



**JNCC Report  
No: 585**

**Conceptual Ecological Modelling of Shallow Sublittoral Sand Habitats to Inform  
Indicator Selection**

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In addition to the appendices listed, a spreadsheet containing ancillary electronic information supporting the literature review also accompanies this report, as referred to within the main report sections.

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## Appendix 1 – List of species included in project scope

Please see accompanying spreadsheet for full species list and details of how this list was refined.

*Acrocnida brachiata*  
*Abra alba*  
*Alcyonidium diaphanum*  
*Ammodytes tobianus*  
*Ampelisca brevicornis*  
*Aonides paucibranchiata*  
*Arenicola marina*  
*Aricidea cerrutii*  
*Asterias rubens*  
*Astropecten irregularis*  
*Bathyporeia elegans*  
*Carcinus maenas*  
*Cerianthus lloydii*  
*Chaetozone setosa*  
*Chamelea gallina*  
*Crassikorophium crassicorne*  
*Diastylis rathkei*  
*Echinocardium cordatum*  
*Echinocyamus pusillus*  
*Ensis ensis*  
*Eudorellopsis deformis*  
*Eurydice pulchra*  
*Flustra foliacea*  
*Gastrosaccus spinifer*  
*Glycera lapidum*  
*Goniada maculata*  
*Hydrallmania falcata*  
*Kurtiella bidentata*  
*Lanice conchilega*  
*Liocarcinus depurator*  
*Lumbrineris latreilli*  
*Magelona mirabilis*  
*Moerella pygmaea*  
*Nephtys cirrosa*  
*Nucula nitidosa*  
*Ophelia borealis*  
*Ophiura ophiura*  
*Owenia fusiformis*  
*Pagurus bernhardus*  
*Parexogone hebes*  
*Phaxas pellucidus*  
*Philine quadripartita*  
*Pholoe inornata*  
*Polydora ciliata*  
*Sabella pavonina*  
*Saccharina latissima*  
*Scoloplos armiger*  
*Sertularia cupressina*  
*Sphaerosyllis bulbosa*  
*Spio filicornis*  
*Spiophanes bombyx*  
*Spisula subtruncata*  
*Tellina fabula*  
*Thracia phaseolina*  
*Travisia forbesii*  
*Urothoe elegans*  
*Urticina felina*

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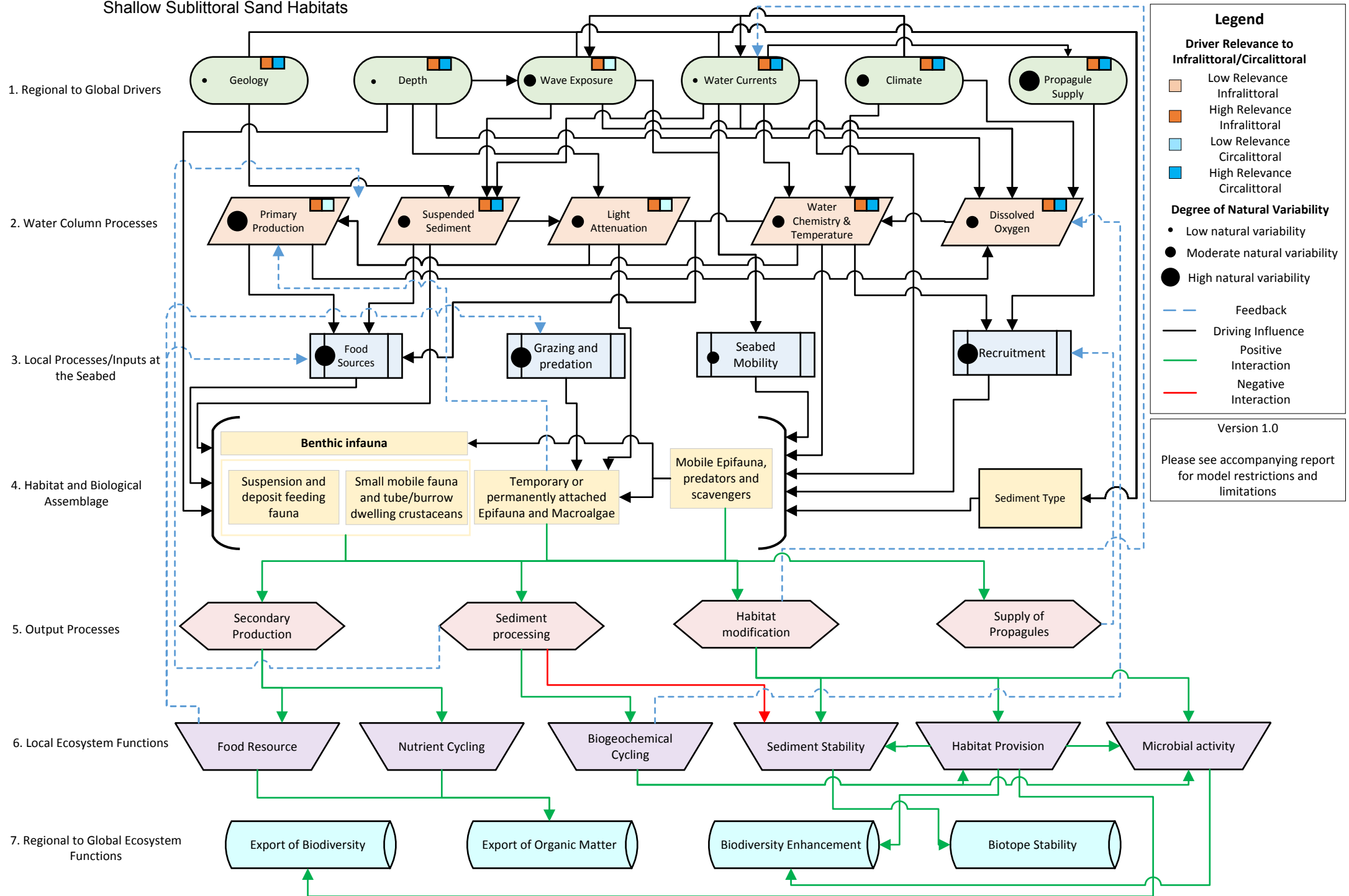
## Appendix 2 – List of keywords used as search terms

