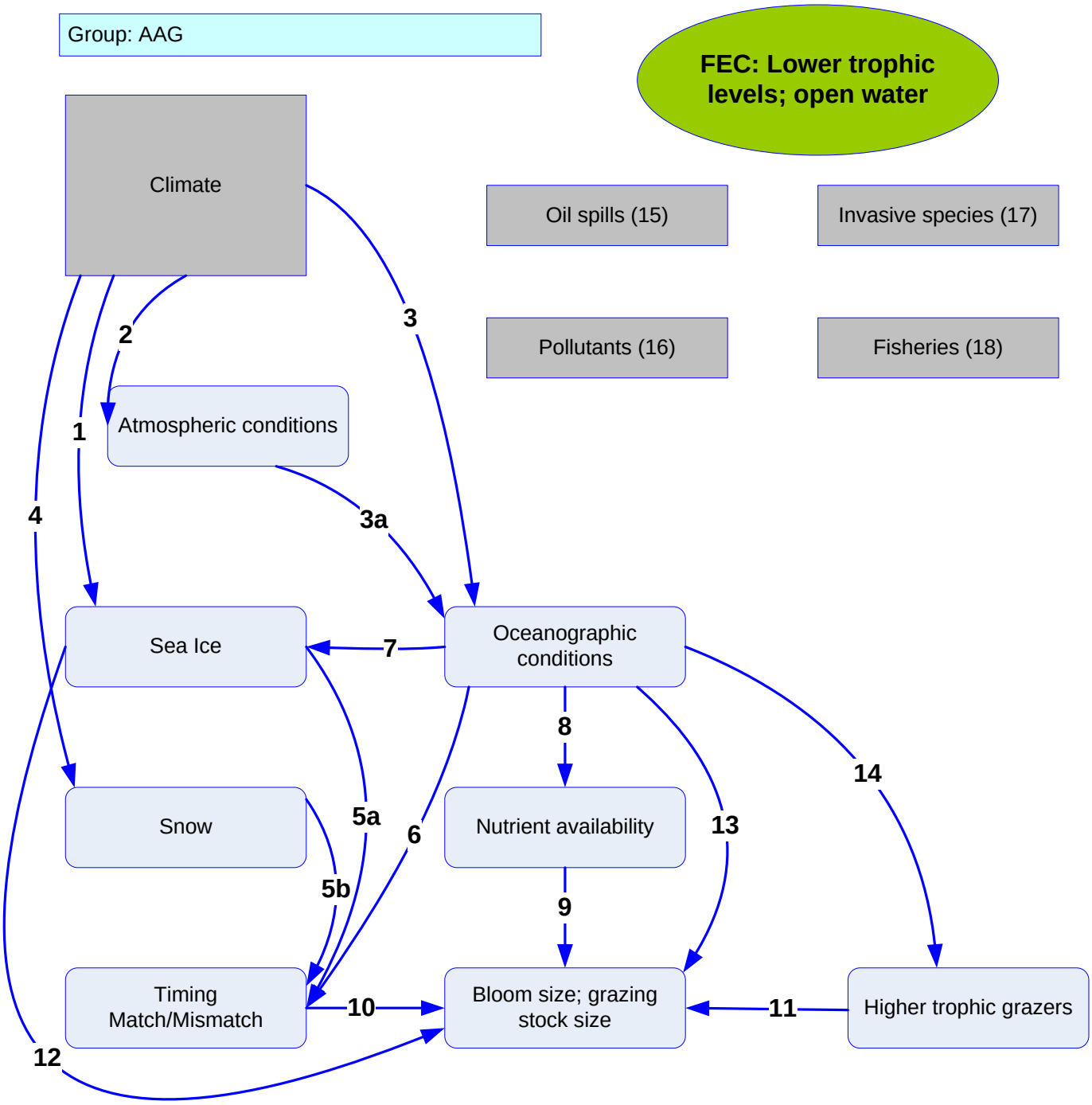
Flow charts from CBMP-m workshop

AEAM approach

Tromsø, 17.-18. januar 2009

Arctic Atlantic Gateway
(AAG)

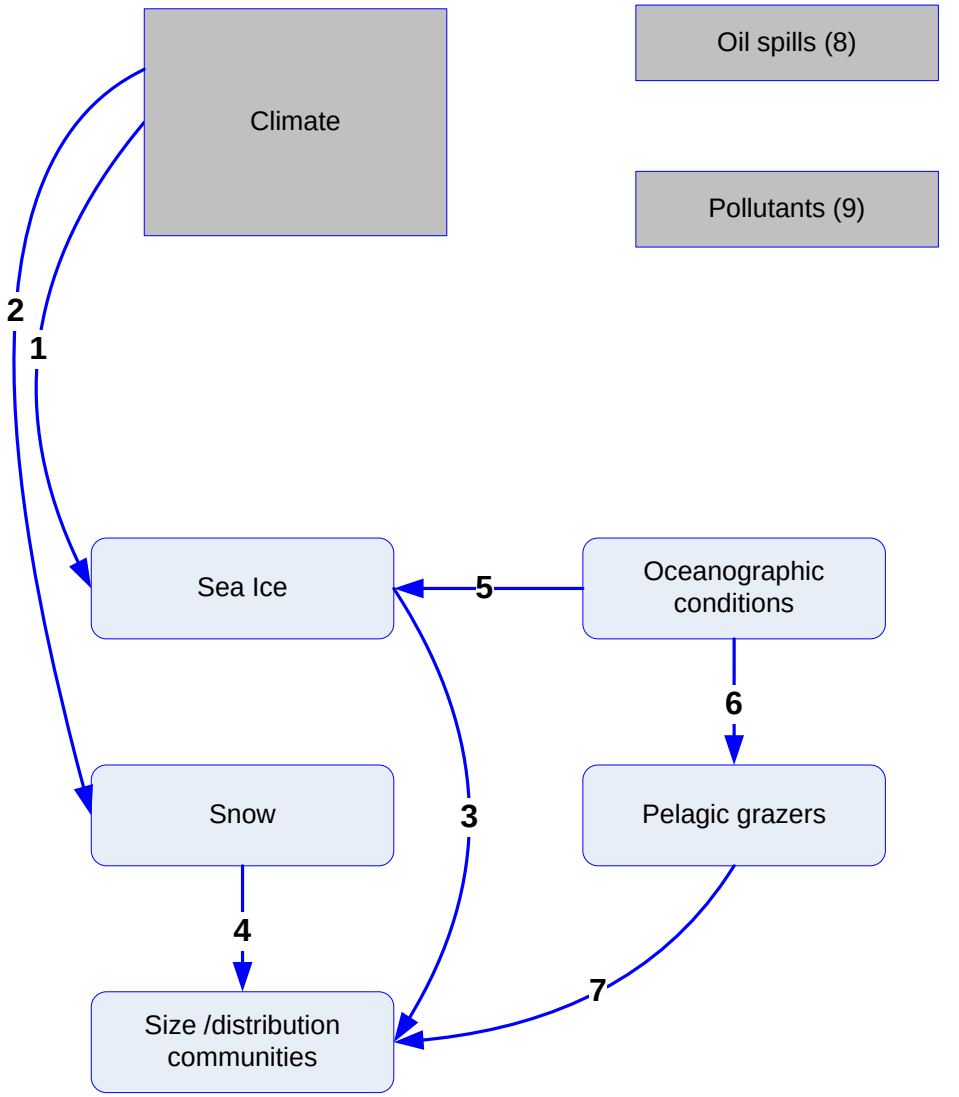


EXPLANATIONS:
1. Sea Ice extent, thickness, concentration
2. Wind, clouds, air temp., radiation, precipitation, etc.
3. water temp., salinity, wave action (3a)
4. snow amount
5. Radiation is controlled to a high degree by sea ice and snow cover
6. Influences stability of the water column and transport of organisms
7. Ice freezing and melting (on various time scales)
8. Mixing
9. Regulates phytoplankton biomass and species composition
10. decides grazing possibilities
11. impact phytoplankton/zooplankton biomass
12. affects light condition and stability of water masses
13. wave action is affecting stability
14. affects occurrance of high trophic grazers (bd, amounts,…)

EXPLANATIONS:
15. Oil spills: Only problem if major, otherwise local effect.
16. Pollutants: No direct effects on phytoplankton and zooplankton, but on food quality (food for higher trophic levels)
17. Invasive species: Worst case scenario would be shift in species composition.
18. Fisheries: Only indirect effect through grazers.

Group: AAG

FEC: Ice algae/ice fauna



EXPLANATIONS:
1. Sea Ice extent, thickness, type and concentration
2. amount of snow
3. different ice types results in different types of communities; thickness influences radiation
4. radiation/light conditions influences also communities
5. Influence freezing and melt
6. Availability of grazers and their different life stages
7. Influence biomass

EXPLANATIONS:
8. Oil spills: Only problem if major, otherwise local effect.
9. Pollutants: No direct effects on ice algae and ice fauna, but on food quality (food for higher trophic levels)

Group:

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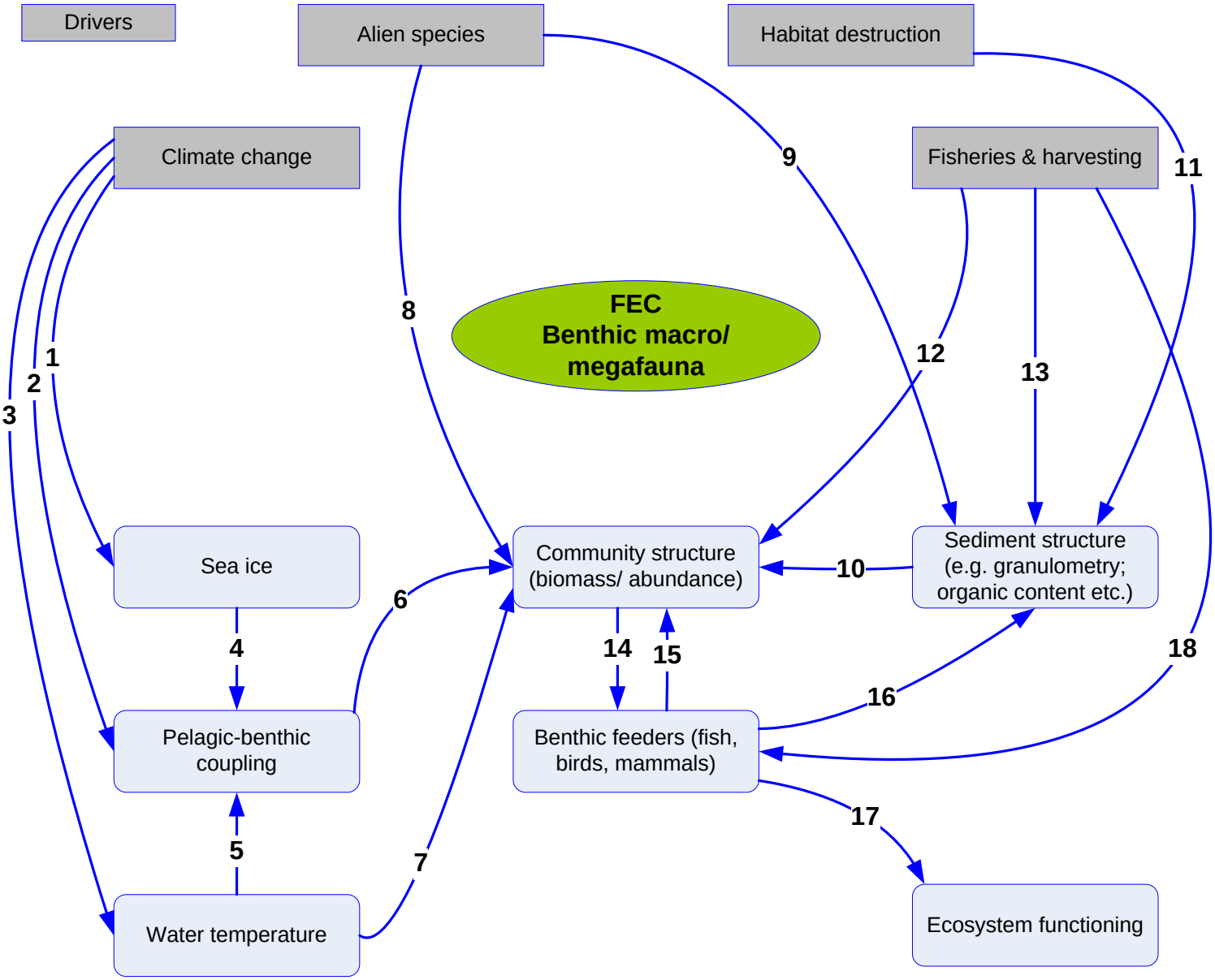


EXPLANATIONS:

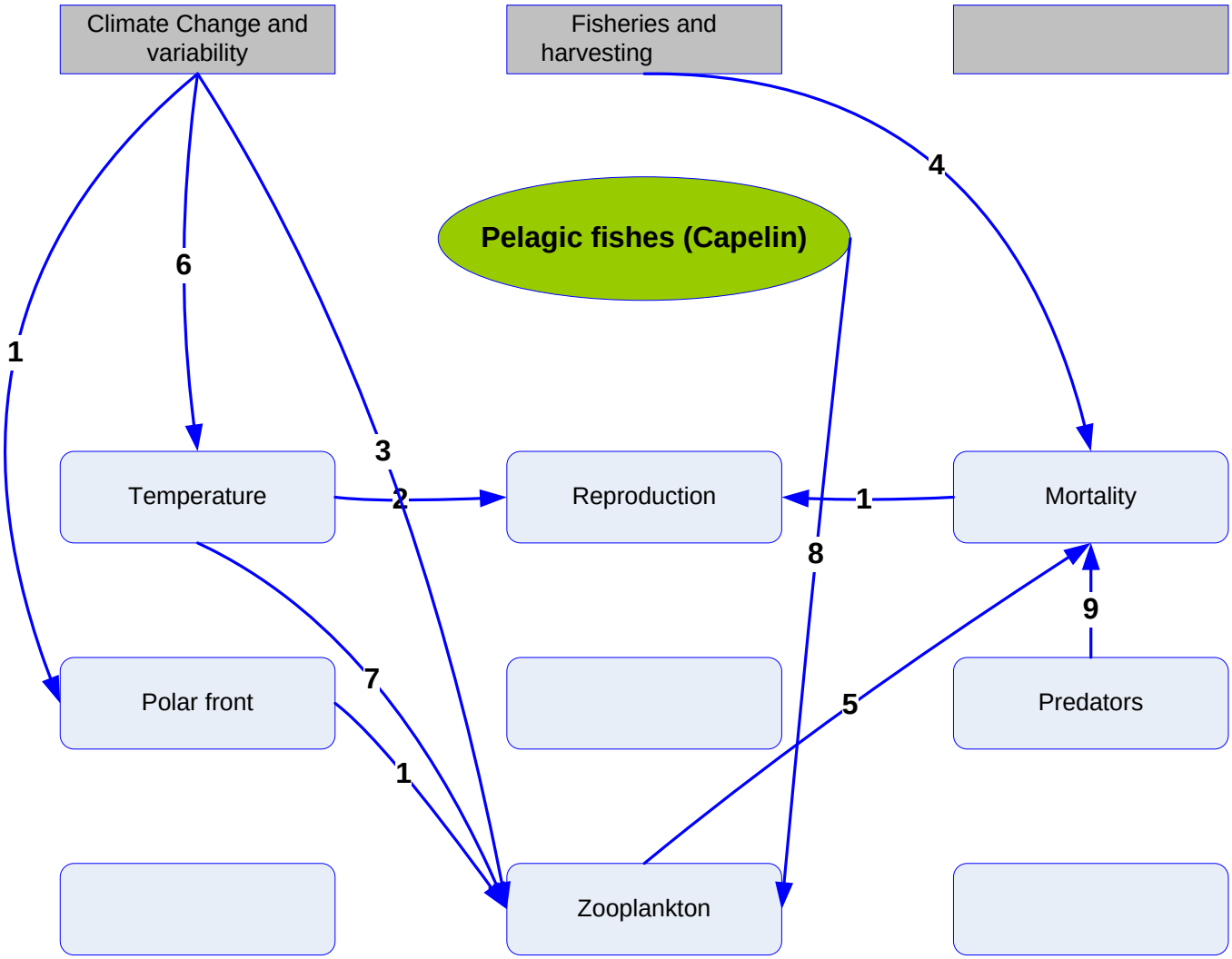
1. Climate change alters the thickness and extent of sea ice;
2. Climate change alters the distribution of high/ low productivity areas (e.g. hotspots);
3. Climate change alters sea temperature;
4. Sea ice regulates timing and mechanisms of energy transfer (production, grazing, vertical export etc.);
5. Water temperature may affect promary productivity;
6. Macro/megabenthic community structure responds to the overlying primary primary productivity regime (benthic-pelagic coupling);
7. Distribution ranges of taxa are affected by water temperature;
8. Alien species may change macro/megabenthic community structure (e.g. by prey removal, competition etc.);
9. Activities of alien species (e.g. king crab) may physically affect sediment structure (local impact);

