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Global imprint of climate change on marine life

Supplementary References

Supplementary Methods & Results

What is an observation?

We defined an observation as one where a biological response was, at a minimum, discussed in relation to expected impacts of climate change. We defined six classes of biological observations: abundance, distribution (range and depth), phenology, demography (including condition), calcification, and community (assemblage) composition (see Supplementary Table S2 for examples). We treated each observation class as independent for consistency analyses (see below), while recognising that there may be some relationships among changes in distribution, abundance, phenology and demography[19]. For example, changes in abundance can eventually lead to shifts in distribution, and have often been used to infer distribution shifts.

Data extraction

Data considering observed impacts of climate change on marine life were extracted from studies published in the peer-reviewed literature, whether a relationship was shown or not. We considered only studies published in the peer-reviewed literature (inclusive of peer-reviewed reports) and these were located through extensive searches using the ISI Web of Science, Google Scholar and through our own knowledge. Comprehensive searches were also conducted in six key journals devoted to climate change or marine research (*Global Change Biology, Marine Ecology Progress Series, Progress in Oceanography, Journal of the Marine Biological Association of the UK, Global Ecology and Biogeography* and *Journal of Fish Biology*) from 1990 through to December 2010.

We captured both single-species and multi-species studies of marine biological responses, including null responses, and counted seabird, anadromous fish and polar bear studies as marine given their reliance on marine food sources. We defined the primary climate variable as the one identified by the authors as having the strongest relationship, or inferred as having the strongest relationship, with the biological observation. We selected all studies that focused on climate change regardless of whether the primary climate variable was temperature, sea ice, pH or "climate oscillation" such as the North Atlantic Oscillation index or Pacific Decadal Oscillation. 90% of the 208 studies identified temperature as the primary climate driver and 6% identified sea ice. Climate oscillations were included only where changes in their indices have been explicitly linked to global warming (3 studies[28-30]).

Time series had to include data after 1990 for comparison with recent climate change. The minimum span of time series included in the database was set at 19 yrs. This constraint was applied to minimize the chance of bias resulting from short-term biological responses to natural climate variability or non-climate related shifts. Most terrestrial syntheses of climate impacts on species used 20 years as the cutoff, with concessions made for certain studies to fill data gaps (reviewed in Parmesan[12]). However, there was no quantitative reason for setting a strict time limit at 20 yrs, and by relaxing the 20-yr rule, we added 85 observations from 9 studies of 61 species from the Atlantic, Indian, Pacific and Southern Oceans and the Mediterranean Sea.

For each observation, we recorded metadata including citation, biological observation, length of time series and sample density, organism/community identity, quantitative metrics of rates of change (if available), significance of tests of trends in biological response and attribution to climate change (where available), and whether other potential drivers of change (such as pollution, or exploitation) were considered (Supplementary Table S1). Coordinates for each study were taken as the "center of gravity" of the study area or the nearest ocean location for land breeding sites of polar bears, sea turtles and seabirds. Where distribution surrounded an island or peninsula centroids were plotted leading to some points appearing to fall on land (Fig. 1A).

We identified whether each observation was from a single- or multi-species study. We defined the number of species in a study as the number of species for which observations were entered in the database. For example, if an author indicated that 40 species were sampled, but data and discussion were presented for only 20 of these, then the number of species recorded in the database was 20. If a study reported only on a subset of species but indicated that other species in the study showed non-significant responses, we included these latter observations as no change (and not statistically significant). Where further information may have been available, or where required information were unclear, advice was sought from the original authors. To ensure consistency in interpretation and accuracy of data extraction, each entry was reviewed two or three times, with at least one review was undertaken by ESP, AJR or CJB, who were in close communication.

Species were classified into taxonomic groups for analysis (Supplementary Table S3).

Duplication

Duplication can arise where multiple studies use the same dataset to investigate the same biological response in the same region. Duplication can also arise where multiple, potentially correlated, observations for a single species response in a region were reported within or among studies. For example, observations of first egg laying, peak egg laying and mean hatch date as spring phenology metrics at a single seabird colony are essentially capturing the same response of the species to climate change using different correlated metrics. We applied a filter to eliminate duplicate observations using the following rules: 1) were there multiple entries for a species for the same location? If yes, 2) for each observation class (Supplementary Table S2), were there multiple entries? If yes, 3) reject the observations for which a statistical test for decadal change has not been applied (regardless of result). If multiple entries still remain, 4) reject the observations based on responses of individuals (eg first laying date) rather than metrics based on populations (e.g. peak laying date). If more than one observation remains, 5) select the observation with the longest time series.

Changes in phenology and distribution

Quantitative metrics of change for distribution were captured as km dec^{-1} and for phenology as day dec^{-1}. Where necessary, we converted study estimates to these standard measurements. Rates of change were taken directly from papers or supplementary material, calculated from data or figures in papers or supplementary material or supplied directly by the original authors. Depth changes were not converted into latitudinal equivalents for temperature clines as has been done for terrestrial examples (1 km northward = 1 m upward[11]), because of non-linear temperature discontinuities with depth in the ocean (thermoclines).

The location of the study within a species distributional range were taken from the studies, or estimated from distribution maps, e.g. FishBase (www.fishbase.org). We classified each observation as leading edge (n=111), trailing edge (n=106) or centre (n=105). Centre of distribution encompassed any observations that were not leading or trailing edge e.g. abundance centre, mean latitude of occurrence. Leading edges were not restricted to the poleward edge of a distribution but were taken as any section at the edge of the distribution where it is likely that distribution may be moderated by cooler waters beyond the distributional edge. For example, expansions of intertidal invertebrates eastwards along the English Channel[31, 35] towards the colder North Sea were classified as leading edge expansions. Similarly, equatorward range shifts of flatfish in the southern North Sea[32] were also classified as leading edge as the species were previously excluded from these waters by cold winter temperatures. Conversely, trailing range edges were taken as locations where it is possible that distributions may be constrained by warmer temperatures beyond the range edge. Changes in range edges were calculated as the average of all observed shifts, including no change observations.

19% of leading edge distributions and 16% of trailing edge distributions showed no change (0 km dec^{-1}), whilst 32% of 'centre' observations showed no change (Supplementary Fig S3). Of the observations that showed a response, 86% of leading edges (n=77), 59% of trailing edges (n=83) and 82% of centres (n=108) shifted in the direction expected under climate change, generally polewards. Leading edges expanded by 72.0 ± 13.5 km dec^{-1} (median 24.9 km dec^{-1}), trailing edges contracted by 15.8 ± 8.7 km dec^{-1} (median 0.3 km dec^{-1}) and centres shifted polewards by 9.5 ± 2.1 km dec^{-1} (median 2.3 km dec^{-1}). Estimates of observations from the centre of species' distribution may be biased when the distribution changes outside the geographic region of the study, so may underestimate distribution shifts[33].

Phenology observations were classified into seasons based on calendar month. Northern Hemisphere winter: December, January, February; spring: March, April, May; summer: June, July, August; autumn: September, October, November. Southern Hemisphere summer: December, January, February; autumn: March, April, May; winter: June, July, August; spring: September, October, November.

No change observations (0 days dec^{-1}) were rarer for quantitative phenology responses (n=125); only 2 spring observations showed no change (Supplementary Fig S4). Of the observations that showed a response, 71% of spring phenology (n=49) and 86% of summer phenology (n=51) but only 42% of autumn phenology (n=14) and 25% of winter phenology (n=8) shifted in the direction expected under climate change, generally earlier for spring and summer events and later for autumn and winter. Spring phenology advanced by

4.4 ± 0.7 days dec^{-1} (median 2.4 das dec^{-1}) and summer by 4.0 ± 1.1 days dec^{-1} (median 3.5 days dec^{-1}). In contrast, autumn phenology delayed by 0.4 ± 1.2 days dec^{-1} (median 1.6 days dec^{-1}) and winter by 2.1± 2.5 days dec^{-1} (median 1.4 days dec^{-1}).

Comparison with quantitative shifts in climate

We compared reported responses of phenology and distribution with shifts predicted from the local velocity of climate change (VoCC) and seasonal climate shift (SCS) for the period 1960 to 2009, using global data from Burrows et al[8].

Distribution shifts (n=362 observations) were matched to VoCC values for spatial shifts in average annual sea surface temperature, averaging all values from 1-degree grid cells within a circular buffer distance from each observation . The size of the reported shift in km as the size of the circular spatial buffer. A linear model was fitted to all 362 observations of distribution shift rate (fourth-root transformed km/decade) using local VoCC (same units) and taxonomic group as predictors (Supplementary Table S5). While taxa differed in rates of shift, no influence of local VoCC was detected. Omitting observations showing no shifts (zeros) changed this result markedly (Supplementary Table S5, Fig. 3A): rates of distribution shift were higher for those organisms in areas of higher velocity of climate change. The difference between analyses including and excluding observations of zero shifts appeared to be linked to the tendency for zero shifts to be reported more frequently in areas of high velocity of climate change (VoCC ≥50km/decade: 37%, 39 of 106; VoCC <50km/decade: 17%, 44 of 256). This was a surprising result, and perhaps suggests a greater influence of factors such as alternative responses to climate change, habitat availability, dispersal ability or biotic interactions in areas prone to rapid shifts.

Spring phenology responses (52 spring excluding 2 null responses) were similarly matched to SCS values for April (Northern Hemisphere) and October (Southern

Hemisphere). The buffer radius was set as the square root of the reported area of each observation, divided by π. A linear model was fitted to the spring phenology change data with local SCS and taxonomic group (using a reduced list of five taxa: benthic invertebrates, fish, seabirds, phytoplankton and zooplankton) as predictor variables. Each observation was weighted by the number of years comprising each study. No significant relationship with SCS emerged, but large statistically significant differences in phenology change existed among groups (Fig. 3B and Table S5). Benthic invertebrates showed the largest spring advance in phenology, followed by fish, zooplankton and phytoplankton, with seabirds showing both delay and advance in spring phenology.

Consistency analysis

In our database, we assigned each observation into 1 of 3 categories for consistency with climate change: 1. Response was 'consistent' with direction of change expected under climate change: 2. Response was 'inconsistent' with direction of change expected under climate change or the consistency with or against climate change was unclear, that is no clear expectation of change was given or was available post hoc: and 3. 'No change' indicating no response was found. We focused on the authors' expectations of direction of response to climate change rather than apply general expectations such as poleward shifts and earlier spring events. We therefore captured responses that are inconsistent with general expectations but consistent when regional climate is taken into account. For example, later arrival and egg-laying of seabirds in the Antarctic linked to a regional decrease in sea-ice extent which impacts the quantity and accessibility of food supplies[34]. See also examples in ***Changes in distribution and phenology*** section above.

We used a generalized linear model with a binomial error structure. The response was the proportion consistent and the predictors were taxa, biome and observation type. A visual assessment of residuals suggested that the variance and distribution assumptions were met. The proportion consistent differed significantly among taxa, biomes and observation types. Tukey-type post-hoc comparisons for each predictor were conducted using the general linear hypotheses and multiple comparisons for parametric models in R. For taxa, there were six significant differences (Fig. 4; full data set): bony fish and benthic algae ($p<0.01$), phytoplankton and benthic algae ($p<0.05$), zooplankton and benthic algae ($p<0.001$), zooplankton and benthic crustacean ($p<0.05$), zooplankton and benthic molluscs ($p<0.05$), and zooplankton and bony fish ($p<0.05$). For biome, there were three significant differences: subtropical vs polar ($p<0.05$), tropical vs polar ($p<0.05$), temperate vs subtropical ($p<0.05$). For observation type there were three significant differences: phenology vs abundance ($p<0.01$), phenology vs demography ($p<0.05$), phenology vs distribution ($p<0.001$).

Biases

The complication of publication bias was considered in previous meta-analyses following a number of approaches including selection of studies that report a statistically significant response to climate change only[3,4] or selection of multi-species studies that also report neutral and negative results[11,12]. We found the latter approach, analysing data from only multi-species studies, reduced overall consistency of responses to climate change to 81% (n=1151), but still well above the 50% level expected on the basis of chance alone. Reductions in proportion consistent occurred for benthic invertebrates (other), crustacean, molluscs, seabirds, bony fish and zooplankton (Figure 4). This implies positive publication bias of single-species studies affected meta-analytic results for these taxonomic groups. However, with the exception of benthic invertebrates (other), all taxonomic groups still showed proportions consistent significantly above the 50% level. There were large increases in standard error for polar and tropical regions due to loss of data points, and there was also a reduction in rates of consistency for temperate regions. Phenology, abundance and distribution responses also showed declines in proportion consistent, but remained high at >70% consistent.

Second, responses to climate change can be difficult to distinguish from responses to low-frequency climate variability, which may mask or accentuate patterns and biotic responses. For example, interdecadal ecosystem variability forced by drivers of El Niño-Southern Oscillation, Atlantic Multidecadal Oscillation or Pacific Decadal Oscillation may have influenced many of the studies we synthesized. Taking only studies which spanned 30 yrs or more, to account for variability on decadal-scales, had little discernible influence on our findings (81% consistent, n=497; Supplementary Figure S5).

Third, species' responses may be modified (either accentuated or mitigated) by drivers of change other than climate change. For example, the response of fish populations to climate change is affected by the degree to which populations have been altered by fishing[32,33], which can make stocks more vulnerable to climate change by reducing life expectancy, truncating age structure, and reducing spatial heterogeneity, among other factors. We controlled for many of these factors in our analyses, but recognize the limitations in assigning actual percent contribution of climate versus other factors to realized species changes. In the database, 71% of all relationships between biology and physics included only climate variables and did not consider alternative drivers. These studies could over-estimate the effect of climate change as they do not partition out other pervasive human pressures, such as fishing, eutrophication, species introductions and habitation destruction; neither do they resolve effects of natural climate variability. However, analysing only the subset of studies that discounted the role of alternate drivers from our database had little impact on results (80% consistent, n=1200) (Supplementary Figure S6), suggesting that our conclusions were robust to exclusion of multiple factors in most studies. Among taxonomic groups for which sufficient data remained for analysis, benthic molluscs and crustaceans were the only groups to change from showing a significant (>50%) to non-significant response. This result may be conservative, however, because it excluded rocky-shore studies with benthic mollusc data for which anthropogenic drivers other than climate change are unlikely to play a role in specific responses observed. Rates of consistency of the observed changes in abundance with climate change declined, but was still >0.6; for phenology rates of consistency increased when analyzing only the subset of the data.

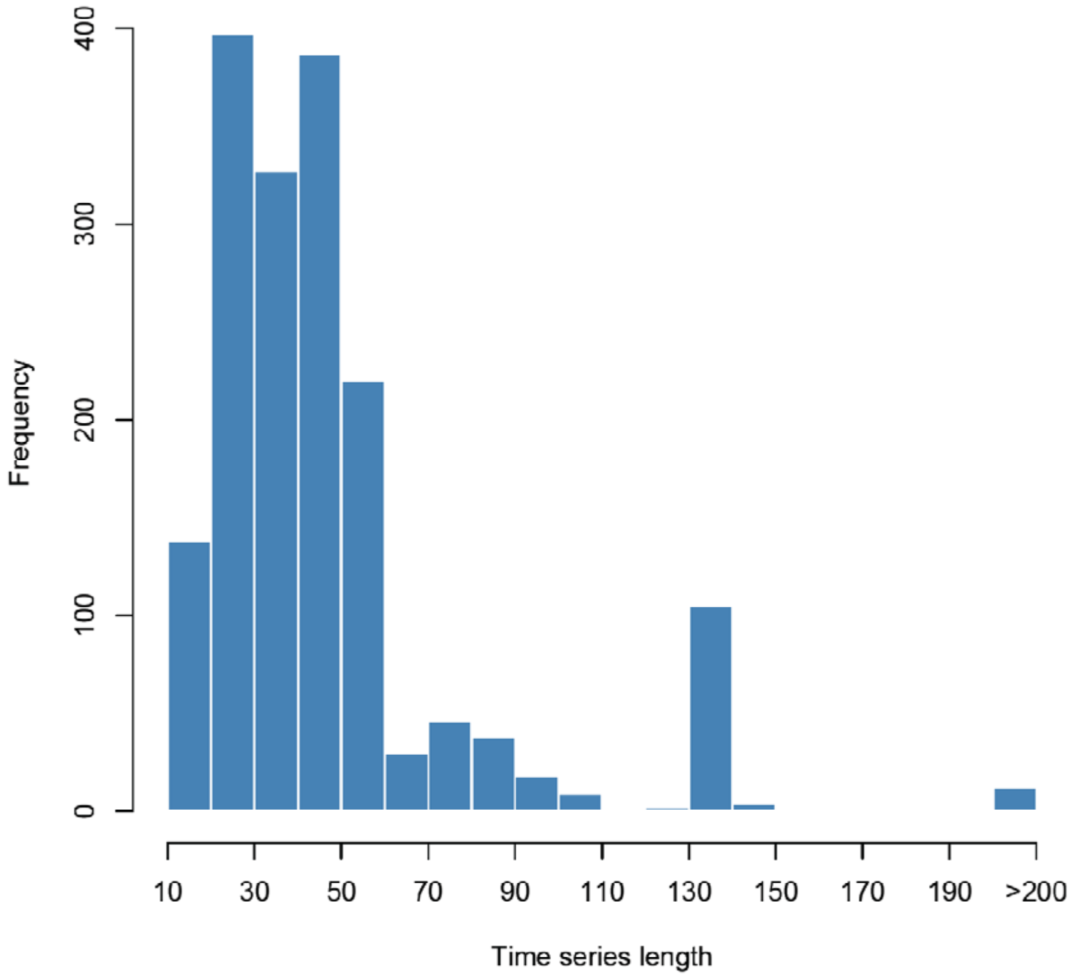
Attribution

Studies that were able to demonstrate a clear climate-related process behind observed changes give additional credence to attribution[11,16]. Systematic responses within regions and across regions, uniquely predicted by climate change, are a powerful diagnostic fingerprint of climate change[11,16]. These broad-scale responses include: 1. Broad changes within local communities or ecosystems, with abundances of warm-water species changing in the opposite direction to colder-water species; 2. Differential responses in populations of a species across distributions consistent with climate change e.g., expansion of distribution at leading edges and contraction at trailing edges or consistent responses at geographically separate range edges.

We found numerous examples of diagnostic fingerprints of climate change[1] in our database. 28 of 29 community or ecosystem studies show increases in the abundance of 'warm-water' species and declines of 'cold-water' species concurrent with warming. These include communities of fish in the Bay of Biscay[36], fish in the North Sea[37,38], fish in the SW Pacific[39], mysids in marine caves in the Mediterranean[40], plankton in the North Sea[41] and Mediterranean[42] and intertidal invertebrates in the NE Atlantic[43] and NE Pacific[44].

Diagnostic patterns of climate forcing include spatial sign-switching, in which opposing responses to warming trends are observed at a mixture of leading and trailing range boundaries, and consistent responses at geographically locations along distinct leading or trailing range edges. For example, expansions of distributions at leading edge (polewards) range boundaries and contractions at trailing edge (equatorwards) range boundaries. Of the 35 species for which data were available at broadly distributed range edges, 24 showed differential responses that were consistent with climate change. These include the intertidal barnacle *Austromegabalanus nigrescens* in the south-west Pacific, which has contracted at its trailing edge[45] and expanded its leading edge[46], and the intertidal mollusc *Osilinus lineatus* which is expanding at three separate leading-edges: northwards (polewards) along the Northern Ireland and North Wales coastlines[47], and eastwards along the English Channel[48]. More subtle changes in abundances and individual growth rates also reflect this type of sign-switching. For example, in the south-west Pacific, Neuheimer et al.[49] document opposing growth rate responses in fish populations at the center (where warming is shown to be associated with increased growth rates of individuals) and trailing edges of their distribution (where warming is shown to be associated with decreased individual growth).

Supplementary Figures



Supplementary Figure S1. Time span of observations included in the Marine Impacts database.

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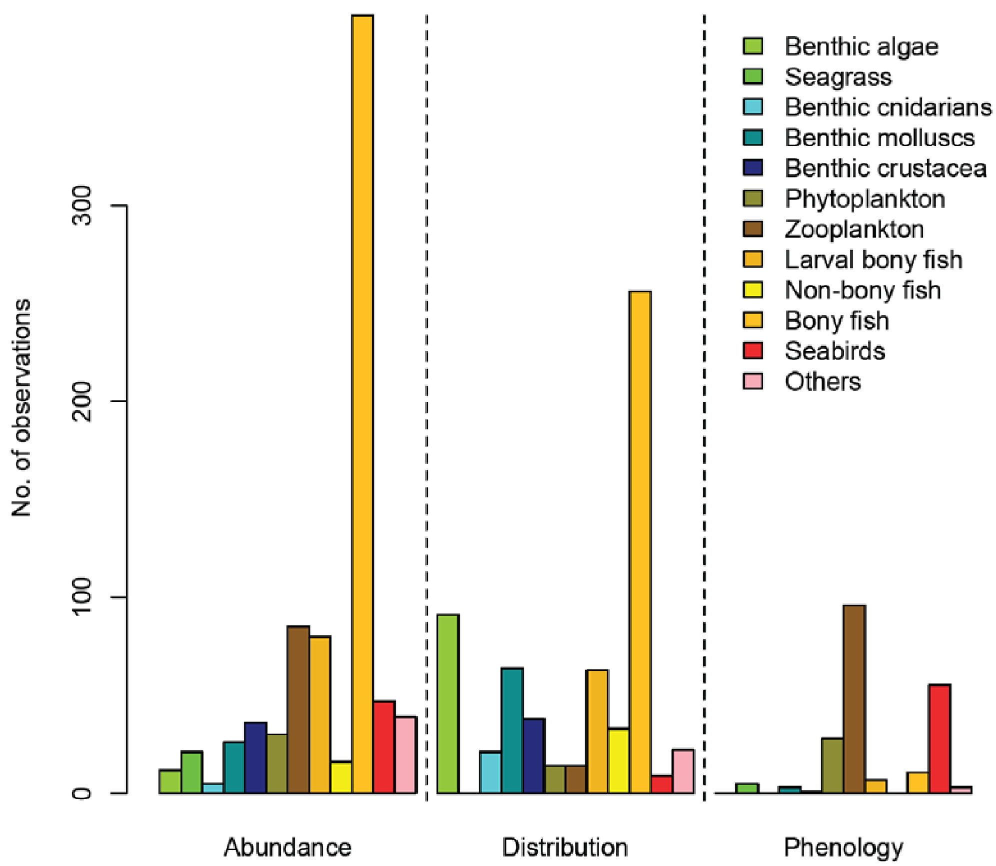
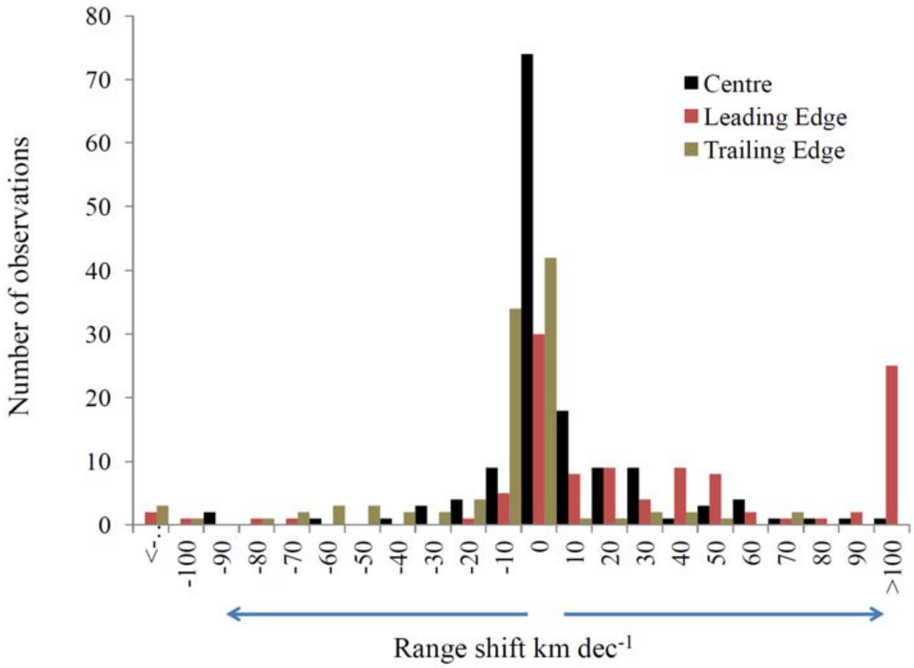
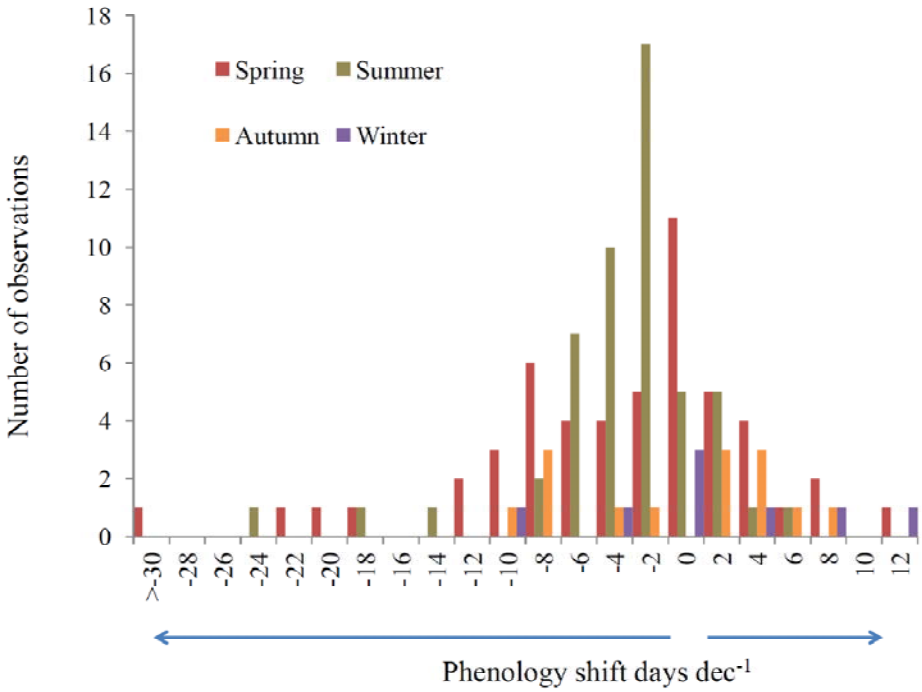