Amphipod	Holothuroidea	Subtidal
Annelida	Hydrodynamic flow	Suspension feeder
Annual variation	Hypoxia	Suspension feeding
Anoxia	Infauna	Temperature
Bacteria	Infralittoral	Temporal variability
Benthic	Interstitial	Tidal stress
Biodeposition	Lifespan	Tolerance
Bioengineering	Light attenuation	Trophic level
Biogeochemical process	Macrofauna	Troughs
Bioirrigation	Marine	Tube dwelling
Biological driver	Microbial activity	Turbidity
Biotope	Mobility	Variability
Bioturbation	Muddy sand	Water chemistry
Bioturbation	Natural variability	Water composition
Bivalve	Nitrogen flux	Water flow
Brittlestar	Nutrient cycling	Wave energy
Burrowing	Nutrient provision	
Circalittoral	Ocean acidification	
Climate	Organic Carbon	
Climate variation	Organic matter	
Crustacea	Physical driver	
Currents	Physiographic	
Currents	Phytoplankton	
Deposit feeder	Polychaete	
Depth	POM	
Depth range	Predator	
Diatoms	Prey	
Dissolved oxygen	Primary production	
Echinodermata	Response	
Ecology	Salinity	
Ecosystem functioning	Sand	
Ecosystem process	Sand bank	
Ecosystem service	Sand ripples	
Environmental driver	Sand waves	
Environmental position	Seabed energy	
Epifauna	Seabed mobility	
Feeding behaviour	Seasonal variability	
Feeding Habits	Secondary production	
Feeding method	Sediment	
Filter feeding	Sediment dynamics	
Fine sands	Sediment resuspension	
Food resource	Sediment stability	
Food web	Sediment transport	
Functional group	Sparse fauna	
Geology	Species trait	
Growth form	Species trait	
Habitat provision	Sublittoral	
Habitat stability	Substratum	

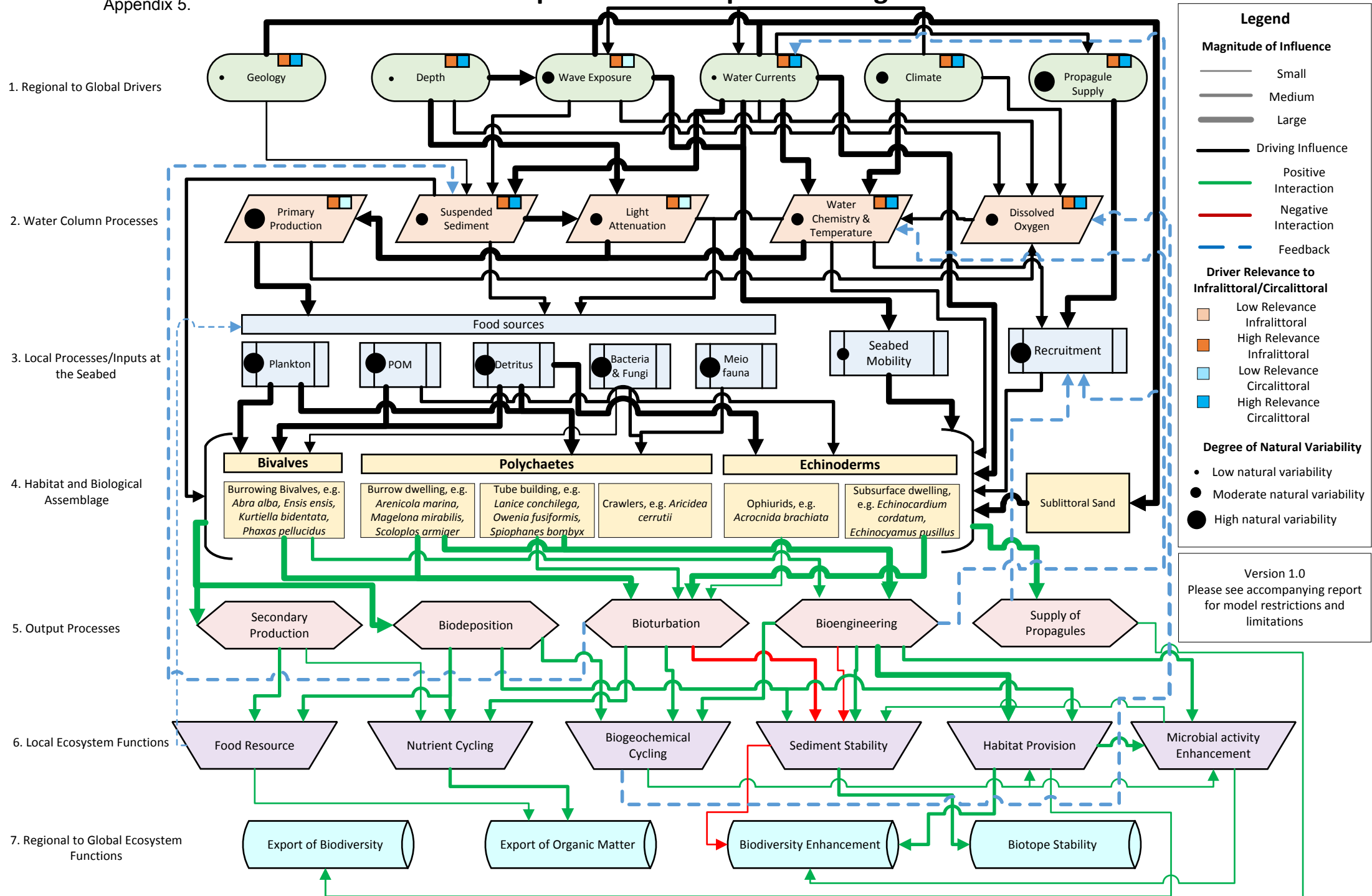
In addition to the search words used above, each of the selected species names were also searched for individually.