EXPLANATIONS:

10. Alterations in sediment structure causes successional changes in macro/megafaunal assemblages, including trophic structure;
11. Habitat destruction changes sediment composition (including topology);
12. Bottom trawling removes or damages large organisms (e.g. large bivalves, corals, sponges, thin-shelled or fragile organisms, bioturbators etc.);
13. Bottom trawling directly impacts sediment structure, including micro-topology;
14. Changed food source/quantity for benthic feeders;
15. Activities of benthic feeders impact macro/ megabenthic communities (removal of organisms);
16. Activities of benthic feeders may affect sediment structure (e.g. digging by walrus);
17. Food web affects ecosystem functioning.
18. Removal of benthic feeding fish may affect benthos

Group: AAG

Drivers



EXPLANATIONS:
1.Changed position of the polar front
2 Indirec effects through temperature changes
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6 Increases inflow of Atlantic water
7 Increases some elements of the foodchain and decreases others
8 Prescence of capelin alter foodchain structure
9 Cod is the dominating predator

EXPLANATIONS:
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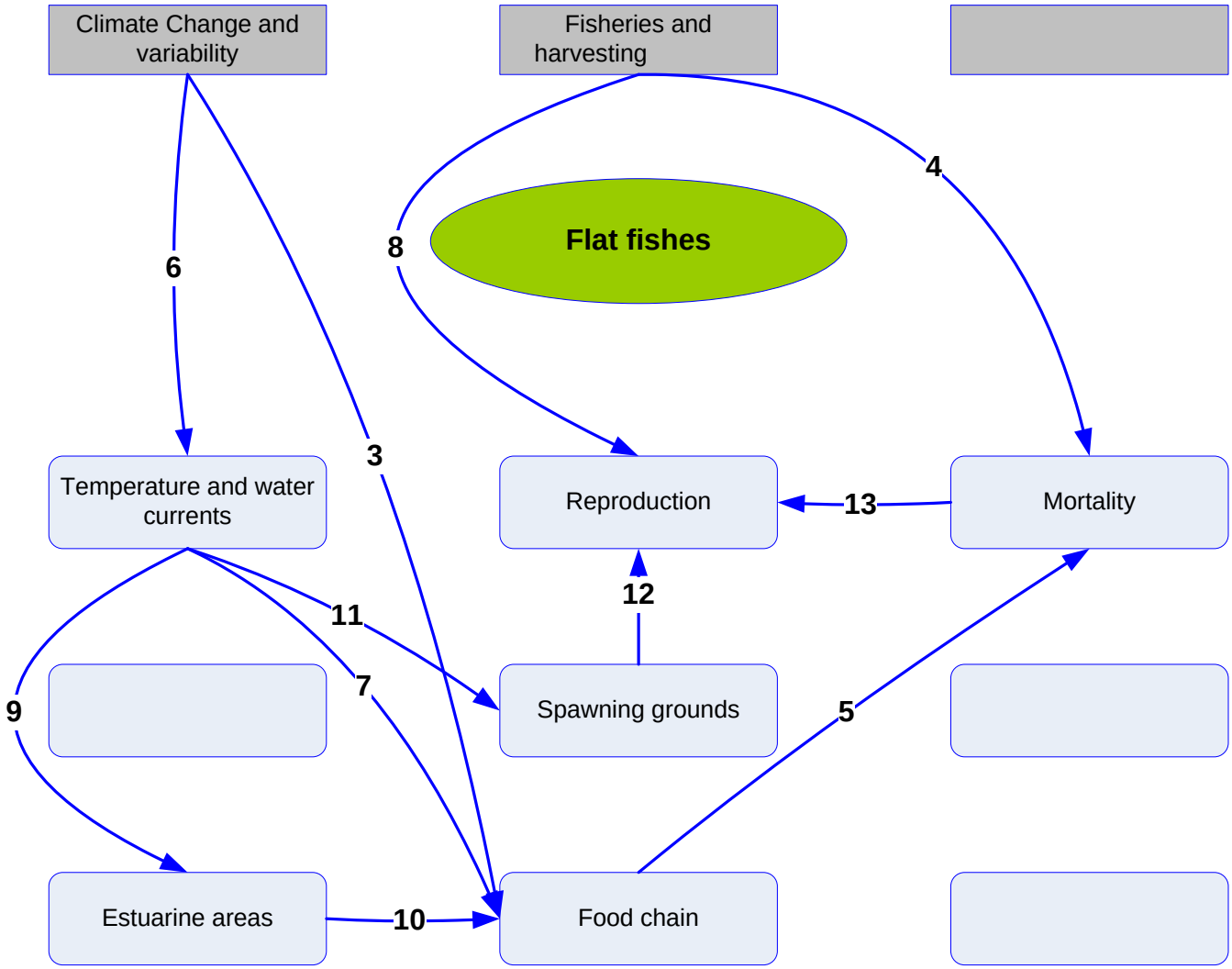
Group: AAG

Drivers



EXPLANATIONS:

3
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6 Increases inflow of Atlantic water
7 Increases some elements of the foodchain and decreases others
8 Catch an bycatch of juvenile cod
9 Changed amount of freshwater outlet from rivers
10 The cod may end up in a different food chain
11 Changes the distribution of suitable spawning grounds
12 Possible change in subpopulation complex

EXPLANATIONS:
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Group:

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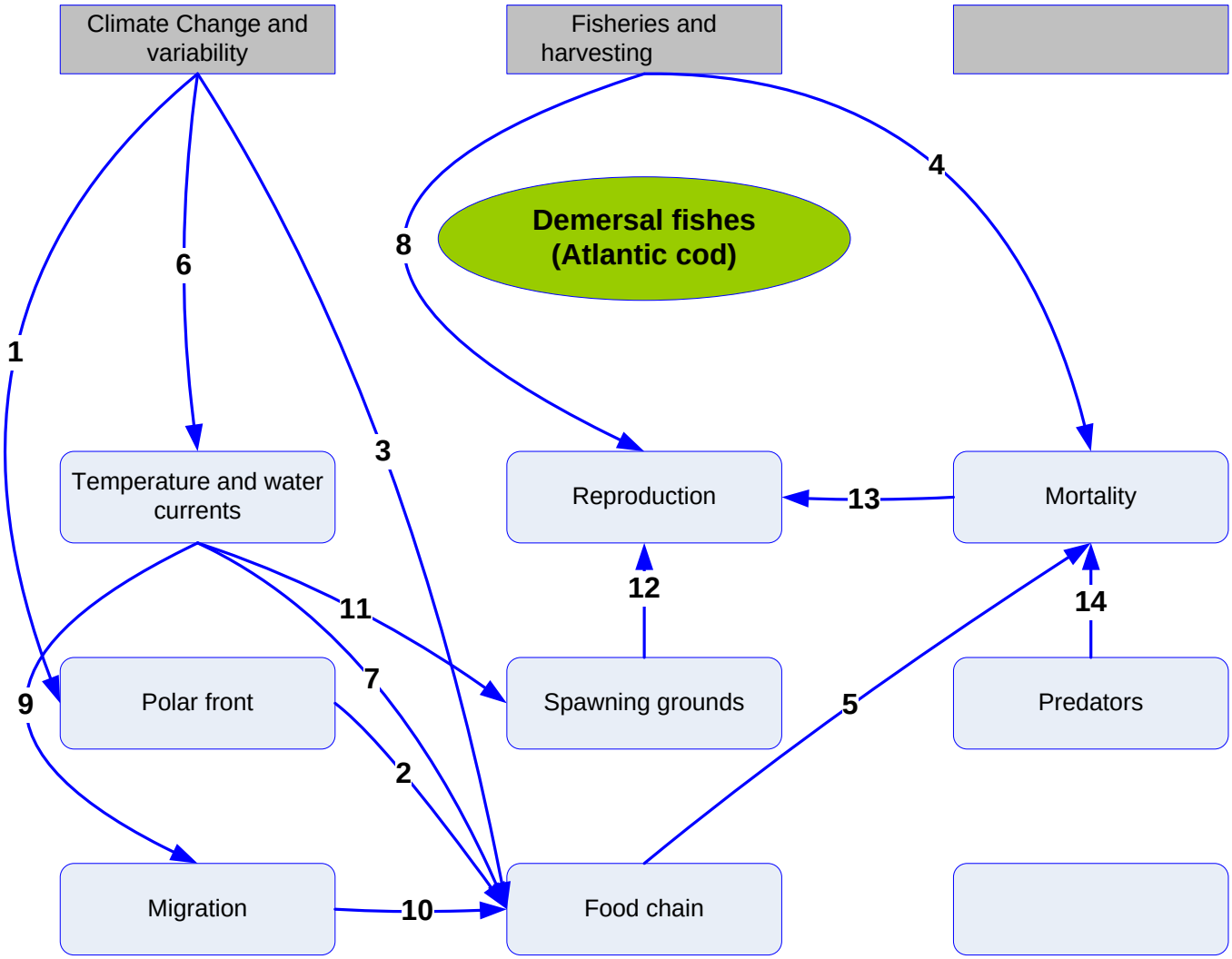
Drivers



EXPLANATIONS:
1.Changed position of the polar front
2 Changed distribution of capelin
3
4
5 Capelin is an important food item
6 Increases inflow of Atlantic water
7 Increases some elements of the foodchain and decreases others
8 Catch an bycatch of juvenile cod
9 Cod distribution is dependent of temperature
10 The cod may end up in a different food chain
11 Changes the distribution of suitable spawning grounds
12 Possible change in subpopulation complex
13
14 Predation on juvenile cod including cannibalism

EXPLANATIONS:
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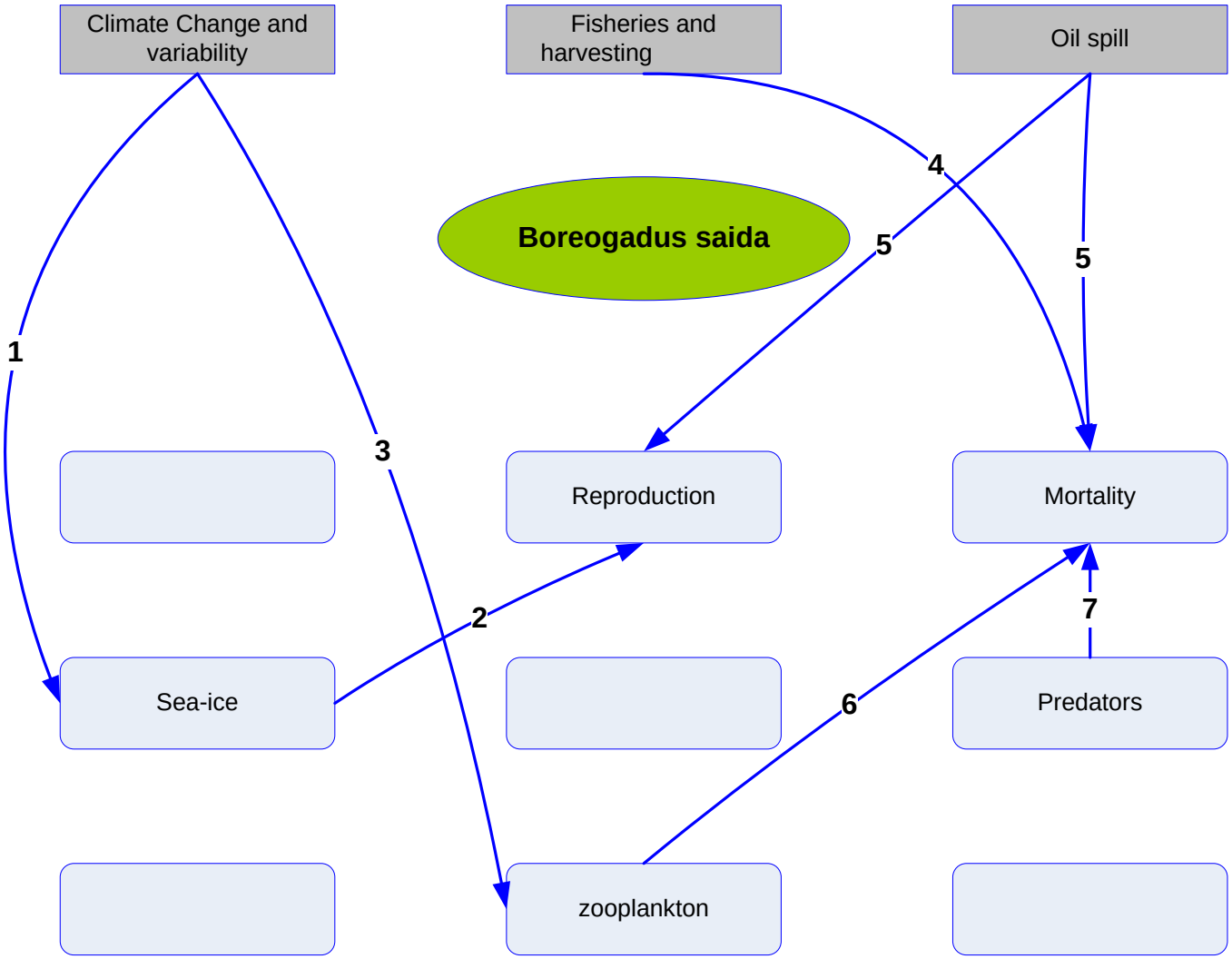
Group: AAG

Drivers



EXPLANATIONS:
1.Ice cover during winter season
2 Spawning under sea-ice
3 Ice related zooplankton
4
5 Oil spill inder the ice will destroy eggs as well as larvae and food
6
7 Main predators are arctic seals and whales