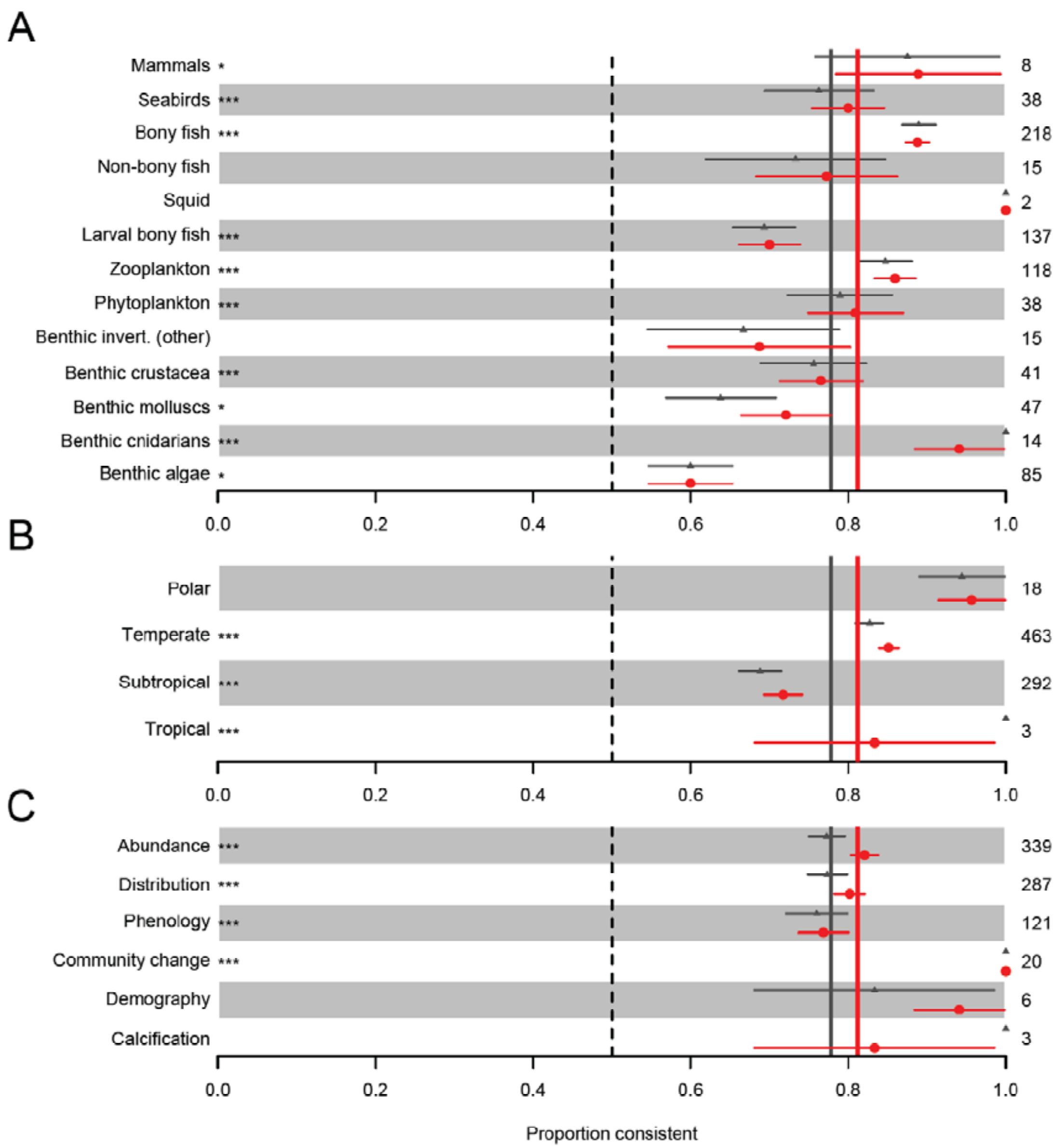
Supplementary Figure S2. Observations included in the Marine Impacts database. Frequency of responses in abundance, distribution and phenology across taxonomic groups. Demography (n=48), calcification (n=27) and community change (n=32) not shown. Others = mammals, mangroves, seagrass, squid and sea turtles.



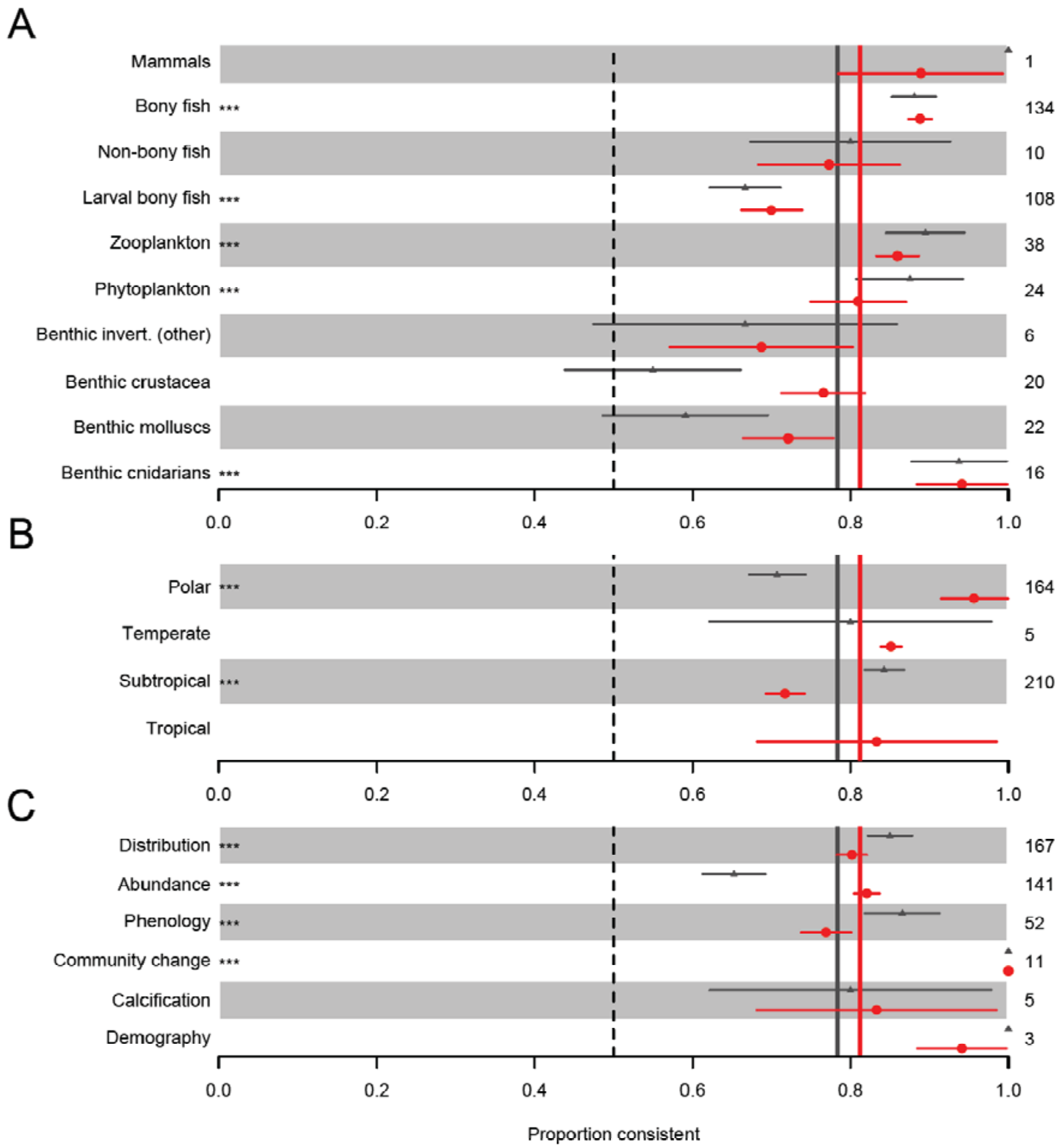
Supplementary Figure S3. Frequency histogram of range shifts from leading edge (n=111), trailing edge (n=106) and centre of distributions (n=142) for marine species, taken from 36 peer-reviewed studies (see Supplementary Table S1) of 318 species or functional groups. Minimum value for each category given on x axis. In general, positive range shifts are consistent with climate change at centre of distribution (100%) and leading edges (100%) and inconsistent with climate change at trailing edges (96%). Negative range shifts are generally inconsistent with climate change at centre of distributions (100%) and leading edges (88%) and consistent with climate change at trailing edges (100%). Some expansions and distributions are influenced by regional climate so may not conform to general expectations. For example, strengthening of upwelling systems leading to regional cooling and possible expansions (positive range shifts) at trailing edges.



Supplementary Figure S4. Frequency histogram of shifts in phenology for spring (n=52), summer (n=51), autumn (n=14) and winter (n=8) events for marine species, taken from 26 peer-reviewed studies (see Supplementary Table S1) of 92 species or functional groups. Maximum value for each category given on x axis. In general, negative phenology shifts (advancement) are considered consistent with climate change during spring (97% consistent with responses expected from climate change) and summer (100%) and inconsistent during autumn (0%) and winter (0%). Positive phenology shifts (delays) are generally considered inconsistent with climate change during spring (90%) and summer (86%) and consistent with climate change during autumn (25%) and winter (83%). Some advancements and delays are influenced by regional climate so may not conform to general expectations.



Supplementary Figure S5. Percent of marine observations consistent with climate change using data from multi-species studies (red circles), and from observations that span >30 years to explore the influence of biases from natural decadal variability (grey triangles). Mean and standard error of responses by (A) taxonomic or functional group, (B) latitudinal region and (C) response measure show significantly higher consistency than expected from random (dashed line at 50% consistency). Solid lines are the mean across all observations. Significance of results for dataset of observations >30 years (grey triangles) are listed next to labels (***: $p < 0.001$; **: $p < 0.01$; *: $p < 0.05$) and sample sizes to the right of each row. Sample sizes and significance of results for dataset from multi-species studies (red circles) are given in Figure 4.



Supplementary Figure S6. Percent of marine observations consistent with climate change using data from multi-species studies (red circles), and observations from studies that discount the influence of other drivers of change (grey triangles). Mean and standard error of responses by (A) taxa, (B) latitudinal region and (C) response measure show significantly higher consistency than expected from random (dashed line at 50% consistency). Solid lines are the mean across all observations. Significance of results are listed next to labels (***: p < 0.001; **: p < 0.01; *: p < 0.05). Significance of results for dataset of observations >30 years (grey triangles) are listed next to labels (***: p < 0.001; **: p < 0.01; *: p < 0.05) and sample sizes to the right of each row. Sample sizes and significance of results for dataset from multi-species studies (red circles) are given in Figure 4.

Supplementary Tables

See separate file for **Table S1: Database content**

Table S2: Observation classes, general expected responses to change in climate (*vice versa* for change in climate in opposite direction), and examples of metrics.

Observation class	Change in climate and expectations in response to change	Metrics
Abundance	Warming: Increase in warm-water species, decline in cold-water species	Annual landings[50], categorical abundance[51], mean density[38]
Distribution	Warming: Polewards shift in distributions, shift into deeper water or lower shore height	range edge location[53,54], mean latitude of occurrence[55], mean depth[55,56], mean shore height[57]
Phenology	Warming: earlier spring and summer events, delays in autumn and winter events	First laying date[58], mean hatch date[59], duration of nesting season[60], mean/median nesting date[61], first spawning date[62], month of maximum abundance[63], month of first appearance[64]
Demography	Warming: increase survival rates and breeding success of warm water species, increase in coral bleaching	Breeding success[34], survival rate[65], percent coral bleached[56]
Calcification	pH decline: decline in calcification rates, decrease in shell/test mass and density.	Mean shell mass[67], skeletal density[68], extension/growth rate[69]
Community composition	Warming: increase in warm water/cold water species ratio, increase in species richness	Diversity[70], community structure[71], species richness[72]

Table S3. Taxonomic groupings for meta-analysis

Taxonomic group	**Contents**
Mangroves	Mangrove tree (*Bruguiera gymnorrhiza*)
Benthic algae	Brown macroalgae, green macrolagae, red macrolagae
Seagrass	Seagrasses only: *Zostera* sp., *Halodule* sp., *Posidonia* sp.
Benthic cnidarians	Post-larval stages only: Sea anemones, hard corals, gorgonians
Benthic crustacea	Post-larval stages only: Barnacles, crabs, shrimps, lobsters, mysids
Benthic invertebrates (other)	Post-larval stages only: Annelids, bryozoans, echinoderms, insects
Benthic molluscs	Post-larval stages only: Gastropods, bivalves, chitons
Phytoplankton	Coccolithophores, diatoms, dinoflagellates
Zooplankton	Larval and egg stages only: Annelids, crustacea, molluscs, bryozoans, copepods, echinoderms, forams, pteropods, tunicates, salps
Larval bony fish	Larval and egg stages only: Bony fish
Bony fish	Post-larval stages only: Demersal and pelagic bony fish
Non-bony fish	Post-larval stages only: Sharks, rays, lamprays, hagfish
Squid	Post-larval stages only: *Dosidicus* sp, *Loligo* sp.
Turtles	Sea turtles only: *Caretta caretta*
Seabirds	All life stages: egg, juvenile and adult
Mammals	Polar bears, seals, whales and dolphins

Table S4. Velocity of temperature and seasonal shift in spring temperature over 1960-2009 calculated using the Hadley Centre data set Had1SST 1.1 dataset and methods presented in Burrows et al[8]. April temperatures used for northern hemisphere (N) seasonal shift and October temperatures for southern hemisphere (S). Values shown are medians, with 25th and 75th percentiles in parentheses, calculated using area-weighted data.

Region	Latitude	Velocity km dec^{-1}	Spring Seasonal Shift days dec^{-1} (N: April, S: October)	Fall Seasonal Shift days dec^{-1} (N: October, S: April)
Northern Polar	>66°N	48.7 (20.6, 112.2)	-2.5 (-16.7, -11.2)	2.9 (0.7, 4.9)
Northern Temperate	40-66°N	31.3 (14.7, 55.6)	-2.9 (-5.5, -3.7)	2.0 (1.3, 2.2)
Northern Subtropical	23.5-40°N	20.3 (7.5, 39.1)	-1.7 (-3.5, -1.7)	1.2 (0.3, 1.3)
Northern Tropical	0-23.5°N	52.8 (21.8, 143.8)	-3.0 (-6.0, -4.7)	4.6 (-3.1, 5.2)
Southern Tropical	0-23.5°S	50.0 (24.4, 106.8)	-5.9 (-11.5, -10.9)	4.4 (0.5, 3.8)
Southern Subtropical	23.5-40°S	14.7 (6.4, 21.7)	-2.7 (-4.2, -2.6)	2.9 (1.6, 3.0)
Southern Temperate	40-66°S	2.6 (-4.7, 9.0)	-1.5 (-5.8, -2.6)	1.4 (-0.2, 2.2)
Southern Polar	>66°S	-7.7 (-29.9, 11.2)	-4.6 (-14.8, -10.7)	0.2 (-3.4, 0.1)

Table S5. Linear models predicting rate of shift in (A) spring phenology from taxonomic group and local spring Seasonal Climate Shift (SCS), and (B) distribution from taxon and local Velocity of Climate Change (VOCC), including and excluding no-shift observations.

(A) Phenology shift rate (days/decade) versus Spring (April/October) seasonal shift (days/decade). Benthic invertebrates were the reference group, so had a coefficient of zero.

Adjusted R-squared: 0.4792; F-statistic: 10.39 on 5 and 46 DF, p-value: 1.039e-06

Coefficients:	Estimate	SE	t value	Pr(>|t|)	
(Intercept)	-18.108	4.277	-4.23	0.0001	***
Spring Seasonal Climate Shift	0.047	0.435	0.11	0.9146	
Fish	9.186	4.128	2.23	0.0310	*
Phytoplankton	11.545	4.110	2.81	0.0073	**
Seabirds	18.882	3.760	5.02	<0.0001	***
Zooplankton	8.018	4.134	1.94	0.0586	.

(B) Distribution shift rate (fourth-root transformed km/decade) versus velocity of climate change (fourth-root transformed absolute value km/decade, 1960-2009). Benthic algae were the reference group, so had a coefficient of zero.

Including zero shifts

Adjusted R-squared: 0.1763; F-statistic: 13.88 on 6 and 355 DF, p-value: 3.451e-14

Coefficients:	Estimate	SE	t value	Pr(>|t|)	
(Intercept)	2.089	0.352	5.93	<0.0001	***
√√abs(VoCC)	-0.209	0.100	-2.10	0.0364	*
Benthic invertebrates	-0.076	0.274	-0.28	0.7809	
Fish	-0.084	0.243	-0.35	0.7306	
Mammals	4.025	1.223	3.29	0.0011	**
Phytoplankton	2.781	0.606	4.59	<0.0001	***
Zooplankton	1.395	0.316	4.41	<0.0001	***

Excluding zero shifts

Adjusted R-squared: 0.3125; F-statistic: 22.06 on 6 and 272 DF, p-value: < 2.2e-16

Coefficients:	Estimate	SE	t value	Pr(>|t|)	
(Intercept)	0.687	0.277	2.48	0.0136	*
√√abs (VoCC)	0.453	0.085	5.34	<0.0001	***
Benthic invertebrates	0.582	0.196	2.97	0.0033	**
Fish	0.336	0.171	1.97	0.0500	.
Mammals	3.200	0.763	4.19	<0.0001	***
Phytoplankton	2.672	0.383	6.98	<0.0001	***
Zooplankton	1.195	0.209	5.73	<0.0001	***

See separate file for **Table S6: Distribution database**

See separate file for **Table S7: Phenology database**

Supplementary References

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Supplementary Table S1. Full Database. Obs = Observation class (see Supplementary Table 2), Taxa = taxonomic group, Biome, Region, Study Area = size of study site, Start Year = first year of data series, Timespan, N Sp = number of species in study, N. Con = number of observations consistent with climate change, No change = number of observations showing no change, N. Incon = numbers of observation inconsistent with climate change, N Data Points = total number of observations from each study, Alt Drivers? = other drivers of change considered, Stat Tests = statistical tests applied to show a relationship with changing climate.

Obs.	Taxa	Biome	Region	Study Area	Start Year	Time-span	N Sp	N. Con	No Change	N. Incon	N Data Points	Alt Drivers?	Stat Tests	Citation
ABUNDANCE														
Abundance	Bony fish	Temperate	North Sea	100000	1969	40	2	2	0	0	44	Yes	No	van Hal, R., K. Smits and A.D. Rijnsdorp 2010. How climate warming impacts the distribution and abundance of two small flatfish species in the North Sea. Journal of Sea Research 64: 76-84.
Abundance	Bony fish	Temperate	Mediterranean Sea	100000	1950	54	1	1	0	0	56	Yes	No	Sabates, A., P. Martin, J. Lloret and V. Raya. 2006. Sea warming and fish distribution: the case of the small pelagic fish, Sardinella aurita, in the western Mediterranean. Global Change Biology. 12: 2209-2219
Abundance	Bony fish	Temperate	North-east Atlantic	1000000	1987	20	15	8	7	0	43	Yes	No	Hermant, M., J. Lobry, S. Bonhommeau, J. Poulard and O. Le Pape. 2010. Impact of warming on abundance and occurrence of flatfish populations in the Bay of Biscay (France). Journal of Sea Research 64: 45-53
Abundance	Benthic algae	Temperate	North-east Atlantic	100000	1958	46	24	4	7	0	74	Yes	Yes	Simkanin, C., et al.. 2005. Using historical data to detect temporal changes in the abundances of intertidal species on Irish shores. Journal of the Marine Biological Association UK 85: 1329-1340

Abundance	Benthic cnidarians	Temperate	North-east Atlantic	100000	1958	46	24	0	1	0	70	Yes	Yes	Simkanin, C., et al.. 2005. Using historical data to detect temporal changes in the abundances of intertidal species on Irish shores. Journal of the Marine Biological Association UK 85: 1329-1340
Abundance	Benthic crustacea	Temperate	North-east Atlantic	100000	1958	46	24	2	1	1	72	Yes	Yes	Simkanin, C., et al.. 2005. Using historical data to detect temporal changes in the abundances of intertidal species on Irish shores. Journal of the Marine Biological Association UK 85: 1329-1340
Abundance	Benthic invert. (other)	Temperate	North-east Atlantic	100000	1958	46	24	0	1	1	70	Yes	Yes	Simkanin, C., et al.. 2005. Using historical data to detect temporal changes in the abundances of intertidal species on Irish shores. Journal of the Marine Biological Association UK 85: 1329-1340
Abundance	Benthic molluscs	Temperate	North-east Atlantic	100000	1958	46	24	1	5	0	71	Yes	Yes	Simkanin, C., et al.. 2005. Using historical data to detect temporal changes in the abundances of intertidal species on Irish shores. Journal of the Marine Biological Association UK 85: 1329-1340
Abundance	Benthic crustacea	Temperate	Mediterranean Sea	1	1981	19	2	1	0	0	22	Yes	No	Chevaldonne, P. and C. Lejeusne 2003. Regional warming-induced species shift in north-west Mediterranean marine caves. Ecology Letters 6:371-379
Abundance	Zooplankton	Temperate	Mediterranean Sea	1	1977	27	2	2	0	0	31	Yes	No	Chevaldonne, P. and C. Lejeusne 2003. Regional warming-induced species shift in north-west Mediterranean marine caves. Ecology Letters 6:371-379
Abundance	Zooplankton	Temperate	Mediterranean Sea	1	1980	24	2	1	0	0	27	Yes	No	Chevaldonne, P. and C. Lejeusne 2003. Regional warming-induced species shift in north-west Mediterranean marine caves. Ecology Letters 6:371-379
Abundance	Zooplankton	Temperate	Mediterranean Sea	1	1962	40	2	2	0	0	44	Yes	No	Chevaldonne, P. and C. Lejeusne 2003. Regional warming-induced species shift in north-west Mediterranean marine caves. Ecology Letters 6:371-379
Abundance	Zooplankton	Temperate	Mediterranean Sea	1	1962	41	2	1	0	0	44	Yes	No	Chevaldonne, P. and C. Lejeusne 2003. Regional warming-induced species shift in north-west Mediterranean marine caves. Ecology Letters 6:371-379
Abundance	Zooplankton	Temperate	Mediterranean Sea	1	1968	33	2	2	0	0	37	Yes	No	Chevaldonne, P. and C. Lejeusne 2003. Regional warming-induced species shift in north-west Mediterranean marine caves. Ecology Letters 6:371-379
Abundance	Zooplankton	Temperate	Mediterranean	1	1962	38	2	2	0	0	42	Yes	No	Chevaldonne, P. and C. Lejeusne 2003. Regional warming-induced species shift in north-west