# Shallow Sublittoral Sand



# Sub-model 1. Suspension and deposit feeding infauna



# Sub-model 2. Small Mobile Fauna and Tube/Burrow Dwelling Crustaceans

1. Regional to Global Drivers

2. Water Column Processes

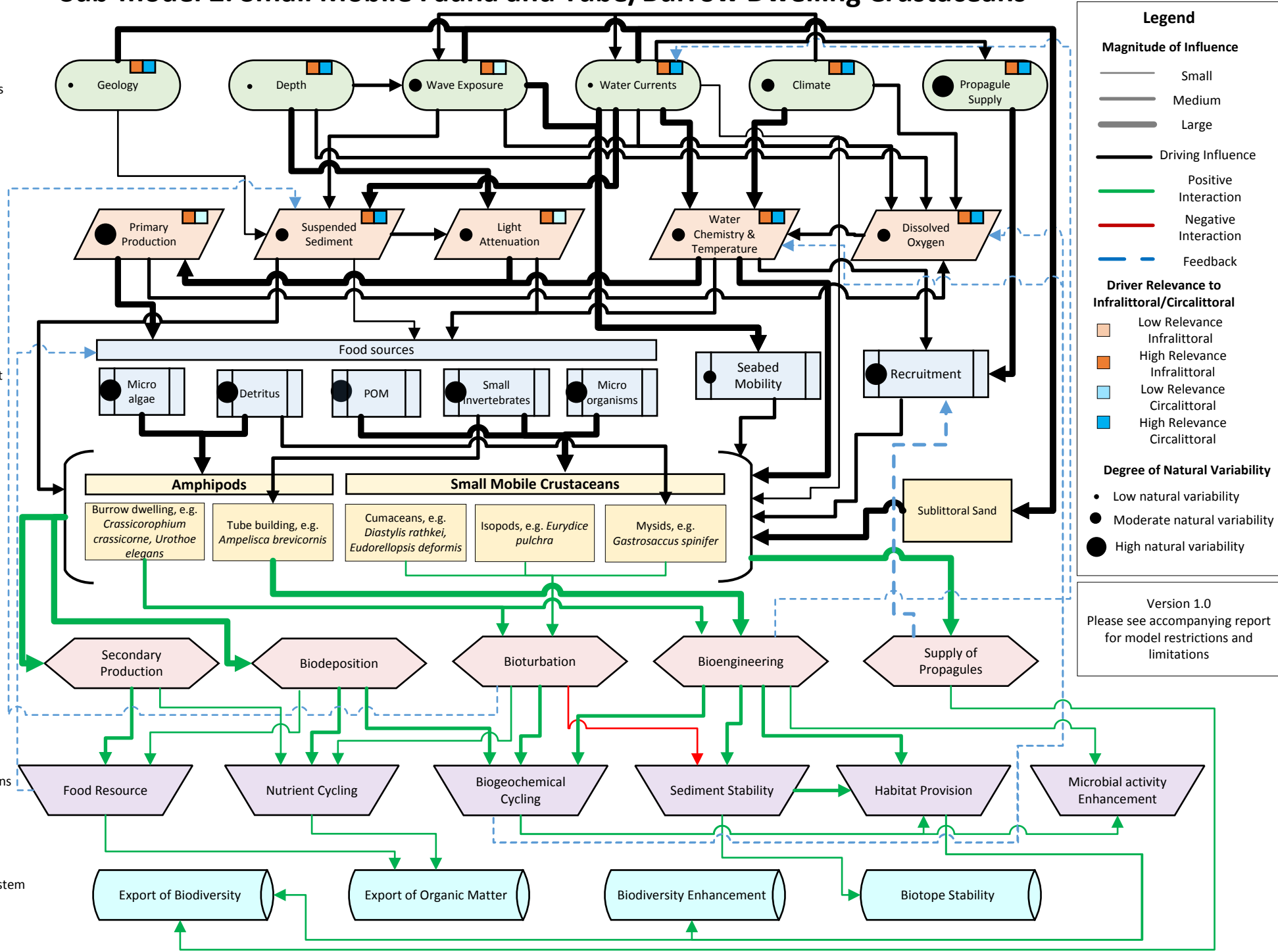
3. Local Processes/Inputs at the Seabed

4. Habitat and Biological Assemblage

5. Output Processes

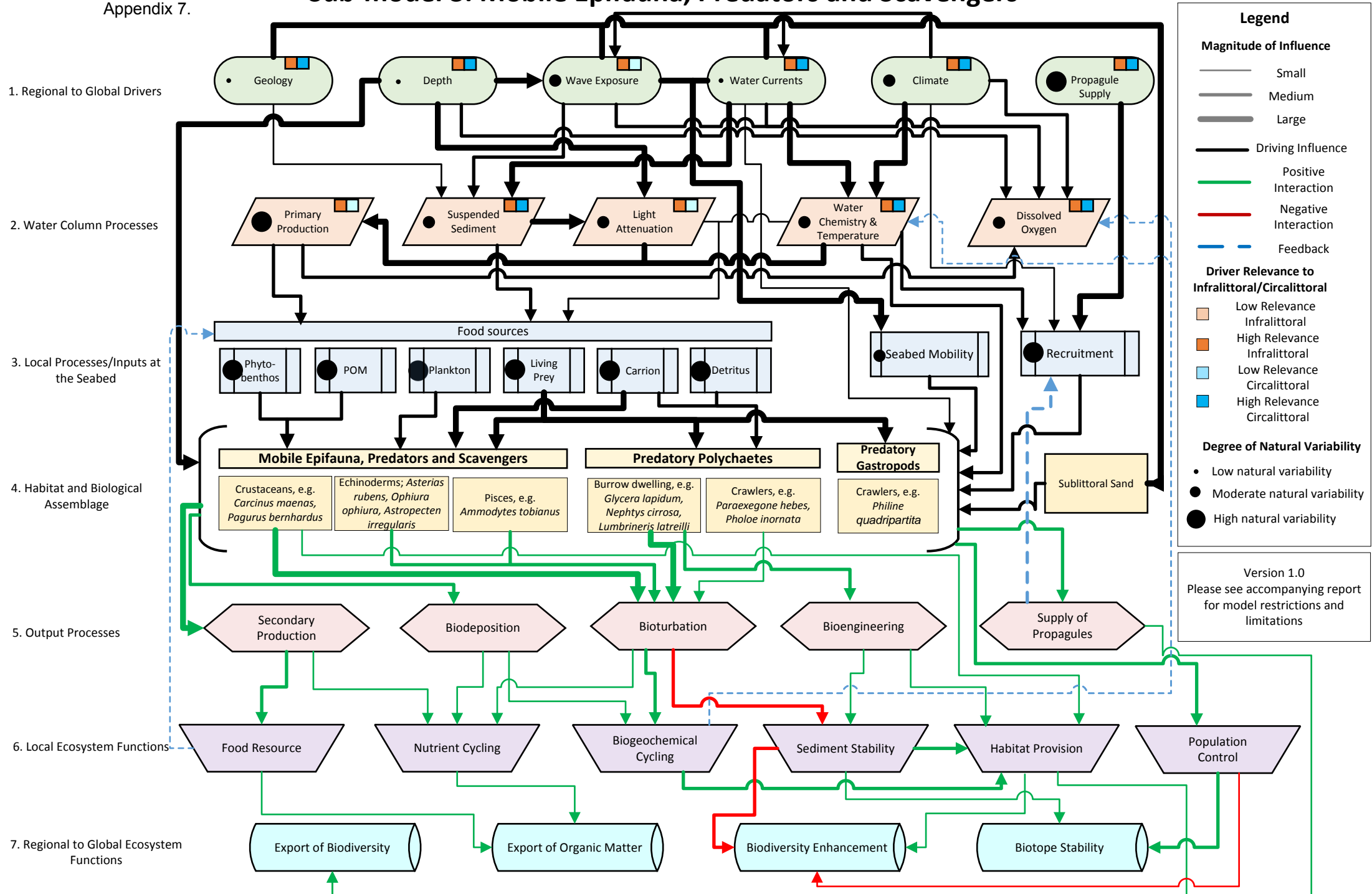