EXPLANATIONS:
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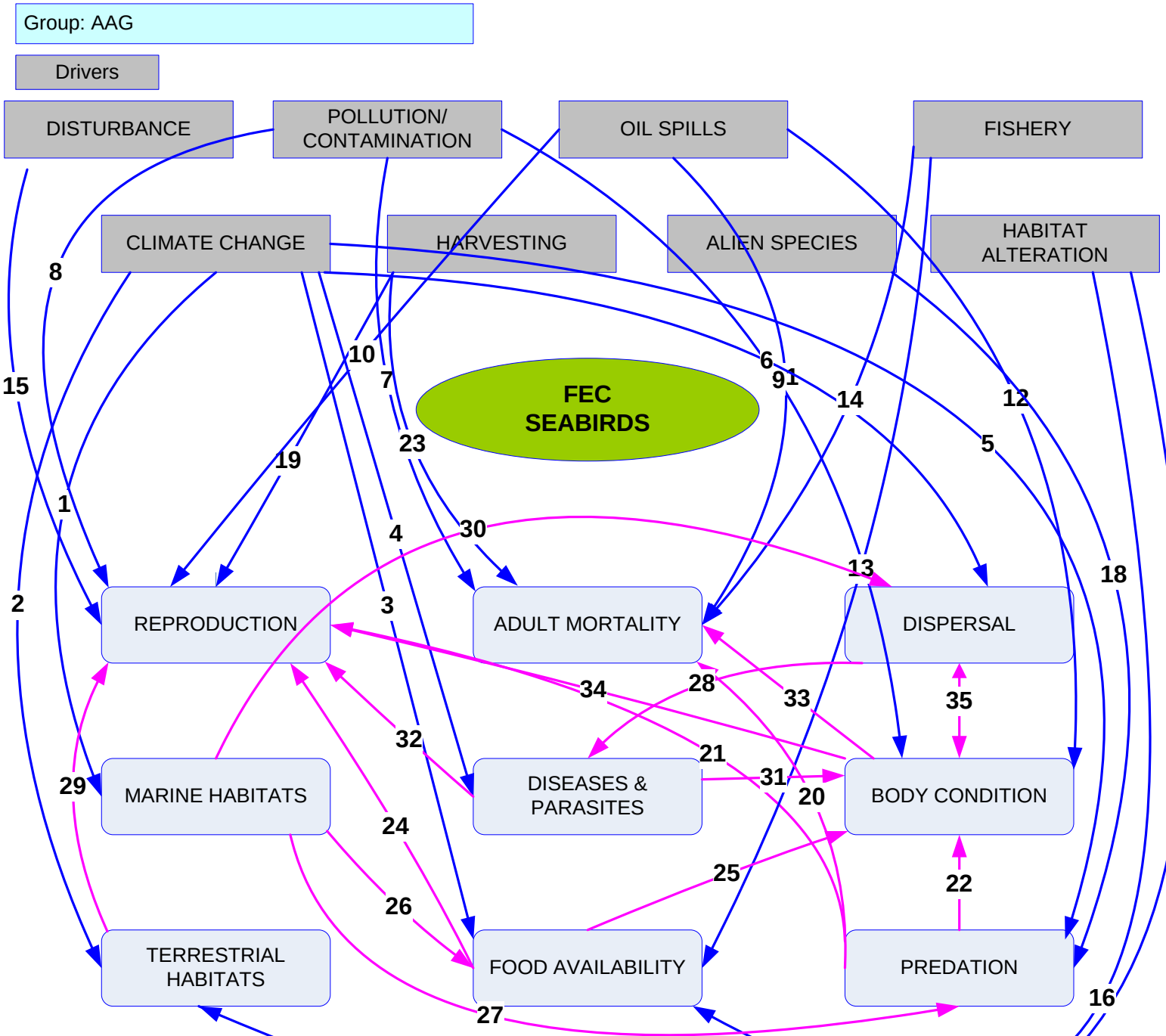
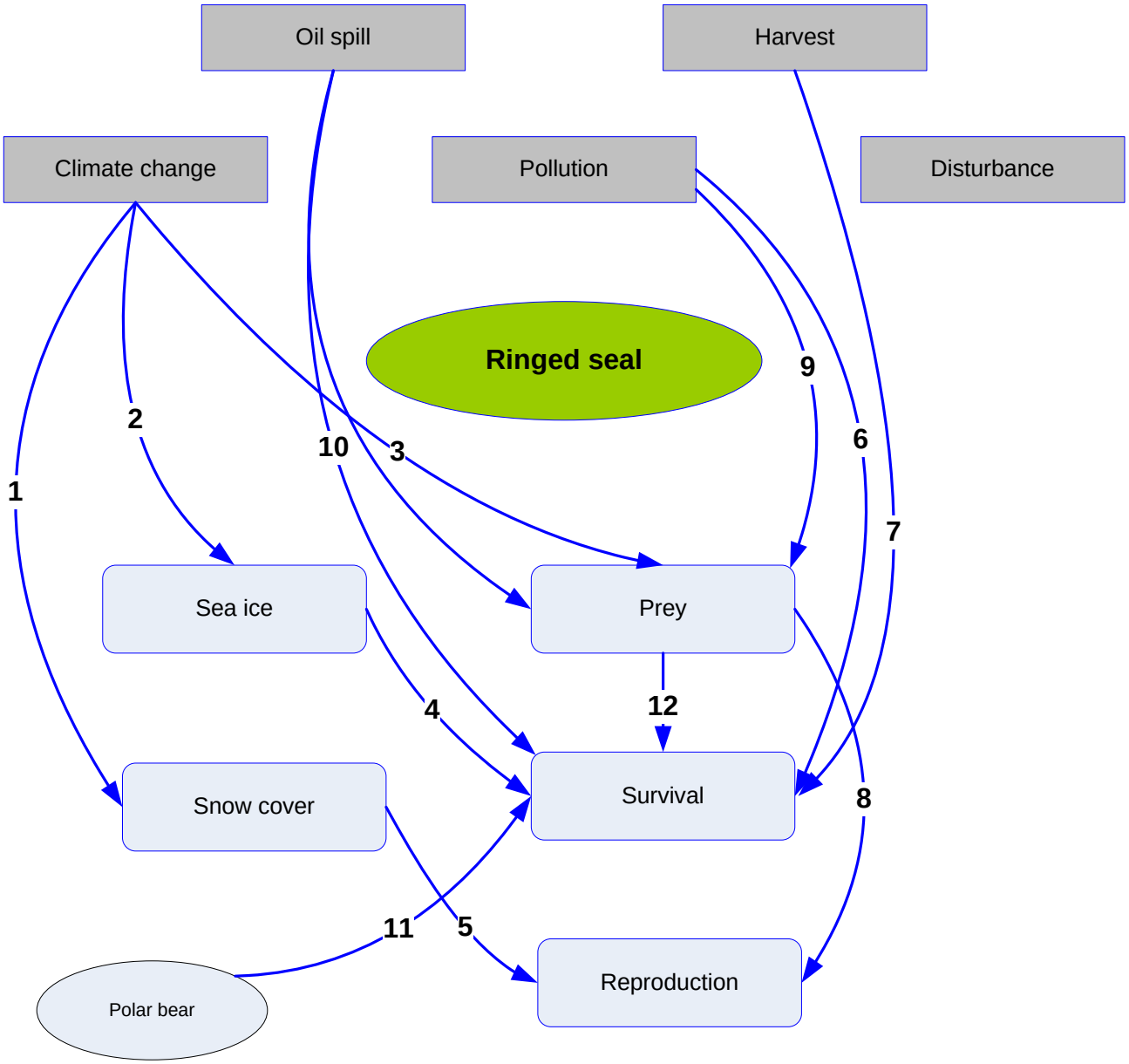


EXPLANATIONS:
CLIMATE CHANGE
1. Climate change affects sea ice distribution and features: water masses distribution
2. Climate change affect snow cover, coastal erosion, sea level which important for breeding sites
3. Climate change affects distribution, abundance and availability of prey
4. Climate change affects distribution, life cycle and virulence of infectouse and parasitic organisms
5. Climate change affects distribution of predators
6. Climate change affects phenology of dispersal and availability of seasonally important areas
POLLUTION & CONTAMINATION
7. Pollution/contamination may increase adult mortality
8. Pollution may reduce reproduction success
9. Pollution may decrease body condition
OIL SPILL
10. Oil spill may reduce reproduction success
11. Oil spill may cause direct mortality
12. Oil spill may decrease body condition
FISHERY
13. Commercial fishery deplete prey species abundance, on another hand, fishery can provide additional food source
14. Fishery can lead to direct seabird mortality in fishing gear (bycatch)
DISTURBANCE
15. Disturbance can affect reproduction success
HABITAT ALTERATION
16. Bottom disturbance may affect food availability for benthos feeding seabirds.
17. Area claim and disturbance may reduce availability of suitable breeding sites

EXPLANATIONS:
20. Decreased body condition may decrease reproductive success
21. Predation on eggs and chicks will reduce reproduction success
22. Seabirds stressed by predators may decrease their body conditions
24. Shortage in food may reduce reproduction success
25. Shortage in food may decrease body condition
26. Changes in distribution and availability of marine habitats may affect food availability for seabirds
27. Alteration in ice habitats can affect accessibility of seabirds for their predators (polar bears, arctic foxes).
29. Alteration of terrestrial habitat may affect availability of suitable breeding sites
30. Changes in distribution of marine habitats may affect migration routes and phenology, location of staging and wintering areas
31. Occurrence and types of pathogens and parasites may affect body conditions
32. Occurrence and types of pathogens and parasites may affect reproduction success
33. Changes in body condition may affect adult mortality
34. Body condition affects reproduction success
35. Body condition affect bird's ability to disperse, and vice versa movement distances and time can affect body condition
28. Changes in dispersal patterns may cause changes in composition and frequency of pathogens and parasites

Group: AAG



EXPLANATIONS:
1. Climate change affects precipitation and snow cover
2. Climate change affects sea ice extent and quality
3. Climate change affects prey availability
4. Less sea ice will affect survival through increased stress due to less core habitat.
5. Less snow cover reduces reproductive success due to less substrate for birth lairs.
6. Polltuion affects survial through toxic effects, acute and/or chronic
7. Harvest obviously reduces survival
8.
9. Pollution probably affects prey species through toxic effects
10. Oil fouling and oil ingestion will increase mortality
11. Ringed seals are prime prey for polar bears
12. Changes in prey availability affects survival

Group: AAG

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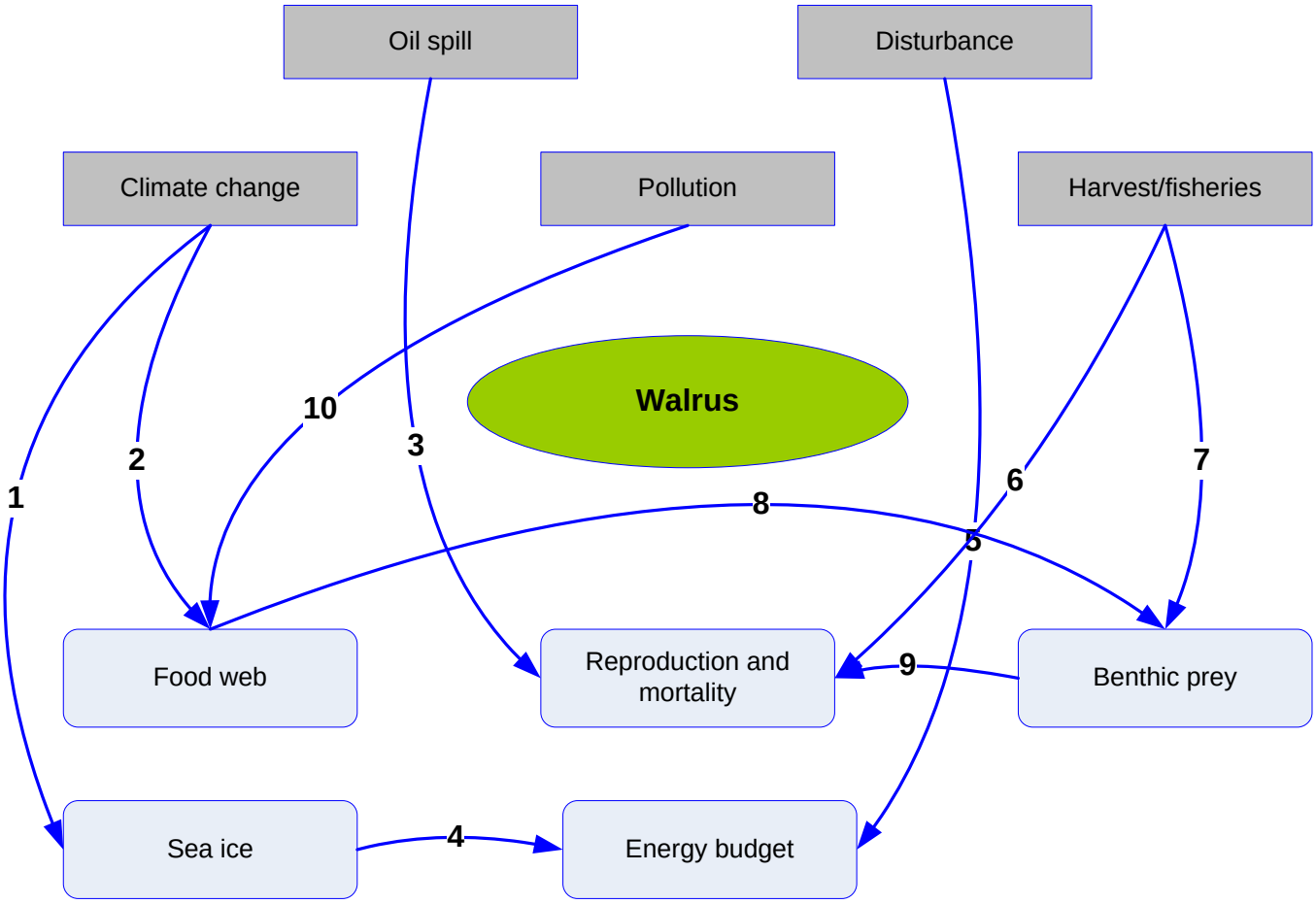
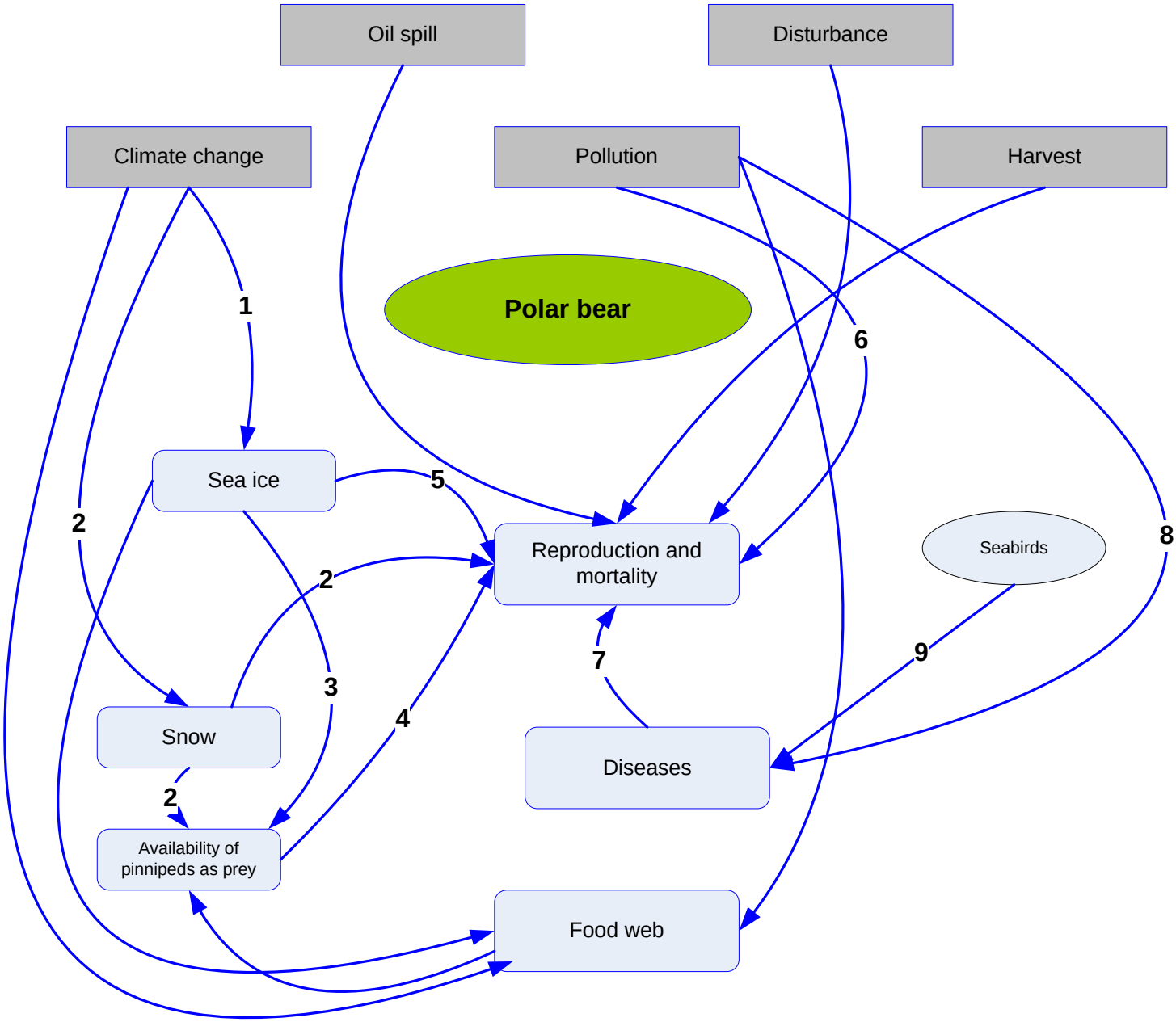


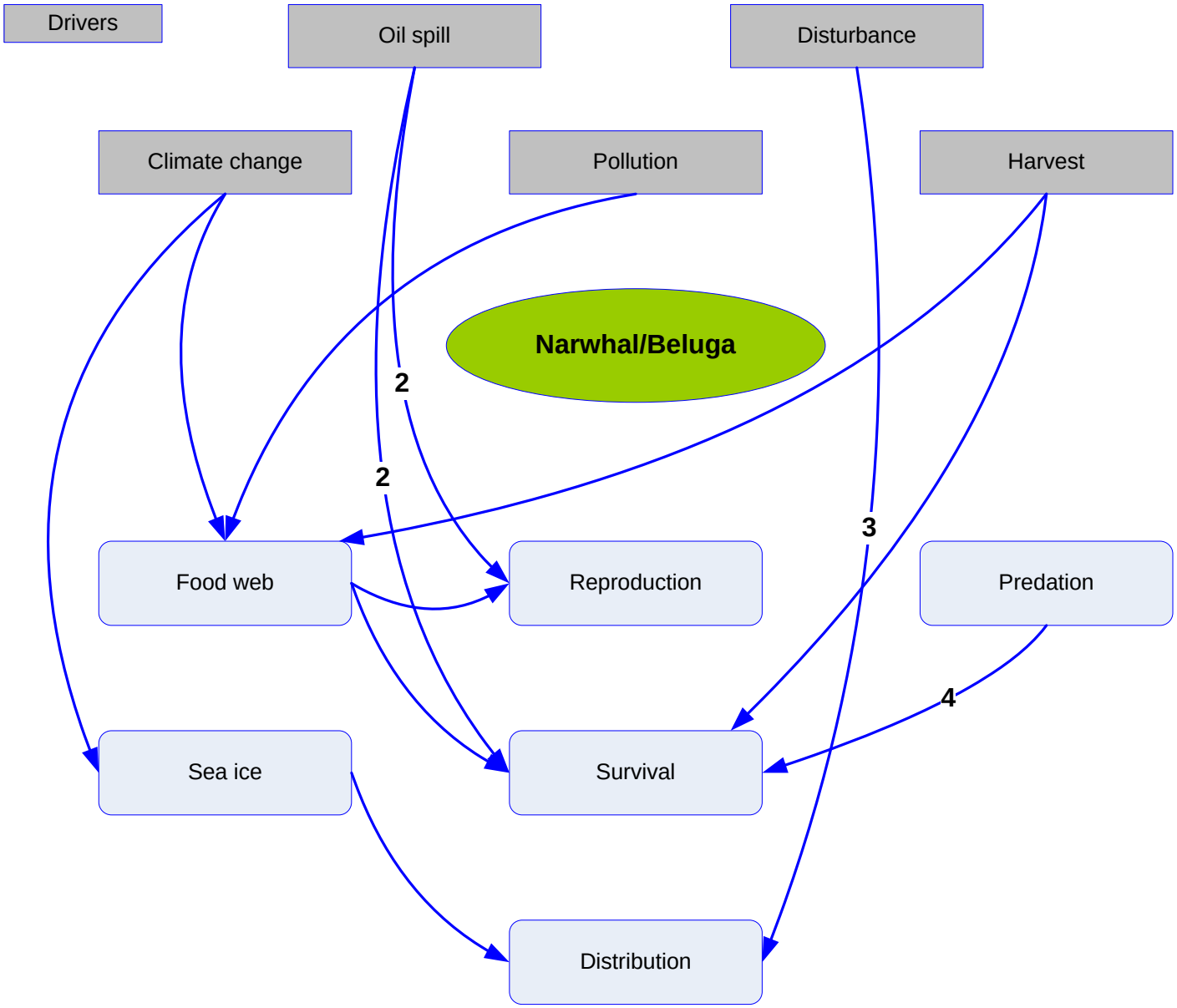
EXPLANATIONS:
1. Climate change affects sea ice extent and quality
2. Climate change will affect food web structure and prey dynamics
3. Oil spill worst case will affect walrus in the sea and possibly destroy access to haul-out sites. Extreme oiling can be toxic.
4. Ice floes are used for haul-out. Less sea ice will reduce avialble ice haul-out sites.
5. Disturbacne of haul-out sites affects walrus energy expenditure
6. Direct hunt obviously affects mortality
7. Shell fisheries/ bottom trawling reduces available prey.
8. Obvious linkage between food web dynamics and benthic prey
9. Less prey available will in the end increase mortality
10. Toxic effects on food web

