Table S1: Data sources for each ecoregion, including literature references for mined data sources and the names of contributed data sets. Contributed data sets are described in more detail in Table S2. Also included are the species represented by each data set in each ecoregion.

Ecoregion	Data source	Species
Agulhas Bank	*Contributed*: South Africa Gansbaii	*Ecklonia maxima*
Aleutian Islands	*Contributed:* Estes NPRB	*Agarum clathrus, Pleurophycus gardneri, Nereocystis luetkeana, Laminaria yezoensis, Laminaria longipes, Eualaria fistulosa, Cymathaere triplicata, Agarum clathratum*
Bassian	*Contributed:* Kelp Cover Australia Victoria, Kelp Cover Temperate Australia	*Undaria pinnatifida, Macrocystis pyrifera, Lessonia corrugata, Ecklonia radiata*
Beaufort Sea	*Contributed:* Konar Beaufort Sea	*Laminaria solidungula, Saccharina latissima, Alaria esculenta*
Cape Howe	*Contributed:* Kelp Cover Australia Victoria, Kelp Cover Temperate Australia	*Ecklonia radiata*
Celtic Seas	*Mined*: 1, 2 *Contributed:* The Brittany Rebent Monitoring, Northern Ireland Summary	*Undaria pinnatifida, Saccharina latissima, Laminaria ochroleuca, Laminaria hyperborea, Laminaria digitata, Alaria esculenta*
Central Chile	*Contributed:* Northern Chile Fondecyt	*Macrocystis pyrifera, Lessonia trabeculata*
Chiloense	*Contributed:* Southern Chile	*Macrocystis pyrifera*
Gulf of Alaska	*Mined:* 3 *Contributed:* Konar Gulf of Alaska	*Saccharina latissima, Pleurophycus gardneri, Nereocystis luetkeana, Laminaria yezoensis, Laminaria longipes, Laminaria bongardiana, Eualaria fistulosa, Cymathaere triplicata, Costaria costata, Alaria marginata, Agarum clathratum*
Gulf of Maine	*Mined:* 4 *Contributed:* Steneck Gulf of Maine, Witman Gulf of Maine, Normandeau Associates	*Saccharina latissima, Laminaria digitata, Alaria esculenta, Agarum clathratum*
Gulf of St. Lawrence	*Mined:* 5, 6	*Saccharina latissima, Alaria esculenta, Agarum clathratum*
Houtman	*Mined:* 7,8,9 *Contributed:* Kelp Cover Temperate Australia, Australia Western Australia Wernberg	*Ecklonia radiata*
Humboldtian	*Mined:* 10 *Contributed:* Northern Chile Fondecyt	*Macrocystis pyrifera, Lessonia trabeculata*
Leeuwin	*Contributed:* Australia Western Australia Wernberg	*Ecklonia radiata*
Manning-Hawkesbury	*Mined:* 11,12,13	*Ecklonia radiata*
Namaqua	*Mined:* 14,15	*Laminaria pallida, Ecklonia maxima*
North American Pacific Fjordland	*Mined:* 16, 17 *Contributed:* Haida Gwaii	*Saccharina latissima, Saccharina groenlandica, Pterygophora californica, Pleurophycus gardneri, Nereocystis luetkeana, Macrocystis pyrifera, Laminaria yezoensis, Laminaria setchellii, Laminaria longipes, Saccharina groenlandica, Eualaria fistulosa, Egregia menziesii, Cymathaere triplicata, Costaria costata, Alaria marginata, Agarum clathrus, Agarum clathratum*
North Sea	*Contributed:* Norway Inner Coast (monitoring), Norway Inner Cast (assessment), Norway Monitoring	*Saccharina latissima, Laminaria hyperborea, Laminaria digitata*
Northeastern New Zealand	*Contributed:* New Zealand Hakurai Gulf, Northern New Zealand	*Lessonia variegata, Ecklonia radiata*
Northern and Central California	*Mined:* 18,19, 20 *Contributed:* Edwards Baja, San Nicholas Island, Channel Islands National Park, PISCO Subtidal	*Undaria pinnatifida, Pterygophora californica, Pleurophycus gardneri, Nereocystis luetkeana, Macrocystis pyrifera, Laminaria setchellii, Saccharina latissima, Laminaria farlowii, Ecklonia arborea, Egregia menziesii, Dictyoneurum californicum, Costaria costata, Alaria marginata, Agarum fimbriatum*
Oregon, Washington, Vancouver Is.	*Mined:* 21, 22, 23, 24, 25 *Contributed:* PISCO Oregon, Vancouver Island	*Undaria pinnatifida, Saccharina latissima, Pterygophora californica, Pleurophycus gardneri, Nereocystis luetkeana, Macrocystis*

		pyrifera, Lessoniopsis littoralis, Laminaria setchellii, Laminaria farlowii, Ecklonia arborea, Egregia menziesii, Costaria costata, Alaria marginata, Agarum fimbriatum, Saccharina groenlandica
Scotian Shelf	*Mined:* 26, 27, 28, 29, 30, 31, 32, 33,34, 35, 36, 37, 38, 39, 40	*Saccharina latissima, Laminaria digitata, Agarum clathratum*
South Australian Gulfs	*Contributed:* Kelp Cover Temperate Australia, Australia Connell Canopy Loss	*Ecklonia radiata*
South European Atlantic Shelf	*Contributed:* The Brittany Rebent Monitoring	*Undaria pinnatifida, Saccharina latissima, Laminaria ochroleuca, Laminaria hyperborea*
Southern California Bight	*Contributed:* Edwards Baja, San Nicholas Island, Channel Islands National Park, PISCO Subtidal, Santa Barbara Coastal Long Term Ecological Research, Isla Natividad	*Undaria pinnatifida, Pterygophora californica, Pleurophycus gardneri, Nereocystis luetkeana, Macrocystis pyrifera, Laminaria setchellii, Saccharina latissima, Laminaria farlowii, Ecklonia arborea, Egregia menziesii, Dictyoneurum californicum, Costaria costata, Alaria marginata, Agarum fimbriatum*
Southern Norway	*Contributed:* Norway Inner Coast (monitoring), Norway Inner Coast (assessment), Norway Monitoring	*Saccharina latissima, Laminaria hyperborea, Laminaria digitata*
Western Bassian	*Contributed:* Kelp Cover Temperate Australia,	*Ecklonia radiata, Macrocystis pyrifera*

Table S2. Contributed data set information, including the corresponding ecoregion, and the years covered, number of sites, contact person, and associated publications.

Data Set Name	Ecoregion	Years	# Sites	Contact	Associated Publications
Vancouver Island	Oregon, Washington Vancouver Coast and Shelf	1987-2011	8	Jane Watson	44
San Nicolas Island	Northern California and Southern California Bight	1980-2011	7	Mike Kenner	45
Witman Gulf of Maine	Gulf of Maine	1979-2014	4	Jon Witman	46, 47
Konar Beaufort Sea	Beaufort Sea	2003-2007	4	Brenda Konar	
Channel Islands National Park	Northern California and Southern California Bight	1986-2011	16	David Kushner	48
South Africa Gansbaai	Agulhas Bank	1992-1994	2	Rob Anderson	
Central Chile Fondecyt # 11110351 & 1151094	Central Chile	2013-2013	5	Alejandro Perez Matus	49
PISCO Subtidal	Central California and Southern California Bight	1999-2012	146	Jenn Caselle Mark Carr	
Santa Barbara Coastal Long Term Ecological Research	Southern California Bight	2001-2014	8	Dan Reed	51
Kelp Cover Temperate Australia	Bassian, Cape Howe, Houtman, South Australian Gulfs, Western Bassian	1992-2012	187	Graham Edgar Neville Barrett	52, 53, 54
Estes NPRB	Aleutian Islands	1987-2010	147	Mike Kenner, Jim Estes	
Isla Natividad, Baja California, Mexico	Southern California Bight	2006-2014	5	Fiorenza Micheli, Jorge Torre (Comunidad y Biodiversidad, Asociacion Civil)	55, 56
New Zealand Hauraki Gulf	Northeastern New Zealand	2007-2011	1	Nick Shears	57
Northern New Zealand	Northeastern New Zealand	1999-2011	12	Nick Shears	58, 59
The Brittany Rebent Monitoring The European Water Framework Directive Monitoring	Celtic Seas, South European Atlantic Shelf	2004-2013	25	Sandrine Derrien-Courtel	60, 61, 62
Australia Western Australia Wernberg	Houtman and Leeuwin	2006-2011	6	Thomas Wernberg	63
PISCO Oregon	Oregon, Washington Vancouver Coast and Shelf	2001-2004	8	Mark Carr	
Norway Monitoring	North Sea and Southern Norway	1990-2013	31	Kjell Magnus Norderhaug	64, 65
Northern Chile Fondecyt # 1040425	Central Chile and Humboldtian	2004-2007	4	Alejandro Perez Matus	66
Northern Ireland Summary	Celtic Seas	1982-2012	226	Julia Nunn and Claire Goodwin	
Haida Gwaii	North American Pacific Fjordland	2010-2013	8	Anne Salomon	
Southern Chile	Chiloense	2012	1	Alejandro Buschmann	67