			Sea										Mediterranean marine caves. Ecology Letters 6:371-379
Abundance	Zooplankton	Temperate	Mediterranean Sea	1	1977	24	2	2	0	0	28	Yes	No	Chevaldonne, P. and C. Lejeusne 2003. Regional warming-induced species shift in north-west Mediterranean marine caves. Ecology Letters 6:371-379
Abundance	Bony fish	Temperate	North Sea	1000000	1963	43	7	1	0	0	51	Yes	Yes	Kirby, R.R., G. Beaugrand and J.A. Lindley. 2009. Synergistic effects of climate and fishin in a marine ecosystem. Ecosystems 12:548-561
Abundance	Zooplankton	Temperate	North Sea	1000000	1949	57	7	3	0	0	67	Yes	Yes	Kirby, R.R., G. Beaugrand and J.A. Lindley. 2009. Synergistic effects of climate and fishin in a marine ecosystem. Ecosystems 12:548-561
Abundance	Zooplankton	Temperate	North Sea	1000000	1957	49	7	1	0	0	57	Yes	Yes	Kirby, R.R., G. Beaugrand and J.A. Lindley. 2009. Synergistic effects of climate and fishin in a marine ecosystem. Ecosystems 12:548-561
Abundance	Bony fish	Temperate	North Sea	1000	1952	44	1	1	0	0	46	Yes	No	Knights, B. 2003. A review of the possible impacts of long-term oceanic and climate changes and fishing mortality on recruitment of anguillid eels of the Northern Hemisphere. The Science of the Total Environment 310: 237-244
Abundance	Squid	Subtropical	California Current	1000000	1985	22	1	1	0	0	24	Yes	No	Field, J.C., K. Baltz, A.J. Phillips and W.A. Walker. 2007. Range expansion and trophic interactions of the Jumbo Squid Dosidicus gigas, in the Californian Current. Californian Cooperative Oceanic Fisheries Investigations Reports 48:131-146
Abundance	Zooplankton	Temperate	North Sea	100	1973	29	3	1	0	0	33	Yes	No	Philippart, C. J. M., et al. 2003. Climate-related changes in recruitment of the bivalve Macoma balthica. Limnology and Oceanography 48:2171-2185.
Abundance	Bony fish	Temperate	North Sea	10000	1970	37	34	7	55	1	78	Yes	Yes	Tulp, I., Bolle, L.J. and A.D. Rijnsdorp. 2008. Signals from the shallows: In search of common patterns in long-term trends in Dutch estuarine and coastal fish. Journal of Sea Research. 60: 54-73
Abundance	Bony fish	Temperate	North Sea	1000	1970	37	34	5	20	2	76	Yes	Yes	Tulp, I., Bolle, L.J. and A.D. Rijnsdorp. 2008. Signals from the shallows: In search of common patterns in long-term trends in Dutch estuarine and coastal fish. Journal of Sea Research. 60: 54-73
Abundance	Non-bony	Temperate	North Sea	10000	1970	37	34	0	1	0	71	Yes	Yes	Tulp, I., Bolle, L.J. and A.D. Rijnsdorp. 2008. Signals from the shallows: In search of common

	fish												patterns in long-term trends in Dutch estuarine and coastal fish. Journal of Sea Research. 60: 54-73
Abundance	Benthic crustacea	Temperate	North-east Atlantic	10	1955	53	1	1	0	0	55	No	No	O'Riordan, R.M., S. Culloty, J. Davenport and R. McAllen. 2009. Increases in the abundance of the invasive barnacle Austrominius modestus on the Isle of Cumbrae, Scotland. Journal of the Marine Biological Association 2 - Biodiversity Records 2: e91 doi:10
Abundance	Bony fish	Temperate	North Sea	1000000	1925	79	2	2	0	0	83	No	No	Beare, D.J. et al. 2004. An increase in the abundance of anchovies and sardines in the north-western North Sea since 1995. Global Change Biology 10:1209-1213
Abundance	Bony fish	Temperate	North Sea	1000000	1925	80	12	12	0	0	104	Yes	No	Beare, D.J., et al.004. Long-term increases in prevalence of North Sea fishes having southern biogeographic affinities. Marine Ecology Progress Series 284: 269-278
Abundance	Bony fish	Temperate	North Sea	100000	1925	79	1	1	0	0	81	Yes	No	Beare, D.J. ,F. Burns, E. Jones, K. Peach and D. Reid. 2005. Red mullet migration into the northern North Sea during late winter. Journal of Sea Research 53: 205-212
Abundance	Benthic crustacea	Temperate	North Sea	100	1973	30	4	1	0	0	35	Yes	No	Beukema, J.J. and R. Dekker. 2005. Decline of recruitment success in cockles and other bivalves in the Wadden Sea: possible role of climate change, predation on postlarvae and fisheries. Marine Ecology Progress Series 287: 149-167
Abundance	Benthic molluscs	Temperate	North Sea	100	1973	30	4	3	0	0	37	Yes	Yes	Beukema, J.J. and R. Dekker. 2005. Decline of recruitment success in cockles and other bivalves in the Wadden Sea: possible role of climate change, predation on postlarvae and fisheries. Marine Ecology Progress Series 287: 149-167
Abundance	Zooplankton	Temperate	North Sea	100	1973	30	4	1	0	0	35	Yes	No	Beukema, J.J. and R. Dekker. 2005. Decline of recruitment success in cockles and other bivalves in the Wadden Sea: possible role of climate change, predation on postlarvae and fisheries. Marine Ecology Progress Series 287: 149-167
Abundance	Bony fish	Temperate	North-east Atlantic	1000000	1985	20	15	11	3	1	46	Yes	No	Bjornsson, H. and O.K. Palsson. 2004. Distribution patterns and dynamics of fish stocks under recent climate change in Icelandic waters. ICES CM2004/K:30
Abundance	Bony fish	Temperate	North-east	100000	1973	30	1	1	0	0	32	No	No	Blanchard, F. and F. Vandermeirsch. 2005 Warming and exponential abundance increase of

			Atlantic											the subtropical fish Capros aper in the Bay of Biscay (1973-2002). C.R. Biologies 328: 505-509
Abundance	Bony fish	Subtropical	North-west Pacific	1000000	1965	37	3	1	0	0	41	No	Yes	Bonhommeau, S. et al. 2008. Impact of climate on eel populations of the Northern Hemisphere. Marine Ecology Progress Series 373: 71-80
Abundance	Bony fish	Temperate	North-west Atlantic	1000000	1974	28	3	1	0	0	32	No	Yes	Bonhommeau, S. et al. 2008. Impact of climate on eel populations of the Northern Hemisphere. Marine Ecology Progress Series 373: 71-80
Abundance	Bony fish	Temperate	North Sea	1000000	1960	46	3	1	0	0	50	No	Yes	Bonhommeau, S. et al. 2008. Impact of climate on eel populations of the Northern Hemisphere. Marine Ecology Progress Series 373: 71-80
Abundance	Bony fish	Temperate	North Sea	1000	1960	40	1	1	0	0	42	Yes	Yes	Bonhommeau, S., E. Chassot and E. Rivot. 2008. Fluctuations in European eel (Anguilla anguilla) recruitment resulting from environmental changes in the Sargasso Sea. Fisheries Oceanography 17: 32-44
Abundance	Bony fish	Temperate	North Sea	1000	1964	42	1	1	0	0	44	Yes	Yes	Bonhommeau, S., E. Chassot and E. Rivot. 2008. Fluctuations in European eel (Anguilla anguilla) recruitment resulting from environmental changes in the Sargasso Sea. Fisheries Oceanography 17: 32-44
Abundance	Bony fish	Temperate	North-east Atlantic	1000	1960	46	1	1	0	0	48	Yes	Yes	Bonhommeau, S., E. Chassot and E. Rivot. 2008. Fluctuations in European eel (Anguilla anguilla) recruitment resulting from environmental changes in the Sargasso Sea. Fisheries Oceanography 17: 32-44
Abundance	Bony fish	Temperate	North-east Atlantic	1000	1971	35	1	1	0	0	37	Yes	Yes	Bonhommeau, S., E. Chassot and E. Rivot. 2008. Fluctuations in European eel (Anguilla anguilla) recruitment resulting from environmental changes in the Sargasso Sea. Fisheries Oceanography 17: 32-44
Abundance	Bony fish	Temperate	North Sea	1000	1969	37	1	1	0	0	39	Yes	Yes	Bonhommeau, S., E. Chassot and E. Rivot. 2008. Fluctuations in European eel (Anguilla anguilla) recruitment resulting from environmental changes in the Sargasso Sea. Fisheries Oceanography 17: 32-44
Abundance	Bony fish	Temperate	North Sea	1000	1960	46	1	1	0	0	48	Yes	Yes	Bonhommeau, S., E. Chassot and E. Rivot. 2008. Fluctuations in European eel (Anguilla anguilla) recruitment resulting from environmental changes in the Sargasso Sea. Fisheries Oceanography 17: 32-44
Abundance	Benthic	Temperate	North	10	1974	34	1	1	0	0	36	Yes	Yes	Campos, J., et al. 2010. Fluctuations of brown

	crustacea		Sea											shrimp Crangon crangon abundance in the western Dutch Wadden Sea. Marine Ecology Progress Series. 405: 203-219
Abundance	Zooplankton	Temperate	North-west Atlantic	1000	1951	53	2	1	0	0	56	No	No	Costello, J.H, B.K. Sullivan and D.J. Gifford. 2006. A physical-biological interaction underlying variable phenological responses to climate change by coastal zooplankton. Journal of Plankton Research 28:1099-1105
Abundance	Bony fish	Temperate	North-east Atlantic	1000	1981	21	4	4	0	0	29	No	No	Desaunay, Y, D. Guerault, O. Le Pape and J. Poulard. 2006. Changes in occurrence and abundance of northern/southern flatfishes over a 20-year period in a coastal nursery area (Bay of Vilaine) and on the eastern continental shelf of the Bay of Biscay. Scie
Abundance	Benthic invert. (other)	Temperate	North-east Atlantic	1000000	1967	39	2	1	0	0	42	No	No	Edward, D.A., J.E. Blyth, R. McKee and A. Simon Gilburn. 2007. Change in the distribution of a member of the strand line community: the seaweed fly (Diptera: Coelopidae). Ecological Entomology 32: 741_746
Abundance	Benthic invert. (other)	Temperate	North-east Atlantic	100000	1981	25	2	1	0	0	28	No	No	Edward, D.A., J.E. Blyth, R. McKee and A. Simon Gilburn. 2007. Change in the distribution of a member of the strand line community: the seaweed fly (Diptera: Coelopidae). Ecological Entomology 32: 741_746
Abundance	Mammals	Temperate	Hudson Bay	10000	1981	20	1	1	0	0	22	Yes	No	Ferguson, S.H., I. Stirling and P. McLoughlin. 2005. Climate change and ringed seal (Phoca hispida) recruitment in western Hudson Bay. Marine Mammal Science 21:121-135
Abundance	Bony fish	Subtropical	Gulf of Mexico	1000	1971	36	17	14	0	3	67	Yes	No	Fodrie, F.J., K.L. Heck, S.P. Powers, W.M. Graham and K.L. Robinson. 2010. Climate-related, decadal-scale assemblage changes of seagrass-associated fishes in the northern Gulf of Mexico. Global Change Biology 16: 48-59
Abundance	Bony fish	Temperate	North-west Atlantic	1000000	1910	88	1	1	0	0	90	Yes	No	Friedland, K.D., D.G. Reddin, J.R. McMenemy and K.F. Drinkwater. 2003. Multidecadal trends in North American Atlantic salmon (Salmo salar) stocks and climate trends relevant to juvenile survival. Canadian Journal of Fisheries and Aquatic Sciences 60: 563-
Abundance	Bony fish	Temperate	North-east Atlantic	1000	1947	58	1	1	0	0	60	Yes	No	Friedland, K.D., M.J. Miller and B. Knights. 2007. Oceanic changes in the Sargasso Sea and declines in recruitment of the European eel. ICES

														Journal of Marine Science 64: 519-530
Abundance	Bony fish	Temperate	North-east Atlantic	1	1981	22	35	2	11	2	59	Yes	Yes	Genner, M.J., et al.. 2004. Regional climatic warming drives long-term community change of British marine fish. Proceedings of the Royal Society of London Series B. 271: 65
Abundance	Bony fish	Temperate	English Channel	1000	1913	90	35	7	21	2	132	Yes	Yes	Genner, M.J., et al.. 2004. Regional climatic warming drives long-term community change of British marine fish. Proceedings of the Royal Society of London Series B. 271: 65
Abundance	Non-bony fish	Temperate	English Channel	1000	1913	90	35	1	2	0	126	Yes	Yes	Genner, M.J., et al.. 2004. Regional climatic warming drives long-term community change of British marine fish. Proceedings of the Royal Society of London Series B. 271: 65
Abundance	Benthic crustacea	Temperate	North-west Atlantic	10	1959	47	25	4	1	5	76	Yes	Yes	Collie, J.S, Wood A.D. and Jeffries H.P. 2008 Long-term shifts in the species composition of a coastal fish community. Canadian Journal of Fisheries and Aquatic Sciences. 65: 1352-1365
Abundance	Benthic invert. (other)	Temperate	North-west Atlantic	10	1959	47	25	0	0	2	72	No	Yes	Collie, J.S, Wood A.D. and Jeffries H.P. 2008 Long-term shifts in the species composition of a coastal fish community. Canadian Journal of Fisheries and Aquatic Sciences. 65: 1352-1365
Abundance	Bony fish	Temperate	North-west Atlantic	10	1959	47	25	18	5	11	90	Yes	Yes	Collie, J.S, Wood A.D. and Jeffries H.P. 2008 Long-term shifts in the species composition of a coastal fish community. Canadian Journal of Fisheries and Aquatic Sciences. 65: 1352-1365
Abundance	Non-bony fish	Temperate	North-west Atlantic	10	1959	47	25	0	0	2	72	No	Yes	Collie, J.S, Wood A.D. and Jeffries H.P. 2008 Long-term shifts in the species composition of a coastal fish community. Canadian Journal of Fisheries and Aquatic Sciences. 65: 1352-1365
Abundance	Squid	Temperate	North-west Atlantic	10	1959	47	25	2	0	0	74	No	Yes	Collie, J.S, Wood A.D. and Jeffries H.P. 2008 Long-term shifts in the species composition of a coastal fish community. Canadian Journal of Fisheries and Aquatic Sciences. 65: 1352-1365
Abundance	Mammals	Polar	Beaufort Sea	100000	1985	20	1	1	0	0	22	Yes	No	Fischbach, A.S., S.C. Amstrup and D.C. Douglas. 2007. Landward and eastward shift of Alaskan polar bear denning associated with recent sea ice changes. Polar Biology 30:1395-1405
Abundance	Bony fish	Temperate	North-east Atlantic	1	1906	95	1	0	1	0	96	Yes	No	Guisande, C. A.R. Vergara, I. Riveiro and J.M. Cabanas. 2004. Climate change and abundance of the Atlantic-Iberian sardine (Sardina pilchardus). Fisheries Oceanography 13: 91-101

Abundance	Mammals	Temperate	Hudson Bay	10000000	1903	103	1	1	0	0	105	Yes	No	Higdon, J.W. and S. H. Ferguson. 2009. Loss of Arctic sea ice causing punctuated change in the sightings of killer whales (Orcinus orca) over the past century. Ecological Applications 19: 1365-1375
Abundance	Larval bony fish	Temperate	North-east Atlantic	10000000	1950	56	1	1	0	0	58	Yes	No	Lindley, J.A., R.R. Kirby, D.G. Johns and P.C. Reid. 2006. Exceptional abundance of the snake pipefish (Entelurus aequoreus) in the north-eastern Atlantic Ocean. ICES CM 2006/C:06
Abundance	Benthic crustacea	Temperate	North-east Atlantic	1	1951	40	3	2	0	0	45	Yes	Yes	Southward, A. J. 1991. Forty years of changes in species composition and population density of barnacles on a rocky shore near Plymouth. Journal of the Marine Biological Association, UK 71:495-513
Abundance	Seabirds	Subtropical	Great Australian Bight	10	1873	125	1	1	0	0	127	Yes	No	Bunce, A., F.I. Norman, N. Brothers, and R. Gales. 2002. Long-term trends in the Australasian gannet (Morus serrator) population in Australia: the effect of climate change and commercial fisheries. Marine Biology 141: 263-269.
Abundance	Seabirds	Subtropical	Great Australian Bight	10	1966	35	1	1	0	0	37	Yes	No	Bunce, A., F.I. Norman, N. Brothers, and R. Gales. 2002. Long-term trends in the Australasian gannet (Morus serrator) population in Australia: the effect of climate change and commercial fisheries. Marine Biology 141: 263-269.
Abundance	Seabirds	Temperate	Great Australian Bight	10	1961	37	1	1	0	0	39	Yes	No	Bunce, A., F.I. Norman, N. Brothers, and R. Gales. 2002. Long-term trends in the Australasian gannet (Morus serrator) population in Australia: the effect of climate change and commercial fisheries. Marine Biology 141: 263-269.
Abundance	Seabirds	Temperate	Great Australian Bight	10	1939	62	1	1	0	0	64	Yes	No	Bunce, A., F.I. Norman, N. Brothers, and R. Gales. 2002. Long-term trends in the Australasian gannet (Morus serrator) population in Australia: the effect of climate change and commercial fisheries. Marine Biology 141: 263-269.
Abundance	Seabirds	Temperate	Great Australian Bight	10	1947	52	1	1	0	0	54	Yes	No	Bunce, A., F.I. Norman, N. Brothers, and R. Gales. 2002. Long-term trends in the Australasian gannet (Morus serrator) population in Australia: the effect of climate change and commercial fisheries. Marine Biology 141: 263-

														269.
Abundance	Zooplankton	Temperate	North Sea	1	1974	21	42	9	0	0	72	Yes	No	Greve, W., F. Reiners and J. Nast. 1996. Biocoenotic changes of the zooplankton in the German Bight: the possible effects of eutrophication and climate. ICES Journal of Marine Science. 53: 951-956.
Abundance	Benthic crustacea	Temperate	North-east Atlantic	100000	1973	23	7	1	0	0	31	No	No	Hemery, G., et al. 2008. Detecting the impact of oceano-climatic changes on marine ecosystems using a multivariate index: The case of the Bay of Biscay (North Atlantic-European Ocean). Global Change Biology 14: 27-38
Abundance	Bony fish	Temperate	North-east Atlantic	100000	1973	23	7	4	0	0	34	No	No	Hemery, G., et al. 2008. Detecting the impact of oceano-climatic changes on marine ecosystems using a multivariate index: The case of the Bay of Biscay (North Atlantic-European Ocean). Global Change Biology 14: 27-38
Abundance	Mammals	Temperate	North-east Atlantic	100000	1976	27	7	1	0	0	35	No	No	Hemery, G., et al. 2008. Detecting the impact of oceano-climatic changes on marine ecosystems using a multivariate index: The case of the Bay of Biscay (North Atlantic-European Ocean). Global Change Biology 14: 27-38
Abundance	Seabirds	Temperate	North-east Atlantic	100000	1976	27	7	1	0	0	35	No	No	Hemery, G., et al. 2008. Detecting the impact of oceano-climatic changes on marine ecosystems using a multivariate index: The case of the Bay of Biscay (North Atlantic-European Ocean). Global Change Biology 14: 27-38
Abundance	Zooplankton	Temperate	Southern Ocean	10000	1976	20	2	1	0	0	23	No	No	Loeb, V., et al. 1997. Effects of sea-ice extent and krill or salp dominance on the Antarctic food web. Nature, 387: 897-900.
Abundance	Zooplankton	Temperate	Southern Ocean	10000	1976	21	2	1	0	0	24	No	No	Loeb, V., et al. 1997. Effects of sea-ice extent and krill or salp dominance on the Antarctic food web. Nature, 387: 897-900.
Abundance	Zooplankton	Subtropical	Gulf of California	100000	1951	58	5	0	9	1	63	No	No	Ohman MD, Lavaniegos BE, Townsend AW. 2009. Multi-decadal variations in calcareous holozooplankton in the California Current System: Thecosome pteropods, heteropods, and foraminifera. Geophysical Research Letters. VOL. 36, L18608, doi:10.1029/2009GL039901
Abundance	Seabirds	Temperate	North-east Pacific	100	1972	23	1	1	0	0	25	Yes	No	Veit, R.R., J.A. McGowan, D.G. Ainley, T.R. Wahl and P. Pyle. 1997. Apex marine predator declines ninety percent in association with changing oceanic climate. Global Change Biology

														3:23-28.
Abundance	Seabirds	Polar	Southern Ocean	10	1952	48	7	1	0	0	56	No	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Seabirds	Polar	Southern Ocean	10	1961	39	7	1	0	0	47	No	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Seabirds	Polar	Southern Ocean	10	1964	37	7	1	0	0	45	No	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Seabirds	Subtropical	Southern Ocean	10	1971	25	7	1	0	0	33	No	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Seabirds	Temperate	Southern Ocean	10	1972	28	7	1	0	0	36	Yes	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Seabirds	Temperate	Southern Ocean	10	1960	40	7	1	0	0	48	Yes	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Seabirds	Temperate	Southern Ocean	10	1965	31	7	1	0	0	39	Yes	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Seabirds	Temperate	Southern Ocean	10	1956	41	7	1	0	0	49	Yes	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Seabirds	Temperate	SOUTHERN OCEAN	10	1976	26	7	1	0	0	34	Yes	No	Weimerskirch, H., P. Inchausti, C. Guinet and C. Barbraud. 2003. Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. Antarctic Science 15:249-256.
Abundance	Phytoplankton	Temperate	North-east Atlantic	1E+08	1958	45	1	1	0	0	47	No	No	Richardson, A.J. and D.S. Schoeman. 2004. Climate impacts on plankton ecosystems in the northeast Atlantic. Science 305:1609-1612
Abundance	Phytoplankton	Temperate	North-east	1000000	1948	48	1	2	0	0	51	Yes	No	Reid, P.C., M. Edwards, H.G. Hunt and A.J. Warner. 1998. Phytoplankton change in the North

			Atlantic											Atlantic. Nature 391:546
Abundance	Phytoplankton	Temperate	North Sea	1000000	1948	48	1	1	0	0	50	Yes	No	Reid, P.C., M. Edwards, H.G. Hunt and A.J. Warner. 1998. Phytoplankton change in the North Atlantic. Nature 391:546
Abundance	Phytoplankton	Temperate	Southern Ocean	100000	1978	29	1	2	0	0	32	Yes	No	Montes-Hugo, M., et al.. 2009. Recent changes in phytoplankton communities associated with rapid regional climate change along the western Antarctic Peninsula. Science 323: 147
Abundance	Seabirds	Temperate	Southern Ocean	10	1978	27	3	3	0	0	33	Yes	No	Forcada, J., P.N. Trathan, K. Reid, E.J. Murphy and J.P. Croxall. 2006. Contrasting population changes in sympatric penguin species in association with climate warming. Global Change Biology 12:411-423
Abundance	Zooplankton	Subtropical	Southern Ocean	10000	1740	262	8	8	0	0	278	Yes	No	Field, D.B., T.R. Baumgartner, C.D. Charles, V. Ferreira-Bartrina and M.D. Ohman. 2006. Planktonic foraminifera of the Californian current reflect 20th-century warming. Science 311:62-66
Abundance	Zooplankton	Temperate	Southern Ocean	1000000	1926	78	2	2	0	0	82	Yes	No	Atkinson, A., V. Siegel, E. Pakhomov and P. Rothery. 2004. Long-term decline in krill stock and increase in salps within the Southern Ocean. Nature 432: 100-103
Abundance	Zooplankton	Temperate	North-east Atlantic	10000	1958	45	1	1	0	0	47	No	No	Kamenos, N.A. 2010. North Atlantic summers have warmed more than winters since 1353, and the response of marine zooplankton. Proceedings of the National Academy of Science USA. 107: 22442-22447.
Abundance	Larval bony fish	Temperate	North-east Atlantic	1000000	1958	48	1	1	0	0	50	Yes	No	Kirby, R.R., D.G. Johns and J.A. Lindley. 2006. Fathers in hot water: rising sea temperatures and a Northeastern Atlantic pipefish baby boom. Biology Letters 2: 597-600
Abundance	Bony fish	Temperate	English Channel	1000	1911	97	3	1	1	0	101	Yes	Yes	Genner MJ, et al. 2010. Body size-dependent responses of a marine fish assemblage to climate change and fishing over a century-long scale. Glob Change Biology 16(2): 517-527.
Abundance	Benthic algae	Temperate	Irish Sea	1	1962	41	3	1	0	0	45	Yes	No	Davies, A. J., M. P. Johnson, and C. A. Maggs. 2007. Limpet grazing and loss of Ascophyllum nodosum canopies on decadal time scales. Marine Ecology-Progress Series 339:131-141
Abundance	Benthic crustacea	Temperate	Irish Sea	1	1962	41	3	1	0	0	45	Yes	No	Davies, A. J., M. P. Johnson, and C. A. Maggs. 2007. Limpet grazing and loss of Ascophyllum nodosum canopies on decadal time scales. Marine Ecology-Progress Series 339:131-141

Abundance	Benthic molluscs	Temperate	Irish Sea	1	1962	41	3	1	0	0	45	Yes	No	Davies, A. J., M. P. Johnson, and C. A. Maggs. 2007. Limpet grazing and loss of Ascophyllum nodosum canopies on decadal time scales. Marine Ecology-Progress Series 339:131-141
Abundance	Benthic molluscs	Temperate	Irish Sea	1	1979	26	3	1	0	0	30	Yes	No	Davies, A. J., M. P. Johnson, and C. A. Maggs. 2007. Limpet grazing and loss of Ascophyllum nodosum canopies on decadal time scales. Marine Ecology-Progress Series 339:131-141
Abundance	Benthic crustacea	Temperate	North-east Atlantic	1	1981	28	13	5	0	0	46	No	No	Henderson, P. and D. Bird. 2010. Fish and macro-crustacean communities and their dynamics in the Severn Estuary. Marine Pollution Bulletin 61: 100-114.
Abundance	Bony fish	Temperate	North-east Atlantic	1	1981	28	13	7	0	0	48	No	No	Henderson, P. and D. Bird. 2010. Fish and macro-crustacean communities and their dynamics in the Severn Estuary. Marine Pollution Bulletin 61: 100-114.
Abundance	Benthic crustacea	Temperate	North-east Atlantic	1	1981	24	1	1	0	0	26	No	No	Henderson, P., R. Seaby, and J. Somes. 2006. A 25-year study of climatic and density-dependent population regulation of common shrimp Crangon crangon (Crustacea: Caridea) in the Bristol Channel. Journal of the Marine Biological Association of the UK 86:28
Abundance	Seagrass	Subtropical	North-west Atlantic	1	1985	20	2	5	5	0	27	Yes	Yes	Micheli, F., M. J. Bishop, C. H. Peterson, and J. Rivera. 2008. Alteration of seagrass species composition and function over two decades. Ecological Monographs 78:225-244
Abundance	Seagrass	Subtropical	North-west Atlantic	1	1986	19	2	5	5	0	26	Yes	Yes	Micheli, F., M. J. Bishop, C. H. Peterson, and J. Rivera. 2008. Alteration of seagrass species composition and function over two decades. Ecological Monographs 78:225-244
Abundance	Benthic cnidarians	Subtropical	North-east Pacific	1	1931	66	21	4	0	0	91	Yes	Yes	Sagarin, R. D., J. P. Barry, S. E. Gilman, and C. H. Baxter. 1999. Climate-related change in an intertidal community over short and long time scales. Ecological Monographs 69:465-490
Abundance	Benthic crustacea	Subtropical	North-east Pacific	1	1931	66	21	2	0	1	89	Yes	Yes	Sagarin, R. D., J. P. Barry, S. E. Gilman, and C. H. Baxter. 1999. Climate-related change in an intertidal community over short and long time scales. Ecological Monographs 69:465-490
Abundance	Benthic invert. (other)	Subtropical	North-east Pacific	1	1931	66	21	1	0	2	88	Yes	Yes	Sagarin, R. D., J. P. Barry, S. E. Gilman, and C. H. Baxter. 1999. Climate-related change in an intertidal community over short and long time scales. Ecological Monographs 69:465-490