Group: AAG



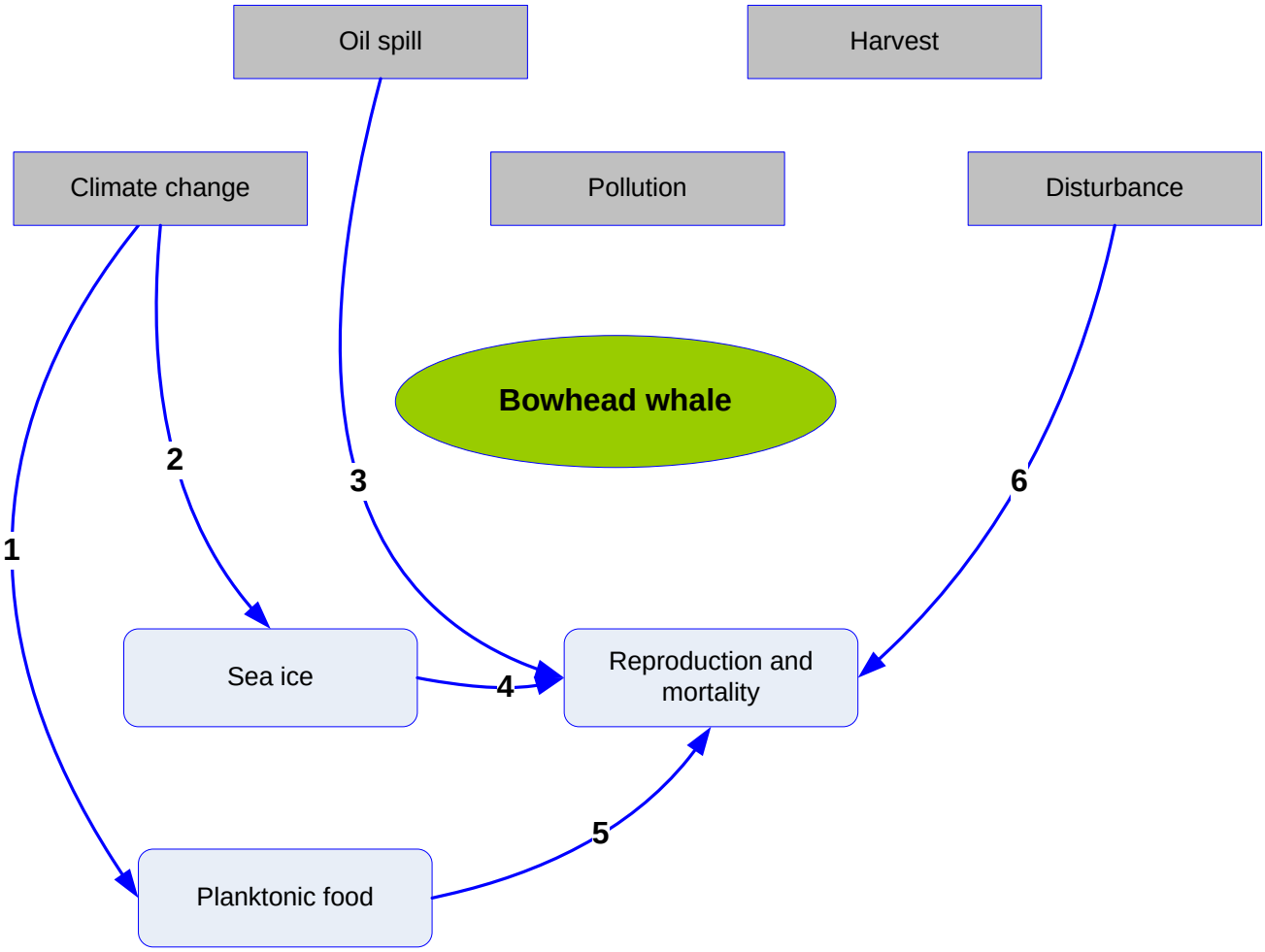
EXPLANATIONS:
1.Climate change reduces sea ice extent and quality. Sea ice as platform.
2 Snow is needed for maternity dens and ringed seal birth lairs
3 Sea ice change affects bearded seal and ringed seal availability
4 Food is needed
5 Sea ice needed for transport/migration.
6. Pollution affects mortality
7. Diseases increase mortality
8. Probable link, needs attention.
9. Seabirds transfer diseases to polar bears

Group: AAG



EXPLANATIONS:
1.
2 Worst case scenario oil spill will affect both species
3 Shipping can displace narwhals from summer areas (e.g. Mine in East Greenland)
4 Killer whale predation can be substantial in some areas in Greenland

Group: AAG



EXPLANATIONS:
1. Climate change affects primary productivity and availability of planktonic food.
2. Climate change affects sea ice extent and quality
3. Oil spill worst case scenario could affect bowhead whales?
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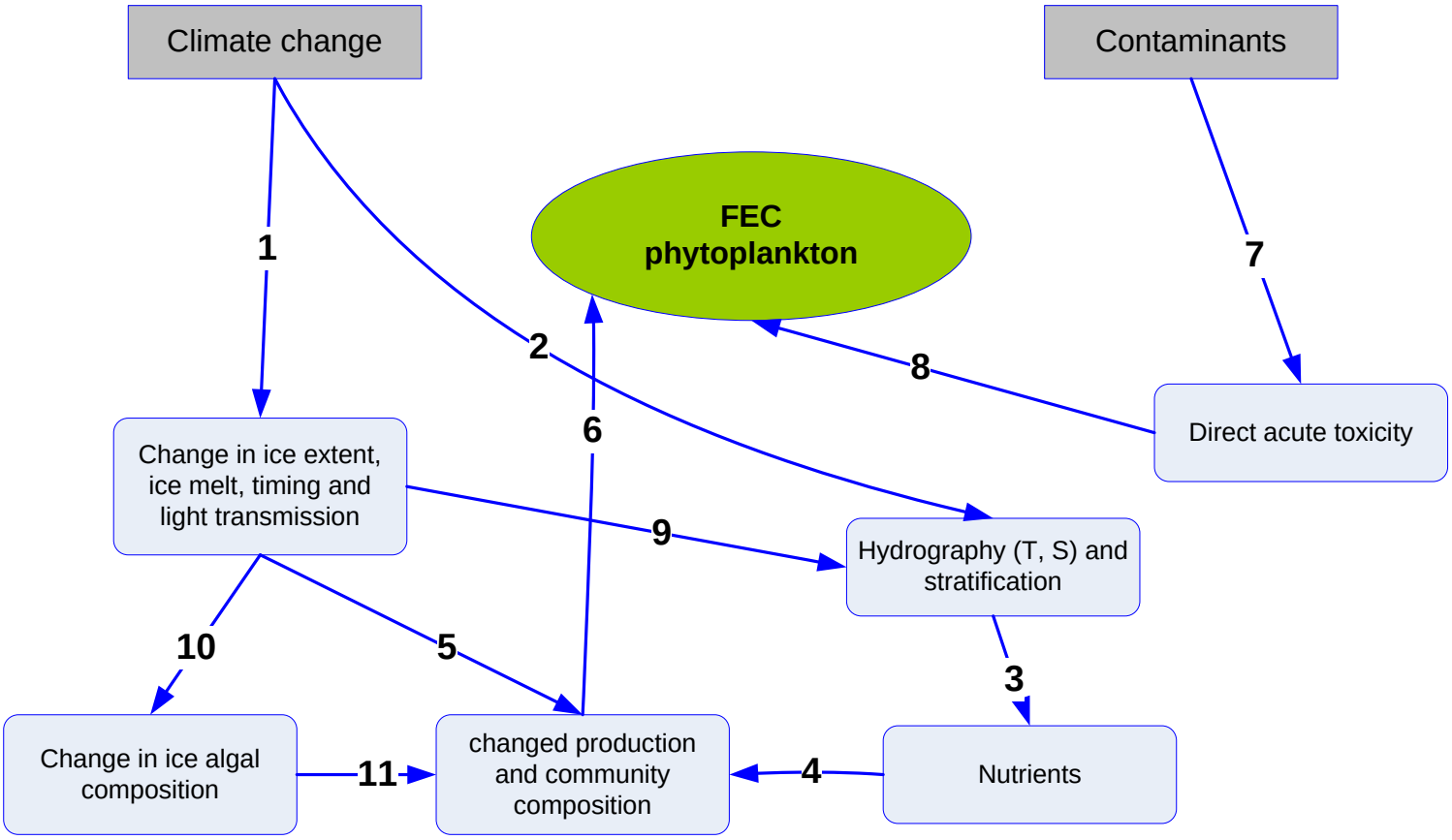
Arctic Pacific Gateway
(APG)

Group: APG

Drivers



EXPLANATIONS:
FEC:
9. for example, deposition of black carbon soot onto sea ice increases snow melt

EXPLANATIONS:
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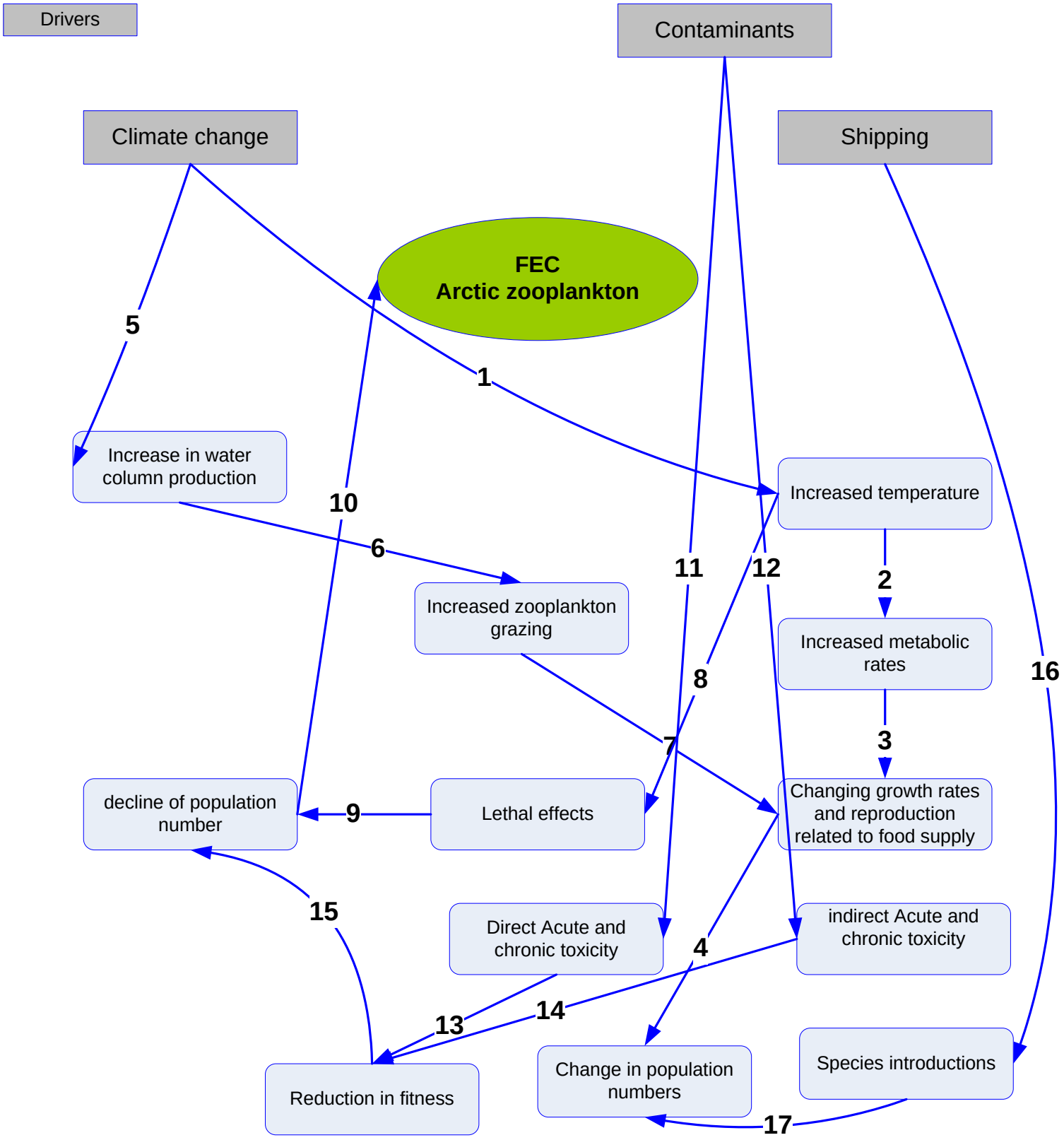
Group: APG



EXPLANATIONS:
FEC: This is one example for benthic infauna, others are polychaetes and amphipods, these are different prey sources for different higher trophic levels

3. If food is limited, growth rates will be reduced; If food is unlimited, growth rates will increase

EXPLANATIONS:
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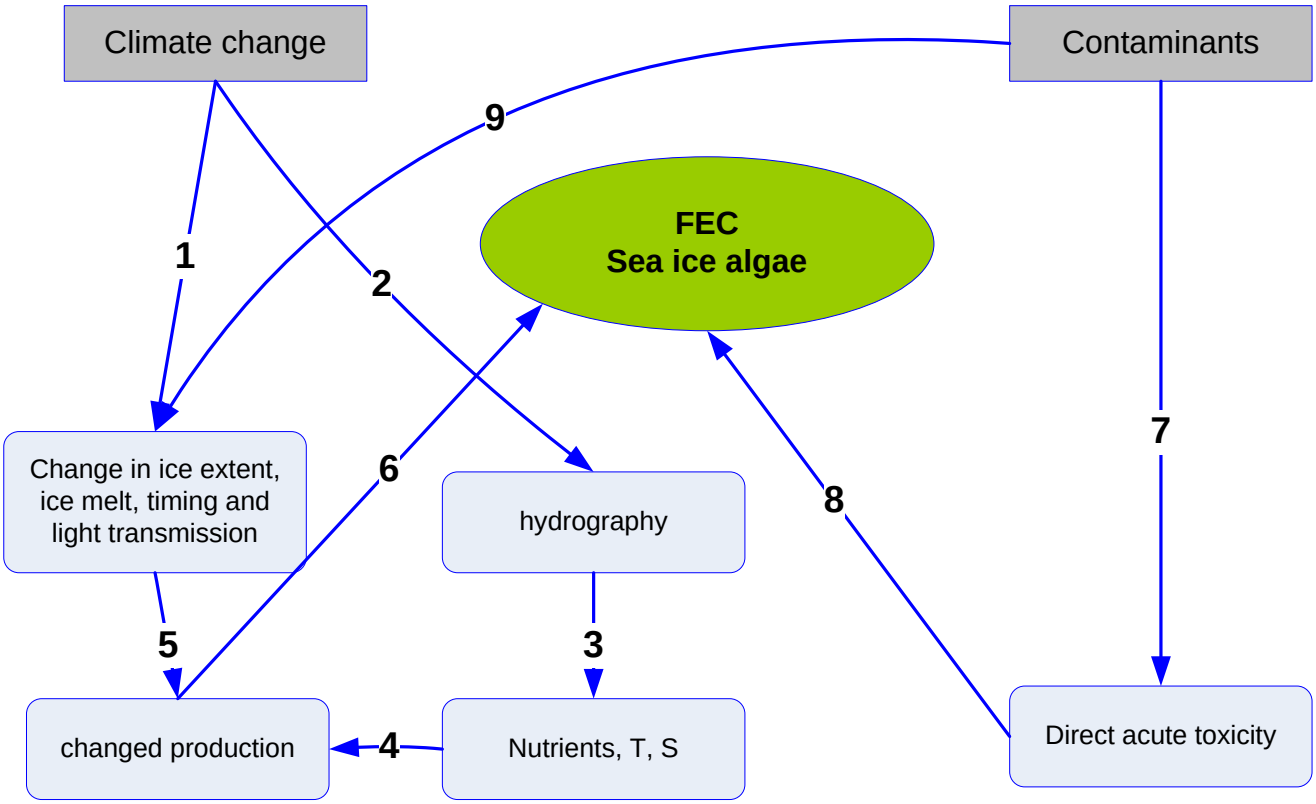
Group: APG

