Supplementary text

Supplementary tables

Table S1: Variables included in the Newfoundland Principal Component Analyses.

Variable	Group	Period
Deep temperature (3Ps, 3LNO spring, 2J, 3K, 3LNO fall)	Physical	1985–2016
Sea-surface temperature (St. Lawrence Estuary, western, eastern, & southern Gulf of St. Lawrence)	Physical	1985–2016
North Atlantic Oscillation (NAO) index	Physical	1985–2016
Atlantic Multi-decadal Oscillation (AMO) index	Physical	1985–2016
Cold Intermediate Layer (CIL) area (Seal Island, White Bay, Bonavista, Flemish Cap)	Physical	1985–2016
Mean ice volume (January-February-March) (Gulf of St. Lawrence + Scotian Shelf)	Physical	1985–2016
Calanus finmarchicus	Zooplankton	1999–2016
Calanus hyperboreus	Zooplankton	1999–2016
Calanus glacialis	Zooplankton	1999–2016
Pseudocalanus spp	Zooplankton	1999–2016
Metridia longa	Zooplankton	1999–2016
Metridia lucens	Zooplankton	1999–2016
Metridia spp	Zooplankton	1999–2016
Temora longicornis	Zooplankton	1999–2016
Microcalanus spp.	Zooplankton	1999–2016
Oithona spp	Zooplankton	1999–2016
Scolecithricella minor	Zooplankton	1999–2016
Larvacea	Zooplankton	1999–2016
Gastropoda	Zooplankton	1999–2016
Bivalvia	Zooplankton	1999–2016
Euphausiacea	Zooplankton	1999–2016
Cnidaria	Zooplankton	1999–2016
Hydrozoa	Zooplankton	1999–2016
Sea-surface temperature warming (St. Anthony Basin, Northeast Newfoundland Shelf, Hibernia, Flemish Pass, Southeast Shoal)	Phenology	1999–2016
Final day of sea ice (Newfoundland Shelf)	Phenology	1999–2016
Mean ice area (Newfoundland Shelf)	Phenology	1999–2016
Annual peak in *Calanus finmarchicus* abundance (Station 27)	Phenology	1999–2016
Annual peak in proportion of *Calanus finmarchicus* life stages I+II+III relative to total population (Station 27)	Phenology	1999–2016
Annual peak in *Calanus hyperboreus* abundance (Station 27)	Phenology	1999–2016
Annual peak in proportion of *Calanus hyperboreus* life stages I+II+III relative to total population (Station 27)	Phenology	1999–2016
Annual peak in total zooplankton biomass (Station 27)	Phenology	1999–2016
Start of phytoplankton bloom (St. Anthony Basin, Northeast Newfoundland Shelf, Hibernia, Flemish Pass, Southeast Shoal)	Phenology	1999–2016
Duration of phytoplankton bloom (St. Anthony Basin, Northeast Newfoundland Shelf, Hibernia, Flemish Pass, Southeast Shoal)	Phenology	1999–2016

Table S2: Variables included in the Gulf of St. Lawrence Principal Component Analyses.

Variable	Group	Period
Deep (300m) temperature (St. Lawrence Estuary, western, eastern, & southern Gulf of St. Lawrence)	Physical	1985–2016
Sea-surface temperature (St. Lawrence Estuary, western, eastern, & southern Gulf of St. Lawrence)	Physical	1985–2016
North Atlantic Oscillation (NAO) index	Physical	1985–2016
Atlantic Multi-decadal Oscillation (AMO) index	Physical	1985–2016
Annual mean St. Lawrence river flux	Physical	1985–2016
Cold Intermediate Layer (CIL) minimum temperature index (Gulf of St Lawrence)	Physical	1985–2016
Mean ice volume (January-February-March) (Gulf of St. Lawrence + Scotian Shelf)	Physical	1985–2016
Calanus finmarchicus	Zooplankton	1999–2016
Calanus hyperboreus	Zooplankton	1999–2016
Calanus glacialis	Zooplankton	1999–2016
Pseudocalanus spp	Zooplankton	1999–2016
Metridia longa	Zooplankton	1999–2016
Metridia lucens	Zooplankton	1999–2016
Metridia spp	Zooplankton	1999–2016
Temora spp	Zooplankton	1999–2016
Microcalanus spp.	Zooplankton	1999–2016
Oithona spp	Zooplankton	1999–2016
Scolecithricella minor	Zooplankton	1999–2016
Larvacea	Zooplankton	1999–2016
Gastropoda	Zooplankton	1999–2016
Bivalvia	Zooplankton	1999–2016
Euphausiacea	Zooplankton	1999–2016
Cnidaria	Zooplankton	1999–2016
Sea-surface temperature warming (Northwest Gulf of St. Lawrence, Northeast Gulf of St. Lawrence, Magdalen Shallows, Cabot Strait)	Phenology	1999–2016
Final day of sea ice (Gulf of St. Lawrence + Scotian Shelf)	Phenology	1999–2016
Mean ice area (Gulf of St. Lawrence + Scotian Shelf; Jan-Mar)	Phenology	1999–2016
Annual peak in *Calanus finmarchicus* CI+II+III generation 1 (Rimouski Station)	Phenology	1999–2016
Annual peak in Calanus finmarchicus CI+II+III generation 2 (Rimouski Station)	Phenology	1999–2016
Annual peak in ratio of generations 2 and 1 for Calanus finmarchicus CI+II+ III (Rimouski Station)	Phenology	1999–2016
Start of phytoplankton bloom (Northwest Gulf of St. Lawrence, Northeast Gulf of St. Lawrence, Magdalen Shallows, Cabot Strait)	Phenology	1999–2016
Duration of phytoplankton bloom (Northwest Gulf of St. Lawrence, Northeast Gulf of St. Lawrence, Magdalen Shallows, Cabot Strait)	Phenology	1999–2016

Table S3: Variables included in the Scotian Shelf Principal Component Analyses.

