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Accelerating loss of seagrasses across the globe threatens coastal ecosystems

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Communicated by Robert T. Paine, University of Washington, Seattle, WA, May 20, 2009 (received for review October 26, 2008)

Coastal ecosystems and the services they provide are adversely affected by a wide variety of human activities. In particular, seagrass meadows are negatively affected by impacts accruing from the billion or more people who live within 50 km of them. Seagrass meadows provide important ecosystem services, including an estimated \$1.9 trillion per year in the form of nutrient cycling; an order of magnitude enhancement of coral reef fish productivity; a habitat for thousands of fish, bird, and invertebrate species; and a major food source for endangered dugong, manatee, and green turtle. Although individual impacts from coastal development, degraded water quality, and climate change have been documented, there has been no quantitative global assessment of seagrass loss until now. Our comprehensive global assessment of 215 studies found that seagrasses have been disappearing at a rate of 110 km^2 yr^{-1} since 1980 and that 29% of the known areal extent has disappeared since seagrass areas were initially recorded in 1879. Furthermore, rates of decline have accelerated from a median of 0.9% yr^{-1} before 1940 to 7% yr^{-1} since 1990. Seagrass loss rates are comparable to those reported for mangroves, coral reefs, and tropical rainforests and place seagrass meadows among the most threatened ecosystems on earth.

ecosystem decline | global trajectories | habitat loss | marine habitat

Coastal ecosystems such as salt marshes, coral reefs, mangroves, and seagrasses have declined, leading to growing concern because they have recognized ecological and economic values (1–5). Seagrasses, marine flowering plants that include the widely distributed genera *Zostera*, *Thalassia*, and *Posidonia*, form some of the most productive ecosystems on earth, rivaling even crops of corn and sugar cane (6). Further, seagrass meadows provide high-value ecosystem services such as supporting commercial fisheries worth as much as \$3500 ha^{-1} yr^{-1} (7), subsistence fisheries that support entire communities (8), nutrient cycling (9, 10), sediment stabilization (11), and globally significant sequestration of carbon (12). Seagrasses and the services they provide are threatened by the immediate impacts of coastal development and growing human populations as well as by the impacts of climate change and ecological degradation (11, 13). Seagrass losses also disrupt important linkages between seagrass meadows and other habitats (14), and their ongoing decline is likely producing much broader and long-lasting impacts than the loss of the meadows themselves.

Previous efforts to assess general trends in seagrass abundance have been based on a few case studies with limited quantitative data for the time periods studied (15–19) or on extrapolations from a few reported regional rates (11, 15, 19). These assessments vary in their conclusions, ranging from those asserting widespread and abrupt declines, as reported in several recent studies (16–18), to those reporting less dramatic declines on the order of 2–5% yr^{-1} (19) and occasional increases at local scales (20, 21). To expand on these efforts, we synthesized quantitative data from 215 sites with a total of 1,128 observations around the world covering the time period 1879–2006, creating the most comprehensive data set compiled to date (Table S1). Our results extend previous findings in showing that seagrass areal cover is declining across the globe and that the rate of loss is accelerating.

Results

Our analysis of the change in areal extent of seagrass populations demonstrates that, since the earliest records in 1879, seagrass meadows have declined in all areas of the globe where quantitative data are available, including both high and low latitudes. Comparing all sites across their total study length, there were significantly more declines in seagrass meadows than predicted by chance: 58% of sites declined, 25% increased, and 17% exhibited no detectable change (Table 1; $\chi^2 = 5.9$, $P < 0.002$, df = 2). Over the entire time period of our analysis, there was a mean decline in seagrass area of 1.5% yr^{-1} (median = 0.9% yr^{-1}). Not only are the rates of loss high, but the total seagrass area lost is large. Overall, the measured area of seagrass loss was 3,370 km^2 between 1879 and 2006 (i.e., 27 km^2 yr^{-1}), representing 29% of the maximum area measured (11,592 km^2). In addition, the difference in area lost among sites that declined was more than 10 times greater than that among sites that increased (Table 1). Bootstrap analysis supported the robustness of these results; subsampling recovered similar overall rates of change independent of subsample size (Fig. S1). Extrapolation to the global scale must be qualified by limited seagrass mapping efforts in turbid water systems and in some geographic regions that have received less attention from the scientific community. Thus, global estimates of total seagrass area remain poorly resolved; however, based on actual mapped areas and inferring additional unmapped area (19), the current estimate of the total area of seagrasses is ≈177,000 km^2. Extrapolating our conser-

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Author contributions: M.W., C.M.D., T.J.B.C., R.J.O., W.C.D., S.O., A.C., J.W.F., K.L.H.J., R.H., G.A.K., W.J.K., F.T.S., and S.L.W. designed research; M.W., C.M.D., T.J.B.C., R.J.O., W.C.D., S.O., A.C., J.W.F., K.L.H.J., R.H., G.A.K., W.J.K., F.T.S., and S.L.W. performed research; M.W., C.M.D., T.J.B.C., R.J.O., W.C.D., S.O., A.C., J.W.F., K.L.H.J., R.H., G.A.K., W.J.K., F.T.S., and S.L.W. analyzed data; and M.W., C.M.D., T.J.B.C., R.J.O., W.C.D., S.O., A.C., J.W.F., K.L.H.J., R.H., G.A.K., W.J.K., F.T.S., and S.L.W. wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

Freely available online through the PNAS open access option.

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This article contains supporting information online at www.pnas.org/cgi/content/full/0905620106/DCSupplemental.

Table 1. Percentage rate of change for seagrass meadows globally

Trajectory*	Median % rate of change, μ (N)	Proportion in category, %	Mean % rate of change, μ ($\pm$SE, N)	Net maximum measured area, km^2	Net change in study areas, km^2 (% of maximum)	Mean study length, yr
Declining	−3.7 (126)	58	−6.9 (±0.9, 116)	9,147	−3,662 (40)	25
Increasing	5.4 (53)	25	11.8 (±3.6, 43)	879	314 (36)	20
No detectable change	−0.06 (36)	17	−0.2 (±0.2, 36)	1,565	−19 (1)	14
Overall	−0.9 (215)	100	−1.5 (±1.1, 196)	11,592	−3,367 (29)	22

Rate of change expressed as μ, % yr^{-1}.
*Meadows were categorized as declining (<90% of initial area), increasing (final area >110% of initial area), or having no detectable change (final area within ±10% of initial area).

vative net loss (29%) to this global scale suggests that more than 51,000 km^2 of seagrass meadows have been lost during the past 127 years.

In addition, decadal time-course analysis reveals that the rate of decline in seagrass meadows has accelerated over the past 8 decades (Fig. 1). The median rate of decline was <1% yr^{-1} before 1940 but was 5% yr^{-1} after 1980 (Fig. 1*A*). The largest losses occurred after 1980 (Fig. 1*B*): in total, a loss of 35% of seagrass area. The acceleration in detected rates of decline cannot be attributed to increased sampling effort; there was a net change of −37 km^2 site^{-1} decade^{-1} after 1980, twice the rate of loss before 1980 (−18 km^2 site^{-1} decade^{-1}). Comparing decadal trends, there was again a significantly greater number of sites experiencing decreases compared with increases (Wilcoxon signed pair ranked test, P = 0.002) (Fig. S2; χ^2 = 23.7, P < 0.0001, df = 2). The median rate of change from 1879–2006 for sites with increased seagrass area was 5.4% yr^{-1} (mean: 11.8 ± 3.6% yr^{-1}), which includes reports of the formation of 23 seagrass meadows where previously absent. As with loss rates, the rate of increase also accelerated from 4.3% between 1970 and 1980 to 8.4% in the period from 1990 to the 2000s. To date, however, the observed increase in seagrass area has been small compared with the total area lost globally (Table 1); details are available in Table S2.