Edwards Baja	Northern California and Southern California Bight	1997-2006	62	Matt Edwards	
Kelp Cover Australia Victoria	Bassian and Cape Howe	1998-2011	45	Scott Ling	68
Australia Connell Canopy Loss	South Australian Gulfs	1968-2008	2	Sean Connell	69
Steneck Gulf of Maine	Gulf of Maine	1996-2003	16	Bob Steneck	
Konar Gulf of Alaska	Gulf of Alaska	2003-2012	4	Brenda Konar	
Norway Inner Coast (monitoring)	North Sea/Southern Norway	1976-2012	1	Kjell Magnus Norderhaug	70
Norway Inner Coast (assessment)	North Sea and Southern Norway	1975-2006	9	Frithjof E Moy	71, 72
Normandeau Associates	Gulf of Maine	1978-2011	4	Paul Geoghegan	**Error! Reference source not found.**

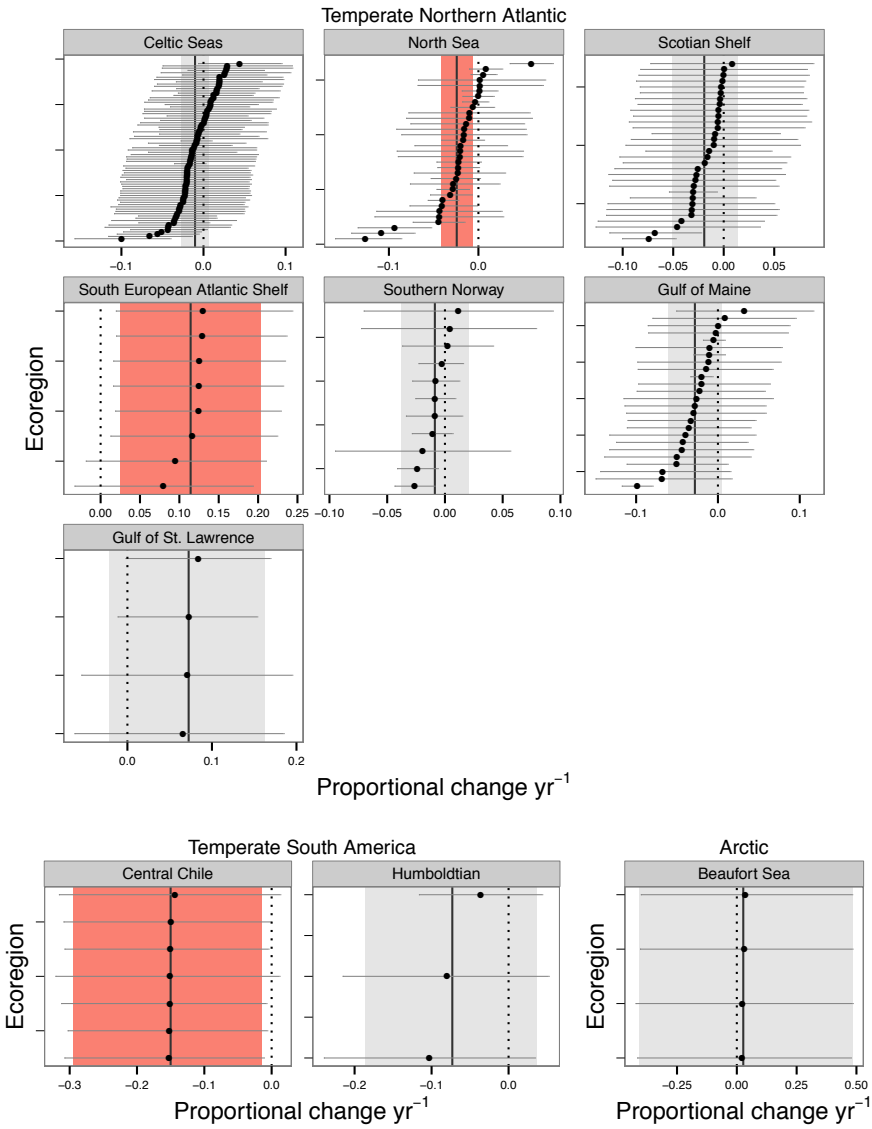
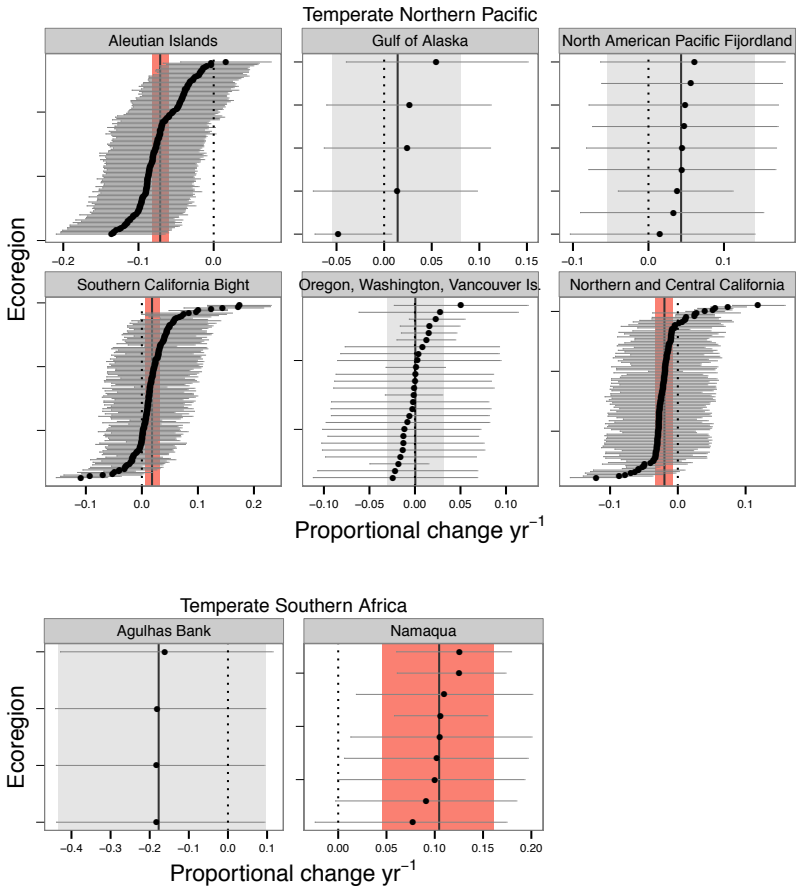


Figure S1. Black circles show site level estimates of mean slope with bars denoting 90% credible intervals (data from 1-72). Sites are grouped by ecoregion and realm, with solid black vertical lines showing ecoregion level mean slopes and shaded bars indicating 90% credible intervals. Dashed lines denote 0. Bars are colored red where there is a high probability (>95%) that the slope does not overlap with zero.



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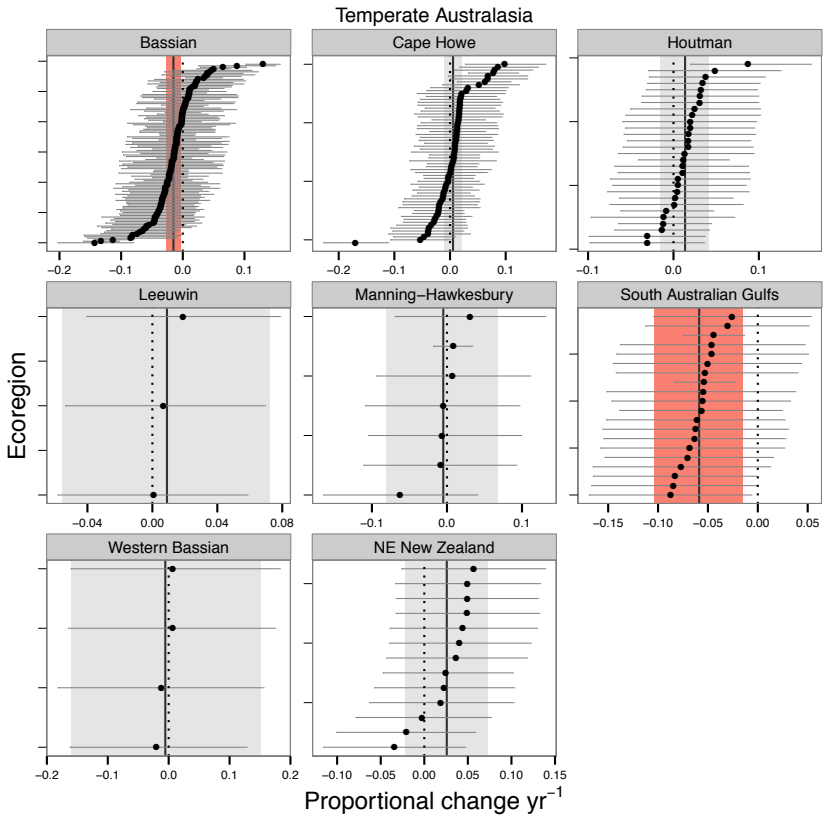