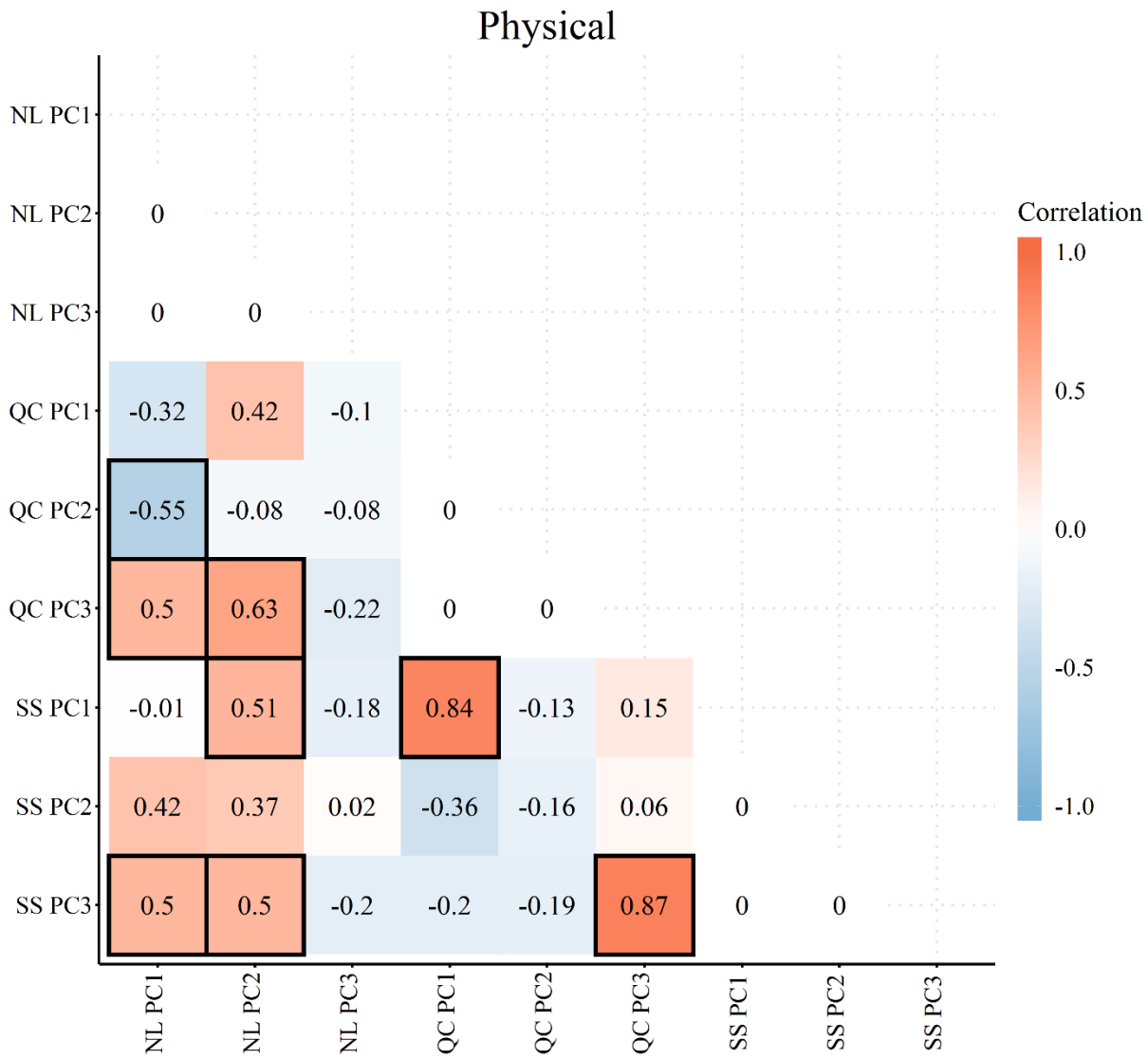
Variable	Group	Period
July bottom temperature (4X, 4W, 4V)	Physical	1985–2016
Sea-surface temperature, Jan-Dec, except 4V Apr-Dec (4XSS, 4W, 4V, Gulf of Maine + Bay of Fundy)	Physical	1985–2016
North Atlantic Oscillation (NAO) index	Physical	1985–2016
Atlantic Multi-decadal Oscillation (AMO) index	Physical	1985–2016
Annual mean St. Lawrence river flux	Physical	1985–2016
Cold Intermediate Layer (CIL) volume (August-September) (Scotian Shelf)	Physical	1985–2016
Mean ice volume (January-February-March) (Gulf of St. Lawrence + Scotian Shelf)	Physical	1985–2016
Stratification (Scotian Shelf)	Physical	1985–2016
Calanus finmarchicus	Zooplankton	1999–2016
Calanus hyperboreus	Zooplankton	1999–2016
Calanus glacialis	Zooplankton	1999–2016
Pseudocalanus spp	Zooplankton	1999–2016
Metridia longa	Zooplankton	1999–2016
Metridia lucens	Zooplankton	1999–2016
Metridia spp	Zooplankton	1999–2016
Temora spp	Zooplankton	1999–2016
Microcalanus spp.	Zooplankton	1999–2016
Oithona spp	Zooplankton	1999–2016
Oithona similis	Zooplankton	1999–2016
Oithona atlantica	Zooplankton	1999–2016
Paracalanus spp	Zooplankton	1999–2016
Centropages typicus	Zooplankton	1999–2016
Centropages spp	Zooplankton	1999–2016
Scolecithricella minor	Zooplankton	1999–2016
Larvacea	Zooplankton	1999–2016
Gastropoda	Zooplankton	1999–2016
Bivalvia	Zooplankton	1999–2016
Euphausiacea	Zooplankton	1999–2016
Sea-surface temperature warming (Mar-May)	Phenology	1999–2016
Final day of sea ice (Gulf of St. Lawrence + Scotian Shelf)	Phenology	1999–2016
Mean ice area (Gulf of St. Lawrence + Scotian Shelf; Jan-Mar)	Phenology	1999–2016
Annual peak in *Calanus finmarchicus* abundance (Station HL2)	Phenology	1999–2016
Annual peak in proportion of *Calanus finmarchicus* life stages I+II+III relative to total population (Station HL2)	Phenology	1999–2016
Annual peak in total zooplankton biomass (Station HL2)	Phenology	1999–2016
Start of phytoplankton bloom (Eastern, Central, and Western Scotian Shelf)	Phenology	1999–2016
Duration of phytoplankton bloom (Eastern, Central, and Western Scotian Shelf)	Phenology	1999–2016