Evidence of causes of decline was available for 77 of 128 declining sites. Among these, 2 major causes of seagrass loss were indicated: (*i*) direct impacts from coastal development and dredging activities (21 sites) and (*ii*) indirect impacts from declining water quality (35 sites). Only 6 sites with decreases were classified as being caused by natural processes such as storm damage or biological disturbance. Of the 51 sites with increases, 29 had attributed causes, including 11 increases attributable to improved water quality and habitat remediation. Among the remaining increasing sites, recoveries from historical declines attributable to storm damage or episodes of wasting disease were the most common explanations.

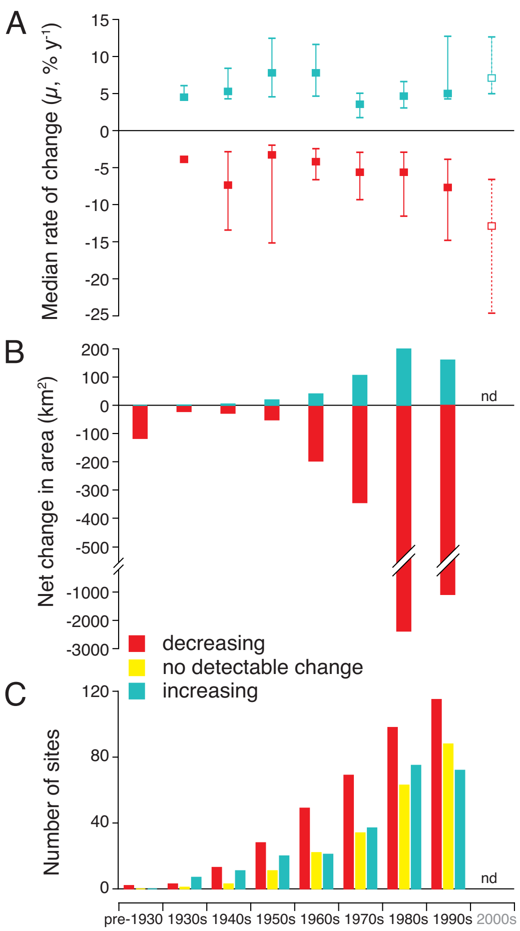

Fig. 1. Decadal trends in seagrass areal extent. Sites were categorized as declining in area, as increasing in area, or as having no detectable change (i.e., ±10% of initial area). Values for the 2000s (dotted line) include 2000–2006 data only. nd, not determined because of incomplete data. (*A*) Median % rate of change (μ) by decade across sites. Error bars represent 25% and 75% quartiles. (*B*) Measured net change in seagrass area, calculated as the net change across each decade. (*C*) Number of sites in each category (decreasing, increasing, or no change) by decade.

Discussion

Our analysis included data from all 6 global seagrass bioregions (22), although sites were not distributed evenly. Europe, North America, and Australia were well represented (Fig. 2), reflecting monitoring efforts in these relatively affluent regions and their strong focus on coastal issues. Major gaps in information exist for West Africa, northeast South America, and the northwest Pacific area of the United States, where seagrasses are typically restricted in distribution. However, the largest data gap exists in the tropical Indo-Pacific region (from East Africa to Hawaii), where seagrasses are widespread and abundant. Seagrasses in this region perform vital ecosystem services for local human populations, support numerous elements of local economies (8), and are food for endangered species such as dugong and green turtle (22). Furthermore, this region has the highest number of seagrass species, including several endemic species (22). Given the rapid population growth and development pressures in the Indo-Pacific, there is a pressing need to acquire more data on seagrass extent in this important region to aid in evaluating the status of seagrasses.

Seagrass losses have been attributed to a broad spectrum of anthropogenic and natural causes (11). Because seagrass meadows are often dominated by a single seagrass species, they are susceptible to pandemic disease outbreaks like the "wasting disease" of the 1930s that killed as much as 90% of all eelgrass

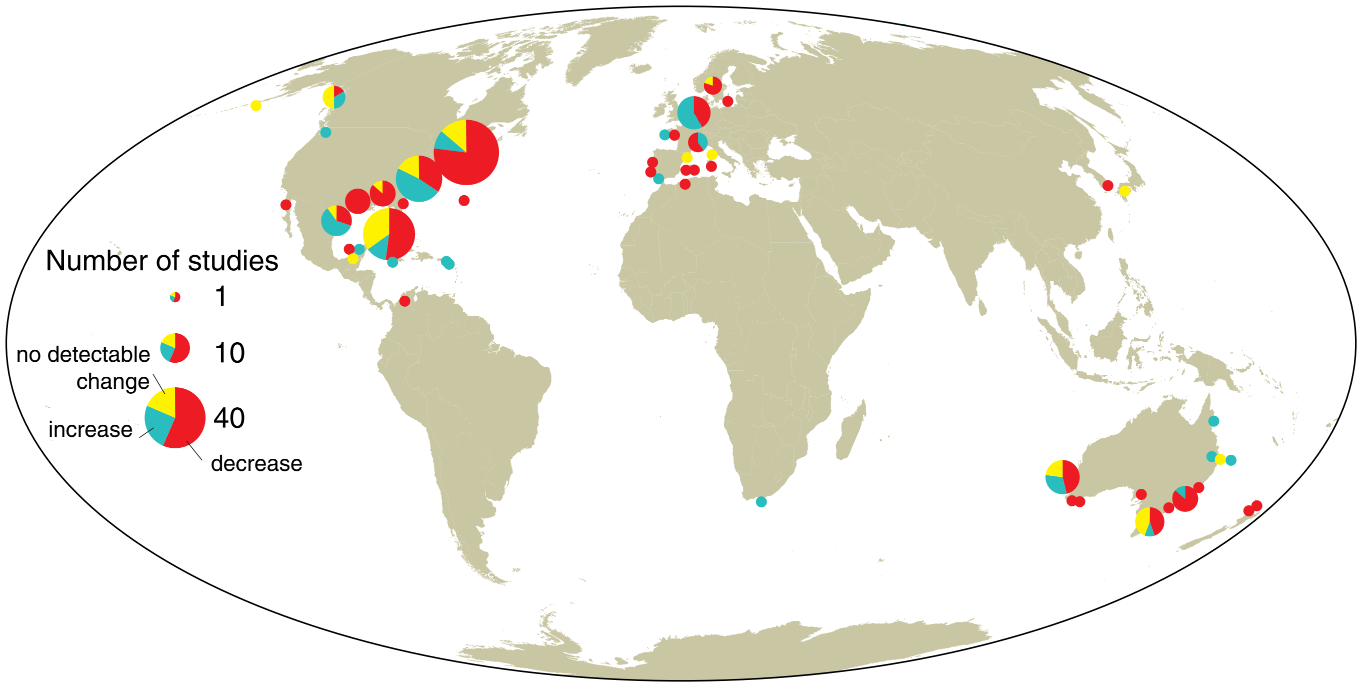

Fig. 2. Global map indicating changes in seagrass area plotted by coastline regions. Changes in seagrass areal extent at each site are defined as declining (red) or increasing (green) when areal extent changed by >10%, or no detectable change (yellow) when final area was within ±10% of the initial area. There were 131 sites in North America, 34 sites in Europe, and 40 sites in Australia.