Figure S1 continued

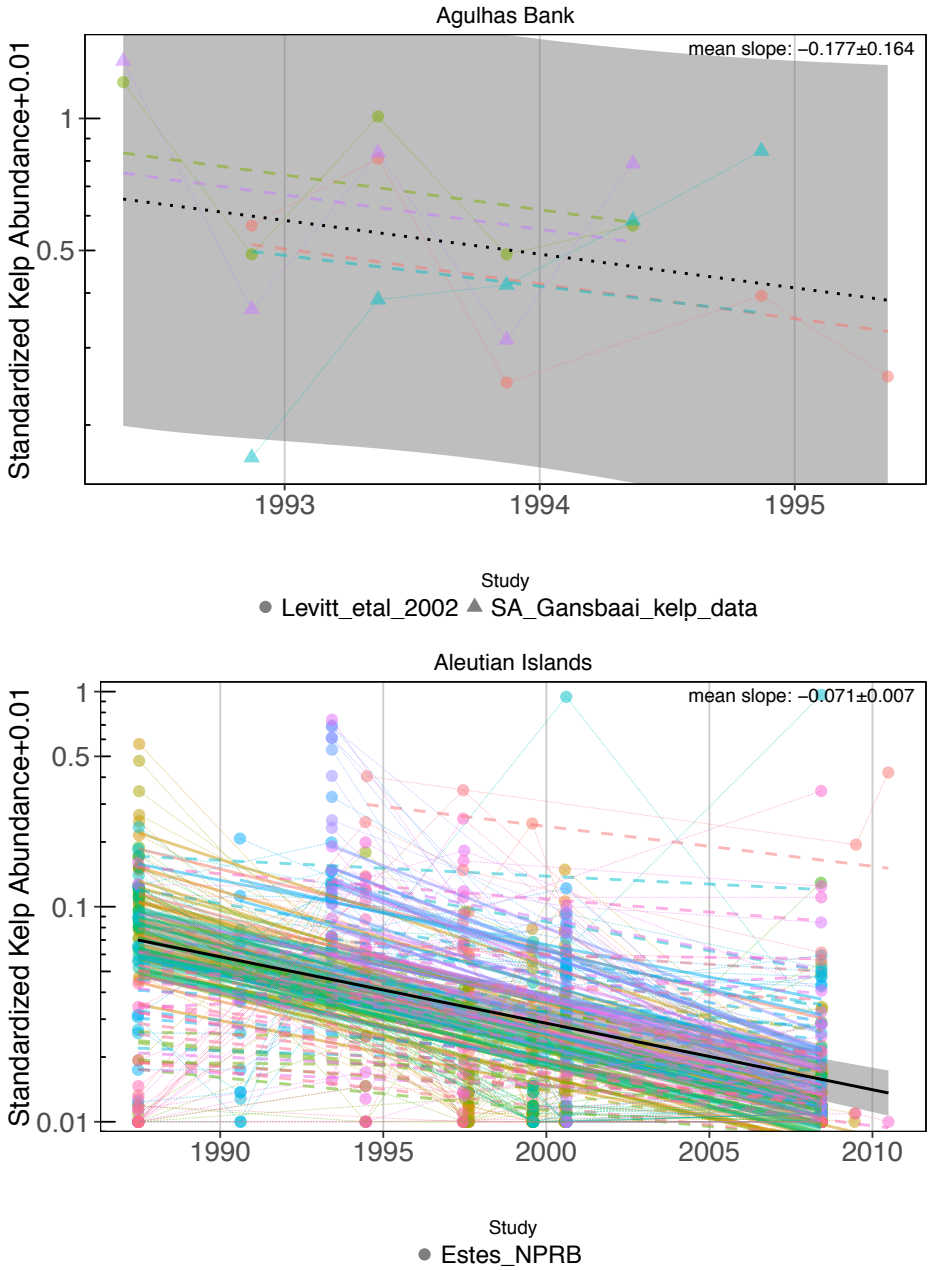
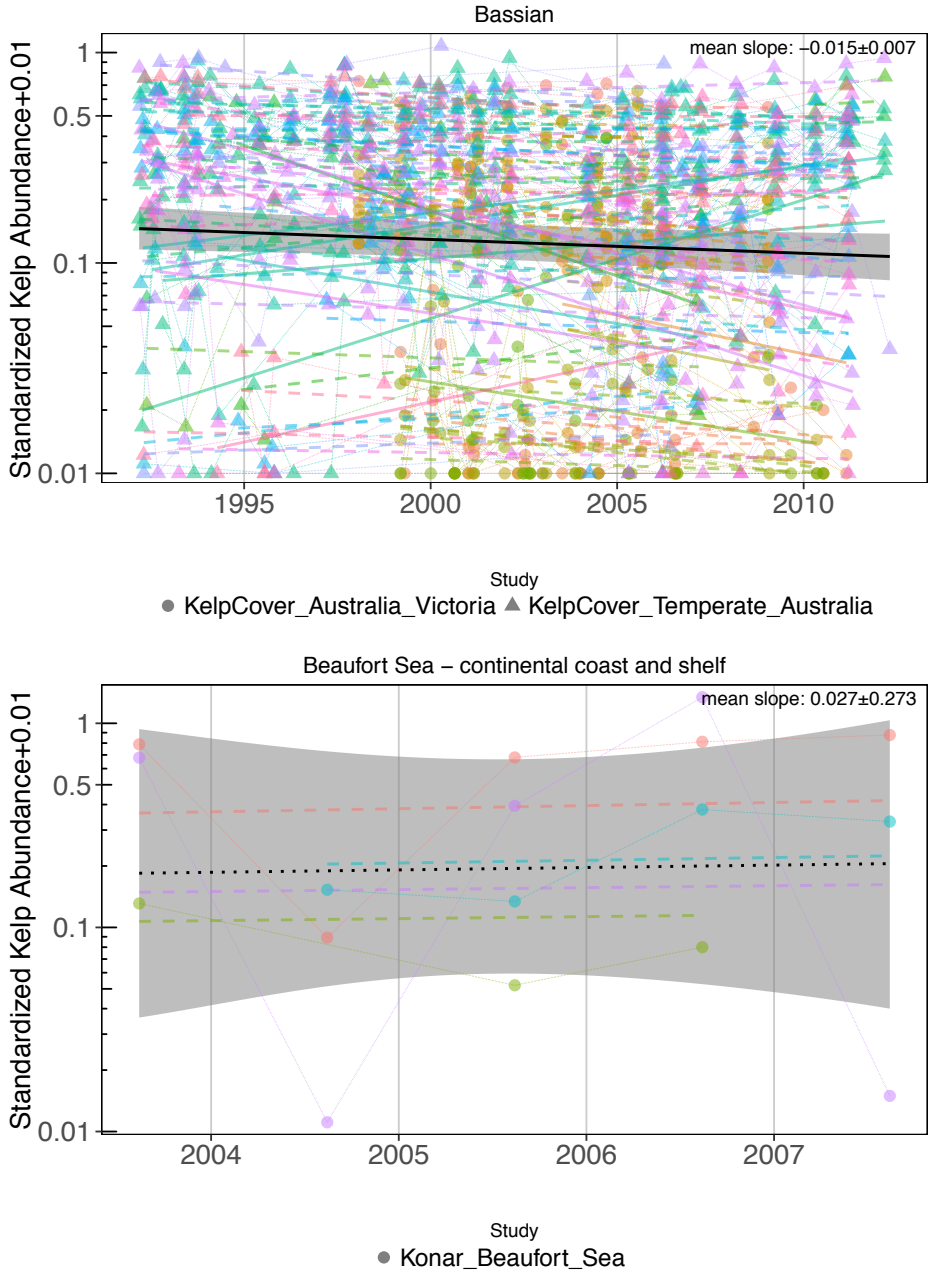


Figure S2. Raw data by ecoregion with site and ecoregion level modeled slopes (data from 1-72). Data and slope estimates are colored and symboled by study (i.e., literature reference or contributed data set), while black lines show the ecoregion mean slope. Solid lines are used where site and ecoregion level slopes have a high probability (>95%) of being different from zero, and dashed lines are used where slopes do not meet this criterion. Shaded bands show the 90% credible interval around the mean rate of change (the black line).