Drivers



EXPLANATIONS:
FEC:
9. for example, deposition of black carbon soot onto sea ice increases snow melt

EXPLANATIONS:
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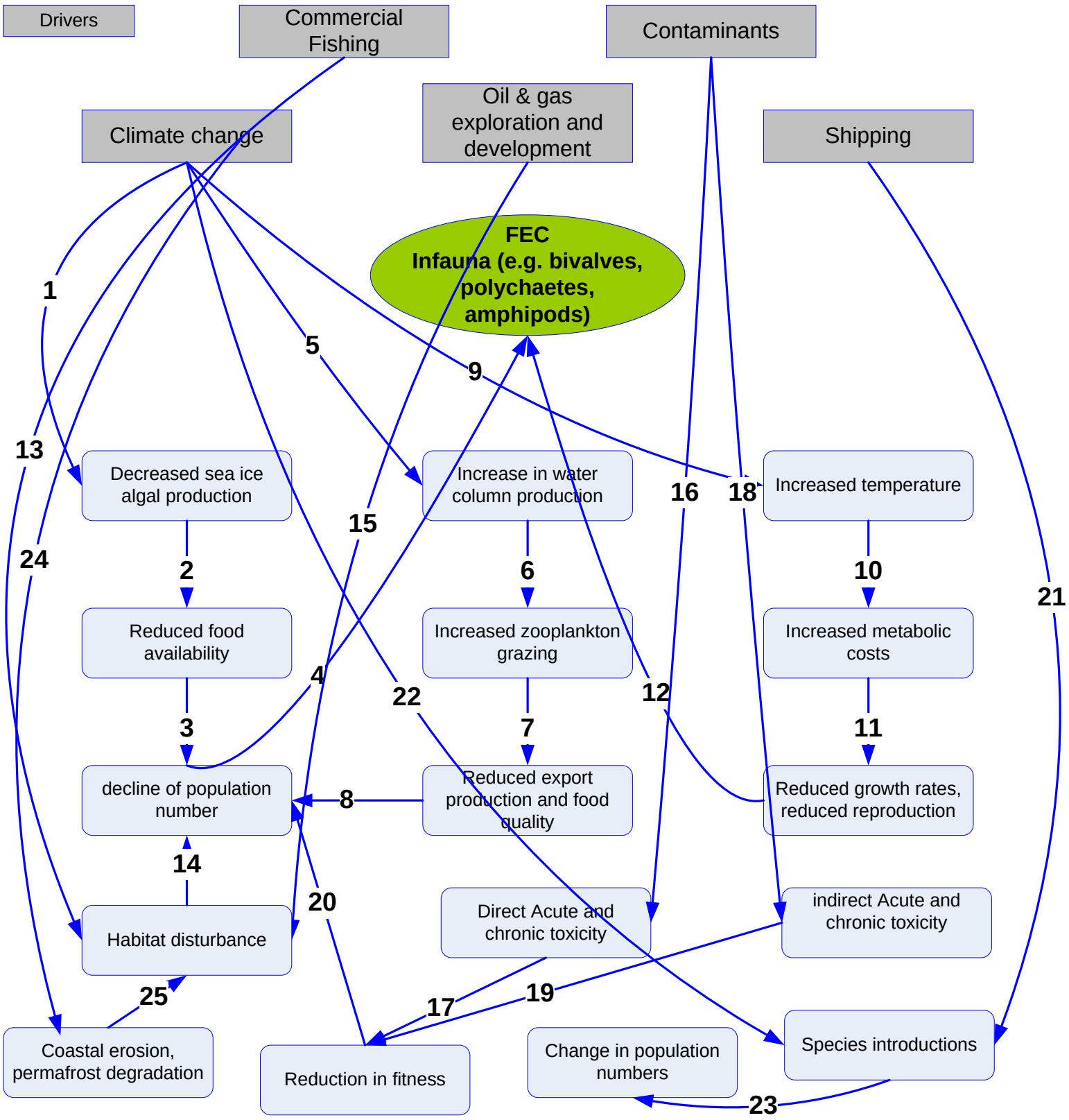
Group: APG



EXPLANATIONS:
FEC: different taxa are different prey sources for different higher trophic levels
Bivalves: prey source for walrus, fishes
Amphipods: prey source for gray whales, fishes
Polychates: prey source for fishes

EXPLANATIONS:
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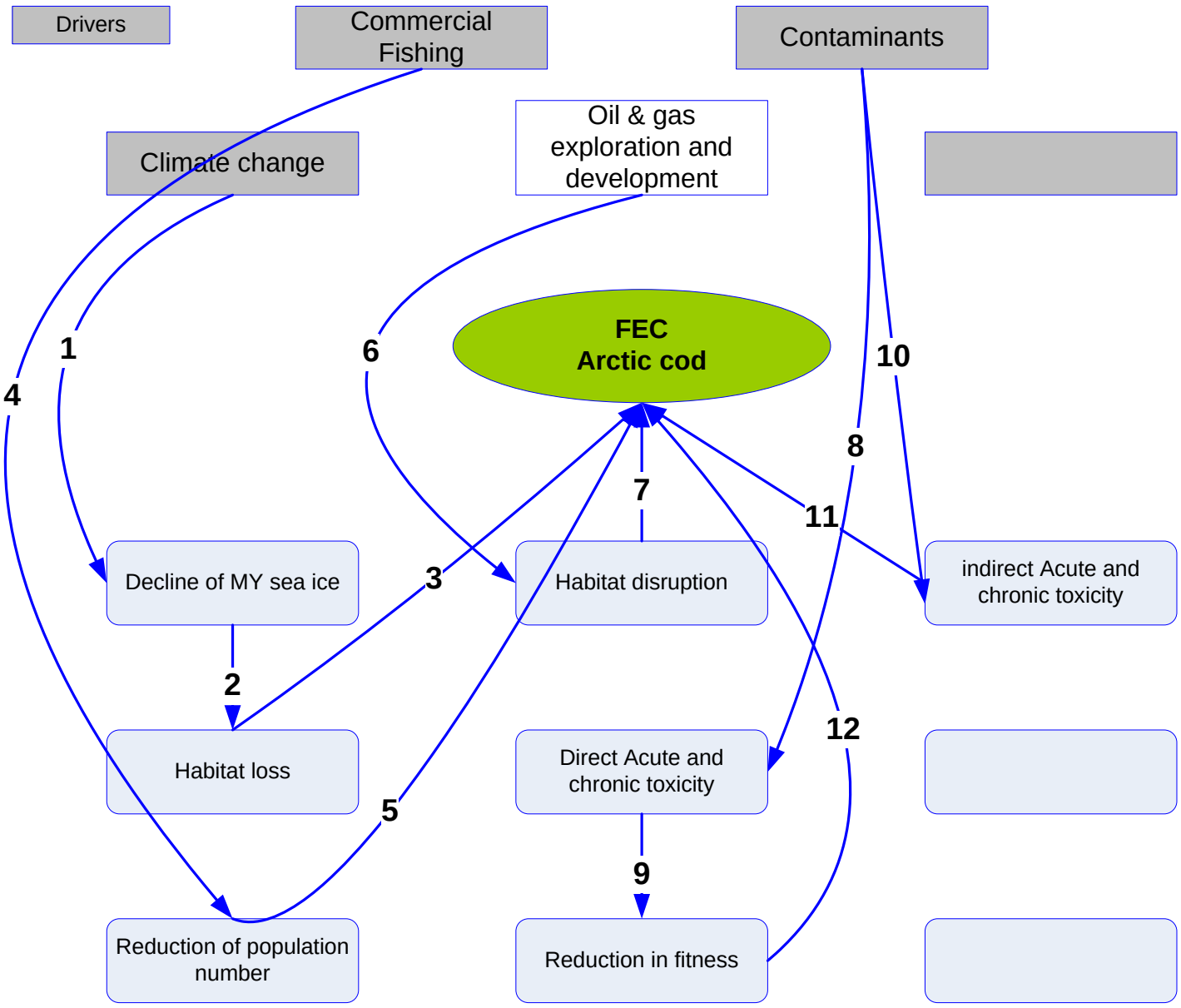
Group: APG



EXPLANATIONS:
1. warming temperatures cause ice melt
2. Loss of MY ice causes reduction of crevices and ice structure used as habitat, ice habitat is used as feeding ground, as protection against seal and bird predators
3. expected retraction of distribution northwards, change in population abundance, possible effects on condition
4. Emerging issue
6. Airgunning, etc could disrupt fish, probably impact of lesser importance
8. Oil spills, POP, heavy metals, discharge muds
9. susceptibility to disease, death,
10. contamination in prey and bioaccumulation, habitat disruption of oil spills

EXPLANATIONS:
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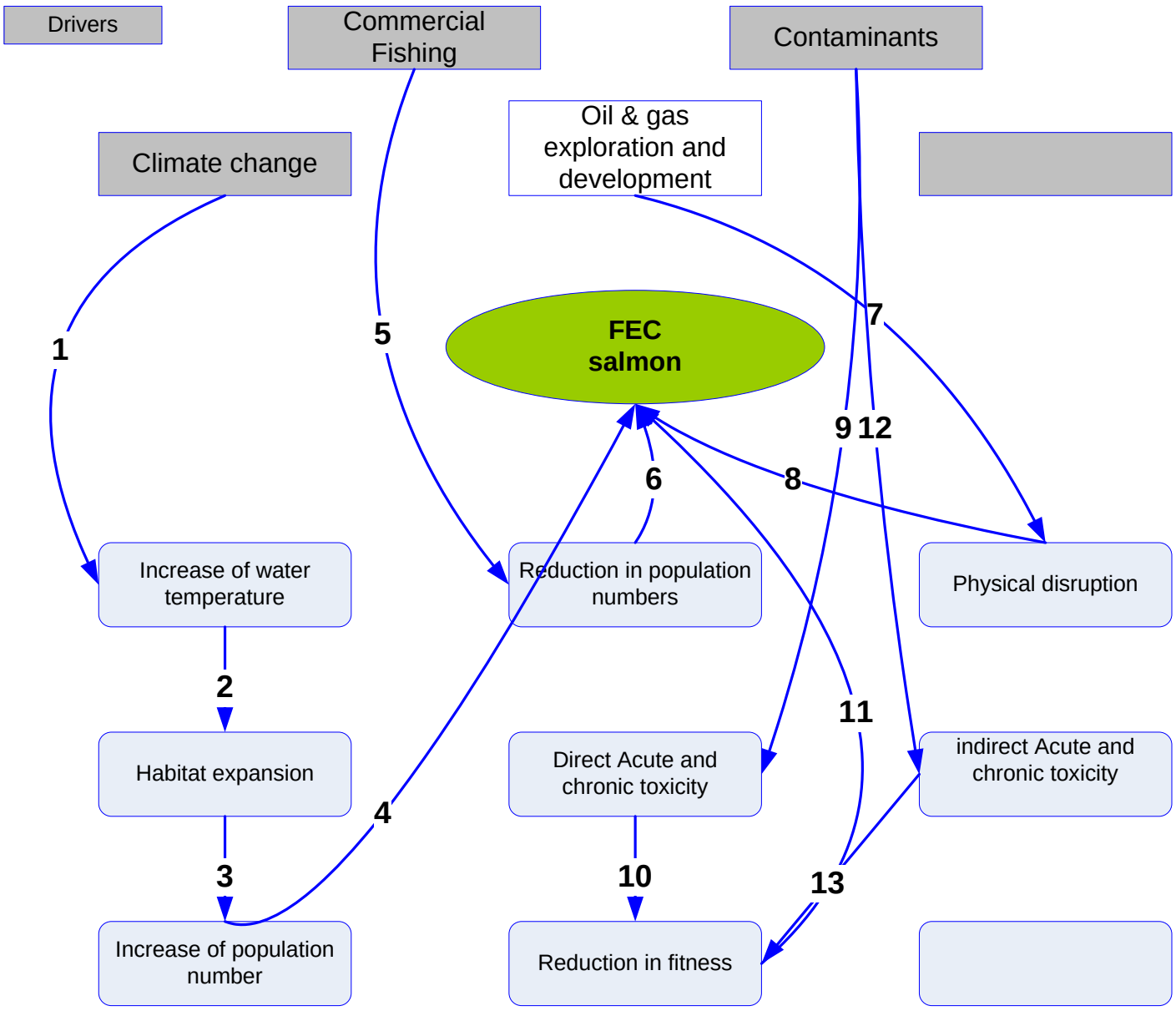
Group: APG



EXPLANATIONS:
1. warming temperatures cause ice melt, increased temperatures allow metabolic processes
2. formerly inaccessible area becomes accessible
3. expected expansion of distribution northwards, change (increase) in population abundance, possible effects on condition
4.
6. Airgunning, etc could disrupt fish, and migration routes

EXPLANATIONS:
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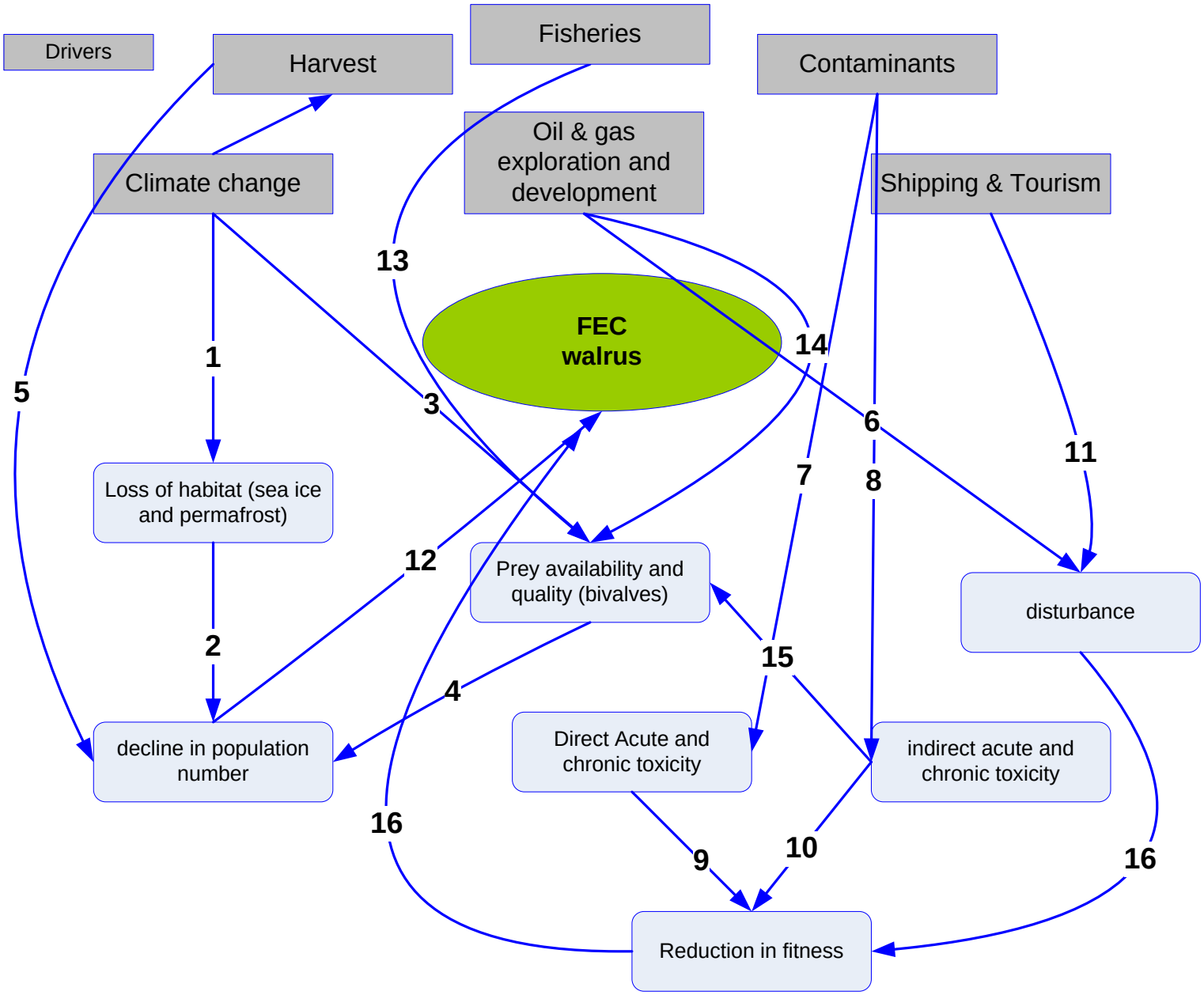
Group: APG