6. Local Ecosystem Functions

7. Regional to Global Ecosystem Functions

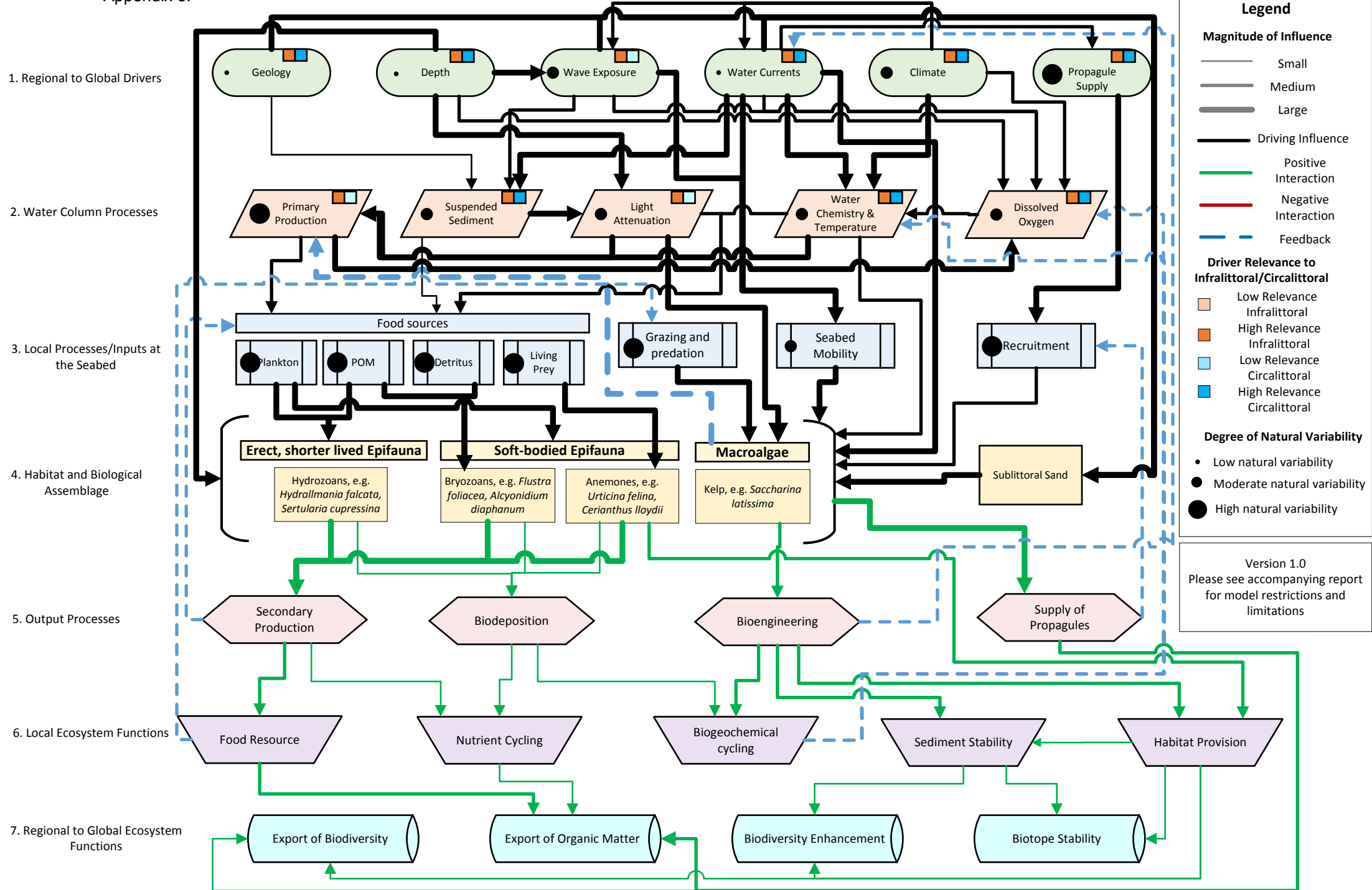




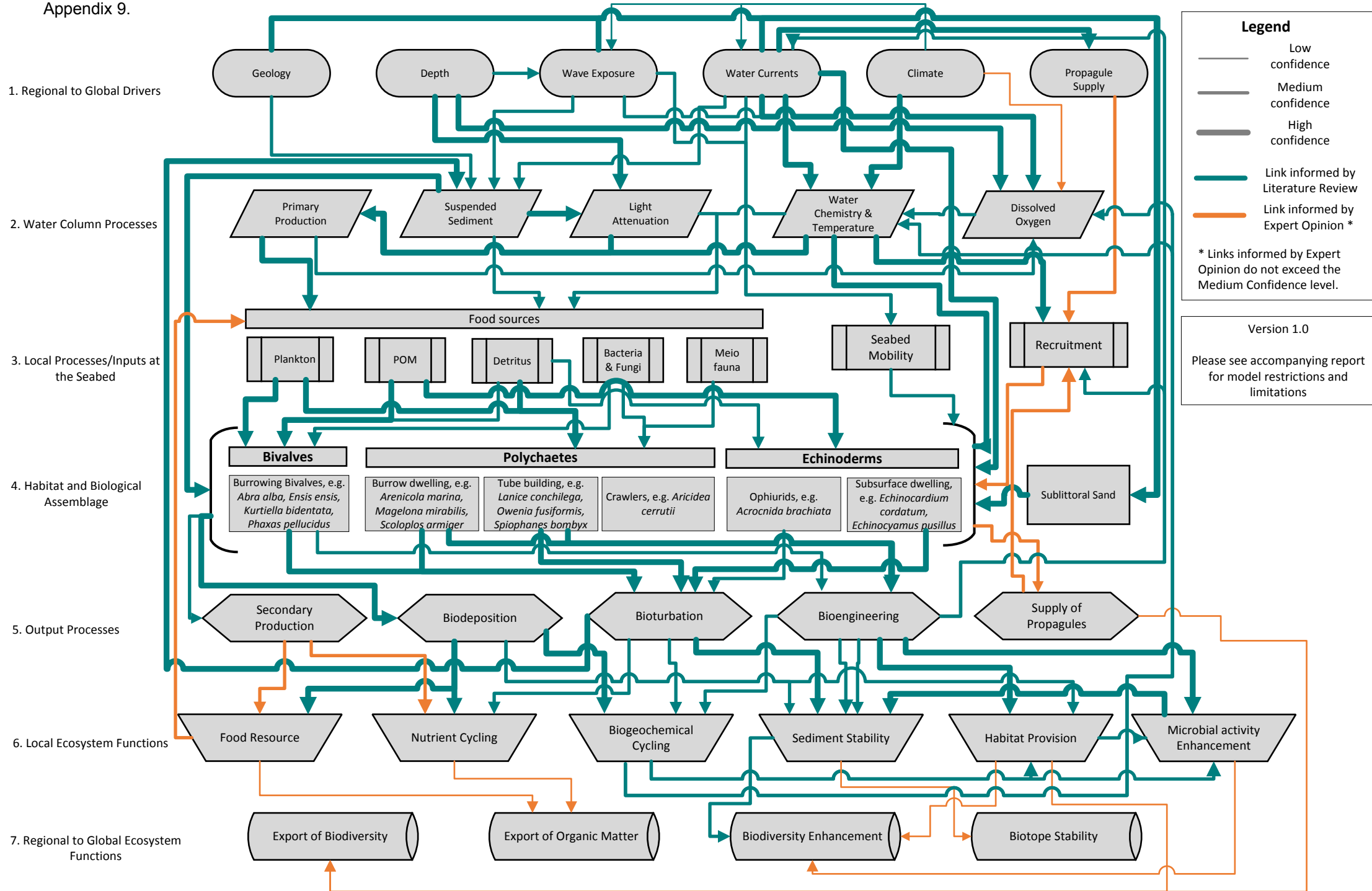
# Sub-model 3. Mobile Epifauna, Predators and Scavengers