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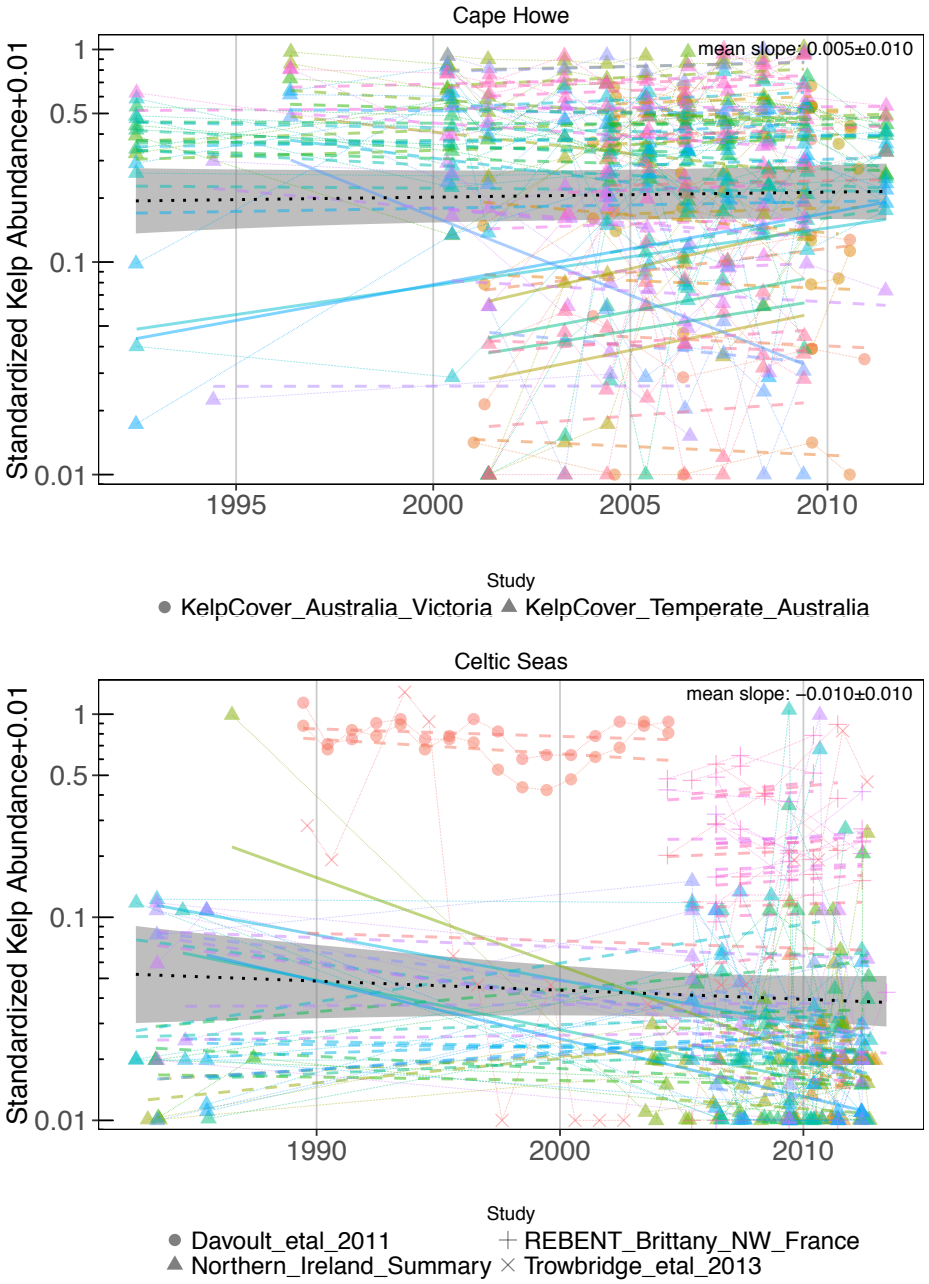

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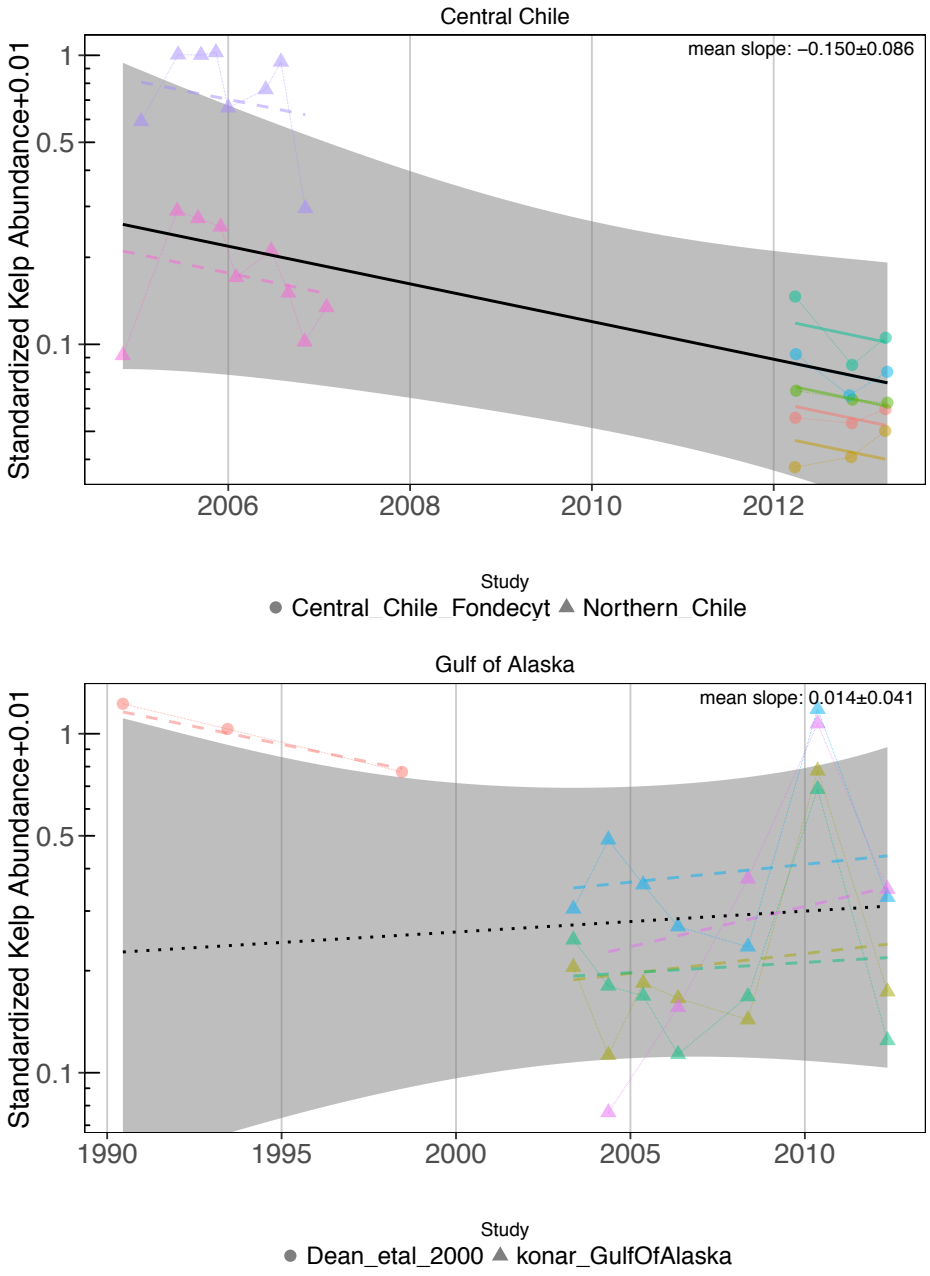

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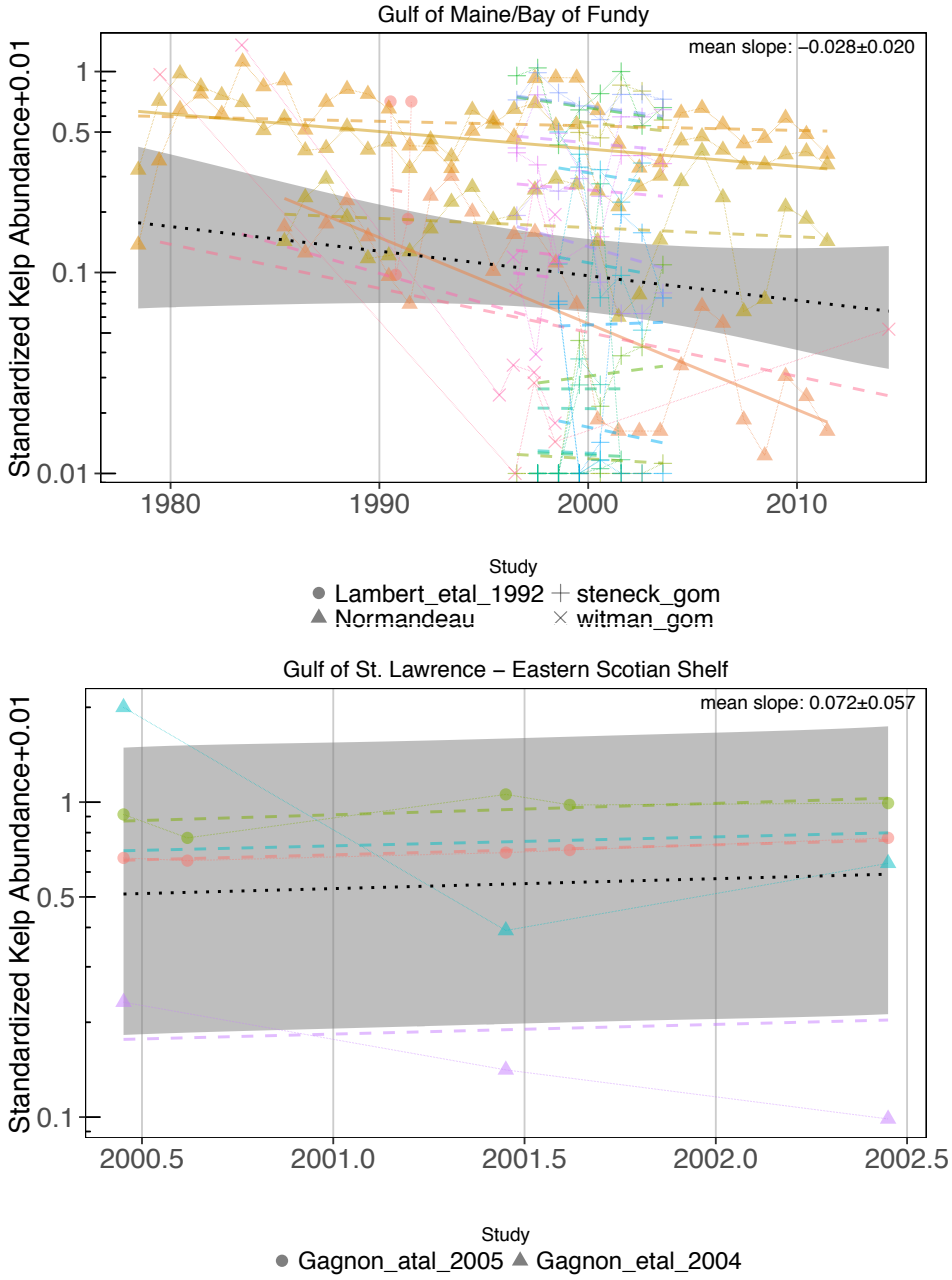