EXPLANATIONS:
FEC:
1. if sea ice habitat declines, coastal habitat is increasingly used, which can lead to increased mortality due to human interactions as well as crushing. This needs to be considered by a coastal group if/when formed
Sea ice (extent, phenology, thickness, type) information needs to be provided at a finer scale than currently available
5. harvest impact may differ by village location, harvest may increase or decrease walrus populations, also dependent if subsistence or commercial or illegal

EXPLANATIONS:
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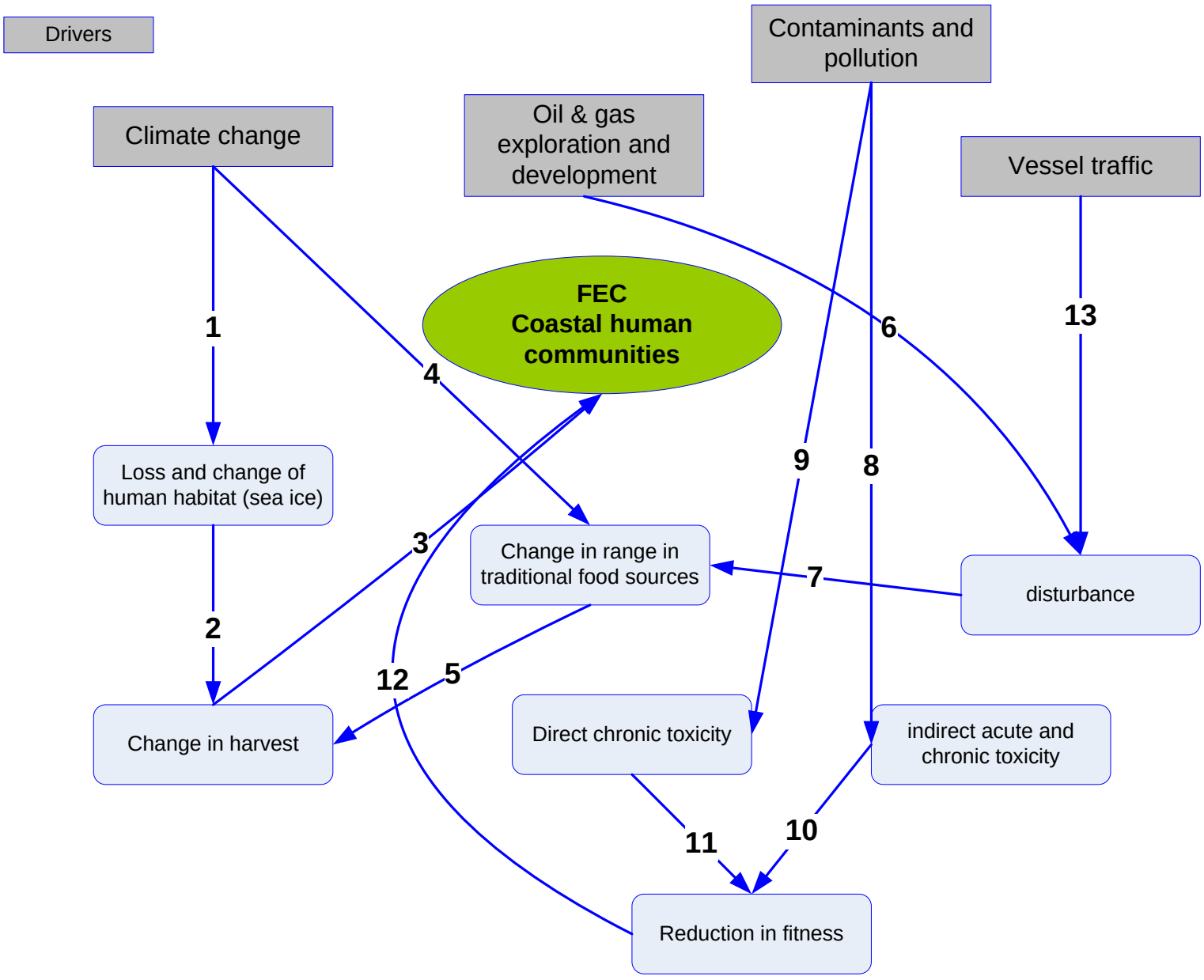
Group: APG



EXPLANATIONS:
FEC:
coastal communities that harvest marine resources, mostly indigenous.

This is regarding coastal human communities as a “predator” in the marine ecosystem, this does NOT cover the preamble of the CBMP to obtain knowledge of local communities to contribute to the ecosystem biodiversity. This diagram was developed without direct input from the local communities

13: This includes shipping and research vessels. Research also has implications that impact human cultural diversity

EXPLANATIONS:
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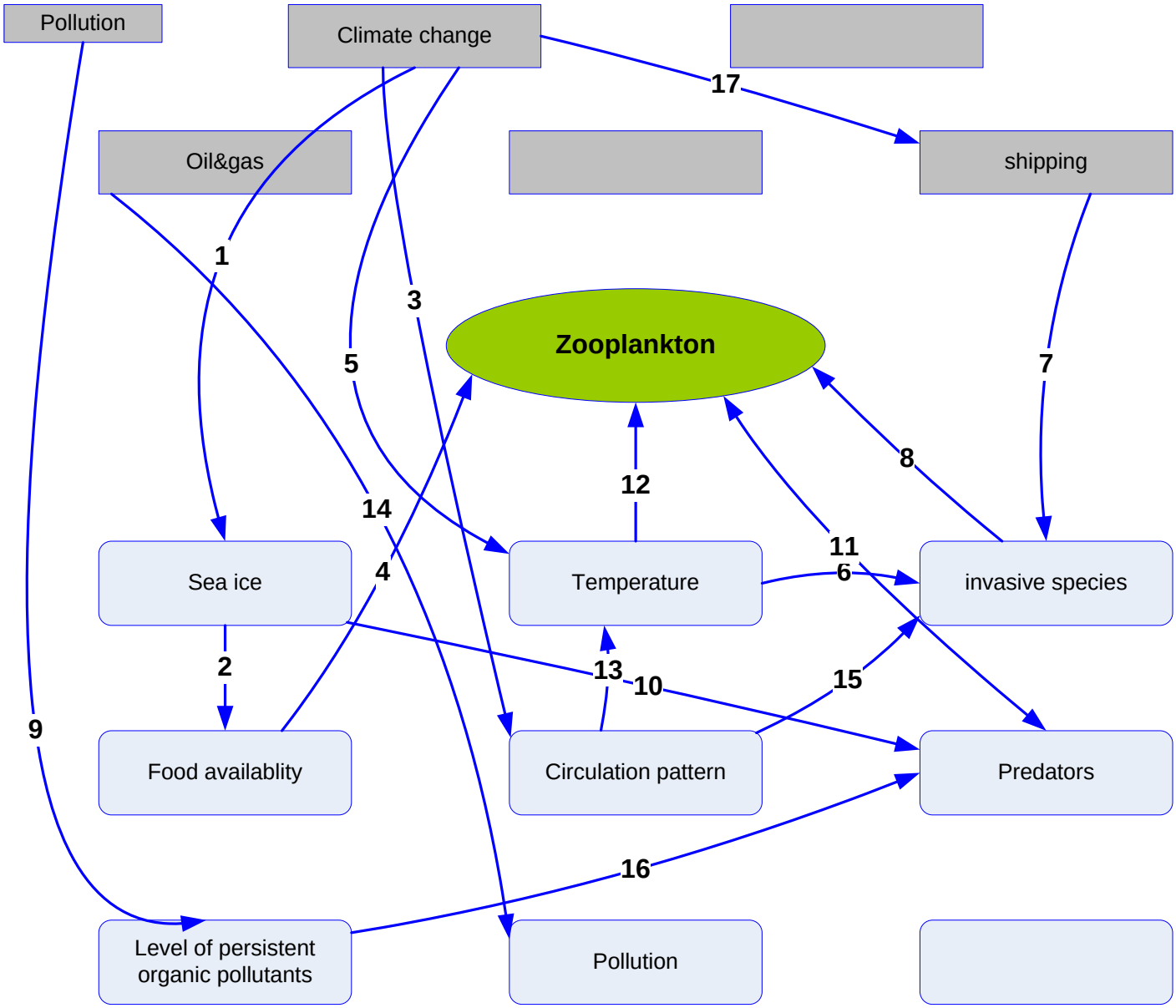
Beaufort Sea, Amundsen Gulf, Viscount Melville, Queen Maud and Arctic Basin (BG)

Group: Beaufort, Arctic Sea



EXPLANATIONS:
1. self evident
2 Less sea ice means less ice algae blooms and less MIZ effects. Potential change in phytoplankton size structure and nutritional content.
3 Currents will change and bring subarctic species into the arctic
4 Less ice blooms
5 selv evident
6 Increased temperature will favor establismhment of sub—Arctic species
7 Invasive species may be introduced through ballast water
8 Effects through competition, disease and predation
9 Zooplnkton accumulate POPs
10 Change in sea ice will change predator community
11. Change in predator community can affect zooplankton and vice versa
12 Increased temperature could change dominance of species
13 Self evident.
14 Oil and gas activity may give local pollution. Not important for overall picture
15 New water masses means new species into the system
16 POPs may affect predators
17 Climate change may bring more shipping into the area

Note: This applies to shallow waters

EXPLANATIONS:
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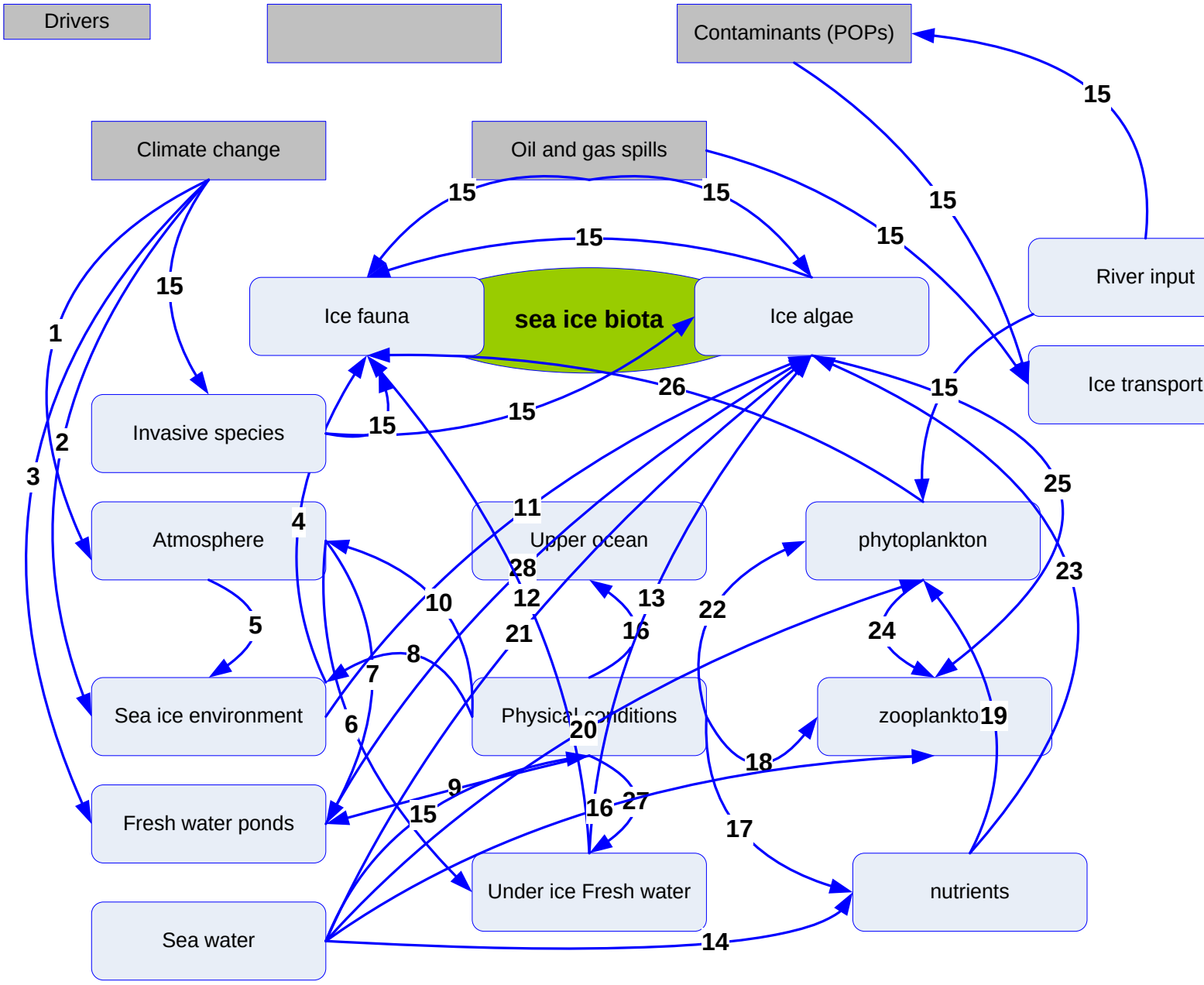
Group: High Arctic Basin



EXPLANATIONS:
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EXPLANATIONS:
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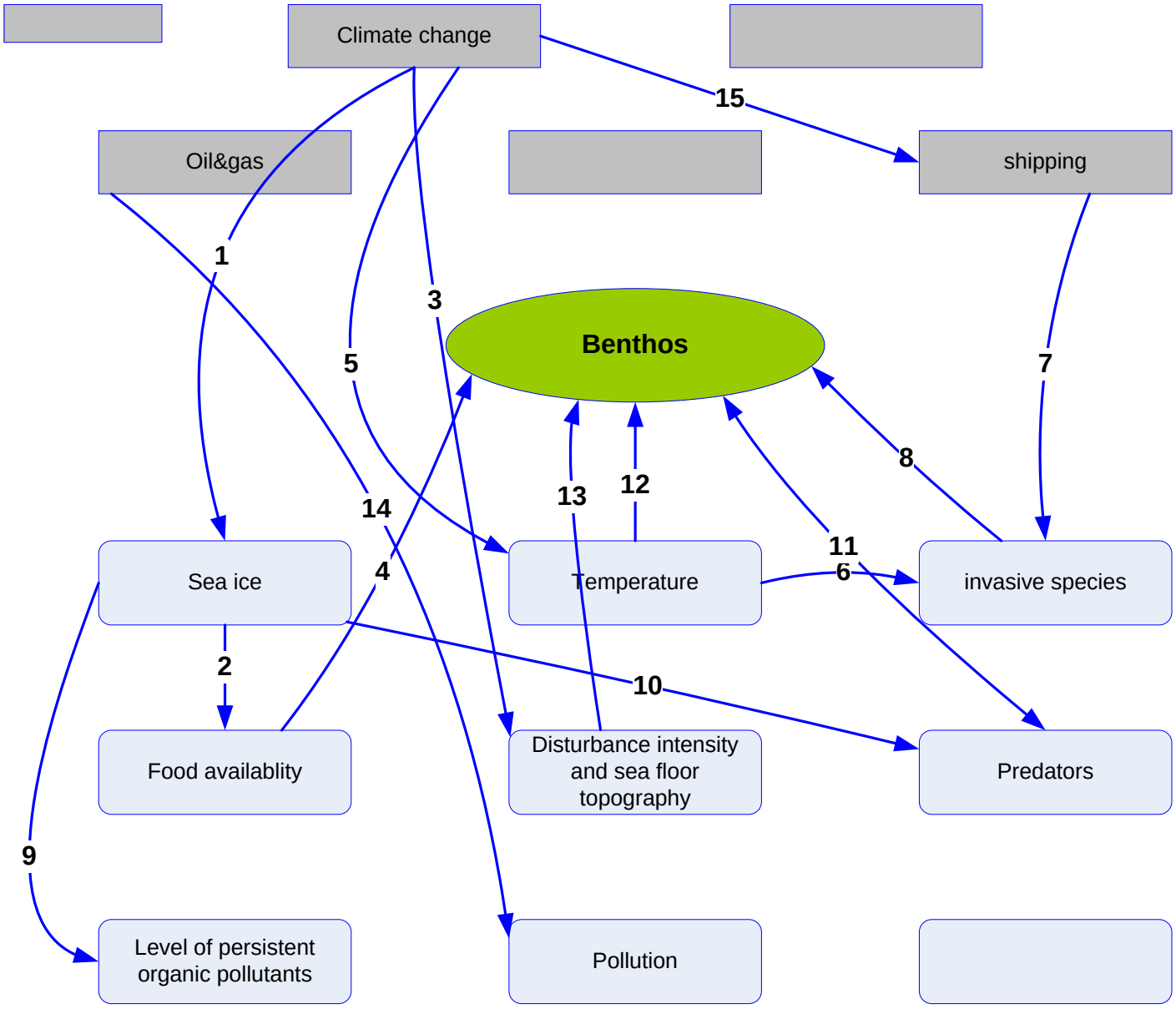
Group: Beaufort, Arctic Sea