# Sub-model 4. Attached Epifauna and Macroalgae



# Sub-model 1. Suspension and deposit feeding infauna - CONFIDENCE



# Sub-model 2. Small Mobile Fauna and Tube/Burrow Dwelling Crustaceans

1. Regional to Global Drivers

2. Water Column Processes

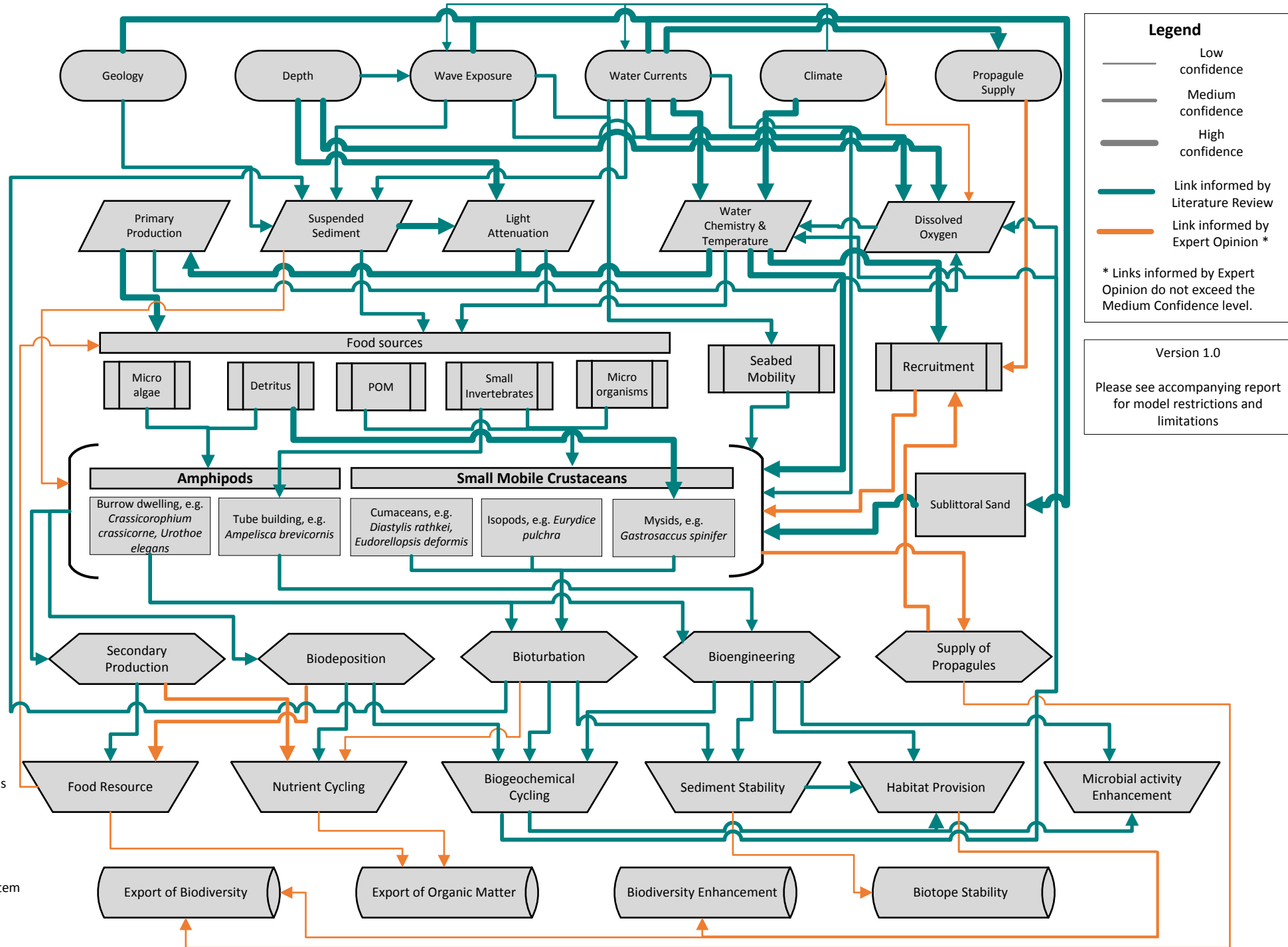
3. Local Processes/Inputs at the Seabed

4. Habitat and Biological Assemblage

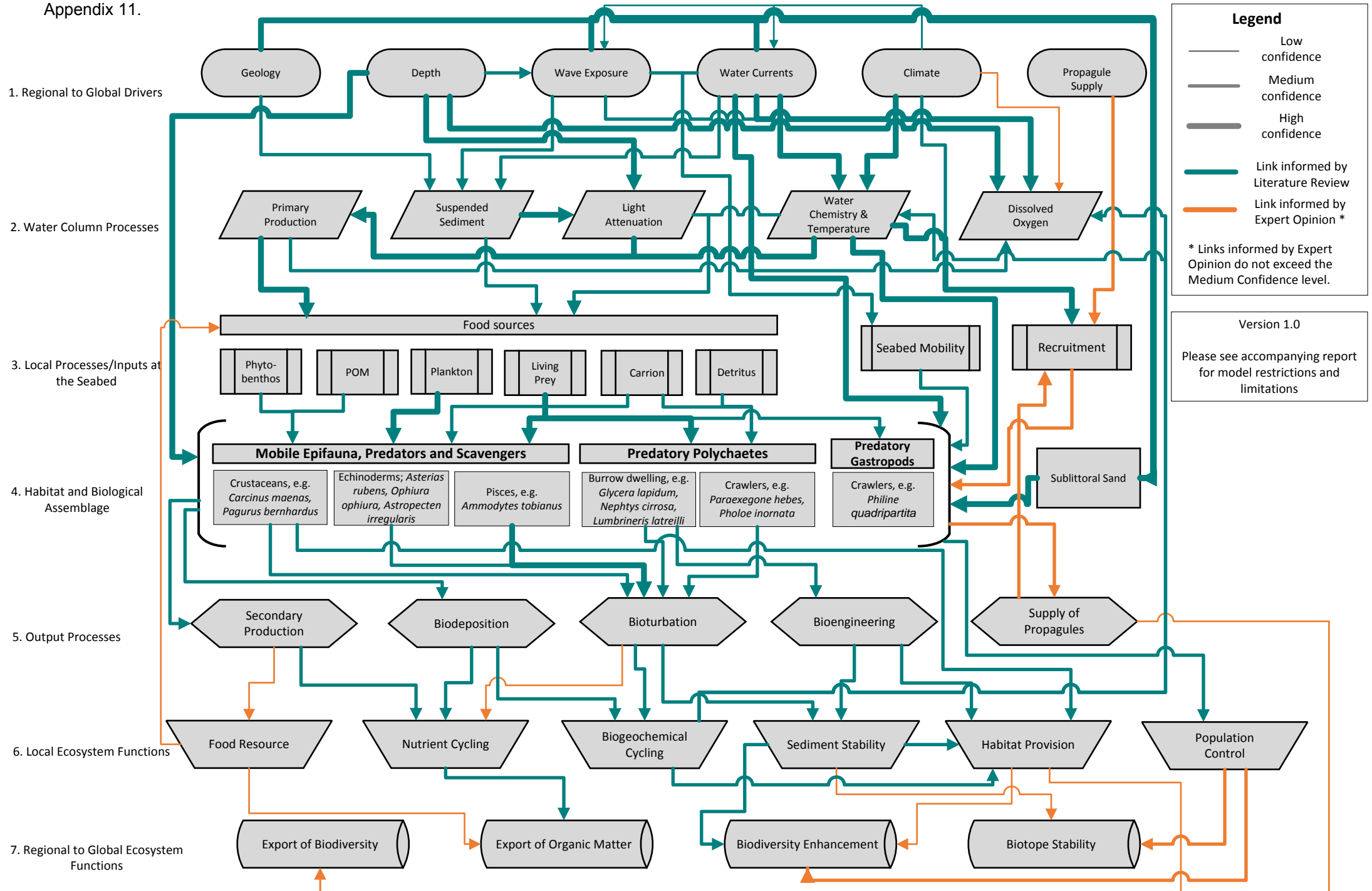
5. Output Processes

6. Local Ecosystem Functions