(*Zostera marina*) in the North Atlantic Ocean (23) or stand diebacks that killed more than 4,000 ha of turtlegrass (*Thalassia testudinum*) in Florida Bay (24). Destructive fishing practices, boat propellers, coastal engineering, cyclones, and tsunamis also cause direct and immediate seagrass loss (3, 4, 11). More indirect and potentially more damaging are the impacts of water quality degradation resulting from increased nutrient additions and sediment runoff in human-altered watersheds. In addition, the indirect effects of aquaculture and invasive species have been observed to affect seagrasses (25, 26). Other indirect effects from overfishing have caused the loss of predators, which can cascade down the food web and lead to the loss of the herbivores that clean seagrasses of fouling algae, resulting in seagrass loss (16, 27, 28). Lastly, global climate change is predicted to have deleterious effects on seagrasses (29) and is emerging as a pressing challenge for coastal management.

Worldwide, seagrasses are experiencing all 5 of the most serious threats to marine biodiversity (30); overexploitation, physical modification, nutrient and sediment pollution, introduction of nonnative species, and global climate change. Seagrass declines have been attributed to all these threats, often in combination. Managing seagrass meadows requires an integrated approach (31), including efforts to avoid excessive nutrient and organic inputs from agricultural, aquaculture, and urban sources and to prevent sediment loading, which causes a deterioration in the submarine light climate so critical for seagrass growth. Best practices should also seek to avoid mechanical damage through anchors, propellers, and fishing gear. Responsible stewardship that promotes favorable growing conditions will confer seagrass meadows with resistance and resilience against pressures that cannot be managed locally, such as those associated with climate change.

Evidence of outcomes from improved management practices are emerging. For example, a concerted effort to reduce point sources of nutrients in Tampa Bay, Florida, over the past 2 decades has resulted in a 50% reduction in total nitrogen loads and an ≈50% increase in water clarity, leading to the recovery of 27 km^2 of seagrasses since 1982 (32). Likewise, mitigation measures adopted in Mondego Bay, a highly eutrophic estuary in Portugal, reduced nitrogen loads and increased seagrass area from 0.02 km^2 (1997) to 1.6 km^2 (2002) by altering estuarine hydraulics and controlling seagrass habitat destruction by fishing practices (33). These system-wide management strategies are improvements on the attempts over past decades to restore seagrass through transplantation. Numerous transplant projects have been attempted worldwide as mitigation measures for seagrass losses (34). However, transplant projects have involved only a few seagrass species and at spatial scales that have failed to alter the trajectories of seagrass loss significantly (34). Science-based protection and management approaches supporting a combination of statutory authorities and consensus planning must be designed to diminish the cumulative effect of stressors and accommodate the broad range of impacts on seagrass meadows to protect them from further losses (35, 36).

Our report of mounting seagrass losses reveals a major global environmental crisis in coastal ecosystems, for which seagrasses are sentinels of change (11). Seagrasses are sensitive integrators of changes in water quality, sediment loading, and other inputs that accumulate as a result of human modification of watersheds and receiving coastal water bodies (37). Seagrass meadows signal the early stages of eutrophication because they give way to faster growing plant competitors like macroalgae and microalgae as water quality decreases (38). More importantly, in contrast to coral reefs, which also herald environmental change but occupy a relatively small portion of the world's oceans, seagrasses are global in extent except for the highest polar regions.

The extent and rate of seagrass losses reported here have had significant ecological consequences. Losses of seagrass meadows will continue to reduce the energy subsidies they provide to other ecosystems such as adjacent coral reefs or distant areas such as deep-sea bottoms, diminishing the net secondary productivity of these habitats (14). Seagrass losses also threaten the future of endangered species such as Chinook salmon (39) and the habitat for many other organisms. Seagrass losses decrease primary production, carbon sequestration, and nutrient cycling in the coastal zone (5). If the current rate of seagrass loss is sustained or continues to accelerate, the ecological losses will also increase, causing even greater ill-afforded economic losses.

Severe impacts to seagrass meadows have received limited public attention compared with changes to other coastal (11, 40) and terrestrial ecosystems, despite the fact that the overall mean rate of seagrass loss calculated here is similar to that of mangrove forests (1.8% yr^{-1}) (41) and even faster than that of tropical forests (0.5% yr^{-1}) (42). Reported changes in Indo-West Pacific (43) coral cover are lower, declining at 0.72% yr^{-1} among reefs repeatedly monitored over the period 1997–2004. Mean decline rates reported in most coral reef studies (1 to 9% yr^{-1}) (44, 45) are based on changes in percent coral cover, as opposed to the actual areal extent of the coral reef ecosystem; however, rates of seagrass meadow and coral reef declines can be considered roughly equivalent, given that seagrass meadows are expected to have a concomitant decline in percent cover as total area declines (46). The cumulative effect of the reported losses in seagrass, mangrove, coral reef, and coastal wetland habitats signals a serious deterioration of coastal environments around the world.

Materials and Methods

We compiled a database that incorporated existing quantitative data on seagrass areal extent from published studies, reports, web sites, online databases, and unpublished but audited sources (see *SI Data Sources*). Sources were identified by conducting a Web of Science search in February 2006 and then again in October 2006 using the following search term: (seagrass* or SAV or submerged aquatic vegetation) and (loss* or change* or recovery or stability or dynamic* or impact* or map* or decline* or increase* or gain*). This search returned 2,346 references (from which we excluded reports referring to ''freshwater species''). We also requested relevant data on the Seagrass Forum listserv in October 2006.

To ensure that reported changes in areal extent were not simply attributable to seasonal variation, we included only studies with at least 2 estimates of areal extent that covered more than 2 years. If the date of a study was not specific within a year, it was assigned to the midyear point (i.e., 1980.5). A known location for each study is referred to as the ''site,'' and each measurement of seagrass area at a site is referred to as an ''event.'' The trajectory of each study was determined as the overall percent rate of change, either positive (i.e., more seagrass area measured) or negative (i.e., less seagrass area measured), across the entire time period of each study and across each decade of the study. At each site, we classified seagrass meadows as declining or increasing if the areal extent changed by >10% or as no detectable change if the areal extent changed by ≤10% [which is typically within the error of assessment techniques (47)]. Departure from even partitioning of meadow trajectories was calculated using a χ^2 test. The final database comprises 215 sites with 1,128 events from 70 sources (Table S1). Several data verification steps were conducted, including independent checks of 63% of all site entries (136 sites).

We conducted 2 types of analyses: (*i*) trajectories were analyzed using the initial and final observations of seagrass area at each site to represent overall trends at sites irrespective of the time period, and (*ii*) trajectories were analyzed decade by decade to account for trends across decades (''decadal analysis'') (see *SI Decadal Analysis*; Fig. S3). Percentage rates of change (the trajectory, μ, % yr^{-1}) for sites were calculated over time interval, t, from the initial to final reported areas (A_o and A_t, respectively) as $\mu = [\ln(A_t/A_o)/t] \times 100$. In addition to the specific rate of change, the net change in area (final area minus initial area) was calculated for each site and for each site in each decade that the study traversed. Trajectories and net change in reported area were calculated across the total time span of each data set and for each decade of the data set (see *SI Decadal Analysis* ; Fig. S3). A test of the relative proportion of sites experiencing decreases as opposed to increases in each decade was conducted by comparing the departure from a 1:1 relationship between these increases and decreases using a χ^2 test and a Wilcoxon signed pair ranked test.