EXPLANATIONS:
1. self evident
2 Less sea ice means less ice algae to the bottom.
3 Less sea ice means less ice scouring
4 Decreased food availability will mean lower biomass. You may also get a shift in species composition.
5 selv evident
6 Increased temperature will favor establismhment of sub—Arctic species
7 Invasive species may be introduced through ballast water or on hulls (fouling community)
8 Effects through competition, disease and predation
9Less sea ice will mean more coastal erosion which will give higher sedimentation rates in nearshore areas (probably not very important for overall picture offshore)
10 Change in sea ice will change predator community
11. Change in predator community can affect benthos and vice versa
12 Increased temperature could change dominance of species
13 Less ice scouring means lower habitat heterogeneity (age) and affects succession, menaing that opprotunistic species becomes locally less abundant
14 Oil and gas activity may give local pollution. Not important for overall picture
15 Climate change can give more ship trafic

Note: This applies to shallow waters

EXPLANATIONS:
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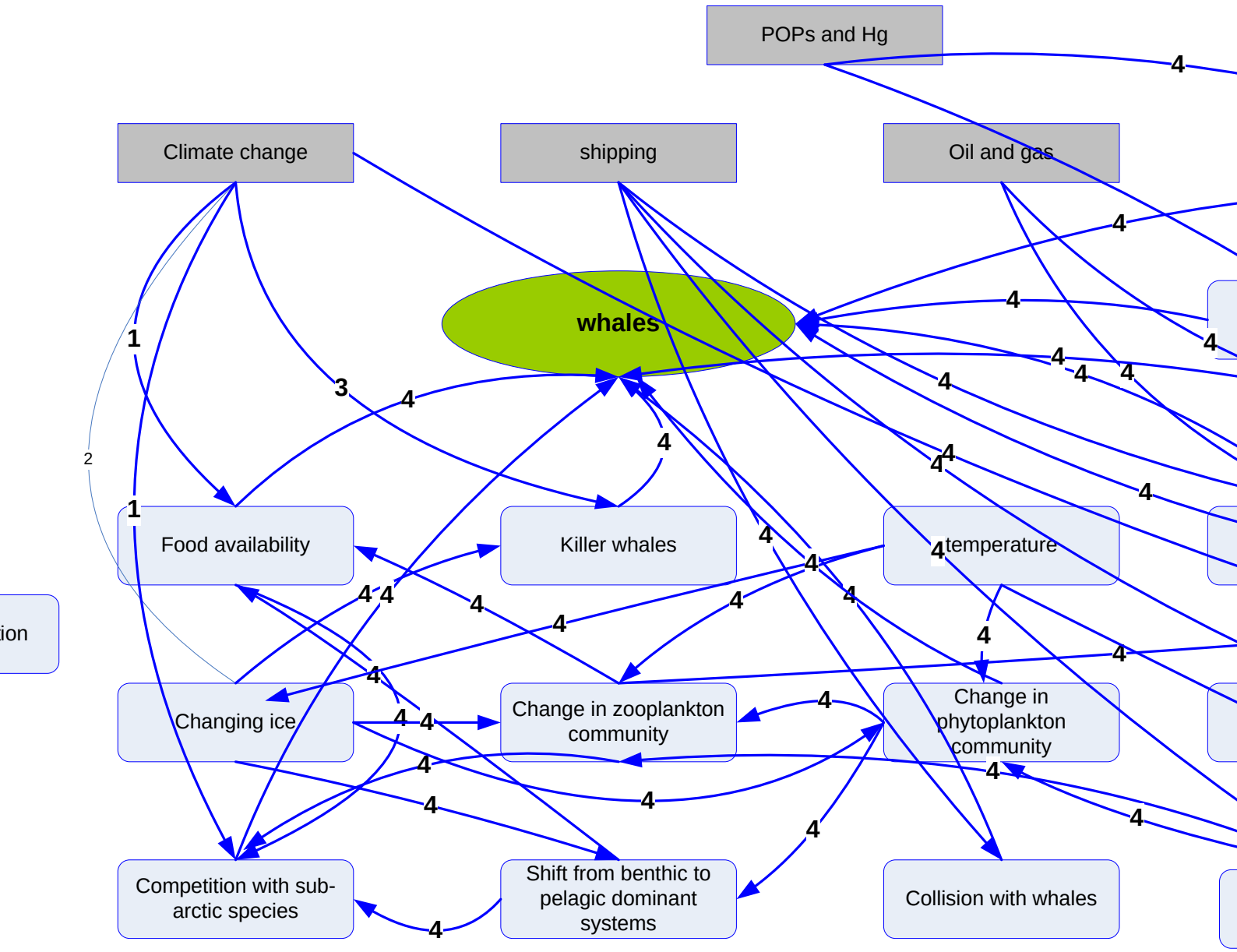
Group: Beaufort/Arctic Basin



EXPLANATIONS:
1.change primary production, change in community structure, potential mismatch between habitat and food source, mismatch within food web – zooplankton decoupled from phytoplankton bloom,
2.climate change effects sea ice
3
4. prey shift/composition could favour sub-arctic species. Eg. grey whale
5

EXPLANATIONS:
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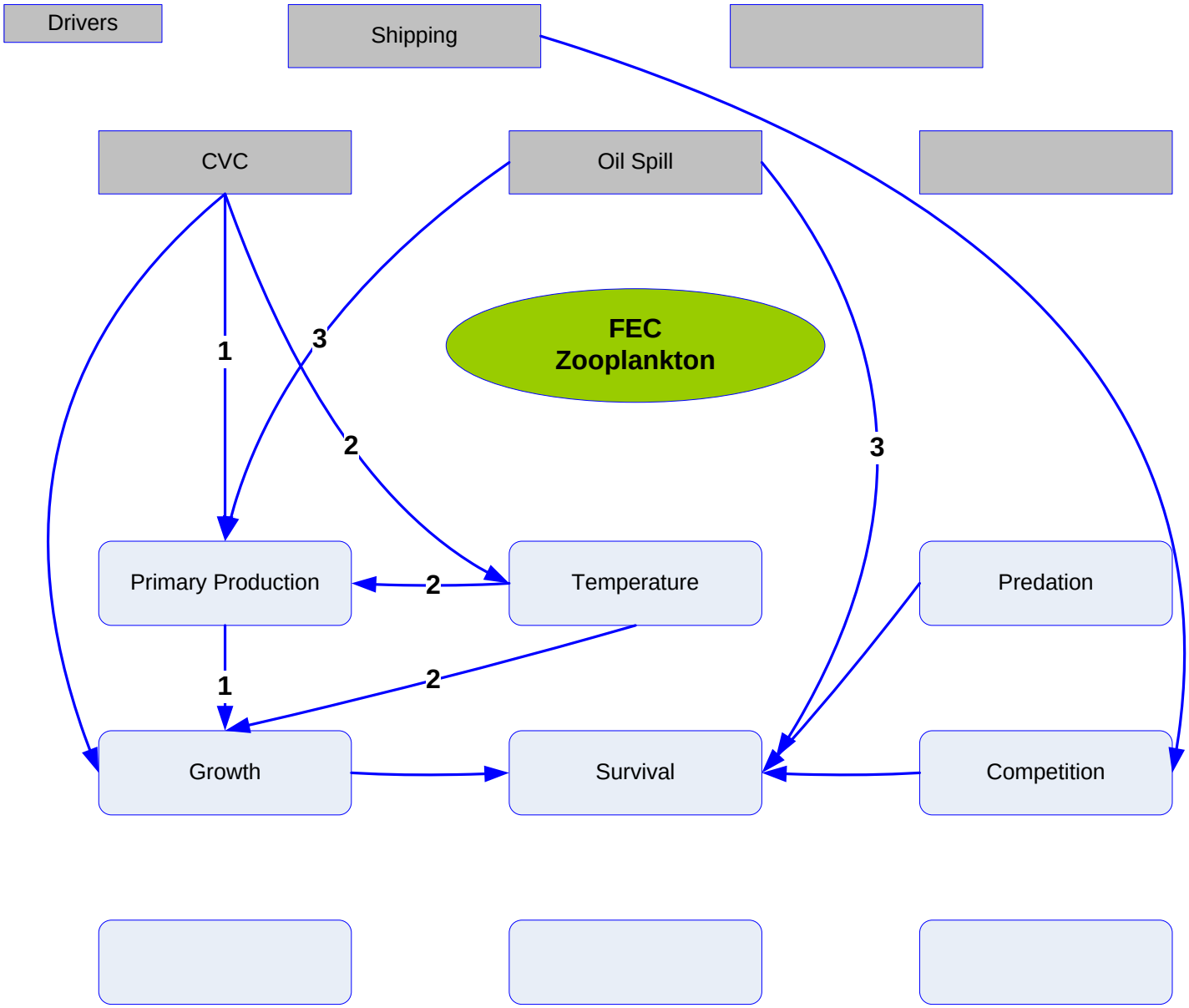
Baffin Bay, Davis Strait, Lancaster Sound
and
Hudson Complex
(BBDS)

Group 4: Baffin Bay etc



EXPLANATIONS:
1. CVC - Primary production
2. CVC – Temp. – primary production
   - growth
3. Oil spill – drilling accident/shipping
   (less important)
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EXPLANATIONS:
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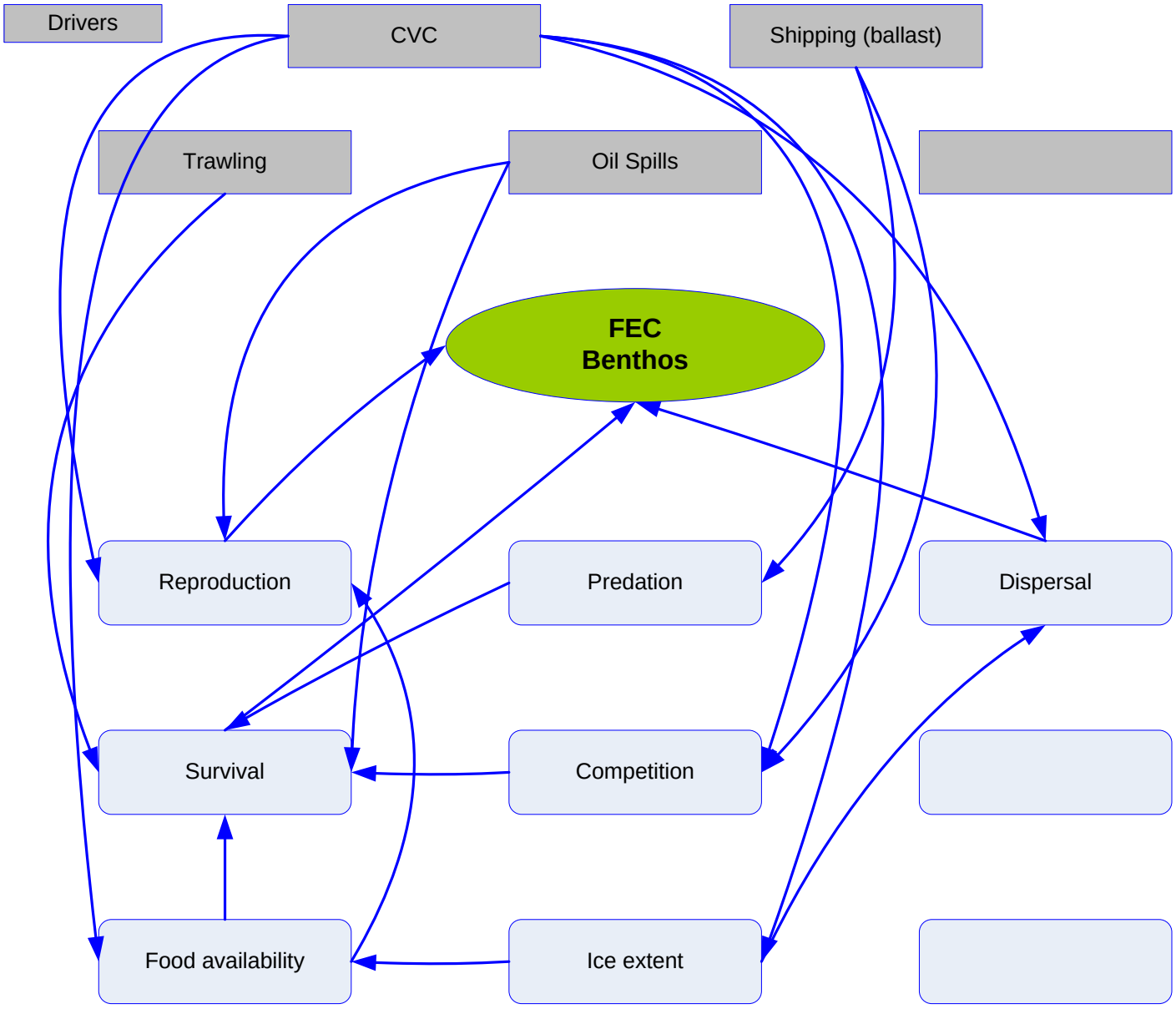
Group 4: BAffin Bay etc



EXPLANATIONS:
1. Trawling – competition/survival – stock size
2
3 Climate – Ice – Food – Survival/Reproduction – stock size
4
5

EXPLANATIONS:
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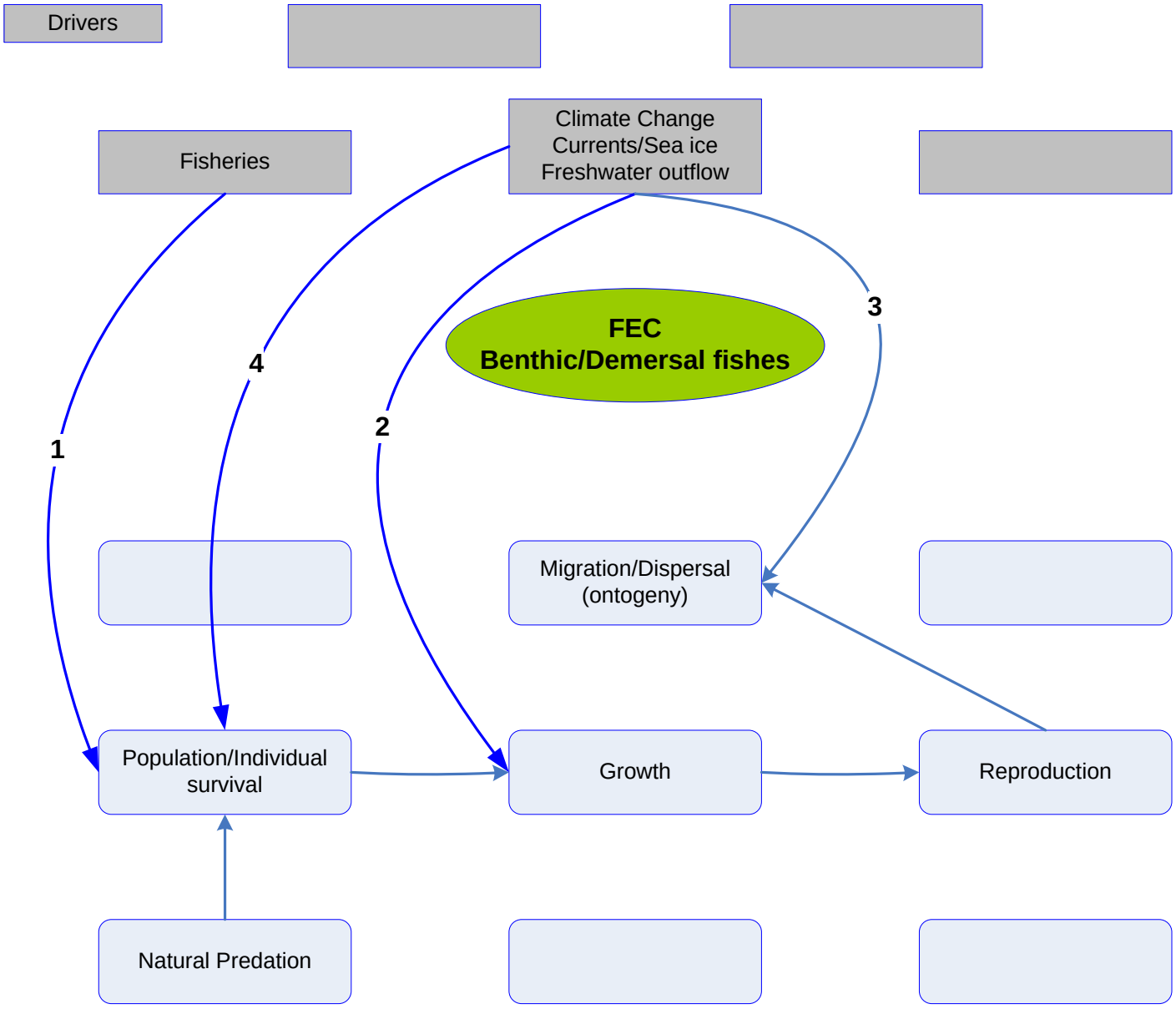
Group 4: Baffin Bay etc