Abundance	Benthic molluscs	Subtropical	North-east Pacific	1	1931	66	21	8	0	4	95	Yes	Yes	Sagarin, R. D., J. P. Barry, S. E. Gilman, and C. H. Baxter. 1999. Climate-related change in an intertidal community over short and long time scales. Ecological Monographs 69:465-490
Abundance	Zooplankton	Temperate	North Sea	1000000	1946	57	1	1	0	0	59	Yes	No	Kirby, R.R., G. Beaugrand, J.A. Lindley, A.J. Richardson, M. Edwards and P.C. Reid. 2007. Climate effects and benthic-pelagic coupling in the North Sea. Marine Ecology Progress Series. 330:31-38.
Abundance	Phytoplankton	Subtropical	North-west Atlantic	1000000	1961	42	1	1	0	0	44	Yes	No	Reid, C. 2005. Atlantic wide regime shift? Globec International Newsletter October 2005
Abundance	Phytoplankton	Temperate	North-west Atlantic	1000000	1960	43	1	1	0	0	45	Yes	No	Reid, C. 2005. Atlantic wide regime shift? Globec International Newsletter October 2005
Abundance	Turtles	Subtropical	PACIFIC	1	1985	20	1	1	0	0	22	Yes	No	Chaloupka M., N. Kamezaki and C. Limpus. 2008. Is climate change affecting the population dynamics of the endangered Pacific loggerhead sea turtle? Journal of Experimental Marine Biology and Ecology 356: 136-143
Abundance	Turtles	Subtropical	PACIFIC	1	1967	38	1	1	0	0	40	Yes	No	Chaloupka M., N. Kamezaki and C. Limpus. 2008. Is climate change affecting the population dynamics of the endangered Pacific loggerhead sea turtle? Journal of Experimental Marine Biology and Ecology 356: 136-143
Abundance	Turtles	Subtropical	PACIFIC	1	1977	28	1	1	0	0	30	Yes	No	Chaloupka M., N. Kamezaki and C. Limpus. 2008. Is climate change affecting the population dynamics of the endangered Pacific loggerhead sea turtle? Journal of Experimental Marine Biology and Ecology 356: 136-143
Abundance	Turtles	Subtropical	Pacific Ocean	1	1954	51	1	1	0	0	53	Yes	No	Chaloupka M., N. Kamezaki and C. Limpus. 2008. Is climate change affecting the population dynamics of the endangered Pacific loggerhead sea turtle? Journal of Experimental Marine Biology and Ecology 356: 136-143
Abundance	Zooplankton	Temperate	North-east Atlantic	1000000	1958	45	2	1	0	0	48	Yes	No	Bonnet et al. 2005. An overview of Calanus helgolandicus ecology in European waters. Progress in Oceanography 65: 1-53
Abundance	Phytoplankton	Polar	Arctic Ocean	10000000	1899	105	1	1	0	0	107	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Phytopl	Subtropical	South	10000000	1956	52	1	1	0	0	54	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global

	ankton		Pacific											phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Phytoplankton	Subtropical	North Pacific	10000000	1907	102	1	1	0	0	104	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Phytoplankton	Subtropical	South Atlantic	10000000	1911	93	1	1	0	0	95	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Phytoplankton	Temperate	North Atlantic	10000000	1903	104	1	1	0	0	106	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Phytoplankton	Tropical	Equatorial Pacific	10000000	1907	101	1	1	0	0	103	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Phytoplankton	Tropical	North Indian	10000000	1942	56	1	0	0	1	57	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Phytoplankton	Tropical	Equatorial Atlantic	10000000	1911	93	1	1	0	0	95	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Phytoplankton	Tropical	South Indian	10000000	1936	72	1	0	0	1	73	Yes	Yes	Boyce DG, Lewis MR, Worm B. 2010. Global phytoplankton decline over the past century. Nature 466: 591-596.
Abundance	Seabirds	Polar	Southern OCean	10	1959	39	1	1	0	0	41	No	No	Croxall, J.P., P.N. Trathan, and E.J. Murphy. 2002. Environmental change and Antarctic seabird populations. Science 297: 1510-1514.
Abundance	Seabirds	Temperate	Southern OCean	10	1978	22	1	2	0	0	25	No	No	Croxall, J.P., P.N. Trathan, and E.J. Murphy. 2002. Environmental change and Antarctic seabird populations. Science 297: 1510-1514.
Abundance	Seabirds	Temperate	Southern Ocean	10	1976	21	1	1	0	0	23	No	No	Croxall, J.P., P.N. Trathan, and E.J. Murphy. 2002. Environmental change and Antarctic seabird populations. Science 297: 1510-1514.
Abundance	Zooplankton	Temperate	North-east Atlantic	100000	1946	60	1	1	0	0	62	Yes	No	Gibbons M., A.J. Richardson. 2009. Patterns of Jellyfish Abundance in the North Atlantic. Hydrobiologia 616: 51-65.
Abundance	Zooplankton	Temperate	North-east Atlantic	1000000	1946	60	1	1	0	0	62	Yes	No	Gibbons M., A.J. Richardson. 2009. Patterns of Jellyfish Abundance in the North Atlantic. Hydrobiologia 616: 51-65.
Abundance	Bony fish	Temperate	North Sea	1000000	1925	81	1	0	0	1	82	Yes	No	Harris, M.P., et al.. 2006. A major increase in snake pipefish (Entelurus aequoreus) in northern European seas since 2003: potential impli

Abundance	Seabirds	Polar	Southern Ocean	1	1984	20	1	1	0	0	22	Yes	No	Jenouvrier, S., C. Barbraud and H. Weimerskirch. 2006. Sea ice affects the population dynamics of Adelie penguins in Terre Adelie. Polar Biology 29:413-423.
Abundance	Seabirds	Polar	Southern Ocean	1	1962	40	3	1	0	0	44	No	No	Jenouvrier, S., H. Weimerskirch, C. Barbraud, Y.-H. Park and B. Cazelles. 2005. Evidence of a shift in the cyclicity of Antarctic seabird dynamics linked to climate. Proceedings of the Royal Society B 272:887-895.
Abundance	Seabirds	Polar	Southern Ocean	1	1963	40	3	1	1	0	44	No	No	Jenouvrier, S., H. Weimerskirch, C. Barbraud, Y.-H. Park and B. Cazelles. 2005. Evidence of a shift in the cyclicity of Antarctic seabird dynamics linked to climate. Proceedings of the Royal Society B 272:887-895.
Abundance	Zooplankton	Temperate	North Sea	1000000	1958	48	4	2	1	1	54	Yes	No	Kirby R, G. Beaugrand, J.A. Lindley. 2008. Climate-induced effects on the meroplankton and the benthic-pelagic ecology of the North Sea. Limnology and Oceanography 53: 1805_1815.
Abundance	Seabirds	Temperate	North-east Atlantic	1000	1960	35	1	0	0	1	36	Yes	No	Munilla, I., C. Diez and A. Velando. 2007. Are edge bird populations doomed to extinction? A retrospective analysis of the common guillemot collapse in Iberia. Biological Conservation 137:359-371.
Abundance	Benthic crustacea	Temperate	Bering Sea	100000	1975	27	2	1	0	0	30	Yes	Yes	Orensanz J., B. Ernst, D.A. Armstrong, P. Stabeno and P. Livingston 2004. Contraction of the geographic range of distribution of snow crab (Chionoecetes opilio) in the eastern Bering Sea: An environmental ratchet? CalCOFI Report 45: 65-79.
Abundance	Bony fish	Temperate	Bering Sea	1000000	1960	41	3	2	0	0	46	No	No	Overland J.E., P.J. Stabeno. 2004. Is the climate of the Bering Sea warming and affecting the ecosystem? EOS 85: 309_316.
Abundance	Bony fish	Temperate	Bering Sea	1000000	1975	26	3	1	0	0	30	No	No	Overland J.E., P.J. Stabeno. 2004. Is the climate of the Bering Sea warming and affecting the ecosystem? EOS 85: 309_316.
Abundance	Seabirds	Temperate	South-west Pacific	10	1936	58	1	1	0	0	60	Yes	No	Peacock, L., M. Paulin and J. Darby. 2000. Investigations into climate influence on population dynamics of yellow-eyed penguins Megadyptes antipodes. New Zealand Journal of Zoology 27:317-325.
Abundance	Zooplankton	Subtropical	California	100000	1951	43	1	2	0	0	46	Yes	No	Roemmich, D. and J. McGowan. 1995. Climatic warming and the decline of zooplankton in the

			Current										California Current. Science 267:1324-1326
Abundance	Bony fish	Subtropical	North-east Pacific	100000	1983	25	11	1	0	0	37	Yes	No	Sydeman, W.Jet al. 2009. Seabirds and climate in the California Current--A synthesis of change. CalCOFI Report 50:82-104.
Abundance	Zooplankton	Tropical	Gulf of Guinea	10	1969	24	1	1	0	0	26	Yes	No	Wiafe, G., H.B. Yaqub, M.A. Mensah and C.L.J. Frid. 2008. Impact of climate change on long-term zooplankton biomass in the upwelling region of the Gulf of Guinea. ICES Journal of Marine Science 65: 318-324
Abundance	Zooplankton	Temperate	Southern Ocean	100000	1926	80	1	0	1	0	81	Yes	No	Ward, P., M.P. Meredith, M.J. Whitehouse and P. Rothery. 2008. The summertime plankton community at South Georgia (Southern Ocean): Comparing the historical (1926/1927) and modern (post 1995) records. Progress in Oceanography 78: 241-256
Abundance	Phytoplankton	Temperate	Mediterranean Sea	100000	1929	77	10	2	0	0	89	No	No	Tunin-Ley, A., F. Ibanez, J-P. Labat, A. Zingone and R. Lemee. 2009. Phytoplankton biodiversity and the NW Mediterranean Sea warming: changes in the dinoflagellate genus Ceratium in the 2Noth century. Marine Ecology Progress Series 375: 85-99
Abundance	Phytoplankton	Temperate	Mediterranean Sea	100000	1908	98	10	2	0	0	110	No	No	Tunin-Ley, A., F. Ibanez, J-P. Labat, A. Zingone and R. Lemee. 2009. Phytoplankton biodiversity and the NW Mediterranean Sea warming: changes in the dinoflagellate genus Ceratium in the 20th century. Marine Ecology Progress Series 375: 85-99
Abundance	Bony fish	Temperate	Bering Sea	1000000	1960	41	4	2	0	0	47	Yes	No	Sinclair, E.H., et al. 2008. Patterns in prey use among fur seals and seabirds in the Pribilof Islands. Deep-Sea Research II 55: 1897-1918
Abundance	Bony fish	Temperate	Bering Sea	1000000	1975	26	4	1	0	0	31	Yes	No	Sinclair, E.H., et al. 2008. Patterns in prey use among fur seals and seabirds in the Pribilof Islands. Deep-Sea Research II 55: 1897-1918
Abundance	Zooplankton	Temperate	Bering Sea	1000000	1960	41	4	1	0	0	46	No	No	Sinclair, E.H., et al. 2008. Patterns in prey use among fur seals and seabirds in the Pribilof Islands. Deep-Sea Research II 55: 1897-1918
Abundance	Seabirds	Subtropical	Southern Ocean	1000000	1981	27	12	2	2	0	41	Yes	No	Peron, C., et l 2010. Interdecadal changes in at-sea distribution and abundance of subantarctic seabirds along a latitudinal gradient in the Southern Indian Ocean. Global Change Biology 16: 189
Abundance	Seabirds	Temperate	Souther	1000000	1981	27	12	4	4	0	43	Yes	No	Peron, C., et l 2010. Interdecadal changes in at-

			n Ocean											sea distribution and abundance of subantarctic seabirds along a latitudinal gradient in the Southern Indian Ocean. Global Change Biology 16: 189
Abundance	Benthic crustacea	Temperate	Gulf of Alaska	10000	1972	34	2	1	0	0	37	Yes	Yes	Litzow, M.A. and L. Ciannelli. 2007. Oscillating trophic control induces community reorganization in a marine ecosystem. Ecology Letters 10: 1124-1134
Abundance	Bony fish	Temperate	Gulf of Alaska	10000	1972	34	2	1	0	0	37	Yes	Yes	Litzow, M.A. and L. Ciannelli. 2007. Oscillating trophic control induces community reorganization in a marine ecosystem. Ecology Letters 10: 1124-1134
Abundance	Phytoplankton	Temperate	North Sea	100000	1958	45	4	1	2	0	50	Yes	No	Edwards, M., D.G. Johns, S.C. Leterme, E. Svendsen and A.J. Richardson. 2006. Regional climate change and harmful algal blooms in the northeast Atlantic. Limnology and Oceanography 51: 820-829
Abundance	Phytoplankton	Temperate	North Sea	100000	1981	22	4	1	0	0	27	Yes	No	Edwards, M., D.G. Johns, S.C. Leterme, E. Svendsen and A.J. Richardson. 2006. Regional climate change and harmful algal blooms in the northeast Atlantic. Limnology and Oceanography 51: 820-829
Abundance	Benthic crustacea	Subtropical	East China Sea	100000	1959	47	2	2	0	0	51	Yes	No	Ma, Z., Z. Xu and J. Zhou. 2009. Effect of global warming on the distribution of Lucifer intermedius and L. hanseni (Decapoda) in the Changjiang estuary. Progress in Natural Science 19: 1389-1395
Abundance	Zooplankton	Subtropical	California Current	100000	1951	47	1	2	0	0	50	Yes	No	Lavaniegos, B.E. and M.D. Ohman. 1998. Hyperiid amphipods as indicators of climate change in the Californian Current. Proceedings of the Fourth International Crustacean Conference
Abundance	Benthic molluscs	Temperate	North Sea	1	1962	45	6	1	0	0	52	Yes	No	Wiltshire, K.H., et al.. 2010. Helgoland Roads, North Sea: 45 years of change. Estuaries and Coasts 33:295-310
Abundance	Phytoplankton	Temperate	North Sea	1	1962	45	6	0	0	1	51	Yes	No	Wiltshire, K.H., et al.. 2010. Helgoland Roads, North Sea: 45 years of change. Estuaries and Coasts 33:295-310
Abundance	Bony fish	Temperate	North-west Atlantic	1E+08	1963	40	4	2	0	0	46	Yes	No	Beaugrand, G., M. Edwards, K. Brander, C. Luczak and F. Ibanez. 2008. Causes and projections of abrupt climate-driven ecosystem shifts in the North Atlantic. Ecology Letters 11: 1157-1168

Abundance	Bony fish	Temperate	North Sea	1E+08	1962	44	4	1	0	0	49	Yes	No	Beaugrand, G., M. Edwards, K. Brander, C. Luczak and F. Ibanez. 2008. Causes and projections of abrupt climate-driven ecosystem shifts in the North Atlantic. Ecology Letters 11: 1157-1168
Abundance	Bony fish	Temperate	North Atlantic	1E+08	1976	25	4	1	0	0	30	Yes	No	Beaugrand, G., M. Edwards, K. Brander, C. Luczak and F. Ibanez. 2008. Causes and projections of abrupt climate-driven ecosystem shifts in the North Atlantic. Ecology Letters 11: 1157-1168
Abundance	Phytoplankton	Temperate	North Sea	1E+08	1958	48	4	1	0	0	53	Yes	No	Beaugrand, G., M. Edwards, K. Brander, C. Luczak and F. Ibanez. 2008. Causes and projections of abrupt climate-driven ecosystem shifts in the North Atlantic. Ecology Letters 11: 1157-1168
Abundance	Bony fish	Temperate	North Sea	1000000	1958	43	7	1	0	0	51	Yes	Yes	Beaugrand, G., K.M. Brander, J.A. Lindley, S. Soussi and P.C. Reid. 2003. Plankton effect on cod recruitment in the North Sea. Nature 426:661-664
Abundance	Zooplankton	Temperate	North Sea	1000000	1958	43	7	4	0	0	54	No	No	Beaugrand, G., K.M. Brander, J.A. Lindley, S. Soussi and P.C. Reid. 2003. Plankton effect on cod recruitment in the North Sea. Nature 426:661-664
Abundance	Zooplankton	Temperate	Bering Sea	100000	1975	31	1	2	0	0	34	Yes	No	Brodeur, R.D., et al.. 2008. Rise and fall of jellyfish in the eastern Bering Sea in relation to climate regime shifts. Progress in Oceanography 77: 103-111
Abundance	Larval bony fish	Subtropical	North-east Pacific	1000000	1951	52	49	25	0	24	126	Yes	Yes	Hsieh, C. H., et al. 2005.A comparison of long-term trends and variability in populations of larvae of exploited and unexploited fishes in the southern California. Progress in Oceanography 67: 160-185
Abundance	Bony fish	Temperate	North-east Atlantic	10000000	1960	41	2	1	0	0	44	Yes	No	Beaugrand, G. and P.C. Reid. 2003. Long-term changes in phytoplankton, zooplankton and salmon related to climate. Global Change Biology 9:801-817
Abundance	Zooplankton	Temperate	North-east Atlantic	10000000	1960	41	2	1	0	0	44	Yes	No	Beaugrand, G. and P.C. Reid. 2003. Long-term changes in phytoplankton, zooplankton and salmon related to climate. Global Change Biology 9:801-817
Abundance	Bony fish	Temperate	Tasman Sea	1000000	1880	131	52	23	14	0	206	Yes	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish

														fauna: a response to climate change and fishing practices. Global Ecology and Biogeography. Global Ecology and Biogeography 20: 58-72
Abundance	Bony fish	Temperate	Bass Strait	1000000	1880	131	52	4	0	0	187	Yes	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography. Global Ecology and Biogeography 20: 58-72Ecology and Biogeography.
Abundance	Bony fish	Temperate	Indian Ocean	1000000	1880	131	52	1	0	0	184	Yes	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography. Global Ecology and Biogeography 20: 58-72
Abundance	Non-bony fish	Temperate	Tasman Sea	1000000	1880	131	52	4	5	0	187	No	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography. Global Ecology and Biogeography 20: 58-72
Abundance	Non-bony fish	Temperate	Bass Strait	1000000	1880	131	52	1	0	0	184	No	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography. Global Ecology and Biogeography 20: 58-72
Abundance	Bony fish	Polar	North-east Atlantic	1000000	1970	29	8	4	0	0	41	Yes	Yes	Brunel T., Boucher J. 2007. Long-term trends in fish recruitment in the north-east Atlantic related to climate change. Fisheries Oceanography 16: 336-349.
Abundance	Bony fish	Temperate	North-east Atlantic	10000	1970	29	8	1	0	0	38	Yes	Yes	Brunel T., Boucher J. 2007. Long-term trends in fish recruitment in the north-east Atlantic related to climate change. Fisheries Oceanography 16: 336-349.
Abundance	Bony fish	Temperate	North-east Atlantic	1000000	1970	29	8	17	0	3	54	Yes	Yes	Brunel T., Boucher J. 2007. Long-term trends in fish recruitment in the north-east Atlantic related to climate change. Fisheries Oceanography 16: 336-349.
Abundance	Bony fish	Temperate	North-east Atlantic	100000	1970	29	8	11	1	2	48	Yes	Yes	Brunel T., Boucher J. 2007. Long-term trends in fish recruitment in the north-east Atlantic related to climate change. Fisheries Oceanography 16: 336-349.
Abundance	Larval bony	Subtropical	North-west	1000000	1951	48	34	16	0	12	98	Yes	No	Hsieh, C., H.J. Kim, W. Watson, E. Di Lorenzo and G. Sugihara. 2009. Climate-driven changes in

	fish		Pacific											abundance and distribution of larvae of oceanic fishes in the southern Californian region. Global Change Biology 15: 2137-2152
Abundance	Zooplankton	Temperate	North Sea	1000000	1958	42	3	2	0	0	47	Yes	No	Beaugrand, G. Long-term changes in copepod abundance and diversity in the north-east Atlantic in relation to fluctuations in the hydroclimatic environment. 2003. Fisheries Oceanography 12: 270-283
Abundance	Mammals	Temperate	North-east Atlantic	10000	1948	56	18	7	11	1	81	Yes	No	MacLeod, C.D., et al.. 2005. Climate change and the cetacean community of north-west Scotland. Biological Conservation 124: 477:483
Abundance	Benthic molluscs	Subtropical	California Current	100	1982	25	2	2	0	0	29	Yes	No	Rogers-Bennett, L. 2007. Is climate change contributing to range reductions and localized extinctions in Northern (Haloitis kamtschatkana) and flat (Haloitis walallensis) abalones? Bulletin of Marine Science 81: 283-293
Abundance	Bony fish	Temperate	Hudson Bay	1	1981	22	4	3	0	0	29	Yes	No	Gaston, A.J., K. Woo and M. Hipfner. 2003. Trends in forage fish populations in Northern Hudson Bay since 1981, as determined from the diet of nestling thick-billed murres Uria lomvia. Arctic 56:227-233
Abundance	Bony fish	Temperate	Hudson Bay	1	1980	20	4	3	0	0	27	Yes	No	Gaston, A.J., K. Woo and M. Hipfner. 2003. Trends in forage fish populations in Northern Hudson Bay since 1981, as determined from the diet of nestling thick-billed murres Uria lomvia. Arctic 56:227-233
Abundance	Zooplankton	Temperate	Hudson Bay	1	1981	22	4	0	1	0	26	No	No	Gaston, A.J., K. Woo and M. Hipfner. 2003. Trends in forage fish populations in Northern Hudson Bay since 1981, as determined from the diet of nestling thick-billed murres Uria lomvia. Arctic 56:227-233
Abundance	Seagrass	Temperate	North-east Atlantic	10	1932	59	1	1	0	0	61	Yes	No	Glemarec, M., Y. Le Faou and F. Cuq. 1997. Long-term changes of seagrass beds in the Glenan Archipelago (South Brittany). Oceanologica Acta 20: 217-227
Abundance	Larval bony fish	Temperate	English Channel	1	1924	77	1	1	0	0	79	No	No	Hawkins, S.J., A.J. Southward and M.J. Genner. 2003. Detection of environmental change in a marine ecosystem-evidence from the western English Channel. The Science of the Total Environment 310:245-256
Abundance	Zooplankton	Temperate	English Channel	1	1924	77	2	2	0	0	81	No	No	Hawkins, S.J., A.J. Southward and M.J. Genner. 2003. Detection of environmental change in a

														marine ecosystem-evidence from the western English Channel. The Science of the Total Environment 310:245-256
Abundance	Bony fish	Temperate	North Sea	1000000	1980	20	2	1	1	0	23	No	No	Hedger, R., et al. 2004. Analysis of the spatial distributions of mature cod (Gadus morhua) and haddock (Melanogrammus aeglefinus) abundance in the North Sea (1980-1999) using generalised additive models. Fisheries Research 70: 17-25
Abundance	Phytoplankton	Temperate	Kattegat	10000	1979	28	2	2	0	0	32	Yes	Yes	Henriksen, P. 2009. Long-term changes in phytoplankton in the Kattegat, the Belt Sea, the Sound and the western Baltic Sea. Journal of Sea Research 61: 114-123
Abundance	Bony fish	Temperate	North Sea	1000000	1958	47	11	4	0	0	62	Yes	No	Kirby, R.R. and G. Beaugrand. 2009. Trophic amplification of climate warming. Proceedings of the Royal Society of London Series B: Biological Sciences 276: 4095-4103
Abundance	Phytoplankton	Temperate	North Sea	1000000	1958	47	11	1	0	0	59	Yes	No	Kirby, R.R. and G. Beaugrand. 2009. Trophic amplification of climate warming. Proceedings of the Royal Society of London Series B: Biological Sciences 276: 4095-4103
Abundance	Zooplankton	Temperate	North Sea	1000000	1958	47	11	7	0	0	65	Yes	No	Kirby, R.R. and G. Beaugrand. 2009. Trophic amplification of climate warming. Proceedings of the Royal Society of London Series B: Biological Sciences 276: 4095-4103
Abundance	Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	46	1	0	0	72	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Abundance	Bony fish	Temperate	Bering Sea	1000000	1982	25	46	1	0	1	72	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Abundance	Bony fish	Subtropical	South west Indian Ocean	10	1989	19	23	11	5	5	53	NA	NA	Lloyd, P., S. Weeks, M. Magno-Canto, G. Plaganyi and E. Plaganyi. 2010 Ocean warming alters species abundance patterns and increases species richness in an African sub-tropical reef-fish community. Fisheries Oceanography 21: 78-94
Abundance	Seabirds	Temperate	North-east Atlantic	100000	1986	19	1	1	0	0	21	No	No	Frederiksen, M., M. Edwards, R.A. Mavor and S. Wanless. 2007. Regional and annual variation in black-legged kittiwake breeding productivity is related to sea surface temperature. Marine