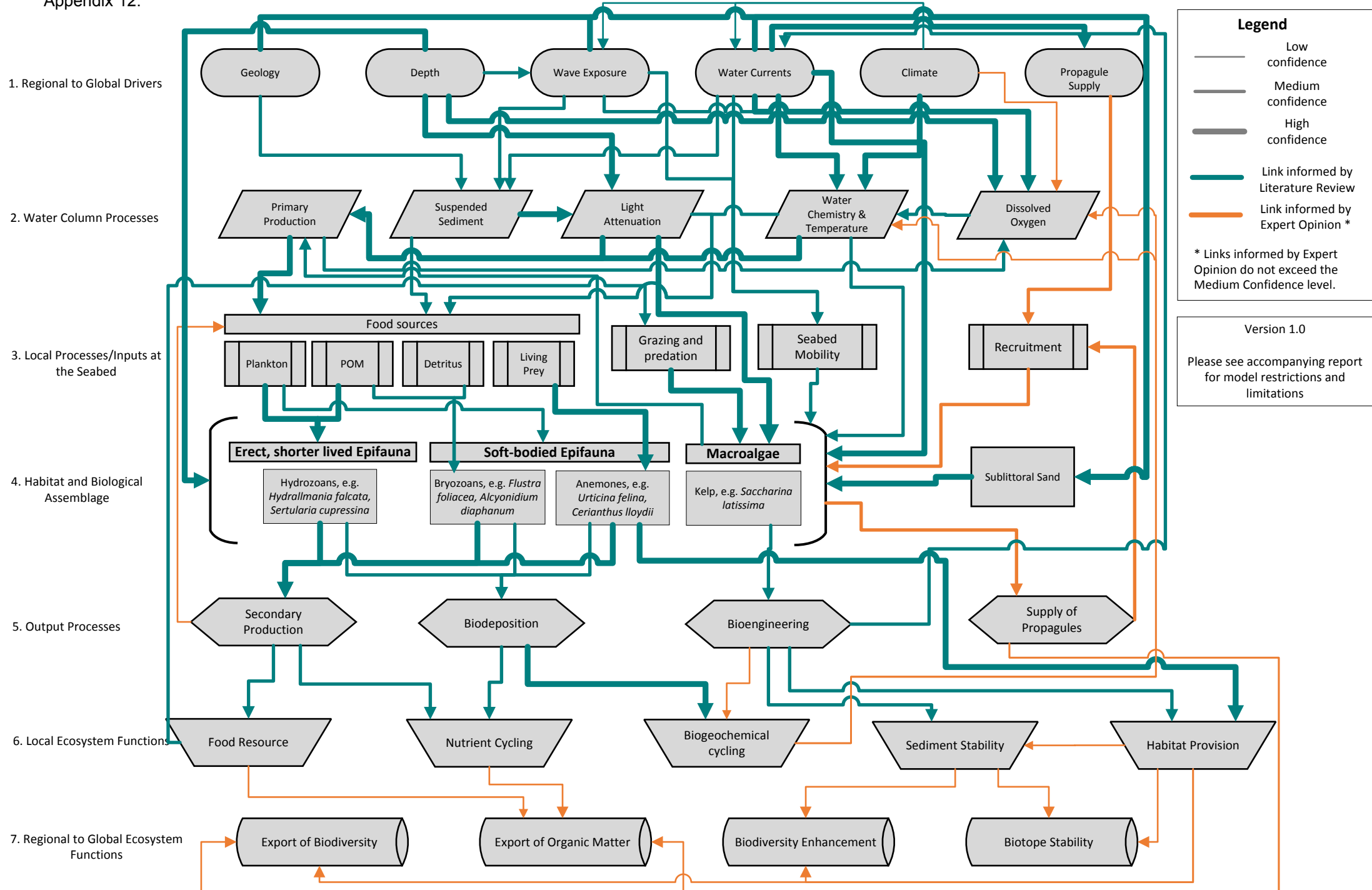
7. Regional to Global Ecosystem Functions



# Sub-model 3. Mobile Epifauna, Predators and Scavengers



# Sub-model 4. Attached Epifauna and Macroalgae - CONFIDENCE



## Appendix 13 – Pressure descriptions

List of anthropogenic pressures relevant to shallow sublittoral sand habitats. Pressures and descriptions are taken from the Intercessional Correspondence Group on Cumulative Effects (ICG-C).