All records of seagrass area before 1930 were grouped for the decade analysis because of limited sample size. The 215 sites assessing change in area of seagrass meadows were not distributed randomly because some regions of the world (the eastern coast of North America, Europe, and southern Australia) have been sampled more intensely than others, irrespective of regional seagrass abundance. In addition to this geographic bias in available data (i.e., developed regions of the world were unavoidably overrepresented), there was a historical bias. More data were available after 1980 (>80% of records), reflecting recent increased research and monitoring effort (see *SI Observational Effort*). To address the influence of sample size effects, bootstrap resampling was used, and we observed the overall trend in μ, as the median rate of change, to be independent of sample size. Bootstrap analysis of μ was conducted for the overall data by random subsampling of 10–80 records in steps of 10, for 100 replicate random samples of each subsample size. For each replicate of a given subsample size, a median value and mean value of μ were calculated and plotted with the 25th and 75th percentiles and maximum and minimum or plus and minus SEs to assess the central tendency for random subsets of samples taken from the total data set (Fig. S1). Because of the lag in reporting changes in measured seagrass areal extent (estimated at >5 years from final date included in the data), the data available for the current decade should be considered incomplete.

Two global estimates of seagrass area that can be substantiated at present are (*i*) the measured global seagrass area, which is the area for which mapping polygons have been established (124,000 km^2; these authors also extrapolate an estimate of expected total area, including unmapped seagrass as 177,000 km^2) (19), and (*ii*) the potential global seagrass area determined by light regimen, bathymetry, and seagrass light requirements (4,300,000 km^2) (48). Although these 2 estimates of global seagrass area result in an extremely wide range (35-fold), further refinement of these global estimates is not possible without more data. Estimates of global seagrass loss calculated in this study were based on the estimated total area value of 177,000 km^2 (19) that we view as a minimum value for total global seagrass area. We note that seagrass meadows grow in turbid, deep, or remote waters in many parts of the world, making mapping their extent problematic.

ACKNOWLEDGMENTS. Ashley Simmons, Karen McGlathery, Richard Pearson, and Simon Robson provided comments on the manuscript. This work was conducted as a part of the Global Seagrass Trajectories Working Group supported by the National Center for Ecological Analysis and Synthesis, a center funded by National Science Foundation (Grant DEB-00–72909), the University of California at Santa Barbara, and the State of California.

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Table S1.

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, μ** *($\% \ y^{-1}$)*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
1	Chincoteague Bay	Temperate North Atlantic	USA	1986	2003	>1000ha	6.39	1986	2100	[1]
								1987	2300	
								1989	2200	
								1990	2300	
								1991	2600	
								1992	3200	
								1993	3400	
								1994	3700	
								1995	3400	
								1996	4000	
								1997	5000	
								1998	5500	
								1999	6300	
								2000	6900	
								2001	6794	
								2002	6300	
								2003	6220	
2	Sinepuxent Bay	Temperate North Atlantic	USA	1986	2003	<1000ha	18.69	1986	29	[1]
								1987	75	
								1989	132	
								1990	180	
								1991	180	
								1992	200	
								1993	230	
								1994	280	
								1995	230	
								1996	350	
								1997	420	
								1998	480	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1999	650	
								2000	690	
								2001	680	
								2002	743	
								2003	696	
4	Southern Delmarva Coastal Bays	Temperate North Atlantic	USA	2001	2003	<100ha	103.34	2001	20	[1]
								2002	85	
								2003	158	
5	Tampa Bay	Tropical Atlantic	USA	1879	2006	>1000ha	-0.78	1879	30970	[2]
								1950	16448	
								1982	8764	
								1988	9427	
								1990	10213	
								1992	10426	
								1994	10736	
								1996	10897	
								1999	10057	
								2002	10558	
								2004	10941	
								2006	11466	
6	Upper Charlotte Harbor	Tropical Atlantic	USA	1982	2002	>1000ha	0.01	1982	7369	[2]
								1988	7507	
								1992	7216	
								1993	7532	
								1996	7781	
								1999	7224	
								2002	7381	
7	Sarasota Bay	Tropical Atlantic	USA	1950	2001	>1000ha	-0.56	1950	4886	[2]
								1987	3476	

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, μ** *(% y^{-1})*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
								1993	3865	
								1995	4158	
								1998	3701	
								2001	3668	
15	Cala Millo	Mediterranean	Spain	1956	2001	<1000ha	-1.68	1956	259.4	[3]
								2001	121.7	
16	Calvia	Mediterranean	Spain	1956	2001	<1000ha	-0.85	1956	313.1	[3]
								2001	213.7	
17	Maquoit Bay	Temperate North Atlantic	USA	1993	2001	<1000ha	5.30	1993	373.2	[4]
								2000	535.5	
								2001	570.1	
18	Holmstange	Temperate North Atlantic	Denmark	1945	1995	<10ha	7.63	1945	0.3601	[5]
								1954	1.1287	
								1959	9.718	
								1974	10.098	
								1981	7.4888	
								1986	4.2047	
								1992	13.8553	
								1995	16.3639	
19	Boddum Vig	Temperate North Atlantic	Denmark	1954	1998	<100ha	3.90	1954	3.0671	[5]
								1958	5.0023	
								1975	11.7847	
								1981	6.7919	
								1986	9.3079	
								1992	28.5837	
								1995	20.5012	
								1998	17.0408	
20	Vejie	Temperate North Atlantic	Denmark	1954	1999	<10ha	2.99	1954	1.2873	[5]
								1960	1.6972	
								1970	4.9942	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1977	5.2349	
								1983	5.1017	
								1995	3.2058	
								1999	4.9388	
21	Amager	Temperate North Atlantic	Denmark	1954	1995	<1000ha	-0.98	1954	138.6405	[5]
								1967	156.8419	
								1974	71.6146	
								1980	117.2306	
								1984	108.0853	
								1989	138.4917	
								1995	92.8247	
22	Samso	Temperate North Atlantic	Denmark	1954	1999	<1000ha	-1.16	1954	147.3958	[5]
								1969	119.3412	
								1975	115.4546	
								1979	90.3404	
								1983	141.4856	
								1988	146.2929	
								1993	67.1163	
								1994	76.7664	
								1995	81.5879	
								1999	87.3645	
23	Terschelling harbour	Temperate North Atlantic	The Netherlands	1995	1998	<100ha	-82.31	1995	18.9	[6]
								1998	1.6	
24	Paap	Temperate North Atlantic	The Netherlands	1994	1997	<100ha	48.01	1994	27	[6]
								1995	64	
								1996	159	
								1997	114	
25	Stromstad	Temperate North Atlantic	Sweden	1980	2000	<1000ha	-2.87	1980	190	[7]
								2000	107	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
26	Lysekil	Temperate North Atlantic	Sweden	1980	2000	<1000ha	-0.12	1980	167	[7]
								2000	163	
27	Uddevalla	Temperate North Atlantic	Sweden	1980	2000	<1000ha	-6.53	1980	384	[7]
								2000	104	
28	Stenungsund	Temperate North Atlantic	Sweden	1980	2000	<1000ha	-1.03	1980	290	[7]
								2000	236	
29	Kungalv	Temperate North Atlantic	Sweden	1980	2000	<1000ha	-8.47	1980	794	[7]
								2000	146	
31	Hillsborough Bay	Tropical Atlantic	USA	1987	1990	<1ha	120.48	1987	0.00112885	[8]
								1987	0.00034993	
								1987	0.00116875	
								1988	0.00024182	
								1988	0.00776219	
								1988	0.01484461	
								1989	0.01828509	
								1989	0.02929817	
								1989	0.04191263	
32	Middle Tampa Bay	Tropical Atlantic	USA	1986	1989	<100ha	23.79	1986	48	[8]
								1989	98	
38	Vaccares Lagoon	Mediterranean	France	1993	2003	>1000ha	-1.89	1993	4721.61	[9]
								1994	3851.47	