														Ecology Progress Series 350:137-143.
Abundance	Seabirds	Temperate	North Sea	10000	1986	19	1	3	0	1	23	No	No	Frederiksen, M., M. Edwards, R.A. Mavor and S. Wanless. 2007. Regional and annual variation in black-legged kittiwake breeding productivity is related to sea surface temperature. Marine Ecology Progress Series 350:137-143.
Abundance	Seabirds	Temperate	Irish Sea	100000	1986	19	1	1	0	0	21	No	No	Frederiksen, M., M. Edwards, R.A. Mavor and S. Wanless. 2007. Regional and annual variation in black-legged kittiwake breeding productivity is related to sea surface temperature. Marine Ecology Progress Series 350:137-143.
CALCIFICATION														
Calcification	Benthic cnidarians	Tropical	South-west Pacific	10000	1900	106	1	1	0	0	108	Yes	No	De'ath, G., J. M. Lough and K.E. Fabricius. 2009. Declining coral calcification on the Great Barrier Reef. Science 323: 116-119
Calcification	Benthic cnidarians	Temperate	Tasman Sea	1	1650	343	1	1	0	0	345	NA	NA	Thresher, R., et al.. 2004. Oceanic evidence of climate change in southern Australia over the last three centuries. Geophysical Research Letters 31 doi:10.1029/2003GL018869
Calcification	Benthic cnidarians	Tropical	Red Sea & Gulf of Aden	1	1930	81	1	1	0	0	83	Yes	No	Cantin, N.E.,A.L. Cohen, K.B. Karnauskas, A.M. Tarrant and D.C. McCorkle. 2010. Ocean warming slows coral growth in the Red Sea. Science 329: 322-325.
Calcification	Benthic cnidarians	Tropical	Caribbean	1	1860	148	1	0	4	0	149	NA	NA	Carilli J.E., Norris R.D., Black B., Walsh S.M., McField M. 2010. Century-scale records of coral growth rates indicate that local stressors reduce coral thermal tolerance threshold. Global Change Biology 16: 1247-1257.
Calcification	Zooplankton	Temperate	Southern Ocean	1000000	-49000	51005	1	1	0	0	51007	Yes	No	Moy, A.D., Howard, W.R., Bray, S.G. and T.W. Trull. 2009. Reduced calcification in modern Southern Ocean planktonic foraminifera. Nature Geoscience 2:276-280.
Calcification	Zooplankton	Tropical	Arabian Sea	1	1890	106	1	1	0	0	108	Yes	Yes	de Moel, H., et al.. 2009. Planktic foraminiferal shell thinning in the Arabian Sea due to anthropogenic ocean acidification? Biogeosciences 6: 1917-1925
Calcification	Phytoplankton	Temperate	North Atlantic	1	1789	216	1	1	0	0	218	No	No	Iglesias-Rodriguez, M.D. et al. 2008. Phytoplankton calcification in a high-CO2 world
Calcification	Phytoplankton	Temperate	North Atlantic	1	1789	216	1	2	0	0	219	Yes	No	Halloran, P.R., I.R. Hall E. Colmenero-Hidalgo and R.E.M. Rickaby. 2008. Evidence for a multi-species coccolith volume change over the past

														two centuries: understanding a potential ocean acidification response. Biogeosciences 5:1651-1655
Calcification	Benthic cnidarians	Tropical	Caribbean	1E+08	1974	32	2	1	0	0	35	Yes	No	Edmunds P.J. 2007. Evidence for a decadal-scale decline in the growth rates of juvenile scleractinian corals. Marine Ecology Progress Series 341: 1-13.
Calcification	Benthic cnidarians	Tropical	Pacific Ocean	10	1974	33	5	2	0	0	40	Yes	No	Manzello, D.P. 2010. Coral growth with thermal stress and ocean acidification: lessons from the eastern tropical Pacific. Coral Reefs 29:749-758
Calcification	Benthic cnidarians	Tropical	Pacific Ocean	10	1983	24	5	1	0	0	30	Yes	No	Manzello, D.P. 2010. Coral growth with thermal stress and ocean acidification: lessons from the eastern tropical Pacific. Coral Reefs 29:749-758
Calcification	Benthic cnidarians	Tropical	Pacific Ocean	10	1979	28	5	1	0	1	34	Yes	No	Manzello, D.P. 2010. Coral growth with thermal stress and ocean acidification: lessons from the eastern tropical Pacific. Coral Reefs 29:749-758
Calcification	Benthic cnidarians	Tropical	Indian Ocean	1000	1984	22	1	8	0	0	31	Yes	No	Tanzil, J.T.I., Brown, B.E., Tudhope, A.W., Dunne, R.P. Decline in skeletal growth of the coral Porites lutea from the Andaman Sea, South Thailand between 1984 and 2005. Coral Reefs 28: 519-528.
Calcification	Benthic cnidarians	Subtropical	North Atlantic	100	1937	60	1	0	1	0	61	Yes	No	Helmle, K.P., Dodge, R.E., Swart, P.K., Gledhill, D.K., Eakin, C.M. (2011) Growth rates of Florida corals from 1937 to 1996 and their response to climate change. Nature Communications 2: 215
COMMUNITY CHANGE														
Community change	Benthic molluscs	Temperate	North Sea	1000000	1958	48	7	1	0	0	56	Yes	Yes	Kirby, R.R., G. Beaugrand and J.A. Lindley. 2009. Synergistic effects of climate and fishin in a marine ecosystem. Ecosystems 12:548-561
Community change	Phytoplankton	Temperate	North Sea	1000000	1949	57	7	1	0	0	65	Yes	Yes	Kirby, R.R., G. Beaugrand and J.A. Lindley. 2009. Synergistic effects of climate and fishin in a marine ecosystem. Ecosystems 12:548-561
Community change	Bony fish	Temperate	North Sea	1000000	1985	22	1	1	0	0	24	Yes	No	Hiddink, J.G. and R. ter Hofstede. 2008. Climate induced increases in species richness of marine fishes. Global Change Biology 14: 453-460
Community change	Bony fish	Temperate	Irish Sea	1	1981	25	2	1	0	0	28	No	No	Henderson, P.A. 2007. Discrete and continuous change in the fish community of the Bristol Channel in response to climate change. Journal of the Marine Biological Association of the United Kingdom 87:589-598
Community	Benthic	Temperate	North-	1	-	12001	1	1	0	0	120	No	No	Warwick R.M., S.M. Turk SM. 2002 Predicting

change	mollusc s		east Atlantic		10000						03			climate change, effects on marine biodiversity: comparison of recent and fossil molluscan death assemblages. Journal of the Marine Biological Association of the United Kingdom, 82:847-850.
Community change	Bony fish	Temperate	Gulf of St Lawrenc e	100000	1971	35	1	1	0	0	37	Yes	Yes	Benoit, H.P. and D.P. Swain. 2008. Impacts of environmental change and direct and indirect harvesting effects on the dynamics of a marine fish community. Canadian Journal of Fisheries and Aquatic Sciences. 65: 2088-2104
Community change	Benthic crustace a	Polar	Arctic Ocean	1000	1908	100	1	0	1	0	101	No	No	Berge J, et al. 2009. Changes in the decapod fauna of an Arctic fjord during the last 100 years (1908_2007). Polar Biology 32:953-961
Community change	Bony fish	Subtropical	Gulf of Mexico	1000	1971	36	17	1	0	0	54	Yes	No	Fodrie, F.J., K.L. Heck, S.P. Powers, W.M. Graham and K.L. Robinson. 2010. Climate-related, decadal-scale assemblage changes of seagrass-associated fishes in the northern Gulf of Mexico. Global Change Biology 16: 48-59
Community change	Bony fish	Temperate	North-west Atlantic	10	1959	47	25	8	0	0	80	Yes	Yes	Collie, J.S, Wood A.D. and Jeffries H.P. 2008 Long-term shifts in the species composition of a coastal fish community. Canadian Journal of Fisheries and Aquatic Sciences. 65: 1352-1365
Community change	Benthic mollusc s	Temperate	North-east Atlantic	1	1980	27	2	1	0	0	30	No	No	Hawkins, S. J., et al. 2008. Complex interactions in a rapidly changing world: responses of rocky shore communities to recent climate change. Climate Research 37: 123-133
Community change	Benthic mollusc s	Temperate	North-east Atlantic	1	1983	24	2	2	0	0	28	No	No	Hawkins, S. J., et al. 2008. Complex interactions in a rapidly changing world: responses of rocky shore communities to recent climate change. Climate Research 37: 123-133
Community change	Bony fish	Temperate	North-east Atlantic	1	1981	28	13	1	0	0	42	No	No	Henderson, P. and D. Bird. 2010. Fish and macro-crustacean communities and their dynamics in the Severn Estuary. Marine Pollution Bulletin 61: 100-114.
Community change	Benthic invert. (other)	Subtropical	North-east Pacific	10000	1970	33	2	2	0	0	37	Yes	No	Smith, J. R., P. Fong, and R. F. Ambrose. 2006. Dramatic declines in mussel bed community diversity: Response to climate change? Ecology 87:1153-1161.
Community change	Benthic invert. (other)	Temperate	North-east Pacific	1	1970	33	2	1	0	0	36	Yes	No	Smith, J. R., P. Fong, and R. F. Ambrose. 2006. Dramatic declines in mussel bed community diversity: Response to climate change? Ecology 87:1153-1161.
Community	Seabirds	Subtropical	North-	10	1975	33	11	1	0	0	45	Yes	No	Sydeman, W.J., et al. 2009. Seabirds and climate

change			east Pacific											in the California Current--A synthesis of change. CalCOFI Report 50:82-104.
Community change	Zooplankton	Subtropical	North-east Pacific	10	1975	33	11	1	0	0	45	Yes	No	Sydeman, W.J., et al. 2009. Seabirds and climate in the California Current--A synthesis of change. CalCOFI Report 50:82-104
Community change	Zooplankton	Temperate	North Sea	1	1962	45	6	1	0	0	52	No	No	Wiltshire, K.H., et al.. 2010. Helgoland Roads, North Sea: 45 years of change. Estuaries and Coasts 33:295-310
Community change	Zooplankton	Temperate	North Sea	1E+08	1958	48	4	1	0	0	53	Yes	No	Beaugrand, G., M. Edwards, K. Brander, C. Luczak and F. Ibanez. 2008. Causes and projections of abrupt climate-driven ecosystem shifts in the North Atlantic. Ecology Letters 11: 1157-1168
Community change	Zooplankton	Temperate	North Sea	1000000	1958	42	3	1	0	0	46	Yes	No	Beaugrand, G. Long-term changes in copepod abundance and diversity in the north-east Atlantic in relation to fluctuations in the hydroclimatic environment. 2003. Fisheries Oceanography 12: 270-283
Community change	Zooplankton	Temperate	North Sea	1000000	1958	47	11	1	0	0	59	Yes	No	Kirby, R.R. and G. Beaugrand. 2009. Trophic amplification of climate warming. Proceedings of the Royal Society of London Series B: Biological Sciences 276: 4095-4103
Community change	Bony fish	Temperate	Bering Sea	1000000	1982	25	46	1	0	0	72	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Community change	Bony fish	Subtropical	South west Indian Ocean	10	1989	19	45	2	0	0	66	NA	NA	Lloyd, P., S. Weeks, M. Magno-Canto, G. Plaganyi and E. Plaganyi. 2010 Ocean warming alters species abundance patterns and increases species richness in an African sub-tropical reef-fish community. Fisheries Oceanography 21: 78-94
DEMOGRAPHY														
Demography	Benthic molluscs	Temperate	North Sea	100	1973	29	3	1	0	0	33	Yes	No	Philippart, C. J. M., et al. 2003. Climate-related changes in recruitment of the bivalve Macoma balthica. Limnology and Oceanography 48:2171-2185.
Demography	Turtles	Subtropical	North-west Atlantic	100	1981	25	1	1	0	0	27	No	No	Hawkes, L., M. A. C. Broderick, M. H. Godfrey, and B. J. Godley. 2007. Investigating the potential impacts of climate change on a marine turtle population. Global Change Biology 13:923-932.

Demography	Benthic crustacea	Subtropical	Indian Ocean	1000	1974	32	1	1	0	0	34	NA	NA	Caputi, N., R. Melville-Smith, S. de Lestang, A. Pearce, and M. Feng. 2010. The effect of climate change on the western rock lobster (Panulirus cygnus) fishery of Western Australia. Canadian Journal of Fisheries and Aquatic Sciences 67:85-96.
Demography	Bony fish	Temperate	North-west Atlantic	10	1959	47	25	2	0	0	74	Yes	Yes	Collie, J.S, Wood A.D. and Jeffries H.P. 2008 Long-term shifts in the species composition of a coastal fish community. Canadian Journal of Fisheries and Aquatic Sciences. 65: 1352-1365
Demography	Bony fish	Temperate	North Sea	100000	1970	35	2	2	0	0	39	NA	NA	Teal, L.R., J.J. de Leeuw, H.W. van der Veer and A.D. Rijnsdorp. 2008. Effects of climate change on growth of 0-group sole and plaice. Marine Ecology Progress Series 358:219-230
Demography	Seabirds	Polar	Southern Ocean	10	1952	49	1	1	0	0	51	No	No	Barbraud, C. and H. Weimerskirch. 2001. Emperor penguins and climate change. Nature 411:183-186.
Demography	Seabirds	Temperate	North Sea	1	1958	48	1	1	0	0	50	Yes	No	Lewis, S., D.A. Elston, F. Daunt, B. Cheney and P.M. Thompson. 2009. Effects of extrinsic and intrinsic factors on breeding success in a long lived seabird. Oikos 118:521.528.
Demography	Seabirds	Temperate	Irish Sea	10	1985	21	1	1	0	0	23	Yes	Yes	Votier, S.C., et al. 2008. Recruitment and survival of immature seabirds in relation to oil spills and climate variability. Journal of Animal Ecology 77:974-983.
Demography	Seabirds	Subtropical	Indian Ocean	10	1983	24	1	0	1	0	25	Yes	Yes	Rivalan, P., C. Barbraud, P. Inchausti and H. Weimerskirch. 2010. Combined impacts of longline fisheries and climate on the persistence of the Amsterdam Albatross Diomedia amsterdamensis. Ibis 152:6-18.
Demography	Benthic molluscs	Polar	Arctic Ocean	1	1967	32	1	1	0	0	34	NA	NA	Sejr M.K., M.E. Blicher and S. Rysgaard. 2009. Sea ice cover affects inter-annual and geographic variation in growth of the Arctic cockle Clinocardium ciliatum (Bivalvia) in Greenland. Marine Ecology Progress Series 389:149-158
Demography	Benthic molluscs	Polar	Arctic Ocean	1	1969	33	1	1	0	0	35	NA	NA	Sejr M.K., M.E. Blicher and S. Rysgaard. 2009. Sea ice cover affects inter-annual and geographic variation in growth of the Arctic cockle Clinocardium ciliatum (Bivalvia) in Greenland. Marine Ecology Progress Series 389:149-158
Demography	Benthic mollusc	Polar	Arctic	1	1982	22	1	0	1	0	23	NA	NA	Sejr M.K., M.E. Blicher and S. Rysgaard. 2009. Sea ice cover affects inter-annual and geographic

	s		Ocean											variation in growth of the Arctic cockle Clinocardium ciliatum (Bivalvia) in Greenland. Marine Ecology Progress Series 389:149-158
Demograph y	Benthic mollusc s	Temperate	Arctic Ocean	1	1983	25	1	0	1	0	26	NA	NA	Sejr M.K., M.E. Blicher and S. Rysgaard. 2009. Sea ice cover affects inter-annual and geographic variation in growth of the Arctic cockle Clinocardium ciliatum (Bivalvia) in Greenland. Marine Ecology Progress Series 389:149-158
Demograph y	Seabirds	Subtropical	North-east Pacific	10	1971	37	11	0	0	1	48	Yes	No	Sydeman, W.J., et al. 2009. Seabirds and climate in the California Current--A synthesis of change. CalCOFI Report 50:82-104.
Demograph y	Seabirds	Subtropical	North-east Pacific	10	1969	28	11	2	0	0	41	No	No	Sydeman, W.J., et al. 2001. Climate change, reproductive performance and diet composition of marine birds in the southern California Current system, 1969-1997. Progress in Oceanography 49:309-329.
Demograph y	Seabirds	Subtropical	North-east Pacific	10	1972	26	11	8	0	0	45	No	No	Sydeman, W.J., et al. 2001. Climate change, reproductive performance and diet composition of marine birds in the southern California Current system, 1969-1997. Progress in Oceanography 49:309-329.
Demograph y	Zooplan kton	Temperate	North Sea	1000000	1958	43	7	1	0	0	51	NA	NA	Beaugrand, G., K.M. Brander, J.A. Lindley, S. Soussi and P.C. Reid. 2003. Plankton effect on cod recruitment in the North Sea. Nature 426:661-664
Demograph y	Seabirds	Temperate	North-west Pacific	10	1975	27	1	1	0	0	29	No	No	Gjerdum, C., et al. 2003. Tufted puffin reproduction reveals ocean climate variability. Proceedings of the National Academy of Science 100: 9377-9382
Demograph y	Seagrass	Temperate	Mediterr anean Sea	1000	1967	26	1	1	0	0	28	NA	NA	Marba, N., and C.M. Duarte. 1997. Interannual changes in seagrass (Posedonia oceanica) growth and environmental change in the Spanish Mediterranean littoral zone. Limnology and Oceanography. 42(5): 800-810.
Demograph y	Benthic invert. (other)	Subtropical	Mediterr anean Sea	100	1970	37	1	1	0	0	39	NA	NA	Staehli, A., R. Schaerer, K. Hoelzle and G. Ribi. 2008. Temperature induced disease in the starfish Astropecten jonstoni. Journal of the Marine Biological Association 2 - Biodiversity Records
Demograph y	Seabirds	Temperate	Irish Sea	1	1965	44	1	1	0	0	46	NA	NA	Riou, S., et al.2011. Recent impact of anthropogenic climate change on a higher marine predator in western Britain. Marine Ecology Progress Series. 422: 105-112

Demography	Benthic algae	Temperate	North-west Atlantic	10	1979	24	1	1	0	0	26	NA	NA	Keser, M., J.T. Swenarton and J.F. Foertch. 2005. Effects of thermal input and climate change on growth of Ascophyllum nodosum (Fucales, Phaeophyceae) in eastern Long Island Sound (USA). Journal of Sea Research 54:211-220
Demography	Benthic cnidarians	Tropical	Pacific Ocean	1E+08	1979	21	1	1	0	0	23	NA	NA	Hoegh-Guldberg, O. (1999) Climate Change, coral bleaching and the world's coral reefs. Marine and Freshwater Research 50: 839-866.
Demography	Benthic cnidarians	Tropical	Pacific Ocean	1E+08	1870	121	1	1	0	0	123	NA	NA	Glynn, P.W. (1993) Coral reef bleaching: ecological perspectives. Coral Reefs 12: 1-17.
Demography	Benthic cnidarians	Tropical	South-west Pacific	1000000	1980	21	1	1	0	0	23	NA	NA	Bellwood, D.R., T.P. Hughes, C. Folke and M. Nystrom. (2004) Confronting the coral reef crisis. Nature 429: 827-833.
Demography	Bony fish	Subtropical	Tasman Sea	10	1952	43	1	1	0	0	45	NA	NA	Neuheimer, A.B., Thresher, R.E., Lyle, J.M. and Semmens, J.M. (2011) Tolerance limit for fish growth exceeded by warming waters. Nature Climate Change 1: 110-113
Demography	Bony fish	Subtropical	Tasman Sea	10	1932	69	1	1	0	0	71	NA	NA	Neuheimer, A.B., Thresher, R.E., Lyle, J.M. and Semmens, J.M. (2011) Tolerance limit for fish growth exceeded by warming waters. Nature Climate Change 1: 110-113
Demography	Bony fish	Temperate	Tasman Sea	10	1924	75	1	1	0	0	77	NA	NA	Neuheimer, A.B., Thresher, R.E., Lyle, J.M. and Semmens, J.M. (2011) Tolerance limit for fish growth exceeded by warming waters. Nature Climate Change 1: 110-113
Demography	Bony fish	Temperate	Tasman Sea	10	1910	91	1	2	0	0	94	NA	NA	Neuheimer, A.B., Thresher, R.E., Lyle, J.M. and Semmens, J.M. (2011) Tolerance limit for fish growth exceeded by warming waters. Nature Climate Change 1: 110-113
Demography	Turtles	Subtropical	Mediterranean Sea	100	1984	19	1	1	0	0	21	No	No	Mazaris, A. D., A. S. Kallimanis, S. P. Sgardelis, and J. D. Pantis. 2008. Do long-term changes in sea surface temperature at the breeding areas affect the breeding dates and reproduction performance of Mediterranean loggerhead turtles? Implications for c
Demography	Benthic invert. (other)	Polar	Southern Ocean	1000	1985	19	1	1	0	0	21	NA	NA	Barnes, D.K.A., K. Webb and K. Linse. 2006. Slow growth of Antarctic Bryozoans increases over 20 years and is anomalously high in 2003. Marine Ecology Progress Series 314:187-195

Demography	Seabirds	Temperate	North Sea	10000	1986	19	1	3	0	1	23	No	No	Frederiksen, M., M. Edwards, R.A. Mavor and S. Wanless. 2007. Regional and annual variation in black-legged kittiwake breeding productivity is related to sea surface temperature. Marine Ecology Progress Series 350:137-143.
Demography	Seabirds	Temperate	Irish Sea	100000	1986	19	1	1	0	0	21	No	No	Frederiksen, M., M. Edwards, R.A. Mavor and S. Wanless. 2007. Regional and annual variation in black-legged kittiwake breeding productivity is related to sea surface temperature. Marine Ecology Progress Series 350:137-143.
Demography	Seabirds	Temperate	North-east Atlantic	100000	1986	19	1	1	0	0	21	No	No	Frederiksen, M., M. Edwards, R.A. Mavor and S. Wanless. 2007. Regional and annual variation in black-legged kittiwake breeding productivity is related to sea surface temperature. Marine Ecology Progress Series 350:137-143.
DISTRIBUTION														
Distribution	Non-bony fish	Temperate	Mediterranean Sea	10000	1870	140	1	1	0	0	142	No	No	Francour, P., J.M. Cottalorda, M. Aubert, S. Bava, M. Colombey, P. Gilles, H. Kara, P. Lelong, L. Mangialajo, R. Miniconi and J-P. Quignard 2010 Recent occurrences of Opah, Lampris Guttatus (Actinopterygii, Lampriformes, Lampridae) in the Western Mediterr
Distribution	Bony fish	Temperate	North-east Atlantic	1000000	1966	30	1	1	0	0	32	No	No	Swaby, S.E. and G.W. Potts 1999. The sailfin dory, a first British record. Journal of Fish Biology 54: 1338-1340
Distribution	Bony fish	Subtropical	Mediterranean Sea	100000	1982	22	1	1	0	0	24	Yes	No	Tsikliras, A.C. 2008. Climate-related geographic shift and sudden population increase of a small pelagic fish (Sardinella aurita) in the estern Mediterranean Sea. Marine Biology Research 4: 477-481
Distribution	Bony fish	Temperate	North Sea	100000	1969	40	2	2	0	0	44	Yes	No	van Hal, R., K. Smits and A.D. Rijnsdorp 2010. How climate warming impacts the distribution and abundance of two small flatfish species in the North Sea. Journal of Sea Research 64: 76-84.
Distribution	Bony fish	Temperate	Mediterranean Sea	100000	1950	55	1	1	0	0	57	Yes	No	Sabates, A., P. Martin, J. Lloret and V. Raya. 2006. Sea warming and fish distribution: the case of the small pelagic fish, Sardinella aurita, in the western Mediterranean. Global Change Biology. 12: 2209-2219
Distribution	Benthic crustacea	Temperate	North-east Atlantic	10000	1972	35	2	2	0	0	39	Yes	No	Wethey, D. S. and S. A. Woodin. 2008. Ecological hindcasting of biogeographic responses to climate change in the European

														intertidal zone. Hydrobiologia 606:139-151.
Distribution	Benthic invert. (other)	Temperate	North-east Atlantic	10000	1923	84	2	1	0	0	87	No	No	Wethey, D. S. and S. A. Woodin. 2008. Ecological hindcasting of biogeographic responses to climate change in the European intertidal zone. Hydrobiologia 606:139-151.
Distribution	Benthic mollusc s	Subtropical	South-east Pacific	100000	1947	54	10	0	1	1	64	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Distribution	Benthic mollusc s	Subtropical	South-east Pacific	100000	1949	52	10	0	1	1	62	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Distribution	Benthic mollusc s	Subtropical	South-east Pacific	100000	1958	43	10	0	1	0	53	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Distribution	Benthic mollusc s	Subtropical	South-east Pacific	100000	1962	39	10	1	1	2	50	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Distribution	Benthic mollusc s	Subtropical	South-east Pacific	100000	1975	26	10	1	1	0	37	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Distribution	Benthic crustace a	Temperate	English Channel	100000	1964	38	2	2	0	0	42	Yes	No	Herbert, R. J. H., S. J. Hawkins, M. Sheader, and A. J. Southward. 2003. Range extension and reproduction of the barnacle Balanus perforatus in the eastern English Channel. Journal of the Marine Biological Association of the United Kingdom 83:73-82.
Distribution	Benthic crustace a	Temperate	English Channel	100000	1955	47	2	1	0	0	50	Yes	No	Herbert, R. J. H., A. J. Southward, M. Sheader, and S. J. Hawkins 2007 Influence of recruitment and temperature on the distribution of intertidal barnacles in the English Channel. Journal of the Marine Biological Association of the United Kingdom 87: 487-
Distribution	Benthic crustace a	Temperate	English Channel	100000	1955	50	2	1	0	0	53	Yes	No	Herbert, R. J. H., A. J. Southward, M. Sheader, and S. J. Hawkins 2007 Influence of recruitment and temperature on the distribution of intertidal barnacles in the English Channel. Journal of the Marine Biological Association of the United