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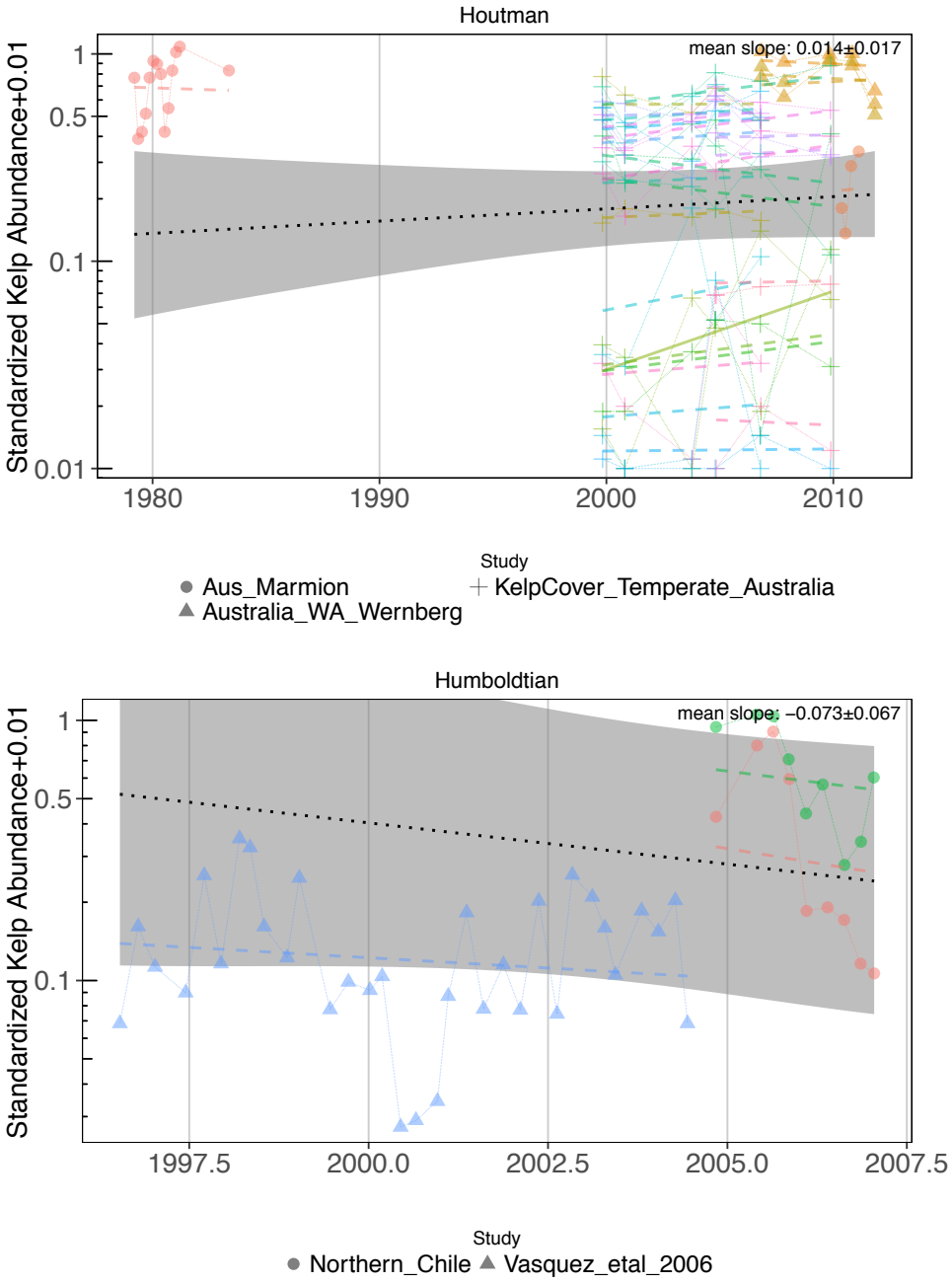

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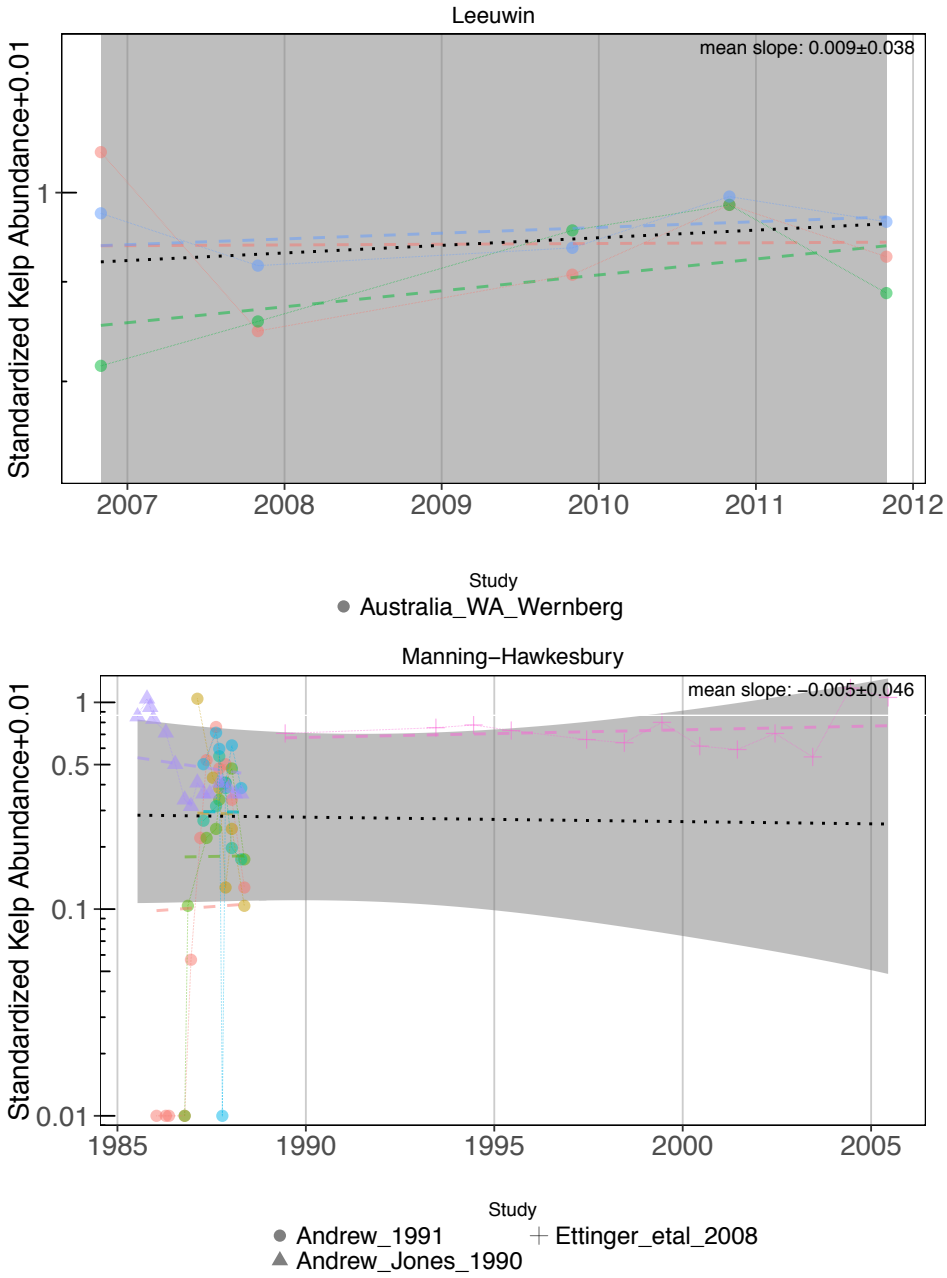