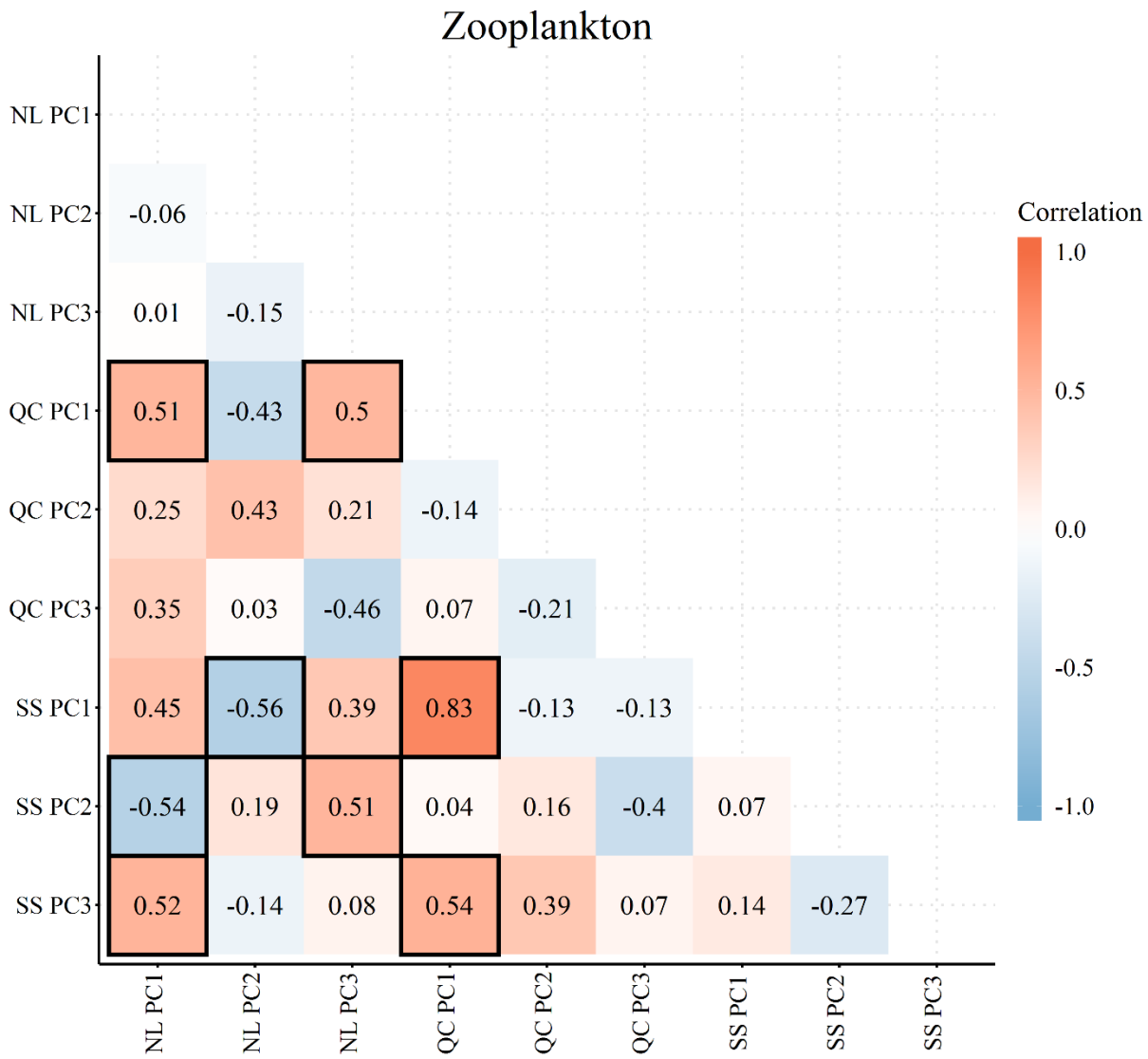
Table 2: Variables included in the Quebec Principal Component Analyses.