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, μ** *(% y^{-1})*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
								1995	3826.11	
								1996	3541.93	
								1997	96.85	
								1998	1583.78	
								1999	1599.23	
								2000	2963.57	
								2001	4109.8	
								2002	3975.45	
								2003	3909.16	
39	Mondego Estuary (South Arm)	Temperate North Atlantic	Portugal	1986	2002	<10ha	-13.99	1986	15	[10]
								1993	1.6	
								1997	0.02	
								2000	0.9	
								2002	1.6	
41	Ria Formosa	Temperate North Atlantic	Portugal	1940	1998	<100ha	1.84	1940	7.1	[11]
								1980	6	
								1989	7.9	
								1996	50.1	
								1998	20.7	
44	Urangan	Tropical Indo-Pacific	Australia	1998	2002	<100ha	0.21	1998	91.48	[12]
								1999	0	
								1999	0	
								2002	92.26	
45	Wanggoolba Creek	Tropical Indo-Pacific	Australia	1998	2002	<100ha	2.99	1998	119.5	[12]
								1999	4.37	
								1999	0	
								2002	134.7	
46	Northern Great Sandy Strait	Tropical Indo-Pacific	Australia	1998	2002	>1000ha	15.52	1998	1995	[12]
								1999	913.3	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1999	98.1	
								2002	3712	
62	Marseilles	Mediterranean	France	1984	1999	<1ha	1.27	1984	0.67	[13]
								1987	0.63	
								1991	0.68	
								1994	0.7	
								1999	0.81	
65	Cockburn Sound East	Temperate Southern Oceans	Australia	1967	1999	<1000ha	-15.32	1967	1750	[14]
								1972	310	
								1981	14	
								1994	26	
								1999	13	
66	Cockburn Sound South	Temperate Southern Oceans	Australia	1967	1999	<1000ha	-2.42	1967	634	[14]
								1972	528	
								1981	283	
								1994	291	
								1999	292	
67	Cockburn Sound West	Temperate Southern Oceans	Australia	1967	1999	<1000ha	-1.33	1967	545	[14]
								1972	504	
								1981	443	
								1994	372	
								1999	356	
69	Hornillo Bay	Mediterranean	Spain	1988	1998	<100ha	-7.52	1988	40	[15]
								1994	18.85	
								1998	18.85	
70	Success Bank East	Temperate Southern Oceans	Australia	1965	2004	<1000ha	1.91	1965	229.4	[16]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1972	340.9	
								1982	456.5	
								1995	482.7	
71	Success Bank Central	Temperate Southern Oceans	Australia	1965	2004	<1000ha	1.47	1965	53.4	[16]
								1972	121.9	
								1982	138.8	
								1995	94.6	
72	Success Bank West	Temperate Southern Oceans	Australia	1965	2004	<1000ha	1.83	1965	224.5	[16]
								1972	297.7	
								1982	382.8	
								1995	458.6	
73	Parmelia Bank East	Temperate Southern Oceans	Australia	1965	2004	<1000ha	-1.04	1965	487	[16]
								1972	491.5	
								1982	289.2	
								1995	324.1	
74	Parmelia Bank West	Temperate Southern Oceans	Australia	1965	2004	<1000ha	1.06	1965	248.1	[16]
								1972	285.2	
								1982	343.6	
								1995	375.1	
75	Spencer Gulf	Temperate Southern Oceans	Australia	1987	1994	>1000ha	-13.05	1987	15953	[17]
								1994	6401	
78	Vaccares Lagoon	Mediterranean	France	1984	1994	>1000ha	3.60	1984	3000	[18]
								1994	4300	
79	Izembek Lagoon	Temperate	USA	1978	1987	>1000ha	0.63	1978	15067	[19]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
		North Pacific								
								1987	15915	
								1995	15951	
81	Tuggerah Lakes	Temperate Southern Oceans	Australia	1954	1985	>1000ha	5.48	1954	350	[20]
								1963	4190	
								1965	3120	
								1966	2820	
								1980	1434	
								1981	1313	
								1981	1760	
								1982	1419	
								1983	1864	
								1984	1628	
								1985	1911	
82	Urbinu Lagoon	Mediterranean	France	1990	1999	<1000ha	0.67	1990	137.2597	[21]
								1994	106.1578	
								1996	161.6553	
								1999	145.8419	
83	Botany Bay, Northern Shoreline	Temperate Southern Oceans	Australia	1930	1985	<100ha	-0.47	1930	35	[22]
								1942	93	
								1951	22	
								1961	49	
								1977	16	
								1985	27	
84	Botany Bay, Southern Shoreline	Temperate Southern Oceans	Australia	1942	1984	<1000ha	-0.61	1942	668	[22]
								1951	567	
								1961	598	
								1970	740	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1977	483	
								1979	394	
								1982	541	
								1984	516	
88	Glenan Archipelago	Temperate North Atlantic	France	1932	1992	<1000ha	-0.98	1932	278.8	[23]
								1952	128.3	
								1961	168.4	
								1967	175.3	
								1969	161.2	
								1976	170.3	
								1978	154.9	
								1982	145.9	
								1987	115.8	
								1990	154.6	
96	Mourillion	Mediterranean	France	1964	1999	<1000ha	-1.81	1964	147	[24]
								1979	78	
97	Marseille	Mediterranean	France	1900	1994	<1000ha	-0.62	1900	471	[24]
								1994	263	
115	Whangamata Harbour	Temperate Southern Oceans	New Zealand	1944	1998	<100ha	-0.51	1944	79	[25]
								1998	60	
116	Wallis Lake	Temperate Southern Oceans	Australia	1988	2002	>1000ha	-0.95	1988	2374	[26]
								1991	2184	
								1995	1856	
								2002	2078	
119	Esperance Bay	Temperate Southern Oceans	Australia	1956	2001	<1000ha	-0.57	1956	585	[27]
								1969	509	
								1977	428	

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, µ** *(% y^{-1})*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
								1989	482	
								1995	463	
								2001	453	
120	Warnbro Sound	Temperate Southern Oceans	Australia	1953	2002	<1000ha	-0.64	1953	273	[28]
								1963	263	
								1989	265	
								1995	223	
								2002	200	
121	Swan-Canning Estuary	Temperate Southern Oceans	Australia	1976	1982	<1000ha	0.87	1976	563	[29]
								1982	593	
123	Princess Royal Harbour	Temperate Southern Oceans	Australia	1960	1988	<1000ha	-6.25	1960	1440	[30]
								1988	250	
124	Oyster Harbour	Temperate Southern Oceans	Australia	1960	1988	<1000ha	-5.52	1960	610	[30]
								1988	130	
126	Hamblin Pond, Waquoit Bay	Temperate North Atlantic	USA	1987	1997	<100ha	-9.78	1987	17.3	[31]
								1988	19.3	
								1989	14.6	
								1992	10.1	
								1997	6.5	
127	Eel Pond, Waquoit Bay	Temperate North Atlantic	USA	1987	2000	<10ha	undefined	1987	14.3	[31]
								1988	13.3	
								1989	12.1	
								1992	6.2	
								1994	0.66	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								2000	0	
128	Jehu Pond, Waquoit Bay	Temperate North Atlantic	USA	1987	1997	<10ha	-17.77	1987	11.8	[31]
								1988	9.6	
								1989	4.3	
								1992	4.5	
								1997	2	
129	Central Basin, Waquoit Bay	Temperate North Atlantic	USA	1987	1992	<100ha	-27.88	1987	23.2	[31]
								1988	9.7	
								1989	12.6	
								1992	5.8	
130	Great River, Waquoit Bay	Temperate North Atlantic	USA	1987	1992	<10ha	-24.87	1987	14.4	[31]
								1988	10.4	
								1989	6.0	
								1992	4.2	
131	Tim's Pond, Waquoit Bay	Temperate North Atlantic	USA	1987	1992	<10ha	1.75	1987	2.4	[31]
								1988	2.3	
								1989	2.3	
								1992	2.6	
132	Offshore, Waquoit Bay	Temperate North Atlantic	USA	1987	1992	<1ha	-1.84	1987	1.0	[31]
								1988	0.9	
								1989	0.8	
								1992	0.9	
133	Ninigret Pond	Temperate North Atlantic	USA	1960	1992	<10ha	-1.68	1960	5.2	[32]
								1974	4.4	
								1980	3.3	
								1992	3.1	
134	Japan	Temperate North Pacific	Japan	1978	1991	>1000ha	-0.30	1978	51500	[33]