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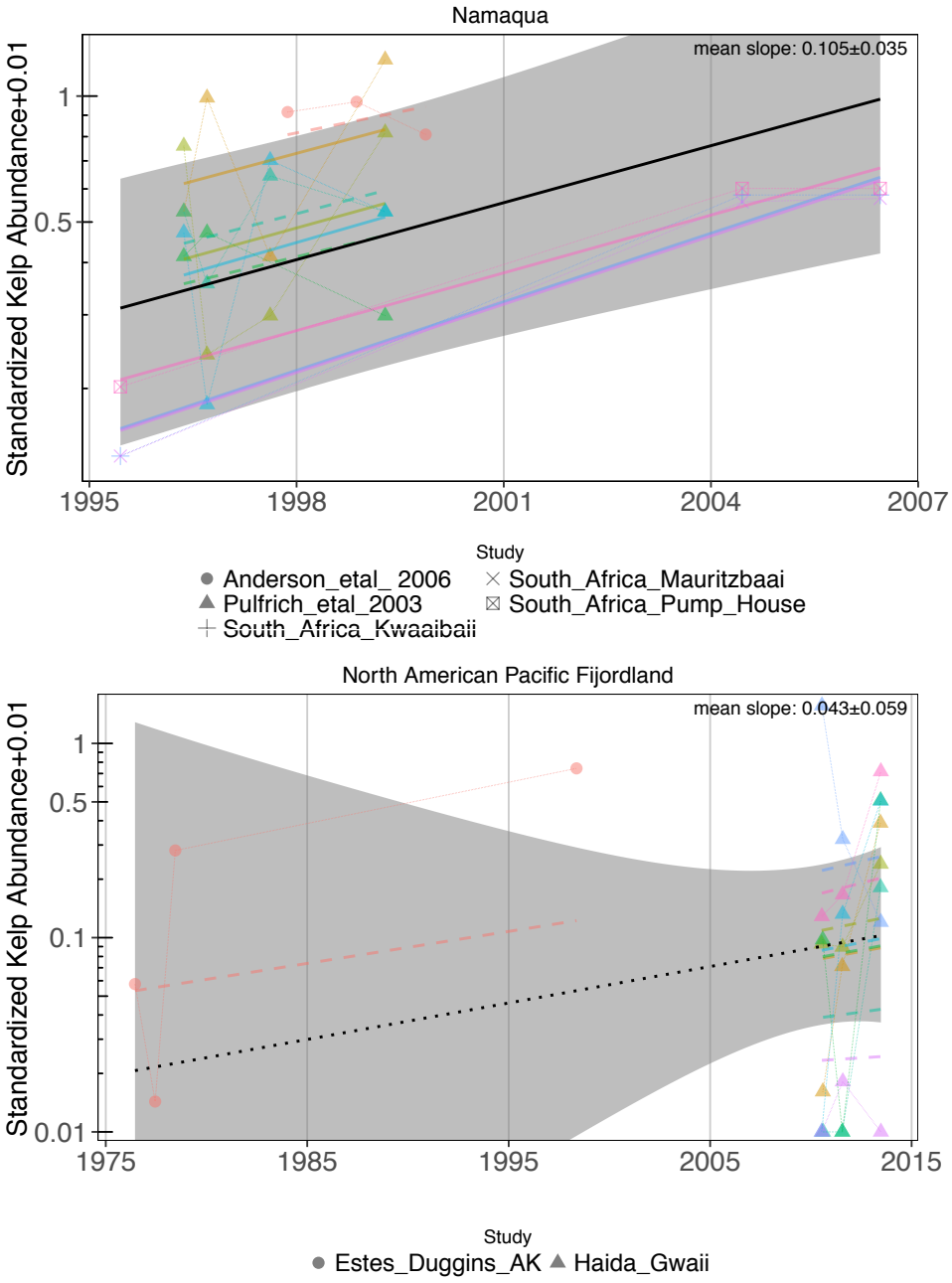

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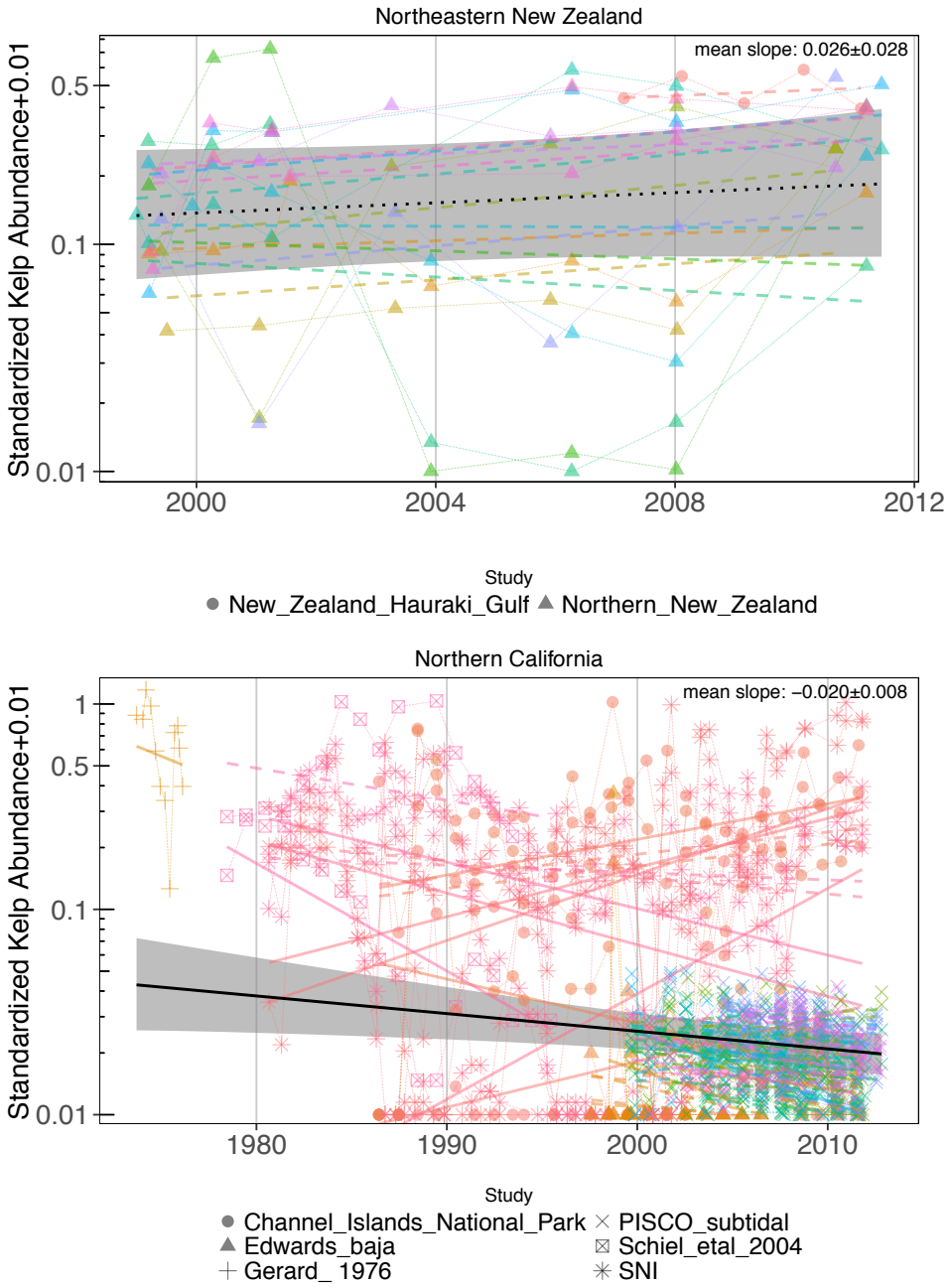

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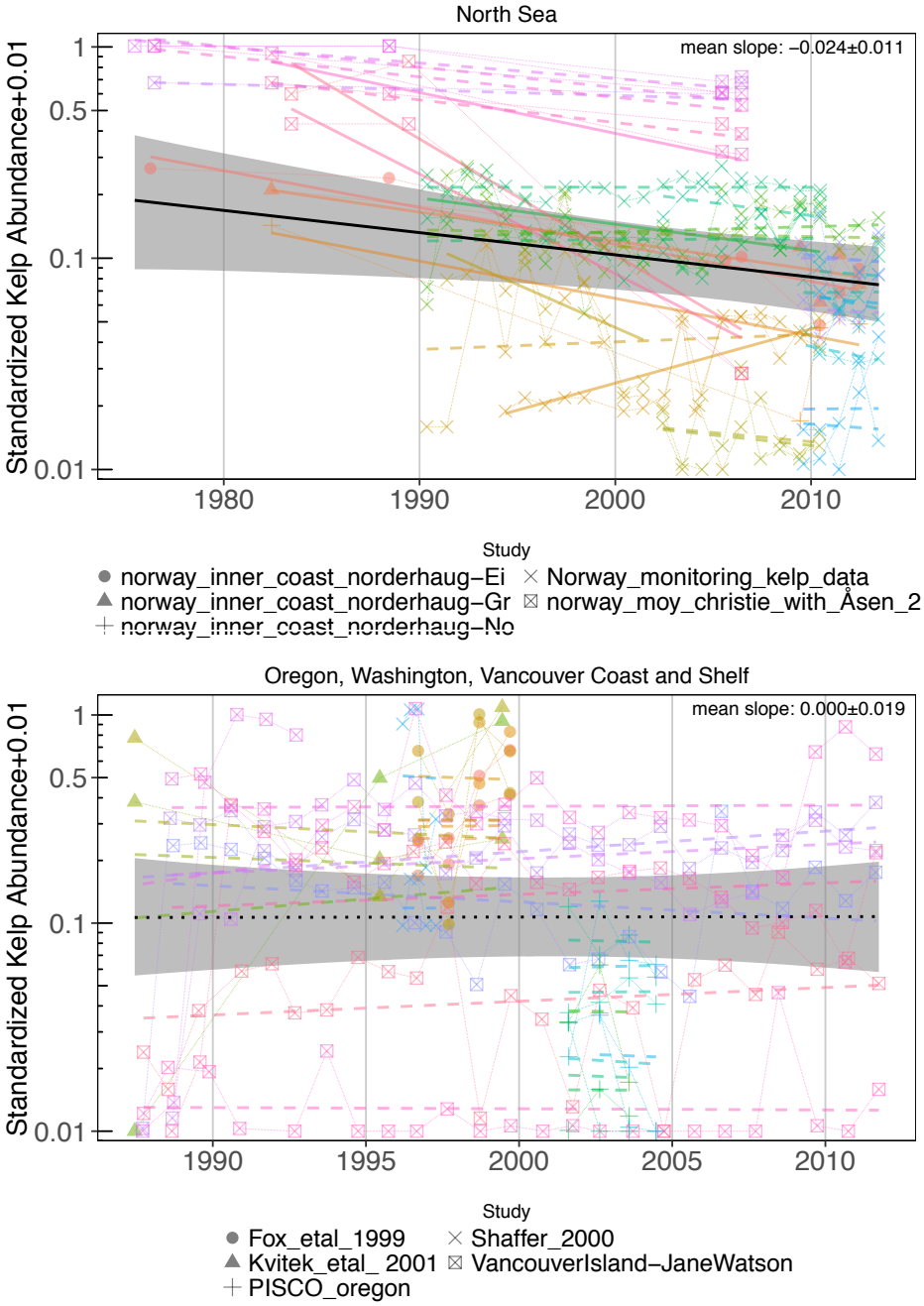