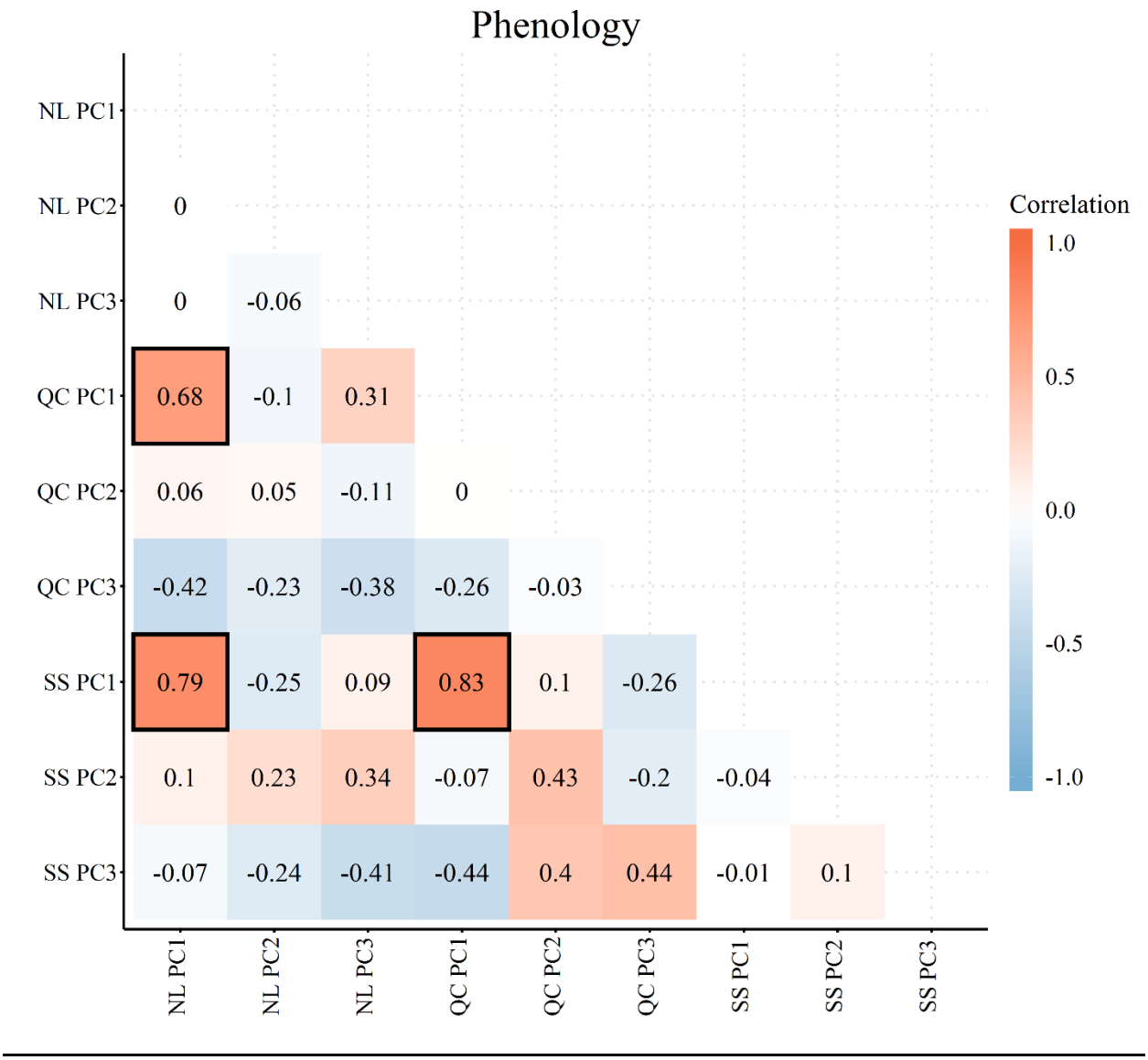
Table S4: Metrics used as response variables in the Generalised Additive Models.

Region	Fish	Attribute	Metric
NL	Capelin	Recruitment	Abundance of 2 year olds (2 year lag)
NL	Capelin	Condition	Weight at 15 cm
NL	Capelin	Abundance	Mean abundance of adults
GSL	Capelin	Condition	Fulton's coefficient
GSL	Herring 4R/4T	Abundance	Spawning stock biomass
GSL	Herring 4R/4T	Recruitment	Abundance of 1 year olds (1 year lag)
GSL	Herring 4R/4S	Condition	Fulton's coefficient
GSL	Mackerel	Abundance	Spawning stock biomass
GSL	Mackerel	Condition	Fulton's coefficient
GSL	Mackerel	Recruitment	Abundance of 1 year olds (Lagged?)
SS	Herring	Recruitment	Change in acoustically-determined biomass
SS	Herring	Abundance	Stratified mean abundance
SS	Herring	Condition	Stratified mean relative weight at 28 cm
SS	Silver Hake	Condition	Stratified random mean weight at 25 cm
SS	Silver Hake	Abundance	Stratified random mean adult abundance
SS	Silver Hake	Recruitment	Stratified random mean abundance 10-18cm (1 year lag)