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, μ** *(% y^{-1})*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
								1991	49500	
136	Puget Sound	Temperate North Pacific	USA	2000	2004	>1000ha	8.27	2000	14470	[34]
								2001	20990	
								2002	20390	
								2003	20620	
								2004	20140	
137	Indian River Lagoon segment SV	Tropical Atlantic	USA	1943	2005	<1000ha	-0.31	1943	305	[35]
								1986	43.2	
								1989	34.8	
								1992	67.1	
								1994	61.7	
								1996	119.8	
								1999	205.3	
								2001	214.9	
								2003	241.7	
								2005	252	
138	Indian River Lagoon Segment NV	Tropical Atlantic	USA	1943	2005	<1000ha	0.08	1943	233	[35]
								1986	18	
								1989	47.1	
								1992	29.9	
								1994	92.5	
								1996	134.3	
								1999	194.5	
								2001	220.4	
								2003	242.3	
								2005	245	
139	Indian River Lagoon Segment MP	Tropical Atlantic	USA	1943	2005	<1000ha	-0.68	1943	411.8	[35]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1986	243.8	
								1989	240.8	
								1992	246.5	
								1994	152.4	
								1996	240.5	
								1999	243.1	
								2001	264.5	
								2003	267.8	
								2005	269.5	
140	Bermuda Platform	Tropical Atlantic	Bermuda	1997	2004	>1000ha	-3.66	1997	2100	[36]
								2004	1625	
164	Lower Laguna Madre	Tropical Atlantic	USA	1965	1988	>1000ha	-0.80	1965	66608	[37]
								1974	54468	
								1988	55437	
165	Turkey Point	Tropical Atlantic	USA	1967	1969	<100ha	undefined	1967	20.2	[38]
								1968	13.1	
								1969	0	
201	CB5MH - Chesapeake Bay	Temperate North Atlantic	USA	1984	2005	<1000ha	6.22	1984	270	[39]
								1985	172	
								1986	203	
								1987	321	
								1989	490	
								1990	608	
								1991	635	
								1992	778	
								1993	813	
								1994	757	
								1995	703	
								1996	709	
								1997	667	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1998	659	
								1999	640	
								2000	725	
								2001	944	
								2002	1120	
								2003	352	
								2004	742	
								2005	997	
202	CB6PH - Chesapeake Bay	Temperate North Atlantic	USA	1984	2005	<1000ha	-0.76	1984	305	[39]
								1985	328	
								1986	322	
								1987	242	
								1989	351	
								1990	373	
								1991	396	
								1992	467	
								1993	512	
								1994	454	
								1995	431	
								1996	396	
								1997	362	
								1998	313	
								1999	268	
								2000	288	
								2001	289	
								2002	310	
								2003	286	
								2004	198	
								2005	260	
203	CB7PH - Chesapeake Bay	Temperate North Atlantic	USA	1984	2005	>1000ha	0.74	1984	2822	[39]
								1985	2899	
								1986	2989	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, µ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1987	2942	
								1989	3241	
								1990	3324	
								1991	4007	
								1992	4151	
								1993	4470	
								1994	4014	
								1995	3560	
								1996	3831	
								1997	3937	
								1998	3617	
								1999	3335	
								2000	3403	
								2001	3712	
								2002	3966	
								2003	3720	
								2004	2896	
								2005	3294	
204	CB8PH - Chesapeake Bay	Temperate North Atlantic	USA	1984	2005	<10ha	undefined	1984	0	[39]
								1985	0	
								1986	0	
								1987	0	
								1989	0	
								1990	0	
								1991	0	
								1992	0	
								1993	0	
								1994	0	
								1995	4	
								1996	4	
								1997	4	
								1998	4	
								1999	3	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								2000	3	
								2001	3	
								2002	4	
								2003	2	
								2004	2	
								2005	4	
206	JMSPH - James	Temperate North Atlantic	USA	1984	2005	<100ha	undefined	1984	0	[39]
								1985	0	
								1986	0	
								1987	3	
								1989	4	
								1990	3	
								1991	3	
								1992	3	
								1993	4	
								1994	6	
								1995	15	
								1996	19	
								1997	76	
								1998	52	
								1999	31	
								2000	38	
								2001	94	
								2002	114	
								2003	53	
								2004	30	
								2005	0	
207	LYNPH - Lynnhaven	Temperate North Atlantic	USA	1984	2005	<100ha	-7.42	1984	38	[39]
								1985	37	
								1986	43	
								1987	40	
								1989	38	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1990	29	
								1991	24	
								1992	20	
								1993	21	
								1994	43	
								1995	13	
								1996	30	
								1997	16	
								1998	17	
								1999	38	
								2000	19	
								2001	17	
								2002	16	
								2003	0	
								2004	4	
								2005	8	
208	MOBPH - Mobjack	Temperate North Atlantic	USA	1984	2005	>1000ha	0.30	1984	2736	[39]
								1985	2847	
								1986	2821	
								1987	2913	
								1989	3667	
								1990	3983	
								1991	4287	
								1992	4361	
								1993	4430	
								1994	4375	
								1995	4389	
								1996	4303	
								1997	4442	
								1998	4082	
								1999	3584	
								2000	3694	
								2001	3850	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								2002	3538	
								2003	3423	
								2004	3055	
								2005	2916	
209	PIAMH - Piankatank	Temperate North Atlantic	USA	1984	2005	<1000ha	14.52	1984	10	[39]
								1985	10	
								1986	10	
								1987	43	
								1989	142	
								1990	242	
								1991	270	
								1992	323	
								1993	435	
								1994	250	
								1995	144	
								1996	142	
								1997	175	
								1998	132	
								1999	117	
								2000	171	
								2001	218	
								2002	284	
								2003	181	
								2004	179	
								2005	211	
210	POCMH - Pocomoke	Temperate North Atlantic	USA	1984	2005	<1000ha	2.46	1984	431	[39]
								1985	385	
								1986	556	
								1987	474	
								1989	600	
								1990	595	
								1991	732	