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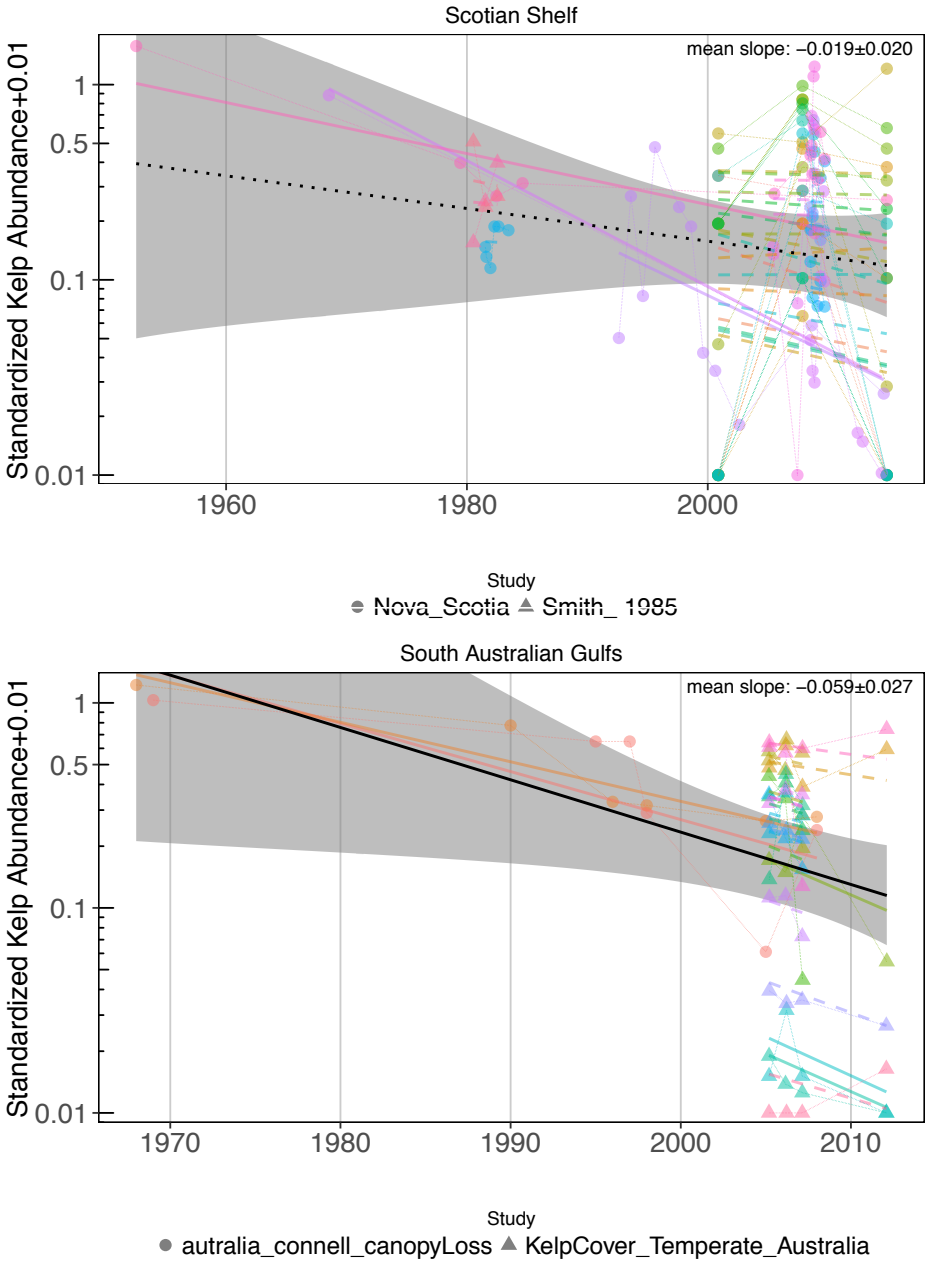

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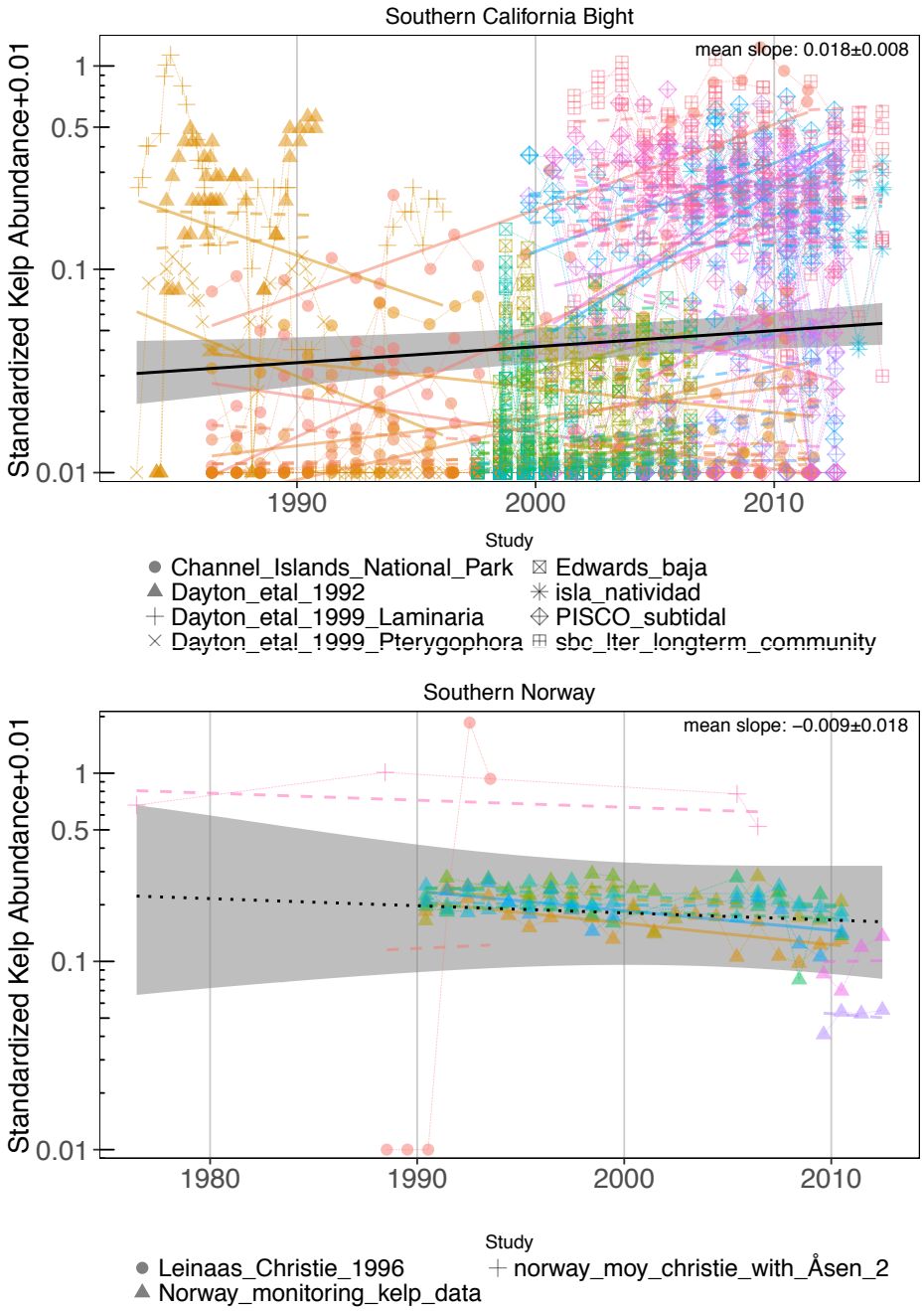