EXPLANATIONS:
1. Fisheries affect adult survival
2. CVC affects fish growth via food quality/quantity
3. CVC affects ontogenetic development via currents, sea ice change and freshwater inputs
4. CVC affects survival, especially young stages
5

EXPLANATIONS:
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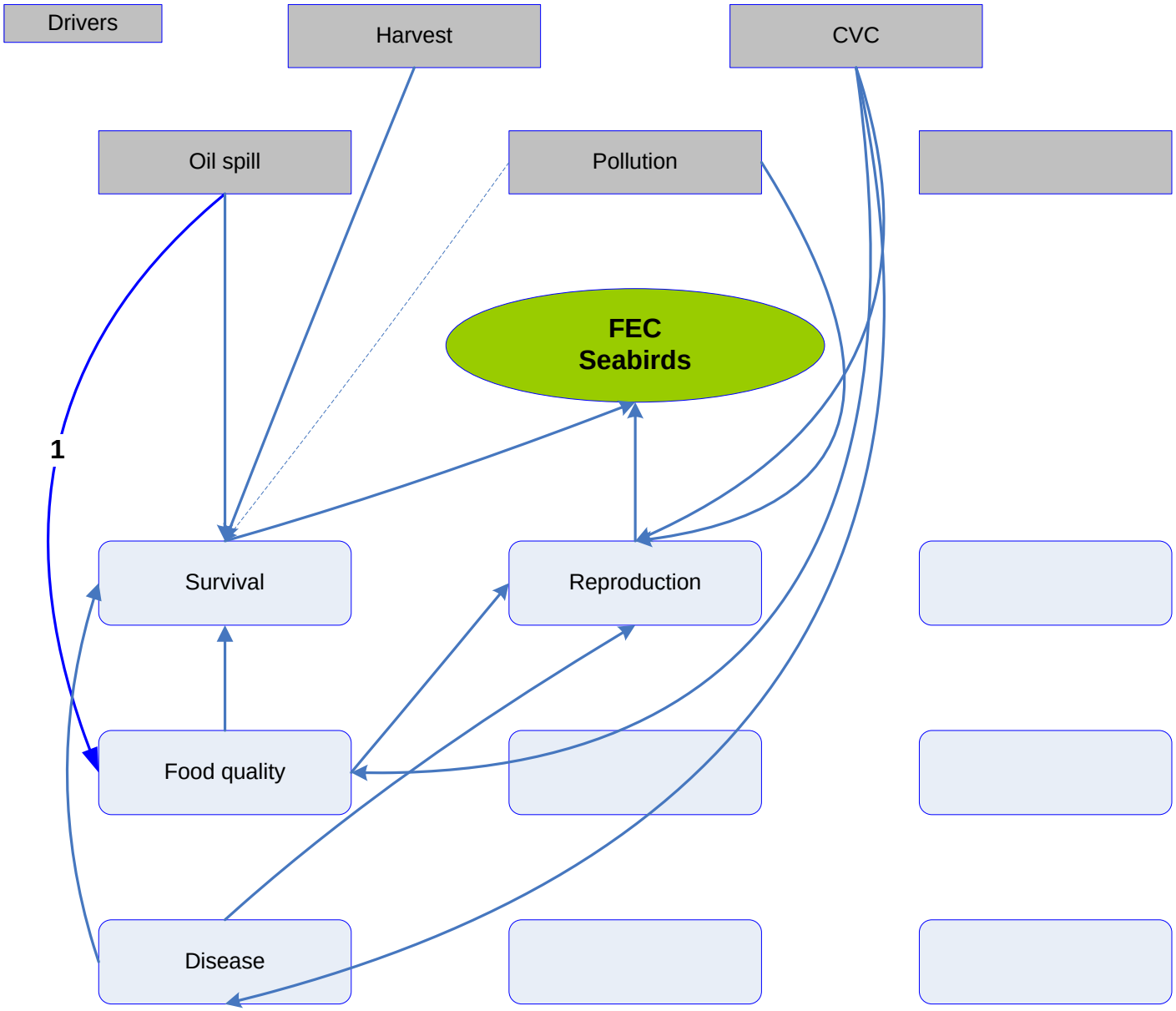
5

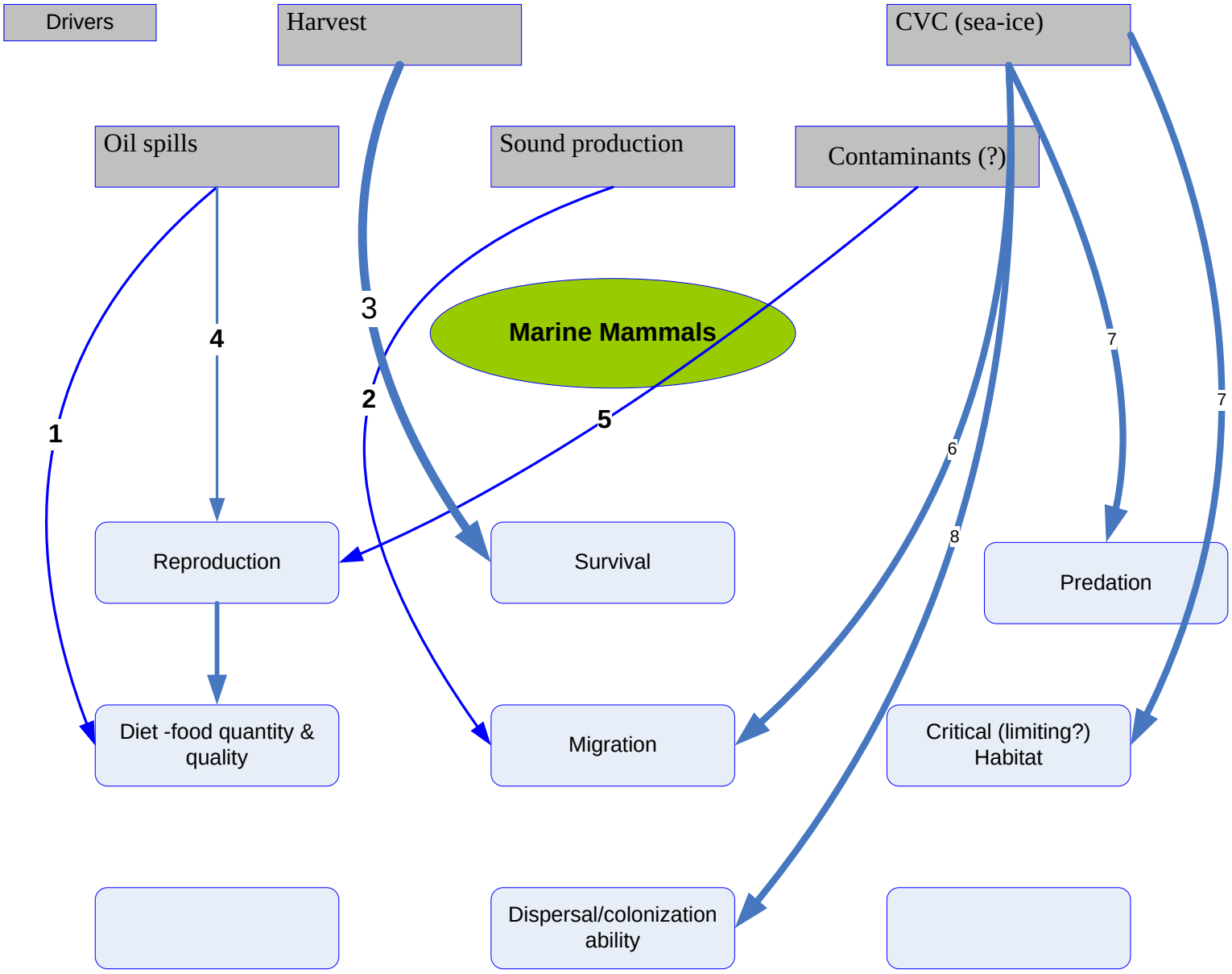
Group 4: Baffin Bay



EXPLANATIONS:
1.
2
3
4
5

EXPLANATIONS:
1.
2
3
4
5

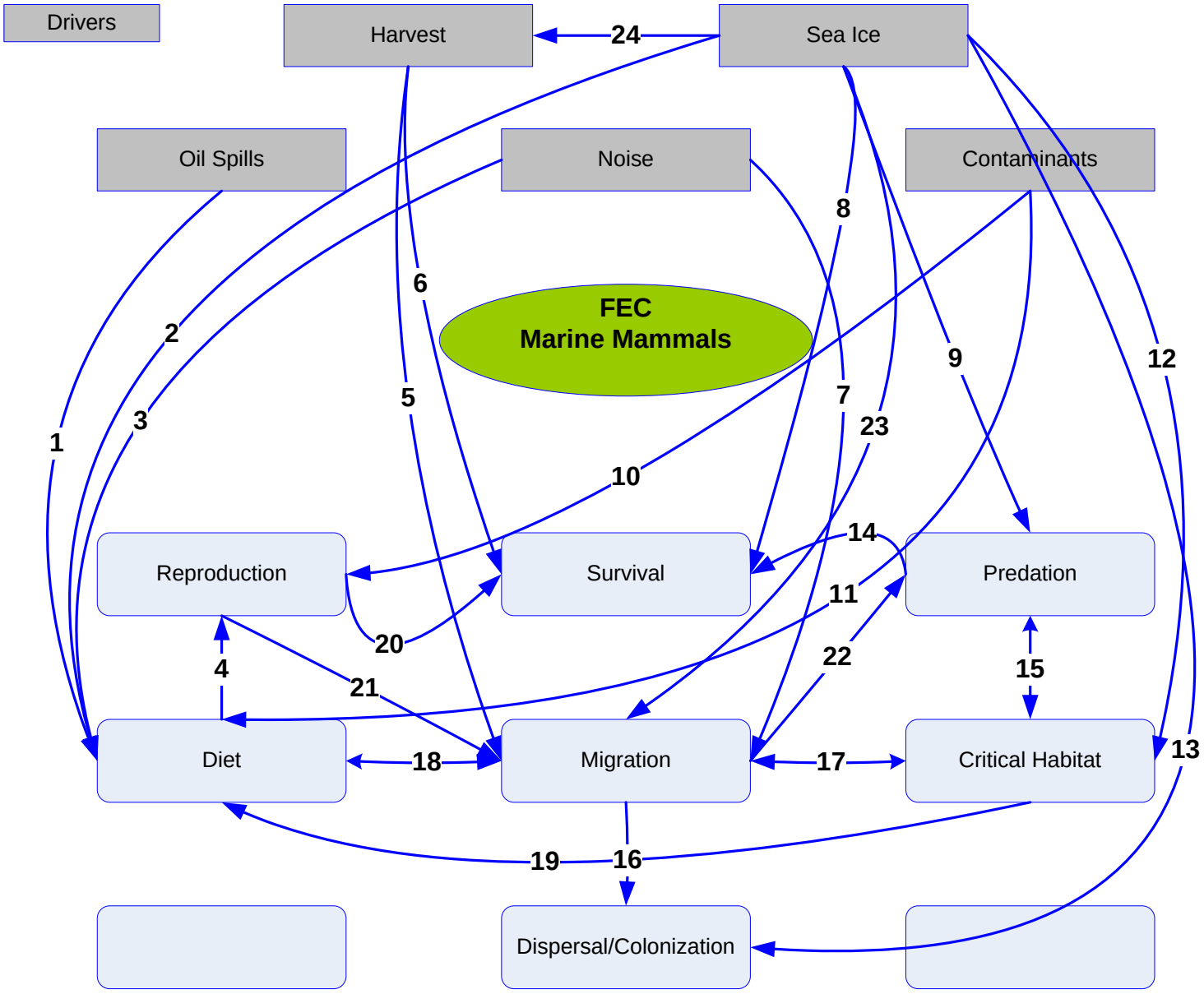
Group: 4 Baffin Bay etc



EXPLANATIONS:
1.
2
3
4
5

EXPLANATIONS:
1. Effects and consequences will differ among different mm species.
2
3
4
5

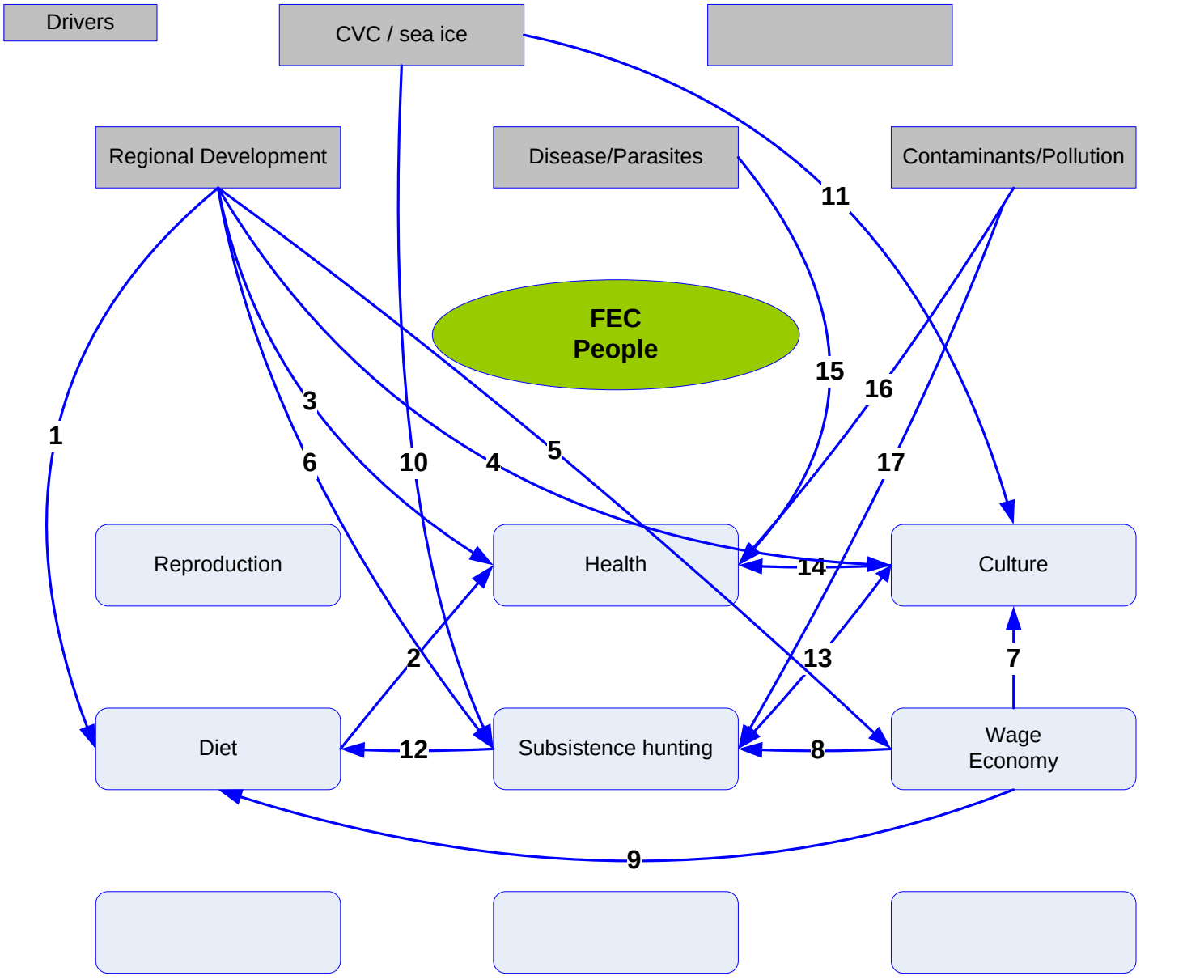
Group 4: Baffin Bay etc



EXPLANATIONS:
1.
2
3
4
5.
6. harvest /survival: subsistence hunt
7
8
9. sea ice – predation/ migration – critical habitat – survival

EXPLANATIONS:
1.
2
3
4
5

Group 4: Baffin Bay etc



EXPLANATIONS:
1.
2
3
4
5

EXPLANATIONS:
1.
2
3
4
5