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, μ** *(% y^{-1})*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
								1992	719	
								1993	776	
								1994	665	
								1995	655	
								1996	652	
								1997	530	
								1998	459	
								1999	466	
								2000	489	
								2001	619	
								2002	733	
								2003	674	
								2004	471	
								2005	723	
211	RPPMH - Rappahannock	Temperate North Atlantic	USA	1984	2005	<100ha	11.42	1984	4	[39]
								1985	1	
								1986	0	
								1987	13	
								1989	48	
								1990	51	
								1991	31	
								1992	37	
								1993	62	
								1994	27	
								1995	19	
								1996	12	
								1997	9	
								1998	5	
								1999	3	
								2000	10	
								2001	57	
								2002	122	
								2003	9	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								2004	5	
								2005	44	
212	TANMH - Tangier	Temperate North Atlantic	USA	1984	2005	>1000ha	-0.42	1984	4486	[39]
								1985	4441	
								1986	5173	
								1987	4250	
								1989	5391	
								1990	5535	
								1991	5941	
								1992	5996	
								1993	5727	
								1994	4325	
								1995	4065	
								1996	3965	
								1997	3738	
								1998	2623	
								1999	3785	
								2000	4233	
								2001	4368	
								2002	4922	
								2003	3463	
								2004	3202	
								2005	4107	
213	YRKPH - York	Temperate North Atlantic	USA	1984	2005	<1000ha	-0.05	1984	179	[39]
								1985	176	
								1986	173	
								1987	190	
								1989	233	
								1990	272	
								1991	267	
								1992	274	
								1993	282	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1994	296	
								1995	302	
								1996	307	
								1997	339	
								1998	303	
								1999	265	
								2000	308	
								2001	324	
								2002	373	
								2003	359	
								2004	242	
								2005	177	
214	BIGMH - Big Annenessex	Temperate North Atlantic	USA	1984	2005	<100ha	undefined	1984	0	[39]
								1985	52	
								1986	76	
								1987	26	
								1989	47	
								1990	41	
								1991	75	
								1992	70	
								1993	77	
								1994	64	
								1995	71	
								1996	44	
								1997	59	
								1998	38	
								1999	65	
								2000	84	
								2001	93	
								2002	105	
								2003	63	
								2004	90	
								2005	112	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
215	East River	Temperate North Atlantic	USA	1937	2006	<1000ha	-0.68	1937	327.71	[39]
								1953	488.71	
								1963	428.80	
								1971	420.00	
								1974	211.43	
								1978	239.51	
								1981	151.10	
								1984	201.18	
								1985	177.28	
								1986	173.64	
								1987	185.41	
								1989	225.94	
								1990	235.76	
								1991	252.62	
								1992	267.43	
								1993	269.52	
								1994	298.50	
								1995	303.21	
								1996	302.72	
								1997	309.05	
								1998	298.35	
								1999	265.92	
								2000	308.89	
								2001	310.33	
								2002	299.02	
								2003	294.67	
								2004	290.74	
								2005	275.29	
								2006	205.20	
216	Fleets Bay	Temperate North Atlantic	USA	1937	2006	<1000ha	-0.19	1937	267.86	[39]
								1953	296.09	
								1961	543.09	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1969	523.76	
								1974	300.00	
								1978	77.31	
								1981	73.04	
								1984	109.40	
								1985	90.99	
								1986	94.74	
								1987	154.85	
								1989	210.57	
								1990	240.27	
								1991	239.45	
								1992	285.81	
								1993	307.46	
								1994	302.75	
								1995	289.27	
								1996	293.91	
								1997	271.83	
								1998	280.44	
								1999	266.24	
								2000	291.69	
								2001	299.40	
								2002	366.08	
								2003	239.99	
								2004	252.12	
								2005	294.76	
								2006	234.17	
217	Jenkins Neck	Temperate North Atlantic	USA	1937	2006	<1000ha	-0.46	1937	203.33	[39]
								1951	360.26	
								1960	364.16	
								1971	223.01	
								1974	200.00	
								1978	129.00	
								1981	125.23	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, µ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1984	193.01	
								1985	192.24	
								1986	198.95	
								1987	202.75	
								1989	247.19	
								1990	259.06	
								1991	272.43	
								1992	281.41	
								1993	282.31	
								1994	301.12	
								1995	300.85	
								1996	301.33	
								1997	328.38	
								1998	305.48	
								1999	278.87	
								2000	298.14	
								2001	303.00	
								2002	309.55	
								2003	312.30	
								2004	215.43	
								2005	152.74	
								2006	147.60	
218	Vaucluse Shores	Temperate North Atlantic	USA	1938	2006	<1000ha	-0.99	1938	405.18	[39]
								1949	399.41	
								1955	370.54	
								1966	399.36	
								1972	355.88	
								1978	316.27	
								1981	290.08	
								1984	290.18	
								1985	277.23	
								1986	295.74	
								1987	259.41	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1989	280.01	
								1990	307.71	
								1991	339.36	
								1992	370.74	
								1993	395.20	
								1994	353.09	
								1995	349.18	
								1996	344.91	
								1997	368.03	
								1998	354.61	
								1999	365.33	
								2000	355.90	
								2001	354.88	
								2002	350.36	
								2003	351.30	
								2004	303.83	
								2005	306.92	
								2006	206.04	
219	Parrott Islands	Temperate North Atlantic	USA	1937	1971	<1000ha	undefined	1937	189.53	[39]
								1951	355.37	
								1960	353.73	
								1968	277.62	
								1971	0.00	
220	Mumfort Islands	Temperate North Atlantic	USA	1937	2000	<1000ha	-10.97	1937	91.63	[39]
								1953	241.92	
								1960	213.84	
								1971	200.00	
								1974	5.67	
								1990	1.48	
								2000	0.09	
224	Bass River	Temperate North Atlantic	USA	1994	2000	<10ha	-26.58	1994	5.86	[40]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, µ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								2000	1.19	
225	Beverly Harbor/Danvers River	Temperate North Atlantic	USA	1995	2001	<10ha	-9.78	1995	4.11	[40]
								2001	2.29	
226	Boston Harbor South	Temperate North Atlantic	USA	1995	2001	<100ha	-25.45	1995	73.06	[40]
								2001	15.87	
227	Bournes Pond	Temperate North Atlantic	USA	1994	2000	<100ha	-8.59	1994	18.91	[40]
								2000	11.29	
228	Buttermilk and Little Buttermilk Bays	Temperate North Atlantic	USA	1996	2002	<100ha	undefined	1996	38.22	[40]
								2002	0	
229	Cape Pogue Pond\Pochet Pond\Calebs Pond	Temperate North Atlantic	USA	1994	1999	<1000ha	-4.15	1994	220.43	[40]
								1999	179.11	
230	Duxbury/Plymouth Harbors	Temperate North Atlantic	USA	1995	2000	<1000ha	-2.71	1995	906.03	[40]
								2000	791.38	
232	Gloucester Harbor	Temperate North Atlantic	USA	1996	2001	<100ha	-3.88	1996	18.37	[40]
								2001	15.13	
234	Herring River	Temperate North Atlantic	USA	1994	2000	<10ha	-13.31	1994	3.40	[40]
								2000	1.53	
235	Hyannis Harbor	Temperate North Atlantic	USA	1994	2000	<100ha	-4.11	1994	68.35	[40]
								2000	53.40	
236	Lagoon Pond	Temperate North Atlantic	USA	1994	1999	<100ha	-16.55	1994	66.44	[40]
								1999	29.04	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, µ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
237	Lake Tashmoo	Temperate North Atlantic	USA	1994	1999	<100ha	-17.36	1994	36.92	[40]
								1999	15.50	
238	Little Pond	Temperate North Atlantic	USA	1994	2000	<10ha	-14.75	1994	5.96	[40]
								2000	2.46	
239	Lower Pleasant Bay	Temperate North Atlantic	USA	1994	2000	<1000ha	-1.50	1994	513.06	[40]
								2000	468.93	
240	Lynn Harbor	Temperate North Atlantic	USA	1996	2001	<1000ha	-2.15	1996	288.70	[40]
								2001	259.28	
241	Madaket Harbor	Temperate North Atlantic	USA	1994	1999	<1000ha	-2.10	1994	271.66	[40]
								1999	244.59	
242	Manchester Harbor	Temperate North Atlantic	USA	1996	2001	<100ha	-4.11	1996	58.39	[40]
								2001	47.53	
243	Marblehead Harbor	Temperate North Atlantic	USA	1996	2001	<10ha	-14.04	1996	10.21	[40]
								2001	5.06	
244	Menemsha Pond	Temperate North Atlantic	USA	1994	1999	<1000ha	-3.66	1994	171.74	[40]
								1999	143	
245	Morris Island	Temperate North Atlantic	USA	1994	2000	<100ha	-2.33	1994	68.57	[40]
								2000	59.62	
246	Nantucket Harbor	Temperate North Atlantic	USA	1994	1999	<1000ha	-6.44	1994	964.11	[40]
								1999	698.62	
247	New Bedford Harbor(Outer)/Clarks Cove	Temperate North Atlantic	USA	1996	2002	<100ha	-1.97	1996	54.58	[40]
								2002	48.50	