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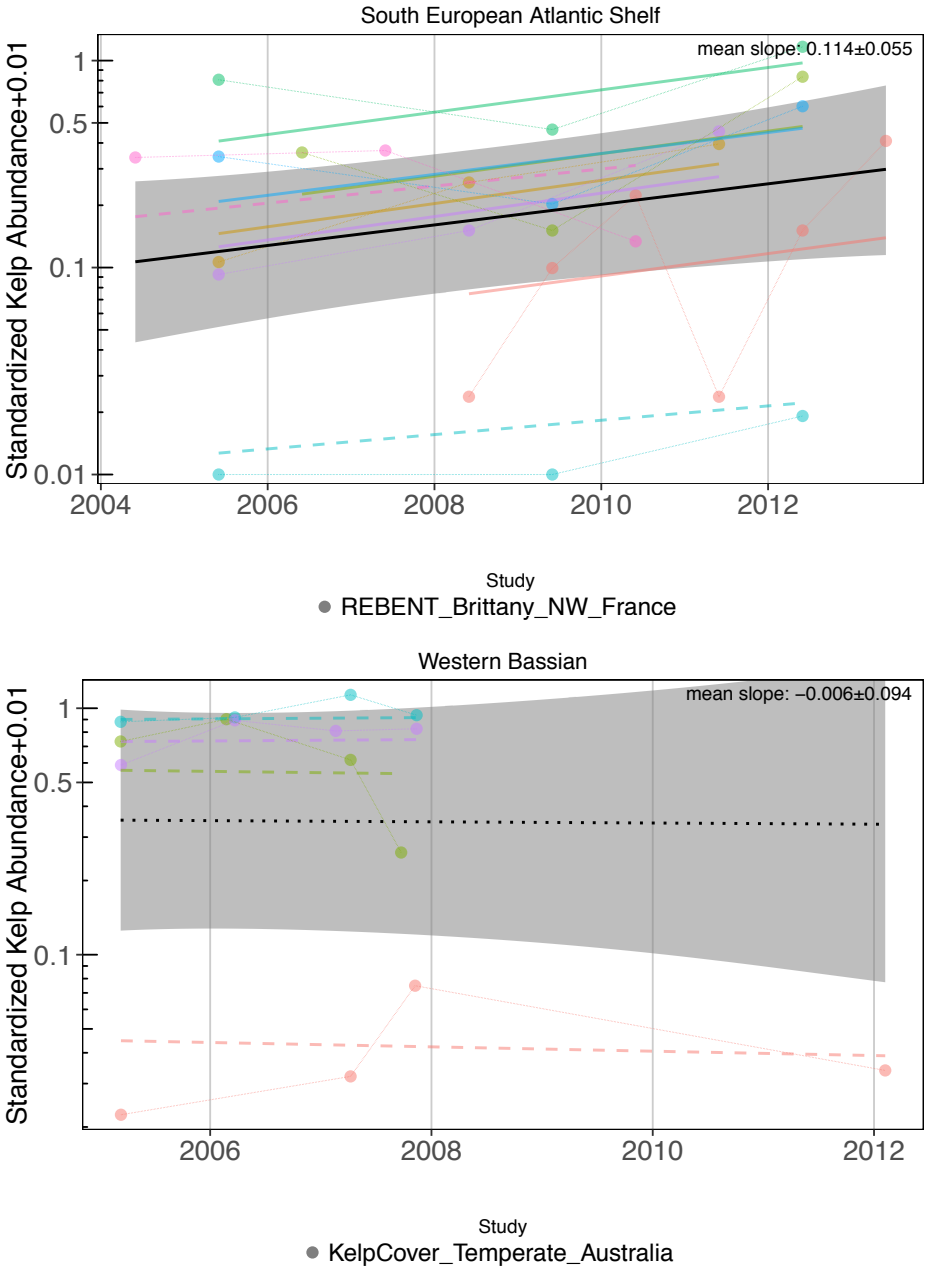

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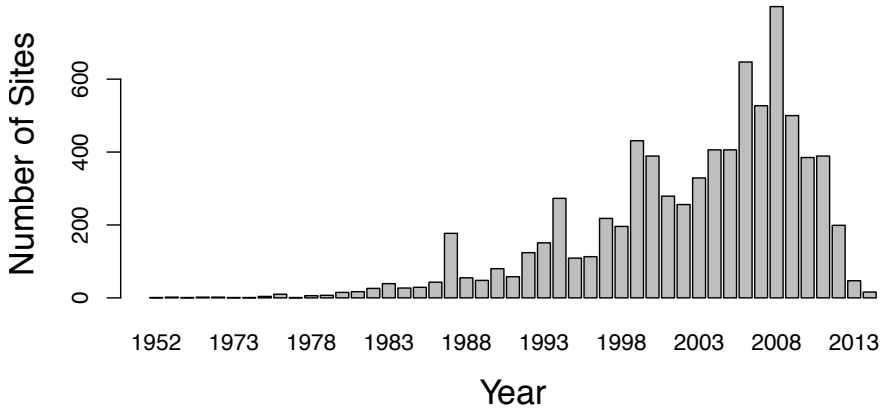

Figure S3. The number of sites in the global data set by year (data from 1-72).

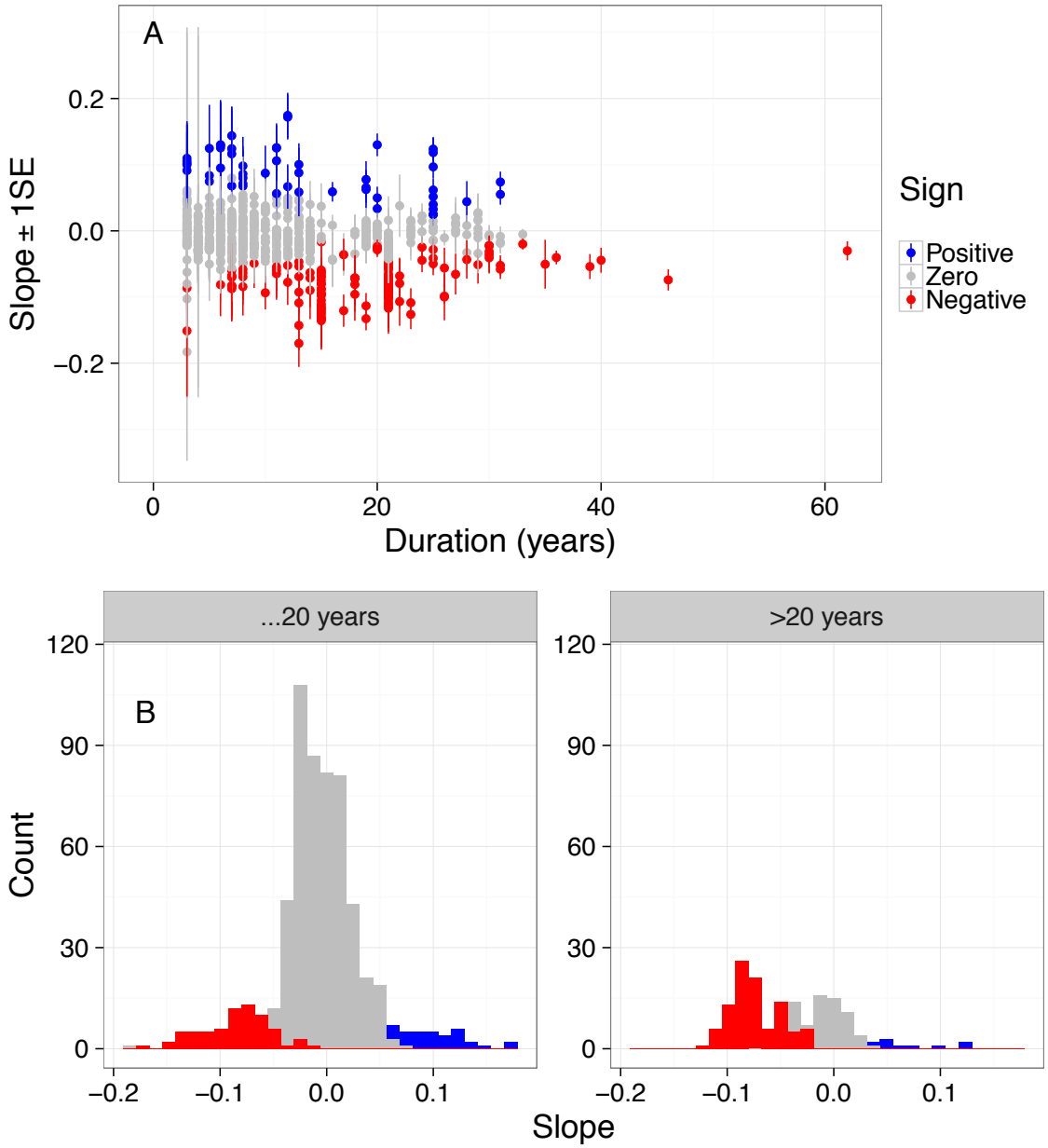

Figure S4. A) Site level slopes and associated standard error, plotted against study duration and colored according to sign (positive, negative, or no change) (data from 1-72). B) Distribution of site level slope estimates colored by sign (positive, negative, or no change).

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