Pressure theme	Pressure	Description	Benchmark (Tillin et al, 2010)
Biological pressures	Removal of non-target species	By-catch associated with all fishing activities. The physical effects of fishing gear on sea bed communities are addressed by the "abrasion" pressure type so this addresses the direct removal of individuals associated with fishing/ harvesting. Ecological consequences include food web dependencies, population dynamics of fish, marine mammals, turtles and sea birds (including survival threats in extreme cases, e.g. Harbour Porpoise in Central and Eastern Baltic).	Removal of features through pursuit of a target fishery at a commercial scale
Physical damage (Reversible Change)	Changes in suspended solids (water clarity)	Changes in water clarity from sediment & organic particulate matter concentrations. It is related to activities disturbing sediment and/or organic particulate matter and mobilising it into the water column. Could be 'natural' land run-off and riverine discharges or from anthropogenic activities such as all forms of dredging, disposal at sea, cable and pipeline burial, secondary effects of construction works, e.g. breakwaters. Particle size, hydrological energy (current speed & direction) and tidal excursion are all influencing factors on the spatial extent and temporal duration. This pressure also relates to changes in turbidity from suspended solids of organic origin (as such it excludes sediments - see the "changes in suspended sediment" pressure type). Salinity, turbulence, pH and temperature may result in flocculation of suspended organic matter. Anthropogenic sources mostly short lived and over relatively small spatial extents.	A change in one rank on the WFD (Water Framework Directive) scale e.g. from clear to turbid for one year
Physical damage (Reversible Change)	Abrasion/disturbance of the substrate on the surface of the seabed	The disturbance of sediments where there is limited or no loss of substrate from the system. This pressure is associated with activities such as anchoring, taking of sediment/geological cores, cone penetration tests, cable burial (ploughing or jetting), propeller wash from vessels, certain fishing activities, e.g. scallop dredging, beam trawling. Agitation dredging, where sediments are deliberately disturbed by and by gravity & hydraulic dredging where sediments are deliberately disturbed and moved by currents could also be associated with this pressure type. Compression of sediments, e.g. from the legs of a jack-up barge could also fit into this pressure type. Abrasion relates to the damage of the sea bed surface layers (typically up to 50cm depth). Activities associated with abrasion can cover relatively large spatial areas and include: fishing with towed demersal trawls (fish & shellfish); bio-prospecting such as harvesting of biogenic features such as maerl beds where, after extraction, conditions for recolonisation remain suitable or relatively localised activities including: seaweed harvesting, recreation, potting, aquaculture. Change from gravel to silt substrate would adversely affect herring spawning grounds.	Damage to seabed surface features
Physical damage (Reversible)	Habitat structure changes -	Unlike the "physical change" pressure type where there is a permanent change in sea bed type (e.g. sand to gravel, sediment to a hard artificial substrate) the	Extraction of sediment to 30cm

<p>Change)</p>	<p>removal of substratum (extraction)</p>	<p>"habitat structure change" pressure type relates to temporary and/or reversible change, e.g. from marine mineral extraction where a proportion of seabed sands or gravels are removed but a residual layer of seabed is similar to the pre-dredge structure and as such biological communities could re-colonise; navigation dredging to maintain channels where the silts or sands removed are replaced by non-anthropogenic mechanisms so the sediment typology is not changed.</p>	
<p>Physical damage (Reversible Change)</p>	<p>Siltation rate changes, including smothering (depth of vertical sediment overburden)</p>	<p>When the natural rates of siltation are altered (increased or decreased). Siltation (or sedimentation) is the settling out of silt/sediments suspended in the water column. Activities associated with this pressure type include mariculture, land claim, navigation dredging, disposal at sea, marine mineral extraction, cable and pipeline laying and various construction activities. It can result in short lived sediment concentration gradients and the accumulation of sediments on the sea floor. This accumulation of sediments is synonymous with "light" smothering, which relates to the depth of vertical overburden.          "Light" smothering relates to the deposition of layers of sediment on the seabed. It is associated with activities such as sea disposal of dredged materials where sediments are deliberately deposited on the sea bed. For "light" smothering most benthic biota may be able to adapt, i.e. vertically migrate through the deposited sediment.          "Heavy" smothering also relates to the deposition of layers of sediment on the seabed but is associated with activities such as sea disposal of dredged materials where sediments are deliberately deposited on the sea bed. This accumulation of sediments relates to the depth of vertical overburden where the sediment type of the existing and deposited sediment has similar physical characteristics because, although most species of marine biota are unable to adapt, e.g. sessile organisms unable to make their way to the surface, a similar biota could, with time, re-establish.</p>	<p>up to 30cm of fine material added to the seabed in a single event</p>
<p>Physical loss (Permanent Change)</p>	<p>Physical change (to another seabed type)</p>	<p>The permanent change of one marine habitat type to another marine habitat type, through the change in substratum, including to artificial (e.g. concrete). This therefore involves the permanent loss of one marine habitat type but has an equal creation of a different marine habitat type. Associated activities include the installation of infrastructure (e.g. surface of platforms or wind farm foundations, marinas, coastal defences, pipelines and cables), the placement of scour protection where soft sediment habitats are replaced by hard/coarse substrate habitats, removal of coarse substrate (marine mineral extraction) in those instances where surficial finer sediments are lost, capital dredging where the residual sedimentary habitat differs structurally from the pre-dredge state, creation of artificial reefs, mariculture i.e. mussel beds. Protection of pipes and cables using rock dumping and mattressing techniques. Placement of cuttings piles from oil &amp; gas activities could fit this pressure type, however, there may be an additional pressures, e.g. "pollution and other chemical changes" theme. This pressure excludes</p>	<p>Permanent loss of existing saline habitat</p>



		navigation dredging where the depth of sediment is changes locally but the sediment typology is not changed.	
Pollution and other chemical changes	Nutrient enrichment	Increased levels of the elements nitrogen, phosphorus, silicon (and iron) in the marine environment compared to background concentrations. Nutrients can enter marine waters by natural processes (e.g. decomposition of detritus, riverine, direct and atmospheric inputs) or anthropogenic sources (e.g. waste water runoff, terrestrial/agricultural runoff, sewage discharges, aquaculture, atmospheric deposition). Nutrients can also enter marine regions from 'upstream' locations, e.g. via tidal currents to induce enrichment in the receiving area. Nutrient enrichment may lead to eutrophication (see also organic enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.	Compliance with WFD criteria for good status
Pollution and other chemical changes	Organic enrichment	Resulting from the degraded remains of dead biota & microbiota (land & sea); faecal matter from marine animals; flocculated colloidal organic matter and the degraded remains of: sewage material, domestic wastes, industrial wastes etc. Organic matter can enter marine waters from sewage discharges, aquaculture or terrestrial/agricultural runoff. Black carbon comes from the products of incomplete combustion (PIC) of fossil fuels and vegetation. Organic enrichment may lead to eutrophication (see also nutrient enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.	A deposit of 100gC/m <sup>2</sup> /yr