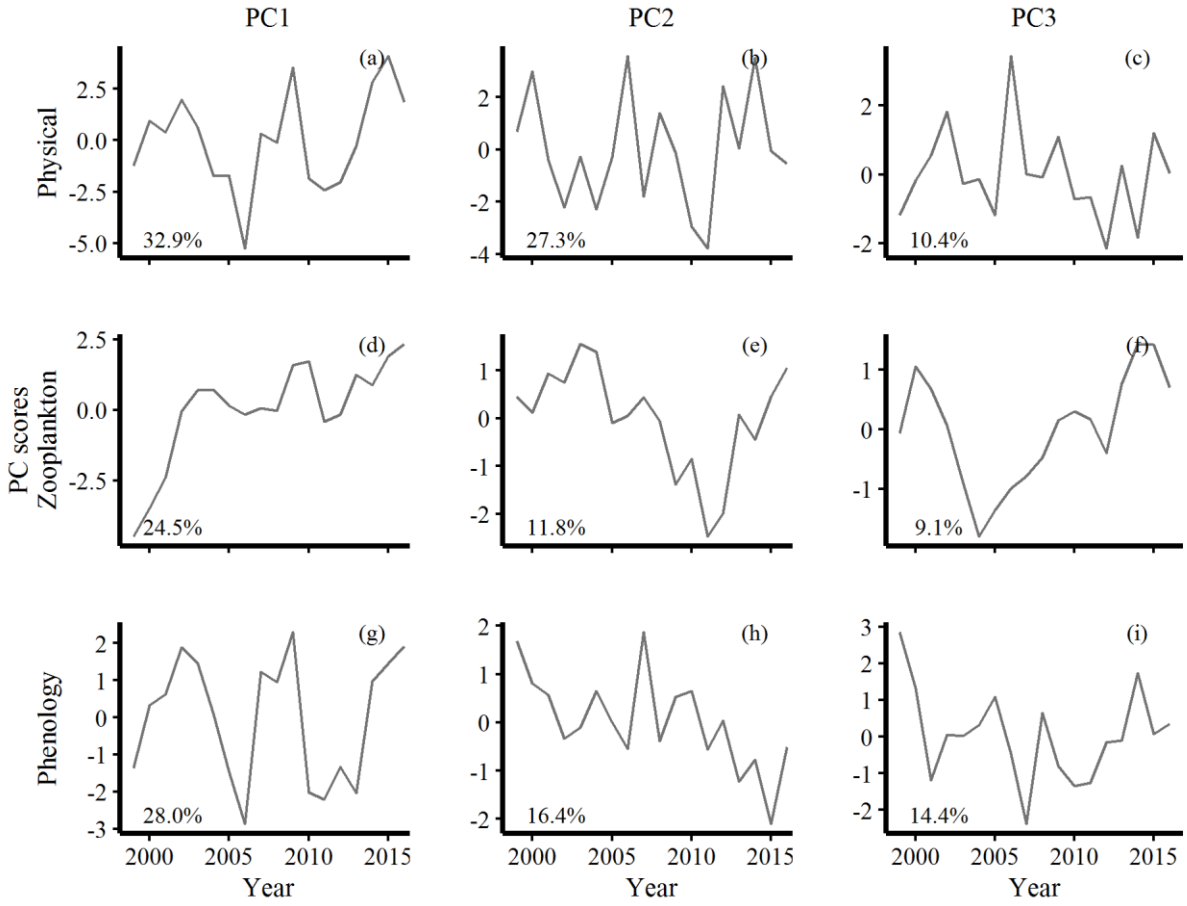
Supplementary figures

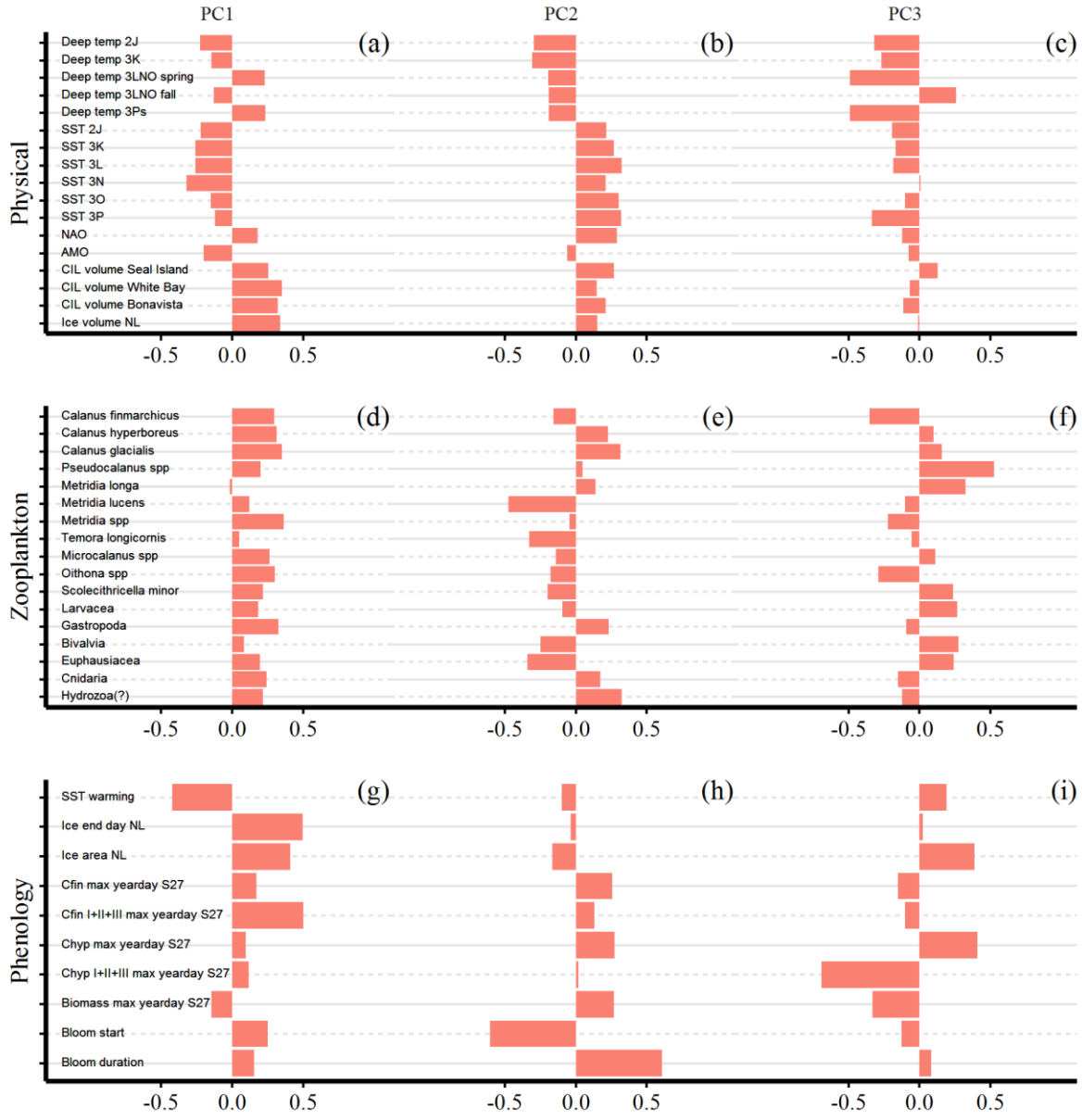

Physical
NL PC1
NL PC2
NL PC3
QC PC1
QC PC2
QC PC3
SS PC1
SS PC2
SS PC3
0
0 0
-0.32 0.42 -0.1
-0.55 -0.08 -0.08 0
0.5 0.63 -0.22 0 0
-0.01 0.51 -0.18 0.84 -0.13 0.15
0.42 0.37 0.02 -0.36 -0.16 0.06 0
0.5 0.5 -0.2 -0.2 -0.19 0.87 0 0
Correlation
1.0
0.5
0.0
-0.5
-1.0


Zooplankton
NL PC1
NL PC2
NL PC3
QC PC1
QC PC2
QC PC3
SS PC1
SS PC2
SS PC3
-0.06
0.01 -0.15
0.51 -0.43 0.5
0.25 0.43 0.21 -0.14
0.35 0.03 -0.46 0.07 -0.21
0.45 -0.56 0.39 0.83 -0.13 -0.13
-0.54 0.19 0.51 0.04 0.16 -0.4 0.07
0.52 -0.14 0.08 0.54 0.39 0.07 0.14 -0.27
Correlation
1.0
0.5
0.0
-0.5
-1.0