														Kingdom 87: 487-
Distribution	Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	37	10	8	10	94	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Distribution	Benthic algae	Temperate	North-east Atlantic	10000	1960	47	37	4	1	4	88	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Distribution	Benthic molluscs	Subtropical	North-east Atlantic	1000	1955	51	1	1	0	0	53	Yes	Yes	Lima, F. P., N. Queiroz, P. A. Ribeiro, S. J. Hawkins, and A. M. Santos. 2006. Recent changes in the distribution of a marine gastropod, Patella rustica Linnaeus, 1758, and their relationship to unusual climatic events. Journal of Biogeography 33:812-822
Distribution	Benthic molluscs	Temperate	North-east Atlantic	1000	1955	51	1	1	0	0	53	Yes	Yes	Lima, F. P., N. Queiroz, P. A. Ribeiro, S. J. Hawkins, and A. M. Santos. 2006. Recent changes in the distribution of a marine gastropod, Patella rustica Linnaeus, 1758, and their relationship to unusual climatic events. Journal of Biogeography 33:812-822
Distribution	Bony fish	Temperate	North Sea	1000000	1980	25	28	24	0	0	77	Yes	Yes	Dulvy, N.K. , S.I. Rogers, S. Jennings, V. Stelzenmuller, S.R. Dye and H.R. Skjoldal. 2008. Climate change and deepening of the North Sea fish assemblage: a biotic indicator of warming seas. Journal of Applied Ecology 45:1029-1039.
Distribution	Non-bony fish	Temperate	North Sea	1000000	1980	25	28	4	0	0	57	Yes	Yes	Dulvy, N.K. , S.I. Rogers, S. Jennings, V. Stelzenmuller, S.R. Dye and H.R. Skjoldal. 2008. Climate change and deepening of the North Sea fish assemblage: a biotic indicator of warming seas. Journal of Applied Ecology 45:1029-1039.
Distribution	Squid	Subtropical	California Current	1000000	1985	22	1	1	0	0	24	Yes	No	Field, J.C., K. Baltz, A.J. Phillips and W.A. Walker. 2007. Range expansion and trophic interactions of the Jumbo Squid Dosidicus gigas, in the Californian Current. Californian Cooperative Oceanic Fisheries Investigations Reports 48:131-146
Distribution	Benthic algae	Temperate	North-east Pacific	1	1978	32	1	1	0	0	34	Yes	No	Harley, C.D.G. and R.T. Paine. 2009 Contingencies and compounded rare perturbations dictate sudden distributional shifts during periods

														of gradual climate change. Proceedings of the National Academy of Science of the United States of America 106: 11172-11
Distribution	Bony fish	Temperate	North-west Atlantic	1000000	1968	40	30	32	27	5	102	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Distribution	Non-bony fish	Temperate	North-west Atlantic	1000000	1968	40	30	3	4	2	73	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Distribution	Benthic molluscs	Temperate	North-east Atlantic	1000	1960	48	1	1	0	0	50	No	No	Beukema, J.J., Dekker, R., Jansen, J.M. 2009. Some like it cold: populations of the tellinid bivalve Macoma balthica (L.) suffer in various ways from a warming climate. Marine Ecology Progress Series 384: 135_145
Distribution	Bony fish	Temperate	North-east Atlantic	1000000	1967	39	2	1	0	0	42	No	No	Dufour, F., H. Arrizabalaga, X. Irigoien and J. Santiago. 2010. Climate impacts on albacore and bluefin tunas migrations phenology and spatial distribution. Progress in Oceanography 86: 283-290
Distribution	Bony fish	Subtropical	Mediterranean Sea	10000000	1900	107	3	1	0	0	111	Yes	No	Ben Rais Lasram, F. and D. Mouillot. 2009. Increasing southern invasion enhances congruence between endemic and exotic Mediterranean fish fauna. Biological Invasions 11:697-711
Distribution	Benthic molluscs	Temperate	North Sea	100	1973	30	4	3	0	0	37	Yes	Yes	Beukema, J.J. and R. Dekker. 2005. Decline of recruitment success in cockles and other bivalves in the Wadden Sea: possible role of climate change, predation on postlarvae and fisheries. Marine Ecology Progress Series 287: 149-167
Distribution	Bony fish	Subtropical	North-east Atlantic	1000	1980	22	12	10	0	2	44	Yes	No	Brander, K., et al.. 2003. Changes in fish distribution in the eastern North Atlantic: Are we seeing a coherent response to a changing temperature?
Distribution	Phytoplankton	Temperate	Southern Ocean	100000	1983	24	1	1	0	0	26	No	No	Cubillos, J.et al. 2007. Calcification morphotypes of the coccolithophorid Emiliania huxleyi in the Southern Ocean: changes in 2001 to 2006

														compared to histori
Distribution	Benthic crustacea	Subtropical	North-east Pacific	1000	1970	27	1	1	0	0	29	Yes	Yes	Dawson, M. N., R. K. Grosberg, Y. E. Stuart, and E. Sanford. 2010. Population genetic analysis of a recent range expansion: mechanisms regulating the poleward range limit in the volcano barnacle Tetraclita rubescens. Molecular Ecology 19:1585-1605
Distribution	Benthic invert. (other)	Temperate	North-east Atlantic	1000000	1967	39	2	1	0	0	42	No	No	Edward, D.A., J.E. Blyth, R. McKee and A. Simon Gilburn. 2007. Change in the distribution of a member of the strand line community: the seaweed fly (Diptera: Coelopidae). Ecological Entomology 32: 741_746
Distribution	Mammals	Polar	Beaufort Sea	100000	1985	20	1	1	0	0	22	Yes	No	Fischbach, A.S., S.C. Amstrup and D.C. Douglas. 2007. Landward and eastward shift of Alaskan polar bear denning associated with recent sea ice changes. Polar Biology 30:1395-1405
Distribution	Mammals	Temperate	Hudson Bay	10000000	1903	103	1	1	0	0	105	Yes	No	Higdon, J.W. and S. H. Ferguson. 2009. Loss of Arctic sea ice causing punctuated change in the sightings of killer whales (Orcinus orca) over the past century. Ecological Applications 19: 1365-1375
Distribution	Benthic algae	Temperate	English Channel	100000	1936	68	5	1	0	0	74	Yes	No	Mieszkowska, N., et al.. 2006. Changes in the range of some common rocky shore species in Britain - a response to climate change? Hydrobiologia 555:241-251.
Distribution	Benthic crustacea	Temperate	English Channel	100000	1936	68	5	1	0	0	74	Yes	No	Mieszkowska, N., et al.. 2006. Changes in the range of some common rocky shore species in Britain - a response to climate change? Hydrobiologia 555:241-251.
Distribution	Benthic invert. (other)	Temperate	English Channel	100000	1954	50	5	1	0	0	56	Yes	No	Mieszkowska, N., et al.. 2006. Changes in the range of some common rocky shore species in Britain - a response to climate change? Hydrobiologia 555:241-251.
Distribution	Benthic molluscs	Temperate	English Channel	100000	1952	52	5	1	0	0	58	Yes	No	Mieszkowska, N., et al.. 2006. Changes in the range of some common rocky shore species in Britain - a response to climate change? Hydrobiologia 555:241-251.
Distribution	Benthic molluscs	Temperate	North Sea	100000	1952	52	5	1	0	0	58	Yes	No	Mieszkowska, N., et al.. 2006. Changes in the range of some common rocky shore species in Britain - a response to climate change? Hydrobiologia 555:241-251..
Distribution	Seabirds	Subtropical	South-	1000000	1970	37	2	1	0	0	40	Yes	No	Crawford, R.J.M. et al. 2008. Recent

			east Atlantic											distributional changes of seabirds in South Africa: is climate having an impact? African Journal of Marine Science 30: 189-193.
Distribution	Seabirds	Subtropical	South-east Atlantic	1000000	1987	20	2	1	0	0	23	Yes	No	Crawford, R.J.M. et al. 2008. Recent distributional changes of seabirds in South Africa: is climate having an impact? African Journal of Marine Science 30: 189-193.
Distribution	Zooplankton	Temperate	North Sea	1000000	1948	57	1	1	0	0	59	Yes	No	Johns, D.G., M. Edwards, W. Greve and A.W.G.S. John. 2005. Increasing prevalence of the marine cladoceran Penilia avirostris (Dana, 1852) in the North Sea. Helgolands Marine Research 59: 214-218
Distribution	Benthic cnidarians	Temperate	English Channel	100	1958	49	23	0	1	0	72	Yes	No	Hinz, H., E. Capasso, M. Lilley, M. Frost, and S. R. Jenkins.2011. Temporal differences across a bio-geographical boundary reveal slow response of sub-littoral benthos to climate change. Marine Ecology Progress Series 423: 69-82
Distribution	Benthic crustacea	Temperate	English Channel	100	1958	49	23	1	0	3	73	Yes	No	Hinz, H., E. Capasso, M. Lilley, M. Frost, and S. R. Jenkins.2011. Temporal differences across a bio-geographical boundary reveal slow response of sub-littoral benthos to climate change. Marine Ecology Progress Series 423: 69-82
Distribution	Benthic invert. (other)	Temperate	English Channel	100	1958	49	23	0	3	0	72	Yes	No	Hinz, H., E. Capasso, M. Lilley, M. Frost, and S. R. Jenkins.2011. Temporal differences across a bio-geographical boundary reveal slow response of sub-littoral benthos to climate change. Marine Ecology Progress Series 423: 69-82
Distribution	Benthic molluscs	Temperate	English Channel	100	1958	49	23	5	5	5	77	Yes	No	Hinz, H., E. Capasso, M. Lilley, M. Frost, and S. R. Jenkins.2011. Temporal differences across a bio-geographical boundary reveal slow response of sub-littoral benthos to climate change. Marine Ecology Progress Series 423: 69-82
Distribution	Benthic invert. (other)	Temperate	Bass Strait	1000	1960	46	1	1	0	0	48	No	No	Ling, S. D., C. R. Johnson, K. Ridgway, A. J. Hobday, and M. Haddon. 2009. Climate-driven range extension of a sea urchin: inferring future trends by analysis of recent population dynamics. Global Change Biology 15:719-731.
Distribution	Benthic molluscs	Subtropical	North-east Pacific	100	1966	31	21	1	0	0	53	No	Yes	Sagarin, R. D., J. P. Barry, S. E. Gilman, and C. H. Baxter. 1999. Climate-related change in an intertidal community over short and long time scales. Ecological Monographs 69:465-490
Distribution	Benthic	Temperate	North-	100	1954	40	21	1	0	0	62	No	Yes	Sagarin, R. D., J. P. Barry, S. E. Gilman, and C.

	molluscs		east Pacific											H. Baxter. 1999. Climate-related change in an intertidal community over short and long time scales. Ecological Monographs 69:465-490
Distribution	Benthic crustacea	Polar	Chukchi Sea	10000	1933	72	3	2	0	0	77	No	No	Sirenko B.I. and S.Y. Gagaev. 2007. Unusual abundance of macrobenthos and biological invasions in the Chucki Sea. Russian Journal of Marine Biology 33: 355-364.
Distribution	Benthic molluscs	Polar	Chukchi Sea	10000	1933	72	3	1	0	0	76	No	No	Sirenko B.I. and S.Y. Gagaev. 2007. Unusual abundance of macrobenthos and biological invasions in the Chucki Sea. Russian Journal of Marine Biology 33: 355-364.
Distribution	Bony fish	Temperate	North Sea	1000000	1977	25	36	30	30	4	91	Yes	No	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Distribution	Non-bony fish	Temperate	North Sea	1000000	1977	25	36	1	6	1	62	Yes	No	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Distribution	Zooplankton	Temperate	North-east Atlantic	1000000	1958	45	2	2	0	0	49	Yes	No	Bonnet et al. 2005. An overview of Calanus helgolandicus ecology in European waters. Progress in Oceanography 65: 1-53
Distribution	Zooplankton	Temperate	North-east Atlantic	1000000	1978	23	2	2	0	0	27	No	No	Lindley JA, Daykin S. 2005. Variations in the distributions of Centropages chierchiae and Temora stylifera (Copepoda: Calanoida) in the north-eastern Atlantic Ocean and western European shelf waters. ICES Journal of Marine Science 62: 869-877.
Distribution	Benthic crustacea	Temperate	Bering Sea	100000	1975	27	2	1	0	0	30	Yes	Yes	Orensanz J., B. Ernst, D.A. Armstrong, P. Stabeno and P. Livingston 2004. Contraction of the geographic range of distribution of snow crab (Chionoecetes opilio) in the eastern Bering Sea: An environmental ratchet? CalCOFI Report 45: 65-79.
Distribution	Bony fish	Temperate	Bering Sea	100000	1978	25	2	1	0	0	28	No	No	Orensanz J., B. Ernst, D.A. Armstrong, P. Stabeno and P. Livingston 2004. Contraction of the geographic range of distribution of snow crab (Chionoecetes opilio) in the eastern Bering Sea: An environmental ratchet? CalCOFI Report 45: 65-79.
Distribution	Phytoplankton	Temperate	Mediterranean Sea	100000	1908	98	10	0	3	3	108	Yes	No	Tunin-Ley, A., F. Ibanez, J-P. Labat, A. Zingone and R. Lemee. 2009. Phytoplankton biodiversity and the NW Mediterranean Sea warming: changes in the dinoflagellate genus Ceratium in the 20th

														century. Marine Ecology Progress Series 375: 85-99
Distribution	Seabirds	Subtropical	Southern Ocean	1000000	1981	27	12	1	1	1	40	Yes	No	Peron, C., M. Authier, C. Barbraud, K. Delord, D. Besson and H. Weimerskirch. 2010. Interdecadal changes in at-sea distribution and abundance of subantarctic seabirds along a latitudinal gradient in the Southern Indian Ocean. Global Change Biology 16: 189
Distribution	Seabirds	Temperate	Southern Ocean	1000000	1981	27	12	1	2	0	40	Yes	No	Peron, C., M. Authier, C. Barbraud, K. Delord, D. Besson and H. Weimerskirch. 2010. Interdecadal changes in at-sea distribution and abundance of subantarctic seabirds along a latitudinal gradient in the Southern Indian Ocean. Global Change Biology 16: 189
Distribution	Phytoplankton	Temperate	North Sea	100000	1958	45	4	1	2	0	50	Yes	No	Edwards, M., D.G. Johns, S.C. Leterme, E. Svendsen and A.J. Richardson. 2006. Regional climate change and harmful algal blooms in the northeast Atlantic. Limnology and Oceanography 51: 820-829
Distribution	Phytoplankton	Temperate	North Sea	100000	1981	22	4	0	1	0	26	Yes	No	Edwards, M., D.G. Johns, S.C. Leterme, E. Svendsen and A.J. Richardson. 2006. Regional climate change and harmful algal blooms in the northeast Atlantic. Limnology and Oceanography 51: 820-829
Distribution	Benthic crustacea	Subtropical	East China Sea	100000	1959	47	2	2	0	0	51	Yes	No	Ma, Z., Z. Xu and J. Zhou. 2009. Effect of global warming on the distribution of Lucifer intermedius and L. hanseni (Decapoda) in the Changjiang estuary. Progress in Natural Science 19: 1389-1395
Distribution	Phytoplankton	Temperate	North-east Atlantic	1000000	1958	47	1	1	0	0	49	No	No	Hays, G.C., A.J. Richardson and C. Robinson. 2005. Climate change and marine plankton. Trends in Ecology and Evolution 20: 337-344
Distribution	Phytoplankton	Temperate	North-west Atlantic	10000000	1962	43	1	1	0	0	45	Yes	No	Reid, P.C., et al.. 2007. A biological consequence of reducing Artic ice cover: arrival of the Pacific diatom Neodenticula seminae in the North Atlantic for the first time in 800 000 years. Global Change
Distribution	Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	9	9	0	0	66	Yes	Yes	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change Biology 15: 1790-1803
Distribution	Larval	Subtropical	North-	1000000	1951	52	29	22	2	5	103	Yes	No	Hsieh, C., C.S., Reiss, R.P. Hewitt and G.

	bony fish		west Pacific											Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Distribution	Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	9	4	5	0	93	No	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Distribution	Benthic cnidarians	Subtropical	North-west Pacific	10000	1931	80	9	3	6	0	92	No	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Distribution	Bony fish	Temperate	Tasman Sea	1000000	1880	131	52	16	21	0	199	Yes	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography.
Distribution	Bony fish	Temperate	Bass Strait	1000000	1880	131	52	4	0	0	187	Yes	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography..
Distribution	Bony fish	Temperate	Indian Ocean	1000000	1880	131	52	1	0	0	184	Yes	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography.
Distribution	Non-bony fish	Temperate	Bass Strait	1000000	1880	131	52	1	0	0	184	No	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography.
Distribution	Non-bony fish	Temperate	Tasman Sea	1000000	1880	131	52	1	8	0	184	No	Yes	Last, P.R., et al. 2010. Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices. Global Ecology and Biogeography.
Distribution	Phytoplankton	Subtropical	Tasman Sea	10000	1950	56	1	1	0	0	58	Yes	Yes	Hallegraeff G., W. Hosja, R. Knuckey and C. Wilkinson 2008. Recent range expansion of the red-tide dinoflagellate Noctiluca scintillans in Australian coastal waters. IOC-UNESCO Algae Newsletter 38:10-11.
Distribution	Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	34	29	5	0	115	Yes	No	Hsieh, C., H.J. Kim, W. Watson, E. Di Lorenzo and G. Sugihara. 2009. Climate-driven changes in abundance and distribution of larvae of oceanic

														fishes in the southern Californian region. Global Change Biology 15: 2137-2152
Distribution	Benthic molluscs	Temperate	North-east Atlantic	1000	1963	42	1	0	1	0	43	Yes	No	Mieszkowska, N., S. J. Hawkins, M. T. Burrows, and M. A. Kendall. 2007. Long-term changes in the geographic distribution and population structures of Osilinus lineatus (Gastropoda : Trochidae) in Britain and Ireland. Journal of the Marine Biological Assoc
Distribution	Benthic molluscs	Temperate	North-east Atlantic	1000	1971	33	1	1	0	0	35	Yes	No	Mieszkowska, N., S. J. Hawkins, M. T. Burrows, and M. A. Kendall. 2007. Long-term changes in the geographic distribution and population structures of Osilinus lineatus (Gastropoda : Trochidae) in Britain and Ireland. Journal of the Marine Biological Assoc
Distribution	Seabirds	Temperate	North-east Atlantic	1000000	1980	24	1	1	0	0	26	Yes	No	Wynn, R.B., S.A. Josey, A.P. Martin, D.G. Johns and P. Yesou. 2007. Climate-driven range expansion of a critically endangered top predator in northeast Atlantic waters. Biology Letters 3: 529-532
Distribution	Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	46	6	0	5	77	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Distribution	Bony fish	Temperate	Bering Sea	1000000	1982	25	46	25	5	5	96	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Distribution	Non-bony fish	Temperate	Bering Sea	1000000	1982	25	46	1	0	0	72	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Distribution	Bony fish	Temperate	North-east Atlantic	1000000	1966	30	6	1	0	0	37	No	No	Quero, J. 1998. Changes in the Euro-Atlantic fish species composition resulting from fishing and ocean warming. Italian Journal of Zoology 65:493-499
Distribution	Bony fish	Temperate	North-east Atlantic	1000000	1960	36	6	2	0	0	44	No	No	Quero, J. 1998. Changes in the Euro-Atlantic fish species composition resulting from fishing and ocean warming. Italian Journal of Zoology 65:493-499
Distribution	Bony fish	Temperate	North-east Atlantic	1000000	1963	33	6	1	0	0	40	No	No	Quero, J. 1998. Changes in the Euro-Atlantic fish species composition resulting from fishing and ocean warming. Italian Journal of Zoology

														65:493-499
Distribution	Benthic cnidarians	Subtropical	South-west Pacific	1000	1955	54	29	0	2	0	83	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Distribution	Benthic crustacea	Subtropical	South-west Pacific	1000	1955	54	29	3	3	0	86	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Distribution	Benthic crustacea	Tropical	South-west Pacific	1000	1955	54	29	0	1	0	83	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Distribution	Benthic invert. (other)	Subtropical	South-west Pacific	1000	1955	54	29	0	3	0	83	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Distribution	Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	29	4	9	4	87	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Distribution	Benthic crustacea	Temperate	Tasman Sea	1000	1955	54	14	1	2	0	69	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Distribution	Benthic invert. (other)	Temperate	Tasman Sea	1000	1955	54	14	2	1	0	70	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Distribution	Benthic molluscs	Temperate	Tasman Sea	1000	1955	54	14	1	7	0	69	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Distribution	Benthic algae	Subtropical	Indian Ocean	1000	1951	50	52	25	1	19	127	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1-5
Distribution	Benthic	Subtropical	South-	1000	1951	50	52	6	0	1	108	No	No	Wernberg T., et al. 2011 Seaweed communities in

	algae		west Pacific											retreat from global warming. Current Biology 21: 1-5
Distribution	Bony fish	Temperate	North Sea	1000000	1923	85	2	1	0	0	88	NA	NA	Engelhard, G.H. Pinnegar, J.K., Kell, L.T., Rijnsdorp, A.D. 2011. Nine decades of North Sea sole and plaice distribution. ICES J. Mar. Sci. 68(6): 1090-1104.
Distribution	Bony fish	Temperate	North Sea	1000000	1913	95	2	1	0	0	98	NA	NA	Engelhard, G.H. Pinnegar, J.K., Kell, L.T., Rijnsdorp, A.D. 2011. Nine decades of North Sea sole and plaice distribution. ICES J. Mar. Sci. 68(6): 1090-1104.
Distribution	Mangroves	Tropical	South-west Pacific	100	1961	44	1	4	0	0	49	NA	NA	Gilman, E., Ellison, J. And Coleman, R. 2007 Assessment of mangrove response to projected relative sea-level rise and recent historical reconstruction of shoreline position Environmental Monitoring and Assessment 124:105-130
Distribution	Mangroves	Tropical	South-west Pacific	1000	1961	44	1	2	0	0	47	NA	NA	Gilman, E., Ellison, J. And Coleman, R. 2007 Assessment of mangrove response to projected relative sea-level rise and recent historical reconstruction of shoreline position Environmental Monitoring and Assessment 124:105-130
Distribution	Bony fish	Temperate	Mediterranean Sea	100	1983	19	35	1	0	0	55	No	No	Azzurro, E. 2008. The advance of thermophilic fishes in the Mediterranean Sea: overview and methodological questions. Climate Warming and Related Changes in Mediterranean Marine Biota. Helgoland May 2008. CIESM F. Briand Ed. 152 pages Monaco
PHENOLOGY														
Phenology	Bony fish	Temperate	Baltic Sea	1000000	1951	48	2	1	0	0	51	No	No	Ahas, R. and A. Aasa 2006. The effects of climate change on the phenology of selected Estonian plant, bird and fish populations. International Journal of Biometeorology 51:17:26
Phenology	Benthic crustacea	Temperate	North Sea	1	1973	29	3	1	0	0	33	No	No	Philippart, C. J. M., et al. 2003. Climate-related changes in recruitment of the bivalve Macoma balthica. Limnology and Oceanography 48:2171-2185.
Phenology	Phytoplankton	Temperate	North Sea	1	1973	29	3	0	1	0	32	No	No	Philippart, C. J. M., et al. 2003. Climate-related changes in recruitment of the bivalve Macoma balthica. Limnology and Oceanography 48:2171-2185.
Phenology	Turtles	Subtropical	North-	100	1983	23	1	0	1	0	24	No	No	Hawkes, L., M. A. C. Broderick, M. H. Godfrey,

			west Atlantic											and B. J. Godley. 2007. Investigating the potential impacts of climate change on a marine turtle population. Global Change Biology 13:923-932.
Phenology	Benthic molluscs	Temperate	North Sea	100	1969	39	1	1	0	0	41	No	No	Beukema, J.J., Dekker, R., Jansen, J.M. 2009. Some like it cold: populations of the tellinid bivalve Macoma balthica (L.) suffer in various ways from a warming climate. Marine Ecology Progress Series 384: 135_145
Phenology	Bony fish	Temperate	North-east Atlantic	100000	1981	25	2	1	0	0	28	Yes	No	Dufour, F., H. Arrizabalaga, X. Irigoien and J. Santiago. 2010. Climate impacts on albacore and bluefin tunas migrations phenology and spatial distribution. Progress in Oceanography 86: 283-290
Phenology	Bony fish	Temperate	North-east Atlantic	1000000	1967	39	2	1	0	0	42	Yes	No	Dufour, F., H. Arrizabalaga, X. Irigoien and J. Santiago. 2010. Climate impacts on albacore and bluefin tunas migrations phenology and spatial distribution. Progress in Oceanography 86: 283-290
Phenology	Zooplankton	Temperate	North-west Atlantic	1000	1951	53	2	1	0	0	56	No	No	Costello, J.H, B.K. Sullivan and D.J. Gifford. 2006. A physical-biological interaction underlying variable phenological responses to climate change by coastal zooplankton. Journal of Plankton Research 28:1099-1105
Phenology	Bony fish	Temperate	North-east Atlantic	100	1978	31	1	1	0	0	33	Yes	No	Kennedy, R. J. and W. W. Crozier. 2010. Evidence of changing migratory patterns of wild Atlantic salmon Salmo salar smolts in the River Bush, Northern Ireland, and possible associations with climate change. Journal of Fish Biology. 76: 1786-1805
Phenology	Bony fish	Temperate	North-west Atlantic	1	1954	39	5	1	0	0	45	Yes	No	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Phenology	Bony fish	Temperate	North-west Atlantic	1	1967	33	5	1	0	0	39	Yes	No	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Phenology	Bony fish	Temperate	North-west Atlantic	1	1978	23	5	2	0	0	30	Yes	No	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern

														edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Phenology	Bony fish	Temperate	North-west Atlantic	1	1978	24	5	1	0	0	30	Yes	No	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Phenology	Benthic molluscs	Temperate	North-east Atlantic	100	1946	62	2	2	0	0	66	No	No	Moore, P.J., R.C. Thompson and S.J. Hawkins. 2011. Phenological changes in intertidal con-specific gastrpods in response to climate warming. Global Change Biology 17: 709-717
Phenology	Bony fish	Temperate	North Sea	100000	1970	35	2	2	0	0	39	Yes	No	Teal, L.R., J.J. de Leeuw, H.W. van der Veer and A.D. Rijnsdorp. 2008. Effects of climate change on growth of 0-group sole and plaice. Marine Ecology Progress Series 358:219-230
Phenology	Seabirds	Subtropical	North-east Pacific	10	1973	29	1	1	0	0	31	No	No	Abraham, C.L. and W.J. Sydeman. 2004. Ocean climate, euphausiids and auklet nesting: inter-annual trends and variation in phenology, diet and growth of a planktivorous seabird, Ptychoramphus aleuticus. Marine Ecology Progress Series 274: 235-250.
Phenology	Seabirds	Polar	Southern Ocean	10	1950	55	10	5	0	0	70	No	No	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Phenology	Seabirds	Polar	Southern Ocean	10	1959	46	10	1	0	0	57	No	No	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Phenology	Seabirds	Polar	Southern Ocean	10	1960	45	10	1	0	0	56	No	No	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Phenology	Seabirds	Polar	Southern Ocean	10	1970	35	10	1	0	0	46	No	No	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Phenology	Seabirds	Polar	Southern Ocean	10	1980	25	10	1	0	0	36	No	No	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Phenology	Seabirds	Temperate	Bering	10	1975	31	4	4	0	4	39	No	No	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S.

