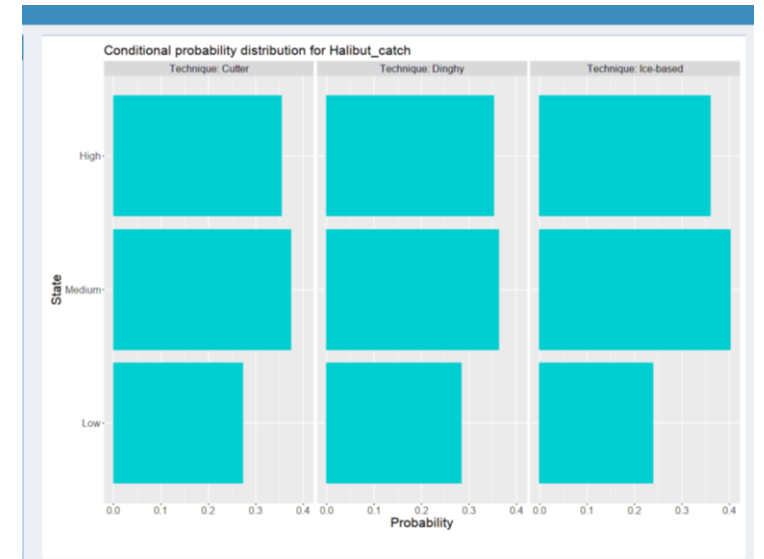




Foto. A. Staverløkk

# Gruppearbejde

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1. Identificer relevante udfordringer for naturressourceforvaltninger i Arktis
2. Byg dit eget BBN på en valgt udfordring
3. Lege med surBayes-værktøjet

# Gruppearbejde

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1. Identificér relevante udfordringer i forbindelse med forvaltning af naturressourcer i Arktis:
  1. Beskriv udfordringen
  2. Angiv områder og tidsperioder af relevans
  3. Bestem outputoplysninger af primær interesse
  4. Identificer mulige fremtidige scenarier
  5. Vurder dets konfliktniveau: vigtighed / deadline

# Gruppearbejde – opbygning af et BBN

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- Brug papir til at blive enige om og tegne, hvilke faktorer der skal være en del af jeres social-økologiske system, og hvordan disse hænger sammen
  - ▶ Relevante faktorer ('nodes'/'knudepunkter') → brug tekstbokse
  - ▶ Forbindelser mellem disse ('edges'/'kanter') → brug forbindelsespile
  - ▶ Kun envejsforbindelser! ('rettet/orienteret acyklisk graf')



# Gruppearbejde – opbygning af et BBN

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- Angiv hvilken type data der kan bruges til hver af noderne ved at mærke boksene:
  1. Forskernes viden (1)
  2. Lokal viden (2)



Foto. A. Staverløkk

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# Plenumdiskussion

# Fremtidige anvendelser af BBN – Idékatalog

- Hvor kan BBN metoden være brugbar?
- Hvad er jeres erfaringer fra gruppearbejdet?
- Tror I BBN metoden kan bruges til forvaltning af levende ressourcer?
- Kan det være en måde at få Lokal Viden bedre integreret i beslutninger om forvaltning af levende ressourcer?



# Samarbejde og ekspertise for en bæredygtig fremtid

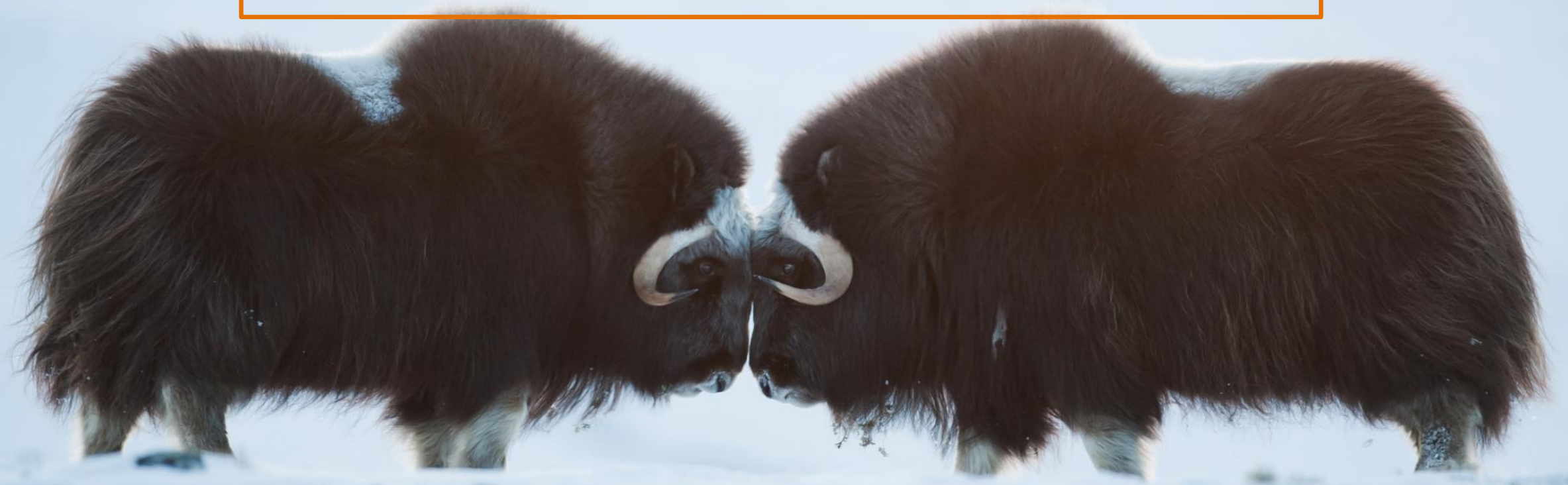


Foto. A. Staverløkk