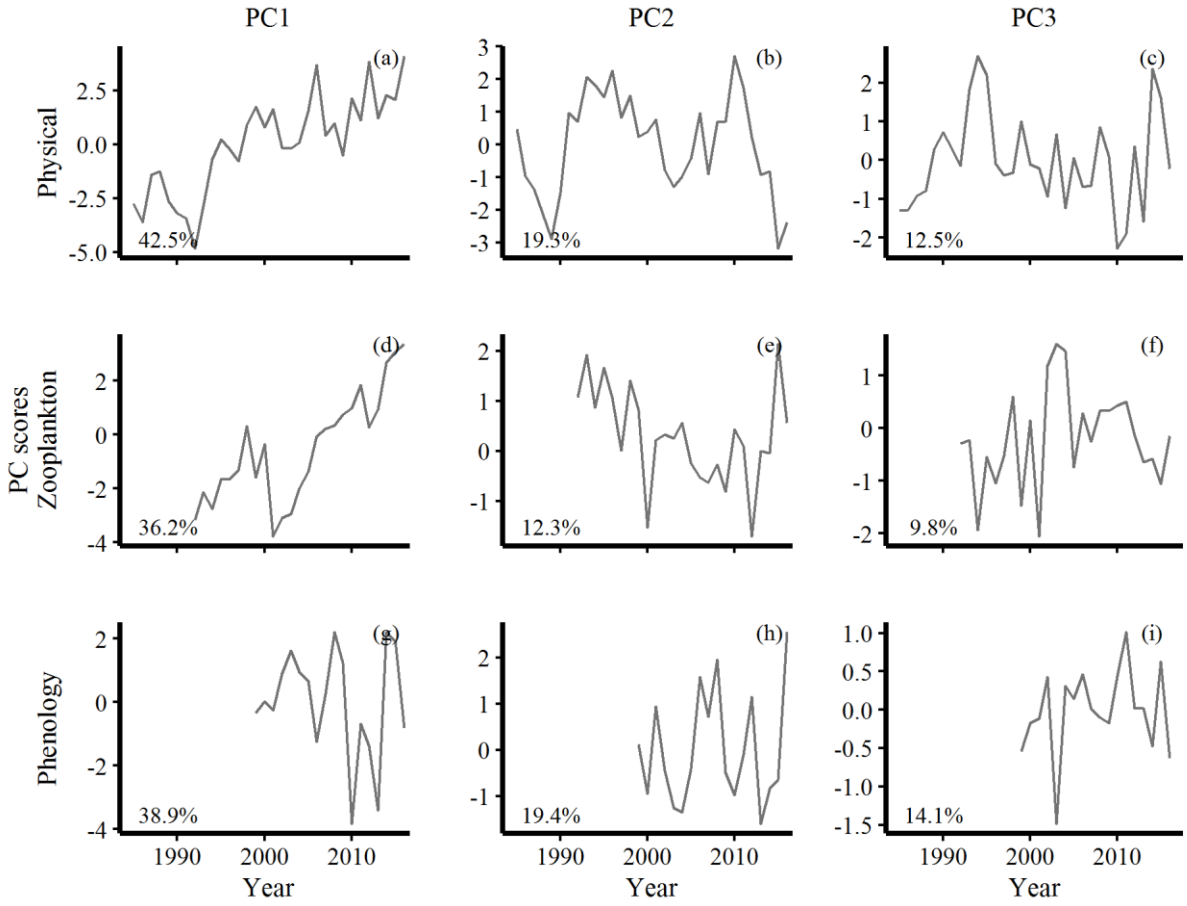

Phenology
NL PC1
NL PC2
NL PC3
QC PC1
QC PC2
QC PC3
SS PC1
SS PC2
SS PC3
0
0 -0.06
0.68 -0.1 0.31
0.06 0.05 -0.11 0
-0.42 -0.23 -0.38 -0.26 -0.03
0.79 -0.25 0.09 0.83 0.1 -0.26
0.1 0.23 0.34 -0.07 0.43 -0.2 -0.04
-0.07 -0.24 -0.41 -0.44 0.4 0.44 -0.01 0.1
Correlation
1.0
0.5
0.0
-0.5
-1.0