			Sea											Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Research II 55: 1856-1867.
Phenology	Seabirds	Subtropical	Bass Strait	1	1968	31	1	0	0	1	32	Yes	No	Chambers, L.E. 2004. Delayed breeding in Little Penguins-- evidence of climate change? Australian Meteorological Magazine 53: 13-19.
Phenology	Seabirds	Temperate	North-east Atlantic	1	1977	30	1	1	0	0	32	Yes	No	D'Alba, L., P. Monaghan, and R.G. Nager. 2010. Advances in laying date and increasing population size suggest poistive responses to climate change in Common Eiders Somateria mollissima in Iceland. Ibis 152:19-28.
Phenology	Larval bony fish	Temperate	North Sea	100000	1958	45	50	2	0	0	97	Yes	No	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phenology	Phytoplankton	Temperate	North Sea	100000	1958	45	50	18	0	3	113	Yes	No	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phenology	Zooplankton	Temperate	North Sea	100000	1958	45	50	23	0	4	118	Yes	No	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phenology	Seabirds	Temperate	Hudson Bay	10	1984	20	1	1	0	0	22	No	No	Gaston, A.J., H.G. Gilchrist and J.M. Hipfner. 2005. Climate change, ice conditions and reproduction in an Arctic nesting marine bird: Brunnich's guillemot (Uria lomvia L.). Journal of Animal Ecology 74:832-841.
Phenology	Larval bony fish	Temperate	North Sea	1	1975	19	42	3	0	0	64	Yes	No	Greve, W., F. Reiners and J. Nast. 1996. Biocoenotic changes of the zooplankton in the German Bight: the possible effects of eutrophication and climate. ICES Journal of Marine Science. 53: 951-956.
Phenology	Phytoplankton	Temperate	North Sea	1	1975	19	42	1	0	0	62	Yes	No	Greve, W., F. Reiners and J. Nast. 1996. Biocoenotic changes of the zooplankton in the German Bight: the possible effects of eutrophication and climate. ICES Journal of Marine Science. 53: 951-956.
Phenology	Zooplankton	Temperate	North Sea	1	1975	19	42	23	0	6	84	Yes	No	Greve, W., F. Reiners and J. Nast. 1996. Biocoenotic changes of the zooplankton in the German Bight: the possible effects of eutrophication and climate. ICES Journal of Marine Science. 53: 951-956.
Phenology	Seabirds	Temperate	North Sea	10000	1929	70	1	1	0	0	72	No	No	Moller, A.P., E. Flensted-Jensen and W. Mardel. 2006. Rapidly advancing laying date in a seabird

														and the changing advantage of early reproduction. Journal of Animal Ecology 75:657-665.
Phenology	Seabirds	Temperate	North Sea	10	1971	36	8	1	1	2	45	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North Sea	10	1972	35	10	0	2	0	45	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North Sea	10	1972	35	8	2	1	0	45	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North Sea	10	1974	33	8	0	0	1	41	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North Sea	10	1976	31	8	0	2	0	39	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North Sea	10	1979	28	8	0	2	0	36	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North Sea	10	1981	26	8	0	0	1	34	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North Sea	10	1982	25	10	0	0	1	35	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North Sea	10	1983	24	8	0	1	0	32	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phenology	Seabirds	Temperate	North-east Atlantic	1000000	1980	28	1	0	0	1	29	Yes	No	Wanless, S., M.P. Harris, S. Lewis, M. Frederiksen and S. Murray. 2008. Later breeding in northern gannets in the eastern Atlantic. Marine Ecology Progress Series 370:263-269.

Phenology	Phytoplankton	Temperate	North Sea	1	1962	40	1	0	1	0	41	No	No	Wiltshire, K.H. and B.F.J. Manly. 2004. The warming trend at Helgoland Roads, North Sea: phytoplankton response. Helgoland Marine Research 58: 269-273
Phenology	Zooplankton	Temperate	North Sea	1	1975	30	3	2	1	0	35	No	No	Schluter, M.H.,et al. 2010. Phenological shifts in three interacting zooplankton groups in relation to climate change. Global Change Biology doi: 10.1111/j.1365-2486.2010.02246.x
Phenology	Zooplankton	Temperate	North-west Pacific	1	1968	29	1	1	0	0	31	Yes	No	Mackas, D.L., R. Goldblatt and A.G. Lewis. 1998. Interdecadal variation in developmental timing of Neocalanus plumchrus populations at Ocean Station P in the subarctic North Pacific. Canadian Journal of Fisheries and Aquatic Sciences 55: 1878-1893
Phenology	Seabirds	Temperate	North-east Pacific	10	1975	25	5	3	1	0	33	No	No	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisited: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.
Phenology	Zooplankton	Temperate	North-east Pacific	1	1975	22	5	1	0	0	28	No	No	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisited: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.
Phenology	Zooplankton	Temperate	North-east Pacific	1	1975	24	5	1	0	0	30	No	No	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisited: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.
Phenology	Zooplankton	Temperate	North Sea	1	1974	31	1	1	0	0	33	No	No	Greve, W, Reiners, F, Nusta, Hoffmann S. 2004. Helgoland Roads meso- and macrozooplankton time-series 1974 to 2004: lessons from 30 years of single spot, high frequency sampling at the only off-shore island of the North Sea. Helgoland Marine Research 58:
Phenology	Seabirds	Polar	Greenland Sea	100	1963	46	2	1	0	0	49	No	No	Moe, B., et al. 2009. Climate change and phenological responses of two seabird species breeding in the high Arctic. Marine Ecology Progress Series 393: 235-246
Phenology	Seabirds	Polar	Greenland Sea	100	1970	39	2	0	0	1	41	No	No	Moe, B., et al. 2009. Climate change and phenological responses of two seabird species breeding in the high Arctic. Marine Ecology Progress Series 393: 235-246
Phenology	Seabirds	Subtropical	North-east	10	1972	35	11	1	0	0	47	Yes	No	Sydeman, W.J. et al. 2009. Seabirds and climate in the California Current--A synthesis of change.

			Pacific											CalCOFI Report 50:82-104.
Phenology	Seabirds	Subtropical	North-east Pacific	10	1973	35	11	1	0	0	47	Yes	No	Sydeman, W.J. et al. 2009. Seabirds and climate in the California Current--A synthesis of change. CalCOFI Report 50:82-104.
Phenology	Phytoplankton	Temperate	Mediterranean Sea	100000	1908	98	10	1	0	0	109	No	No	Tunin-Ley, A., F. Ibanez, J-P. Labat, A. Zingone and R. Lemee. 2009. Phytoplankton biodiversity and the NW Mediterranean Sea warming: changes in the dinoflagellate genus Ceratium in the 20th century. Marine Ecology Progress Series 375: 85-99
Phenology	Phytoplankton	Temperate	North Sea	1	1962	45	6	2	0	1	53	No	No	Wiltshire, K.H., et al. 2010. Helgoland Roads, North Sea: 45 years of change. Estuaries and Coasts 33:295-310
Phenology	Seabirds	Temperate	North-west Pacific	10	1975	28	1	1	0	0	30	No	No	Gjerdum, C., et al. 2003. Tufted puffin reproduction reveals ocean climate variability. Proceedings of the National Academy of Science 100: 9377-9382
Phenology	Seagrass	Subtropical	Mediterranean Sea	1000000	1973	32	1	2	0	0	35	Yes	No	Diaz-Almela, E., N. Marba, and C. M. Duarte. 2007. Consequences of Mediterranean warming events in seagrass (Posidonia oceanica) flowering records. Global Change Biology. 13: 224-235.
Phenology	Seagrass	Subtropical	Mediterranean Sea	10000000	1973	32	1	2	0	0	35	Yes	No	Diaz-Almela, E., N. Marba, and C. M. Duarte. 2007. Consequences of Mediterranean warming events in seagrass (Posidonia oceanica) flowering records. Global Change Biology. 13: 224-235.
Phenology	Seagrass	Temperate	Mediterranean Sea	10000	1973	32	1	1	0	0	34	Yes	No	Diaz-Almela, E., N. Marba, and C. M. Duarte. 2007. Consequences of Mediterranean warming events in seagrass (Posidonia oceanica) flowering records. Global Change Biology. 13: 224-235.
Phenology	Seabirds	Temperate	North Sea	10	1969	34	3	1	0	0	38	Yes	No	Frederiksen, M., M.P. Harris , F. Daunt, P. Rothery, and S. Wanless. 2004. Scale-dependent climate signals drive breeding phenology of three seabird species. Global Change Biology 10: 1214-1221.
Phenology	Seabirds	Temperate	North-east Atlantic	10	1981	22	3	0	0	1	25	Yes	No	Frederiksen, M., M.P. Harris , F. Daunt, P. Rothery, and S. Wanless. 2004. Scale-dependent climate signals drive breeding phenology of three seabird species. Global Change Biology 10: 1214-1221.
Phenology	Seabirds	Temperate	North-east Atlantic	10	1982	21	3	0	0	1	24	Yes	No	Frederiksen, M., M.P. Harris , F. Daunt, P. Rothery, and S. Wanless. 2004. Scale-dependent climate signals drive breeding phenology of three

														seabird species. Global Change Biology 10: 1214-1221.
Phenology	Seabirds	Temperate	Irish Sea	10	1973	36	1	0	0	1	37	Yes	Yes	Votier, S.C., B.J. Hatchwell, M. Mears and T.R. Birkhead. 2009. Changes in the timing of egg-laying of a colonial seabird in relation to population size and environmental conditions. Marine Ecology Progress Series 393:225-233.
Phenology	Turtles	Subtropical	Mediterranean Sea	10	1984	24	1	1	0	0	26	No	No	Mazaris, A. D., A. S. Kallimanis, S. P. Sgardelis, and J. D. Pantis. 2009. Sea surface temperature variations in core foraging grounds drive nesting trends and phenology of loggerhead turtles in the Mediterranean Sea. Journal of Experimental Marine Biolog
Phenology	Turtles	Subtropical	Mediterranean Sea	100	1984	19	1	1	0	0	21	No	No	Mazaris, A. D., A. S. Kallimanis, S. P. Sgardelis, and J. D. Pantis. 2008. Do long-term changes in sea surface temperature at the breeding areas affect the breeding dates and reproduction performance of Mediterranean loggerhead turtles? Implications for c
Phenology	Seabirds	Subtropical	North-east Pacific	10	1988	19	2	1	0	1	22	No	No	Schroeder, I.D., W.J. Sydeman, N. Sarkar, S.A. Thompson, S.J. Bograd and F.B. Schwing. 2009. Winter pre-conditioning of seabird phenology in the California Current. Marine Ecology Progress Series 393:211-223.

Global imprint of climate change on marine life

Supplementary Table S6. Observations of shifts in distribution in km dec^{-1} by season. Taxa = taxonomic group, Biome, Region, Study Area = size of study site, Start Year = first year of data series, Timespan, Alt Drivers? = other drivers of change considered, Stat Tests = statistical tests applied to show a relationship with changing climate.

Taxa	Biome	Region	Study Area	Start Year	Time Span	km dec^{-1}	Alt Drivers	Stat Tests	Citation
LEADING EDGE									
Bony fish	Temperate	North-east Atlantic	1000000	1966	30	536.1	Yes	No	Swaby, S.E. and G.W. Potts 1999. The sailfin dory, a first British record. Journal of Fish Biology 54: 1338-1340
Bony fish	Temperate	North Sea	100000	1969	40	65.6	Yes	Yes	van Hal, R., K. Smits and A.D. Rijnsdorp 2010. How climate warming impacts the distribution and abundance of two small flatfish species in the North Sea. Journal of Sea Research 64: 76-84.
Bony fish	Temperate	North Sea	100000	1969	40	95.9	Yes	Yes	van Hal, R., K. Smits and A.D. Rijnsdorp 2010. How climate warming impacts the distribution and abundance of two small flatfish species in the North Sea. Journal of Sea Research 64: 76-84.
Bony fish	Temperate	Mediterranean Sea	100000	1950	55	40.0	No	Yes	Sabates, A., P. Martin, J. Lloret and V. Raya. 2006. Sea warming and fish distribution: the case of the small pelagic fish, Sardinella

									aurita, in the western Mediterranean. Global Change Biology. 12: 2209-2219
Benthic invert. (other)	Temperate	North-east Atlantic	10000	1923	84	36.0	Yes	Yes	Wethey, D. S. and S. A. Woodin. 2008. Ecological hindcasting of biogeographic responses to climate change in the European intertidal zone. Hydrobiologia 606:139-151.
Benthic molluscs	Subtropical	South-east Pacific	100000	1962	39	55.1	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1975	26	137.7	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1947	54	0	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1949	52	0	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1958	43	0	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1962	39	0	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in

									rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1975	26	0	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1947	54	-155.4	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1962	39	-138.7	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1962	39	-96.7	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic molluscs	Subtropical	South-east Pacific	100000	1949	52	-71.7	Yes	No	Rivadeneira, M.M. and Fernandez, M. 2005 Shifts in southern endpoints of distribution in rocky intertidal species along the south-eastern Pacific coast. Journal of Biogeography 32: 203-209
Benthic crustacea	Temperate	English Channel	100000	1964	38	32.4	Yes	No	Herbert, R. J. H., S. J. Hawkins, M. Sheader, and A. J. Southward. 2003. Range extension and reproduction of the barnacle Balanus perforatus in the eastern English Channel. Journal of the Marine Biological Association of

									the United Kingdom 83:73-82.
Benthic crustacea	Temperate	English Channel	100000	1964	38	50.0	Yes	No	Herbert, R. J. H., S. J. Hawkins, M. Sheader, and A. J. Southward. 2003. Range extension and reproduction of the barnacle Balanus perforatus in the eastern English Channel. Journal of the Marine Biological Association of the United Kingdom 83:73-82.
Benthic crustacea	Temperate	English Channel	100000	1955	50	4.4	Yes	No	Herbert, R. J. H., A. J. Southward, M. Sheader, and S. J. Hawkins 2007 Influence of recruitment and temperature on the distribution of intertidal barnacles in the English Channel. Journal of the Marine Biological Association of the United Kingdom 87: 487-
Benthic crustacea	Temperate	English Channel	100000	1955	47	21.7	Yes	No	Herbert, R. J. H., A. J. Southward, M. Sheader, and S. J. Hawkins 2007 Influence of recruitment and temperature on the distribution of intertidal barnacles in the English Channel. Journal of the Marine Biological Association of the United Kingdom 87: 487-
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	61.1	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	12.6	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	101.1	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do

									distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	57.2	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	68.1	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	39.8	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	126.2	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	41.9	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.

Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	-1.1	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	6.0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	4.3	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic molluscs	Temperate	North-east Atlantic	1000	1955	51	250.0	Yes	No	Lima, F. P., N. Queiroz, P. A. Ribeiro, S. J. Hawkins, and A. M. Santos. 2006. Recent changes in the distribution of a marine gastropod, Patella rustica Linnaeus, 1758, and their relationship to unusual climatic events. Journal of Biogeography 33:812-822
Benthic molluscs	Subtropical	North-east Atlantic	1000	1955	51	0	Yes	No	Lima, F. P., N. Queiroz, P. A. Ribeiro, S. J. Hawkins, and A. M. Santos. 2006. Recent changes in the distribution of a marine gastropod, Patella rustica Linnaeus, 1758, and their relationship to unusual climatic events. Journal of Biogeography 33:812-822
Bony fish	Subtropical	Mediterran	1000000	1900	107	150.0	No	No	Ben Rais Lasram, F. and D. Mouillot. 2009.

		ean Sea	0						Increasing southern invasion enhances congruence between endemic and exotic Mediterranean fish fauna. Biological Invasions 11:697-711
Phytoplankton	Temperate	Southern Ocean	100000	1983	24	693.8	No	No	Cubillos, J.C., et al. 2007. Calcification morphotypes of the coccolithophorid Emiliania huxleyi in the Southern Ocean: changes in 2001 to 2006 compared to historical data. Marine Ecology Progress Series 348: 47-54
Benthic crustacea	Subtropical	North-east Pacific	1000	1970	27	119.0	No	No	Dawson, M. N., R. K. Grosberg, Y. E. Stuart, and E. Sanford. 2010. Population genetic analysis of a recent range expansion: mechanisms regulating the poleward range limit in the volcano barnacle Tetraclita rubescens. Molecular Ecology 19:1585-1605
Benthic invert. (other)	Temperate	North-east Atlantic	1000000	1967	39	56.0	Yes	No	Edward, D.A., J.E. Blyth, R. McKee and A. Simon Gilburn. 2007. Change in the distribution of a member of the strand line community: the seaweed fly (Diptera: Coelopidae). Ecological Entomology 32: 741_746
Benthic algae	Temperate	English Channel	100000	1936	68	77.8	Yes	No	Mieszkowska, N., et al. 2006. Changes in the range of some common rocky shore species in Britain - a response to climate change? Hydrobiologia 555:241-251.
Benthic molluscs	Temperate	English Channel	100000	1952	52	27.8	Yes	No	Mieszkowska, N., et al. 2006. Changes in the range of some common rocky shore species in Britain - a response to climate change? Hydrobiologia 555:241-251.
Benthic molluscs	Temperate	North Sea	100000	1952	52	28.9	No	No	Mieszkowska, N., et al. 2006. Changes in the range of some common rocky shore species in Britain - a response to climate change?

									Hydrobiologia 555:241-251.
Benthic invert. (other)	Temperate	Bass Strait	1000	1960	46	160.0	No	Yes	Ling, S. D., C. R. Johnson, K. Ridgway, A. J. Hobday, and M. Haddon. 2009. Climate-driven range extension of a sea urchin: inferring future trends by analysis of recent population dynamics. Global Change Biology 15:719-731.
Benthic molluscs	Subtropical	North-east Pacific	100	1966	31	53.1	No	No	Sagarin, R. D., J. P. Barry, S. E. Gilman, and C. H. Baxter. 1999. Climate-related change in an intertidal community over short and long time scales. Ecological Monographs 69:465-490
Benthic molluscs	Temperate	North-east Pacific	100	1954	40	151.8	No	No	Sagarin, R. D., J. P. Barry, S. E. Gilman, and C. H. Baxter. 1999. Climate-related change in an intertidal community over short and long time scales. Ecological Monographs 69:465-490
Zooplankton	Temperate	North-east Atlantic	1000000	1978	23	157.0	No	Yes	Lindley JA, Daykin S. 2005. Variations in the distributions of Centropages chierchiae and Temora stylifera (Copepoda: Calanoida) in the north-eastern Atlantic Ocean and western European shelf waters. ICES Journal of Marine Science 62: 869-877.
Zooplankton	Temperate	North-east Atlantic	1000000	1978	23	157.0	No	Yes	Lindley JA, Daykin S. 2005. Variations in the distributions of Centropages chierchiae and Temora stylifera (Copepoda: Calanoida) in the north-eastern Atlantic Ocean and western European shelf waters. ICES Journal of Marine Science 62: 869-877.
Phytoplankton	Temperate	North-east Atlantic	1000000	1958	47	310.0	No	No	Hays, G.C., A.J. Richardson and C. Robinson. 2005. Climate change and marine plankton. Trends in Ecology and Evolution 20: 337-344
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	231.6	No	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change

									Biology 15: 1790-1803
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	217.5	No	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change Biology 15: 1790-1803
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	138.8	No	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change Biology 15: 1790-1803
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	46.3	No	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change Biology 15: 1790-1803
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	46.3	Yes	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change Biology 15: 1790-1803
Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	130.0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	North-west Pacific	10000	1931	80	40.0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	140.0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic	Subtropical	North-west	10000	1931	80	50.0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011.

cnidarians		Pacific							Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	80.0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	North-west Pacific	10000	1931	80	50.0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	50.0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	North-west Pacific	10000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	North-west Pacific	10000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters

									38: L04641
Benthic cnidarians	Subtropical	North-west Pacific	10000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	North-west Pacific	10000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
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Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	North-west Pacific	10000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical

									reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Benthic cnidarians	Subtropical	Japan Sea	1000	1931	80	0	Yes	No	Yamano, H. K. Sugihara and K. Nomura. 2011. Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. Geophysical Research Letters 38: L04641
Phytoplankton	Subtropical	Tasman Sea	10000	1950	56	406.0	Yes	No	Hallegraeff G., W. Hosja, R. Knuckey and C. Wilkinson 2008. Recent range expansion of the red-tide dinoflagellate Noctiluca scintillans in Australian coastal waters. IOC-UNESCO Algae Newsletter 38:10-11.
Benthic molluscs	Temperate	North-east Atlantic	1000	1963	42	18.0	Yes	No	Mieszkowska, N., S. J. Hawkins, M. T. Burrows, and M. A. Kendall. 2007. Long-term changes in the geographic distribution and population structures of Osilinus lineatus (Gastropoda : Trochidae) in Britain and Ireland. Journal of the Marine Biological Association 87: 537-545
Benthic molluscs	Temperate	North-east Atlantic	1000	1971	33	3.0	Yes	No	Mieszkowska, N., S. J. Hawkins, M. T. Burrows, and M. A. Kendall. 2007. Long-term changes in the geographic distribution and population structures of Osilinus lineatus (Gastropoda : Trochidae) in Britain and Ireland. Journal of the Marine Biological Association 87: 537-545
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	-6.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	-4.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302

Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	-0.8	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	5.2	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	5.6	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	10.4	No	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	North-east Atlantic	1000000	1966	30	685.0	No	No	Quero, J. 1998. Changes in the Euro-Atlantic fish species composition resulting from fishing and ocean warming. Italian Journal of Zoology 65:493-499
Bony fish	Temperate	North-east Atlantic	1000000	1963	33	472.0	No	No	Quero, J. 1998. Changes in the Euro-Atlantic fish species composition resulting from fishing and ocean warming. Italian Journal of Zoology 65:493-499
Bony fish	Temperate	North-east Atlantic	1000000	1960	36	432.0	No	No	Quero, J. 1998. Changes in the Euro-Atlantic fish species composition resulting from fishing and ocean warming. Italian Journal of Zoology 65:493-499
Bony fish	Temperate	North-east Atlantic	1000000	1960	36	541.0	Yes	No	Quero, J. 1998. Changes in the Euro-Atlantic fish species composition resulting from fishing and ocean warming. Italian Journal of Zoology 65:493-499
Benthic	Tropical	South-west	1000	1955	54	0	Yes	No	Poloczanska, E.S., et al. 2011. Little change in

molluscs		Pacific							the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Tropical	South-west Pacific	1000	1955	54	11.1	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Tropical	South-west Pacific	1000	1955	54	0	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	15.8	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	93.5	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	24.3	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of

									Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	-68.7	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	33.2	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	-17.8	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic crustacea	Subtropical	South-west Pacific	1000	1955	54	126.7	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic crustacea	Subtropical	South-west Pacific	1000	1955	54	131.5	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic	Temperate	Tasman Sea	1000	1955	54	-3.7	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010

molluscs									Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic invert. (other)	Temperate	Tasman Sea	1000	1955	54	3.7	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic crustacea	Temperate	Tasman Sea	1000	1955	54	3.7	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic crustacea	Temperate	Tasman Sea	1000	1955	54	12.9	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic crustacea	Temperate	Tasman Sea	1000	1955	54	46.3	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic molluscs	Temperate	Tasman Sea	1000	1955	54	16.7	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic molluscs	Temperate	Tasman Sea	1000	1955	54	42.6	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic molluscs	Temperate	Tasman Sea	1000	1955	54	23.1	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic molluscs	Temperate	Tasman Sea	1000	1955	54	23.1	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian

									intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic molluscs	Temperate	Tasman Sea	1000	1955	54	3.7	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic molluscs	Temperate	Tasman Sea	1000	1955	54	22.2	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic molluscs	Temperate	Tasman Sea	1000	1955	54	43.5	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic invert. (other)	Temperate	Tasman Sea	1000	1955	54	43.5	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Benthic invert. (other)	Temperate	Tasman Sea	1000	1955	54	22.2	Yes	No	Pitt N, Poloczanska E.S. and Hobday A.J. 2010 Climate-driven range changes in Tasmanian intertidal fauna. Marine and Freshwater Research 61: 963-970
Bony fish	Temperate	North Sea	1000000	1923	85	10.3	Yes	Yes	Engelhard, G.H. Pinnegar, J.K., Kell, L.T., Rijnsdorp, A.D. 2011. Nine decades of North Sea sole and plaice distribution. ICES J. Mar. Sci. 68(6): 1090-1104.
Bony fish	Temperate	North Sea	1000000	1913	95	24.9	No	Yes	Engelhard, G.H. Pinnegar, J.K., Kell, L.T., Rijnsdorp, A.D. 2011. Nine decades of North Sea sole and plaice distribution. ICES J. Mar. Sci. 68(6): 1090-1104.
TRAILING EDGE									

Benthic crustacea	Temperate	North-east Atlantic	10000	1972	35	-10.0	Yes	Yes	Wethey, D. S. and S. A. Woodin. 2008. Ecological hindcasting of biogeographic responses to climate change in the European intertidal zone. Hydrobiologia 606:139-151.
Benthic crustacea	Temperate	North-east Atlantic	10000	1972	35	-50.0	Yes	Yes	Wethey, D. S. and S. A. Woodin. 2008. Ecological hindcasting of biogeographic responses to climate change in the European intertidal zone. Hydrobiologia 606:139-151.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	-38.3	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	-14.9	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	-13.2	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	-46.6	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	-76.2	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.

Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	-52.1	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern

									species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	0	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	70.2	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	54.7	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	48.3	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	33.4	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	19.2	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east	10000	1960	47	25.7	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J.

		Atlantic							Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	-1.9	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	1.9	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Subtropical	North-east Atlantic	10000	1960	47	5.9	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	1.9	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Benthic algae	Temperate	North-east Atlantic	10000	1960	47	3.8	Yes	No	Lima, F. P., P. A. Ribeiro, N. Queiroz, S. J. Hawkins, and A. M. Santos. 2007. Do distributional shifts of northern and southern species of algae match the warming pattern? Global Change Biology 13: 2592-2605.
Non-bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United

									States continental shelf. Marine Ecology Progress Series. 393: 111-129
Benthic molluscs	Temperate	North-east Atlantic	1000	1960	48	-60.2	No	No	Beukema, J.J., Dekker, R., Jansen, J.M. 2009. Some like it cold: populations of the tellinid bivalve Macoma balthica (L.) suffer in various ways from a warming climate. Marine Ecology Progress Series 384: 135_145
Mammals	Polar	Beaufort Sea	100000	1985	20	-857.0	Yes	No	Fischbach, A.S., S.C. Amstrup and D.C. Douglas. 2007. Landward and eastward shift of Alaskan polar bear denning associated with recent sea ice changes. Polar Biology 30:1395-1405
Non-bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Benthic crustacea	Temperate	Bering Sea	100000	1975	27	-155.4	Yes	No	Orensanz J., B. Ernst, D.A. Armstrong, P. Stabeno and P. Livingston 2004. Contraction of the geographic range of distribution of snow crab (Chionoecetes opilio) in the eastern Bering Sea: An environmental ratchet? CalCOFI Report 45: 65-79.
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	-161.9	No	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change Biology 15: 1790-1803
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	-92.6	No	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change Biology 15: 1790-1803
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	-46.3	No	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change

									Biology 15: 1790-1803
Zooplankton	Temperate	North-east Atlantic	1E+08	1958	48	-57.8	No	No	Beaugrand, G., C. Luczak and M. Edwards. 2009. Rapid biogeographical plankton shifts in the North Atlantic Ocean. Global Change Biology 15: 1790-1803
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	35.6	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic cnidarians	Subtropical	South-west Pacific	1000	1955	54	0	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic cnidarians	Subtropical	South-west Pacific	1000	1955	54	-31.5	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic invert. (other)	Subtropical	South-west Pacific	1000	1955	54	8.4	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	-62.2	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154

Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	0	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	-41.7	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	72.4	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	41.7	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	0	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	0	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast

									after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic molluscs	Subtropical	South-west Pacific	1000	1955	54	8.9	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic crustacea	Subtropical	South-west Pacific	1000	1955	54	-26.8	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic crustacea	Subtropical	South-west Pacific	1000	1955	54	-117.4	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic crustacea	Subtropical	South-west Pacific	1000	1955	54	0	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic crustacea	Subtropical	South-west Pacific	1000	1955	54	-9.6	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154

Benthic crustacea	Tropical	South-west Pacific	1000	1955	54	-27.7	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic invert. (other)	Subtropical	South-west Pacific	1000	1955	54	-15.6	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic invert. (other)	Subtropical	South-west Pacific	1000	1955	54	0	Yes	No	Poloczanska, E.S., et al. 2011. Little change in the distribution of rocky shore faunal communities on the East Australian coast after 50 years of rapid warming. Journal of Experimental Marine Biology and Ecology 400: 145-154
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-1.3	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-1.2	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-1.0	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.9	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.8	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming.

									Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.7	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.5	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.5	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.1	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.1	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.3	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.7	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	1.6	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian	1000	1951	50	-4.8	No	No	Wernberg T., et al. 2011 Seaweed

		Ocean							communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-3.2	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-3.1	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-2.8	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-2.5	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-1.8	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-1.6	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-1.6	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-1.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-1.0	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.7	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832

Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.7	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.6	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.5	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.5	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.1	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	-0.1	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.1	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.1	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.1	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.3	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming.

									Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.3	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.9	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	Indian Ocean	1000	1951	50	0.9	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	South-west Pacific	1000	1951	50	-2.8	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	South-west Pacific	1000	1951	50	-1.9	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	South-west	1000	1951	50	-1.9	No	No	Wernberg T., et al. 2011 Seaweed

		Pacific							communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	South-west Pacific	1000	1951	50	1.6	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	South-west Pacific	1000	1951	50	-1.9	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	South-west Pacific	1000	1951	50	-1.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
Benthic algae	Subtropical	South-west Pacific	1000	1951	50	-1.4	No	No	Wernberg T., et al. 2011 Seaweed communities in retreat from global warming. Current Biology 21: 1828-1832
CENTRE									
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	5.7	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	6.1	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	9.3	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and

									population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	14.8	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	15.5	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	16.1	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	18.7	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	21.0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129

Bony fish	Temperate	North-west Atlantic	1000000	1968	40	25.7	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	34.4	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	35.8	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	38.1	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	43.2	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	54.7	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and

									population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	55.2	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	68.6	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	85.3	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129

Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and

									population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129

Non-bony fish	Temperate	North-west Atlantic	1000000	1968	40	0	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	-38.2	Yes	Yes	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Non-bony fish	Temperate	North-west Atlantic	1000000	1968	40	-13.5	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Bony fish	Temperate	North-west Atlantic	1000000	1968	40	-8.3	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Non-bony fish	Temperate	North-west Atlantic	1000000	1968	40	-8.3	Yes	No	Nye, J.A., J.S. Link, J.A. Hare and W.J. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 393: 111-129
Benthic molluscs	Temperate	North Sea	100	1973	30	-0.9	Yes	No	Beukema, J.J. and R. Dekker. 2005. Decline of recruitment success in cockles and other bivalves in the Wadden Sea: possible role of

									climate change, predation on postlarvae and fisheries. Marine Ecology Progress Series 287: 149-167
Benthic molluscs	Temperate	North Sea	100	1973	30	-1	Yes	No	Beukema, J.J. and R. Dekker. 2005. Decline of recruitment success in cockles and other bivalves in the Wadden Sea: possible role of climate change, predation on postlarvae and fisheries. Marine Ecology Progress Series 287: 149-167
Benthic molluscs	Temperate	North Sea	100	1973	30	-0.3	Yes	No	Beukema, J.J. and R. Dekker. 2005. Decline of recruitment success in cockles and other bivalves in the Wadden Sea: possible role of climate change, predation on postlarvae and fisheries. Marine Ecology Progress Series 287: 149-167
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	69.9	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	39.9	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	38.9	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and

									distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	23.3	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	78	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	118.8	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	61.1	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science.

									308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915

Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Non-bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Non-bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D.

									Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	0	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	-82.1	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Non-bony fish	Temperate	North Sea	1000000	1977	25	-85.5	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	-54.4	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Bony fish	Temperate	North Sea	1000000	1977	25	-21.1	Yes	Yes	Perry, A. L., P. J. Low, J. R. Ellis and J. D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. Science. 308: 1912:1915
Zooplankton	Temperate	North-east Atlantic	1000000	1958	45	9.9	Yes	No	Bonnet et al. 2005. An overview of Calanus helgolandicus ecology in European waters. Progress in Oceanography 65: 1-53
Zooplankton	Temperate	North-east Atlantic	1000000	1958	45	12.3	Yes	No	Bonnet et al. 2005. An overview of Calanus helgolandicus ecology in European waters. Progress in Oceanography 65: 1-53
Bony fish	Temperate	Bering Sea	100000	1978	25	53.4	No	No	Orensanz J., B. Ernst, D.A. Armstrong, P. Stabeno and P. Livingston 2004. Contraction of the geographic range of distribution of snow crab (Chionoecetes opilio) in the

									eastern Bering Sea: An environmental ratchet? CalCOFI Report 45: 65-79.
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	3.2	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	2.3	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	3.2	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	3.2	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	2.3	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	3.2	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony	Subtropical	North-west	1000000	1951	52	5.1	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G.

fish		Pacific							Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	3.7	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	6.0	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	7.4	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	7.4	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	7.4	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	7.4	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries

									and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	7.4	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	7.9	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	8.8	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	7.4	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	10.2	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	9.3	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	10.6	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that

									fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	13.4	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	17.6	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	0	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	0	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	-17.1	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	-3.2	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961

Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	-2.3	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	-3.2	No	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Larval bony fish	Subtropical	North-west Pacific	1000000	1951	52	-1.4	Yes	Yes	Hsieh, C., C.S., Reiss, R.P. Hewitt and G. Sugihara. 2008. Spatial analysis shows that fishing enhances the climatic sensitivity of marine fishes. Canadian Journal of Fisheries and Aquatic Sciences 65: 947-961
Bony fish	Temperate	Bering Sea	1000000	1982	25	-28.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	-28.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	-15.2	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	-15.2	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	-4.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering

									sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	-2.8	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	-2.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	0	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	0	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	0	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	0	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	0	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	0	Yes	No	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications

									18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	0.8	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	1.2	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	2.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	6.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	8.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	9.2	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	10.8	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	13.6	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302

Bony fish	Temperate	Bering Sea	1000000	1982	25	13.6	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	15.6	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	16.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	16.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	18.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	18.8	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	19.2	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	20.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	22.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice

									retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	22.8	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	24.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Benthic crustacea	Temperate	Bering Sea	1000000	1982	25	24.8	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	26.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	30.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	30.4	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Non-bony fish	Temperate	Bering Sea	1000000	1982	25	36.0	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	39.2	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering

									sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	61.2	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302
Bony fish	Temperate	Bering Sea	1000000	1982	25	94.8	Yes	Yes	Mueter, F.J. and M.A. Litzow. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. Ecological Applications 18: 309-302

Global imprint of climate change on marine life

Supplementary Table S7. Observations of phenology shift in days dec^{-1} by season. Taxa = taxonomic group, Biome, Region, Study Area = size of study site, Start Year = first year of data series, Timespan, Alt Drivers? = other drivers of change considered, Stat Tests = statistical tests applied to show a relationship with changing climate. NH = Northern Hemisphere, SH = Southern Hemisphere.

Taxa	Biome	Region	Study Area	Start Year	Time Span	Days dec^{-1}	Alt Drivers	Stat Tests	Citation
SPRING (NH: March, April, May; SH: September, October, November)									
Benthic crustacea	Temperate	North Sea	1	1973	29	-31.0	No	Yes	Philippart, C. J. M., et al. 2003. Climate-related changes in recruitment of the bivalve Macoma balthica. Limnology and Oceanography 48:2171-2185.
Zooplankton	Temperate	North Sea	1	1975	30	-23.3	No	Yes	Schluter, M.H., et al. 2010. Phenological shifts in three interacting zooplankton groups in relation to climate change. Global Change Biology doi: 10.1111/j.1365-2486.2010.02246.x
Bony fish	Temperate	North-west Atlantic	1	1954	39	-21.3	Yes	Yes	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Zooplankton	Temperate	North-east Pacific	1	1975	22	-18.7	No	No	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle

									revisited: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.
Larval bony fish	Temperate	North Sea	100000	1958	45	-12.9	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North-east Pacific	1	1975	24	-12.8	No	No	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisited: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.
Zooplankton	Temperate	North Sea	100000	1958	45	-10.3	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Benthic molluscs	Temperate	North-east Atlantic	100	1946	62	-10.2	No	No	Moore, P.J., R.C. Thompson and S.J. Hawkins. 2010. Phenological changes in intertidal con-specific gastrpods in response to climate warming. Global Change Biology
Benthic molluscs	Temperate	North Sea	100	1969	39	-10.0	No	No	Beukema, J.J., Dekker, R., Jansen, J.M. 2009. Some like it cold: populations of the tellinid bivalve Macoma balthica (L.) suffer in various ways from a warming climate. Marine Ecology Progress Series 384: 135_145
Larval bony fish	Temperate	North Sea	100000	1958	45	-9.5	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	1	1975	30	-9.3	No	Yes	Schluter, M.H., A. Merico, M. Reginatto, M. Boersma, K.H. Wiltshire and W. Greve. 2010. Phenological shifts in three interacting zooplankton groups in relation to climate change. Global Change Biology doi: 10.1111/j.1365-2486.2010.02246.x

Bony fish	Temperate	North-west Atlantic	1	1967	33	-9.1	Yes	Yes	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Phytoplankton	Temperate	North Sea	100000	1958	45	-8.6	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Seabirds	Temperate	North Sea	10	1971	36	-8.4	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Phytoplankton	Temperate	North Sea	100000	1958	45	-8.3	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-7.5	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-7.2	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Bony fish	Temperate	North-west Atlantic	1	1978	24	-7.1	Yes	Yes	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Zooplankton	Temperate	North Sea	100000	1958	45	-6.7	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430:

									881-884.
Bony fish	Temperate	North-west Atlantic	1	1978	23	-5.0	Yes	Yes	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Bony fish	Temperate	North-east Atlantic	100	1978	31	-4.8	Yes	Yes	Kennedy, R. J. and W. W. Crozier. 2010. Evidence of changing migratory patterns of wild Atlantic salmon Salmo salar smolts in the River Bush, Northern Ireland, and possible associations with climate change. Journal of Fish Biology. 76: 1786-1805
Bony fish	Temperate	North-west Atlantic	1	1978	23	-4.5	Yes	Yes	Juanes, F., S. Gephard and K.F. Beland. 2004. Long-term changes in migration timing of adult Atlantic salmon (Salmo salar) at the southern edge of the species distribution. Canadian journal of Fisheries and Aquatic Sciences 61:2392-2400
Seabirds	Temperate	North-east Pacific	10	1975	25	-4.4	No	Yes	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisited: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.
Seabirds	Temperate	North-east Atlantic	1	1977	30	-2.8	Yes	Yes	D'Alba, L., P. Monaghan, and R.G. Nager. 2010. Advances in laying date and increasing population size suggest poistive responses to climate change in Common Eiders Somateria mollissima in Iceland. Ibis 152:19-28.
Seabirds	Temperate	North Sea	10	1972	35	-2.7	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Subtropical	North-east Pacific	10	1988	19	-2.4	No	Yes	Schroeder, I.D., W.J. Sydeman, N. Sarkar, S.A. Thompson, S.J. Bograd and F.B.

									Schwing. 2009. Winter pre-conditioning of seabird phenology in the California Current. Marine Ecology Progress Series 393:211-223.
Seabirds	Temperate	North Sea	10	1969	34	-2.3	Yes	Yes	Frederiksen, M., M.P. Harris , F. Daunt, P. Rothery, and S. Wanless. 2004. Scale-dependent climate signals drive breeding phenology of three seabird species. Global Change Biology 10: 1214-1221.
Bony fish	Temperate	North-east Atlantic	1000000	1967	39	-2.0	No	Yes	Dufour, F., H. Arrizabalaga, X. Irigoien and J. Santiago. 2010. Climate impacts on albacore and bluefin tunas migrations phenology and spatial distribution. Progress in Oceanography 86: 283-290
Seabirds	Temperate	North Sea	10	1972	35	-1.9	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	Irish Sea	10	1973	36	-1.7	Yes	Yes	Votier, S.C., B.J. Hatchwell, M. Mears and T.R. Birkhead. 2009. Changes in the timing of egg-laying of a colonial seabird in relation to population size and environmental conditions. Marine Ecology Progress Series 393:225-233.
Seabirds	Temperate	North Sea	10	1972	35	-1.6	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1979	28	-1.5	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1979	28	-1.2	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1983	24	-0.8	No	No	Wanless, S., M. Frederiksen, J. Walton and

									M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1976	31	-0.5	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1976	31	-0.2	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Bony fish	Temperate	Baltic Sea	1000000	1951	48	-0.1	No	Yes	Ahas, R. and A. Aasa 2006. The effects of climate change on the phenology of selected Estonian plant, bird and fish populations. International Journal of Biometeorology 51:17:26
Phytoplankton	Temperate	North Sea	1	1973	29	0	No	Yes	Philippart, C. J. M., et al. 2003. Climate-related changes in recruitment of the bivalve Macoma balthica. Limnology and Oceanography 48:2171-2185.
Zooplankton	Temperate	North Sea	1	1975	30	0	No	Yes	Schluter, M.H., et al. 2010. Phenological shifts in three interacting zooplankton groups in relation to climate change. Global Change Biology doi: 10.1111/j.1365-2486.2010.02246.x
Seabirds	Temperate	North Sea	10	1972	35	0.1	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1972	35	0.5	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1971	36	1.0	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in

									breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Polar	Southern Ocean	10	1959	46	1.0	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Seabirds	Temperate	North Sea	10	1971	36	1.1	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1974	33	2.5	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North-east Atlantic	10	1982	21	2.6	Yes	Yes	Frederiksen, M., M.P. Harris , F. Daunt, P. Rothery, and S. Wanless. 2004. Scale-dependent climate signals drive breeding phenology of three seabird species. Global Change Biology 10: 1214-1221.
Seabirds	Temperate	North Sea	10	1982	25	2.8	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Subtropical	North-east Pacific	10	1988	19	4.0	No	Yes	Schroeder, I.D., W.J. Sydeman, N. Sarkar, S.A. Thompson, S.J. Bograd and F.B. Schwing. 2009. Winter pre-conditioning of seabird phenology in the California Current. Marine Ecology Progress Series 393:211-223.
Seabirds	Temperate	North-east Atlantic	10	1981	22	5.1	Yes	Yes	Frederiksen, M., M.P. Harris , F. Daunt, P. Rothery, and S. Wanless. 2004. Scale-dependent climate signals drive breeding phenology of three seabird species. Global Change Biology 10: 1214-1221.
Seabirds	Temperate	North Sea	10	1971	36	6.7	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in

									breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Temperate	North Sea	10	1981	26	6.9	No	No	Wanless, S., M. Frederiksen, J. Walton and M.P. Harris. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151:274-285.
Seabirds	Subtropical	Bass Strait	1	1968	31	11.9	Yes	Yes	Chambers, L.E. 2004. Delayed breeding in Little Penguins-- evidence of climate change? Australian Meteorological Magazine 53: 13-19.
SUMMER (NH: June, July, August; SH: December, January, February)									
Seabirds	Temperate	North-east Pacific	10	1975	25	-24.0	No	No	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisited: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.
Zooplankton	Temperate	North-west Pacific	1	1968	29	-19.3	Yes	Yes	Mackas, D.L., R. Goldblatt and A.G. Lewis. 1998. Interdecadal variation in developmental timing of Neocalanus plumchrus populations at Ocean Station P in the subarctic North Pacific. Canadian Journal of Fisheries and Aquatic Sciences 55: 1878-1893
Zooplankton	Temperate	North Sea	1	1974	31	-14.7	No	No	Greve, W, Reiners, F, Nusta, Hoffmann S. 2004. Helgoland Roads meso- and macrozooplankton time-series 1974 to 2004: lessons from 30 years of single spot, high frequency sampling at the only off-shore island of the North Sea. Helgoland Marine Research 58: 274-288
Seabirds	Temperate	North-east Pacific	10	1975	25	-9.5	No	Yes	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisited: interannual variation and ecosystem

									consequences. Progress in Oceanography 49: 283-307.
Seabirds	Temperate	Bering Sea	10	1975	31	-8.8	No	Yes	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S. Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Research II 55: 1856-1867.
Seabirds	Temperate	Bering Sea	10	1975	31	-7.9	No	Yes	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S. Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Research II 55: 1856-1867.
Seabirds	Temperate	North-east Pacific	10	1975	25	-7.8	No	Yes	Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisited: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.
Zooplankton	Temperate	North Sea	100000	1958	45	-6.5	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Seabirds	Temperate	Bering Sea	10	1975	31	-6.4	No	Yes	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S. Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Research II 55: 1856-1867.
Phytoplankton	Temperate	North Sea	100000	1958	45	-6.2	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-6.2	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-6.1	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.

Phytoplankton	Temperate	North Sea	100000	1958	45	-5.9	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-5.9	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Seabirds	Temperate	Bering Sea	10	1975	31	-5.8	No	Yes	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S. Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Research II 55: 1856-1867.
Zooplankton	Temperate	North Sea	100000	1958	45	-5.7	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Seabirds	Temperate	North-west Pacific	10	1975	28	-5.7	No	Yes	Gjerdum, C., et al. 2003. Tufted puffin reproduction reveals ocean climate variability. Proceedings of the National Academy of Science 100: 9377-9382
Phytoplankton	Temperate	North Sea	100000	1958	45	-5.4	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-5.1	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-4.9	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-4.9	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430:

									881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-4.2	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-4.0	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-3.7	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-3.6	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-3.5	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-3.2	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-3.2	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-3.1	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-2.8	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic

									phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-2.8	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-2.7	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-2.7	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Seabirds	Temperate	North Sea	10000	1929	70	-2.6	No	Yes	Moller, A.P., E. Flensted-Jensen and W. Mardel. 2006. Rapidly advancing laying date in a seabird and the changing advantage of early reproduction. Journal of Animal Ecology 75:657-665.
Zooplankton	Temperate	North Sea	100000	1958	45	-2.6	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-2.5	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-2.5	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-2.3	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.

Zooplankton	Temperate	North Sea	100000	1958	45	-2.2	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	-1.9	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-1.8	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-1.7	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-1.4	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Seabirds	Polar	Greenland Sea	100	1963	46	-1.0	No	Yes	Moe, B., et al. Climate change and phenological responses of two seabird species breeding in the high-Arctic. Marine Ecology Progress Series 393: 235-246.
Seabirds	Temperate	Bering Sea	10	1975	31	0.0	No	Yes	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S. Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Research II 55: 1856-1867.
Seabirds	Polar	Southern Ocean	10	1950	55	0.2	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Seabirds	Temperate	Bering Sea	10	1975	31	1.0	No	Yes	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S. Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean

									climate. Deep-Sea Research II 55: 1856-1867.
Seabirds	Polar	Greenland Sea	100	1970	39	1.3	No	Yes	Moe, B., et al. Climate change and phenological responses of two seabird species breeding in the high-Arctic. Marine Ecology Progress Series 393: 235-246.
Seabirds	Temperate	Bering Sea	10	1975	31	1.6	No	Yes	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S. Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Research II 55: 1856-1867.
Seabirds	Temperate	North-east Atlantic	1000000	1980	28	2.1	Yes	Yes	Wanless, S., M.P. Harris, S. Lewis, M. Frederiksen and S. Murray. 2008. Later breeding in northern gannets in the eastern Atlantic. Marine Ecology Progress Series 370:263-269.
Seabirds	Temperate	Bering Sea	10	1975	31	4.7	No	Yes	Byrd, G.V., W.J. Sydeman, H.M. Renner, and S. Minobe. 2008. Responses of piscivorous seabirds at the Pribilof Islands to ocean climate. Deep-Sea Research II 55: 1856-1867.
AUTUMN (NH: September, October, Novermber; SH: March, April, May)									
Bony fish	Temperate	North-east Atlantic	100000	1981	25	-0.4	Yes	Yes	Dufour, F., H. Arrizabalaga, X. Irigoien and J. Santiago. 2010. Climate impacts on albacore and bluefin tunas migrations phenology and spatial distribution. Progress in Oceanography 86: 283-290
Benthic molluscs	Temperate	North-east Atlantic	100	1946	62	3.3	No	No	Moore, P.J., R.C. Thompson and S.J. Hawkins. 2010. Phenological changes in intertidal con-specific gastrpods in response to climate warming. Global Change Biology 17: 709-719
Bony fish	Temperate	North Sea	100000	1970	35	-8.0	Yes	Yes	Teal, L.R., J.J. de Leeuw, H.W. van der Veer and A.D. Rijnsdorp. 2008. Effects of climate change on growth of 0-group sole and plaice. Marine Ecology Progress Series 358:219-230

Bony fish	Temperate	North Sea	100000	1970	35	-10.0	Yes	Yes	Teal, L.R., J.J. de Leeuw, H.W. van der Veer and A.D. Rijnsdorp. 2008. Effects of climate change on growth of 0-group sole and plaice. Marine Ecology Progress Series 358:219-230
Seabirds	Polar	Southern Ocean	10	1960	45	1.9	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Phytoplankton	Temperate	North Sea	100000	1958	45	-0.9	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-0.8	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	-0.3	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	1.4	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	1.8	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	2.9	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	3.2	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430:

									881-884.
Zooplankton	Temperate	North Sea	100000	1958	45	5.6	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
Phytoplankton	Temperate	North Sea	100000	1958	45	6.5	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.
WINTER (NH: December, January, February; SH: June, July, August)									
Zooplankton	Temperate	North-west Atlantic	1000	1951	53	-11.1	No	Yes	Costello, J.H, B.K. Sullivan and D.J. Gifford. 2006. A physical-biological interaction underlying variable phenological responses to climate change by coastal zooplankton. Journal of Plankton Research 28:1099-1105
Seabirds	Polar	Southern Ocean	10	1950	55	0.4	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Seabirds	Polar	Southern Ocean	10	1950	55	3.9	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Seabirds	Polar	Southern Ocean	10	1980	25	12.6	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Seabirds	Polar	Southern Ocean	10	1950	55	1.0	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Seabirds	Polar	Southern Ocean	10	1950	55	1.9	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National

									Academy of Sciences 103: 6248-6251.
Seabirds	Polar	Southern Ocean	10	1970	35	-0.6	No	Yes	Barbraud, C. and H. Weimerskirch. 2006. Antarctic birds breed later in response to climate change. Proceedings of the National Academy of Sciences 103: 6248-6251.
Zooplankton	Temperate	North Sea	100000	1958	45	8.4	Yes	Yes	Edwards, M. and A.J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430: 881-884.