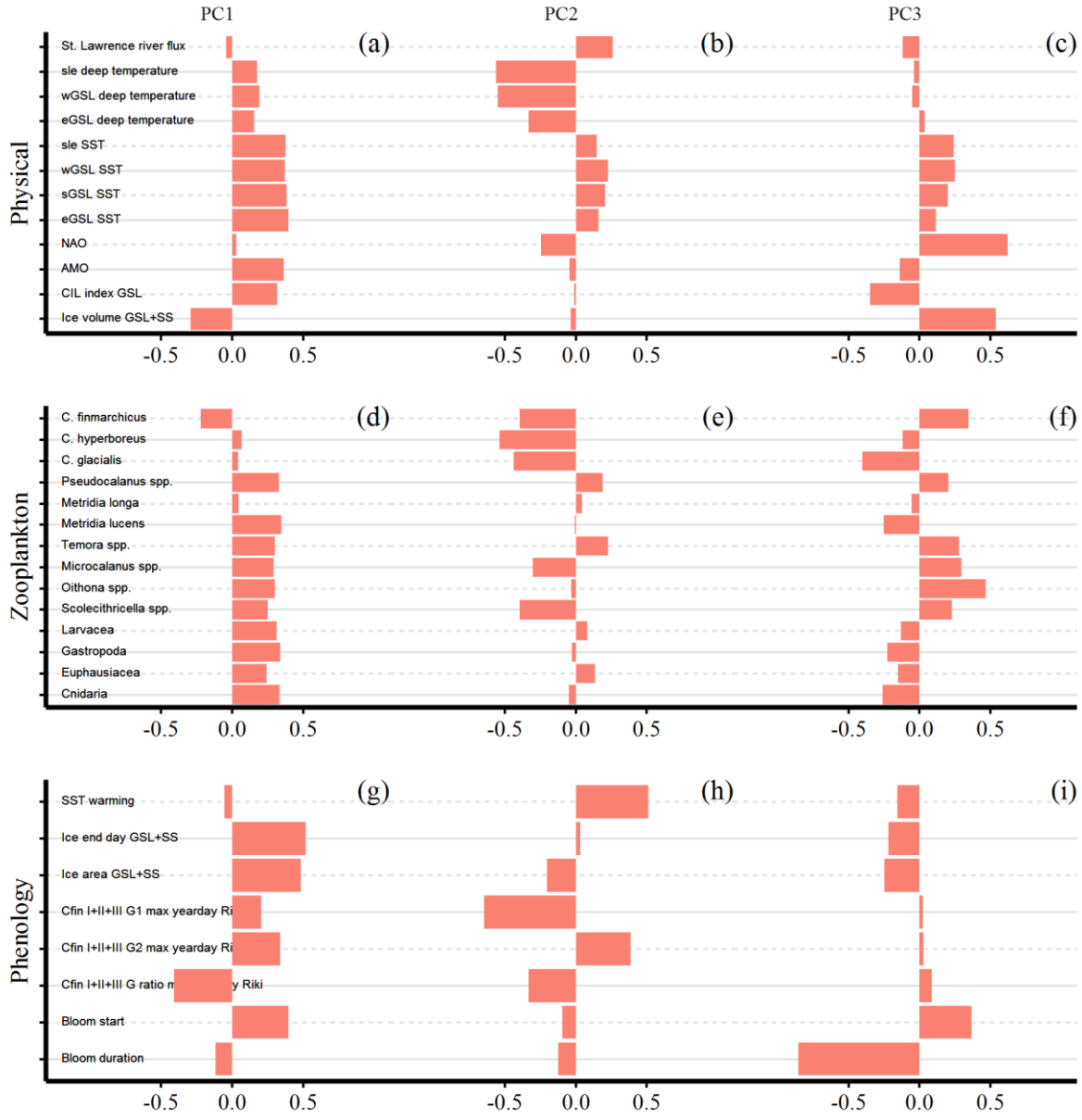
Newfoundland Shelf



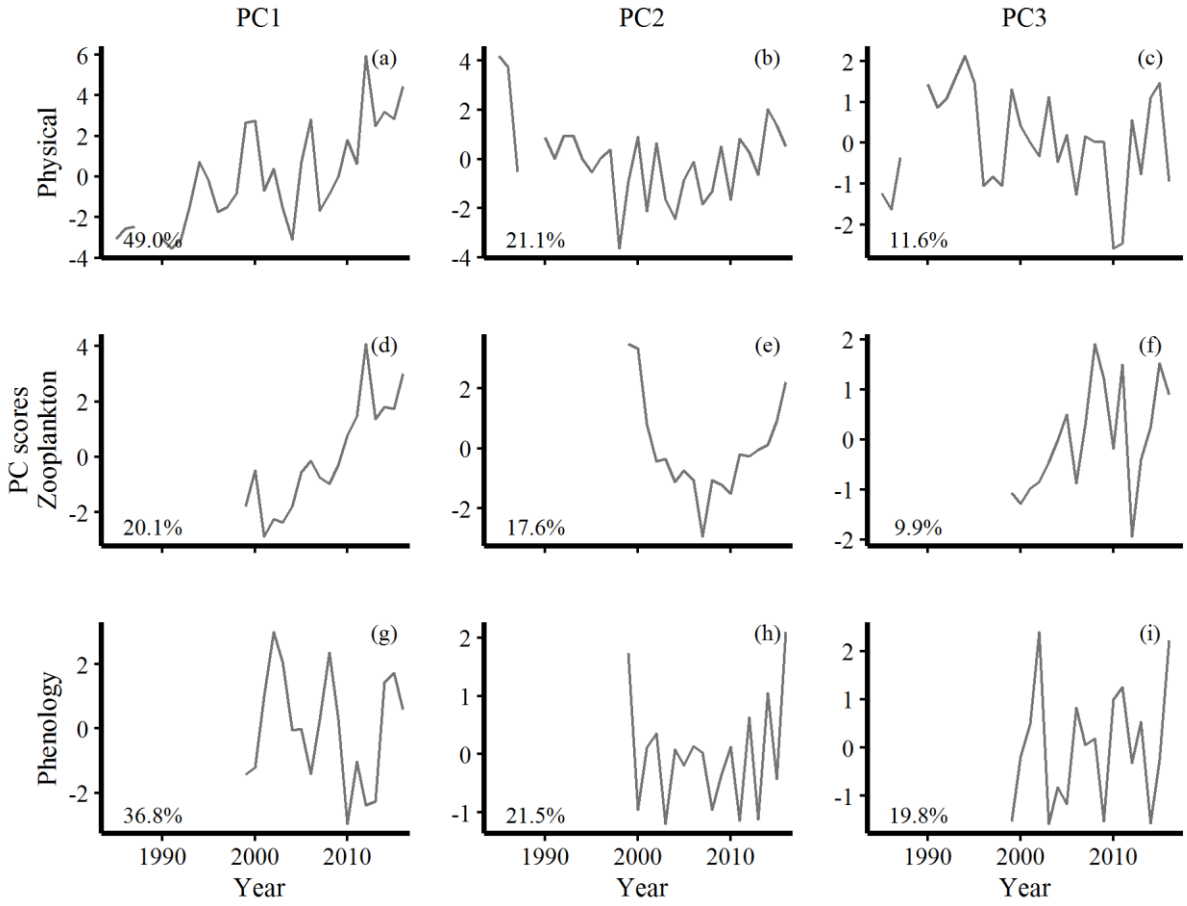

PC1
PC2
PC3
(a)
(b)
(c)
Physical
Deep temp 2J
Deep temp 3K
Deep temp 3LNO spring
Deep temp 3LNO fall
Deep temp 3Ps
SST 2J
SST 3K
SST 3L
SST 3N
SST 3O
SST 3P
NAO
AMO
CIL volume Seal Island
CIL volume White Bay
CIL volume Bonavista
Ice volume NL
(d)
(e)
(f)
Zooplankton
Calanus finmarchicus
Calanus hyperboreus
Calanus glacialis
Pseudocalanus spp
Metridia longa
Metridia lucens
Metridia spp
Temora longicornis
Microcalanus spp
Oithona spp
Scolecithricella minor
Larvacea
Gastropoda
Bivalvia
Euphausiacea
Cnidaria
Hydrozoa(?)
(g)
(h)
(i)
Phenology
SST warming
Ice end day NL
Ice area NL
Cfin max yearday S27
Cfin I+II+III max yearday S27
Chyp max yearday S27
Chyp I+II+III max yearday S27
Biomass max yearday S27
Bloom start
Bloom duration
-0.5
0.0
0.5

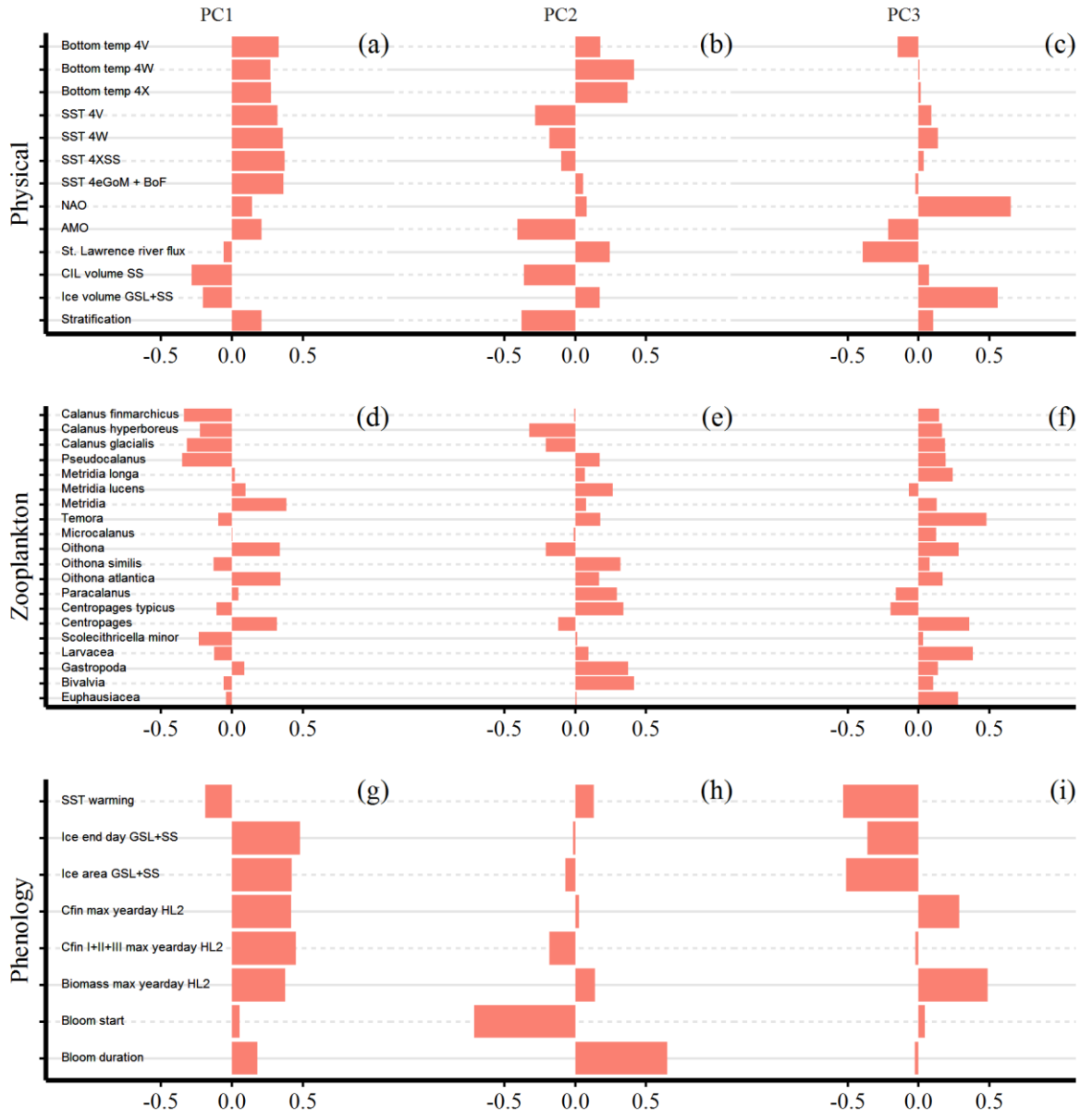
Gulf of St. Lawrence




PC1
PC2
PC3
(a)
(b)
(c)
Physical
St. Lawrence river flux
sle deep temperature
wGSL deep temperature
eGSL deep temperature
sle SST
wGSL SST
sGSL SST
eGSL SST
NAO
AMO
CIL index GSL
Ice volume GSL+SS
(d)
(e)
(f)
Zooplankton
C. finmarchicus
C. hyperboreus
C. glacialis
Pseudocalanus spp.
Metridia longa
Metridia lucens
Temora spp.
Microcalanus spp.
Oithona spp.
Scolecithricella spp.
Larvacea
Gastropoda
Euphausiacea
Cnidaria
(g)
(h)
(i)
Phenology
SST warming
Ice end day GSL+SS
Ice area GSL+SS
Cfin I+II+III G1 max yearday Ri
Cfin I+II+III G2 max yearday Ri
Cfin I+II+III G ratio m
y Riki
Bloom start
Bloom duration
-0.5
0.0
0.5

Scotian Shelf




PC1
PC2
PC3
(a)
(b)
(c)
Physical
Bottom temp 4V
Bottom temp 4W
Bottom temp 4X
SST 4V
SST 4W
SST 4XSS
SST 4eGoM + BoF
NAO
AMO
St. Lawrence river flux
CIL volume SS
Ice volume GSL+SS
Stratification
-0.5
0.0
0.5
(d)
(e)
(f)
Zooplankton
Calanus finmarchicus
Calanus hyperboreus
Calanus glacialis
Pseudocalanus
Metridia longa
Metridia lucens
Metridia
Temora
Microcalanus
Oithona
Oithona similis
Oithona atlantica
Paracalanus
Centropages typicus
Centropages
Scolecithricella minor
Larvacea
Gastropoda
Bivalvia
Euphausiacea
(g)
(h)
(i)
Phenology
SST warming
Ice end day GSL+SS
Ice area GSL+SS
Cfin max yearday HL2
Cfin I+II+III max yearday HL2
Biomass max yearday HL2
Bloom start
Bloom duration