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, μ** *($\% y^{-1}$)*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
248	Ryders Cove/Crow Pond/Bassing Harbor	Temperate North Atlantic	USA	1994	2000	<100ha	-4.70	1994	59.29	[40]
								2000	44.72	
249	Salem Harbor	Temperate North Atlantic	USA	1996	2001	<100ha	-33.43	1996	41.87	[40]
								2001	7.87	
250	Scituate Harbor	Temperate North Atlantic	USA	1995	2000	<10ha	-3.03	1995	4.77	[40]
								2000	4.10	
251	Stage Harbor System	Temperate North Atlantic	USA	1994	2000	<100ha	-7.93	1994	104.59	[40]
								2000	64.99	
252	Three Bays	Temperate North Atlantic	USA	1994	2000	<10ha	undefined	1994	4.35	[40]
								2000	0.00	
253	Upper Pleasant Bay	Temperate North Atlantic	USA	1994	2000	<100ha	-7.67	1994	120.82	[40]
								2000	76.24	
255	Wareham River/Marks Cove	Temperate North Atlantic	USA	1996	2002	<10ha	-23.83	1996	4.39	[40]
								2002	1.05	
256	West Falmouth Harbor	Temperate North Atlantic	USA	1996	2002	<100ha	-1.24	1996	21.92	[40]
								2002	20.35	
257	Westport River - East and West Branch	Temperate North Atlantic	USA	1996	2002	<1000ha	-6.19	1996	273.05	[40]
								2002	188.36	
258	Weweantic River	Temperate North Atlantic	USA	1996	2002	<100ha	-14.16	1996	20.63	[40]
								2002	8.82	
259	Wild Harbor	Temperate	USA	1996	2002	<10ha	-2.16	1996	8.06	[40]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
		North Atlantic								
								2002	7.08	
260	Boston Harbor North	Temperate North Atlantic	USA	1995	2001	<10ha	undefined	1995	0.00	[40]
								2001	11.10	
261	Cohasset Harbor	Temperate North Atlantic	USA	1995	2001	<100ha	0.52	1995	45.56	[40]
								2001	47	
262	Lewis Bay	Temperate North Atlantic	USA	1995	2001	<1ha	18.12	1995	0.16	[40]
								2001	0.48	
271	Coastal Bend	Tropical Atlantic	USA	1958	1994	>1000ha	0.20	1958	10584	[41]
								1994	11385	
272	Galveston Bay	Tropical Atlantic	USA	1956	1998	>1000ha	-5.40	1956	2025	[41]
								1998	210	
273	Chandeleur Islands	Tropical Atlantic	USA	1969	1995	>1000ha	-1.33	1969	6377	[41]
								1969	4669	
								1992	6536	
								1995	4511	
274	Mississippi Sound	Tropical Atlantic	USA	1992	2003	<1000ha	-6.36	1992	600	[41]
								2003	298	
275	Mobile Bay	Tropical Atlantic	USA	1981	2003	<1000ha	-7.77	1981	1105	[41]
								2003	200	
276	Perdido Bay	Tropical Atlantic	USA	1940	2003	<1000ha	-2.18	1940	475	[41]
								2003	120	
277	Pensacola Bay	Tropical Atlantic	USA	1960	1992	>1000ha	-2.31	1968	3800	[41]
								1992	1814	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
278	Choctawhatchee Bay	Tropical Atlantic	USA	1983	1992	>1000ha	3.68	1983	1237	[41]
								1992	1722	
279	St. Andrew Bay	Tropical Atlantic	USA	1964	1992	>1000ha	-0.60	1964	4706	[41]
								1992	3979	
280	Big Bend	Tropical Atlantic	USA	1984	1992	>1000ha	-9.15	1984	520000	[41]
								1992	250000	
283	Greater Charlotte Harbor	Tropical Atlantic	USA	1982	1999	>1000ha	-0.35	1982	23127	[41]
								1999	21802	
284	Florida Bay	Tropical Atlantic	USA	1987	1994	>1000ha	-1.89	1987	142473	[41]
								1994	124787	
285	Cartegena Bay	Tropical Atlantic	Colombia	1945	2001	<1000ha	-4.28	1945	834.34	[42]
								1956	253.50	
								1972	150.09	
								1991	93.80	
								2001	76	
286	Rocky Bay	Temperate Southern Oceans	Australia	1941	1992	<100ha	-0.38	1941	20.44	[43]
								1972	19.63	
								1981	19.50	
								1992	16.83	
287	Thomson Bay South	Temperate Southern Oceans	Australia	1966	1992	<100ha	-0.08	1966	34.02	[43]
								1992	33.34	
288	Thomson Bay North	Temperate Southern Oceans	Australia	1966	1992	<10ha	-0.16	1966	10.12	[43]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1992	9.70	
289	De Keeg-De Ans	Temperate North Atlantic	The Netherlands	1972	1987	<100ha	2.85	1972	15	[44]
								1987	23	
290	Hoorn	Temperate North Atlantic	The Netherlands	1972	1987	<100ha	-2.09	1972	115	[44]
								1987	84	
291	Linthorst Homanpolder	Temperate North Atlantic	The Netherlands	1972	1987	<100ha	undefined	1972	0.00	[44]
								1987	75	
292	Emmapolder	Temperate North Atlantic	The Netherlands	1972	1987	<100ha	undefined	1972	0.00	[44]
								1987	77	
293	Balgzand	Temperate North Atlantic	The Netherlands	1972	1987	<10ha	-16.57	1972	12	[44]
								1987	1	
330	St Georges Basin	Temperate Southern Oceans	Australia	1961	1998	<1000ha	-0.70	1957	377.90	[45]
								1970	343.40	
								1979	351.70	
								1998	292	
331	Wagonga Inlet	Temperate Southern Oceans	Australia	1957	1994	<100ha	-0.29	1957	83.50	[45]
								1982	84.80	
								1999	75.10	
332	Bermagui River	Temperate Southern Oceans	Australia	1957	1998	<100ha	-1.03	1957	42.90	[45]
								1979	28.80	
								1998	28.10	
333	Merimbula Lake	Temperate Southern	Australia	1948	1994	<1000ha	-0.58	1948	200.90	[46]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
		Oceans								
								1962	226.00	
								1972	192.80	
								1977	185.80	
								1994	153.70	
334	Pambula Lake	Temperate Southern Oceans	Australia	1948	1994	<100ha	-0.43	1948	73.20	[46]
								1972	59.90	
								1994	60.20	
335	Sweden west coast	Temperate North Atlantic	Sweden	1980	2000	>1000ha	-4.34	1980	2000	[47]
								2000	840	
339	Glenan Archipelago	Temperate North Atlantic	France	1990	2000	<1000ha	4.70	1990	250	[48]
								2000	400	
340	Medes Islands	Mediterranean	Spain	1984	2001	<10ha	0.00	1984	9	[49]
								1994	9	
								2001	9	
342	Green Island	Tropical Indo-Pacific	Australia	1936	1997	<100ha	6.68	1936	0.39	[50]
								1959	1.10	
								1972	6.50	
								1992	15.31	
								1993	22.70	
								1994	22.90	
								1997	23	
343	Tauranga Harbour	Temperate Southern Oceans	New Zealand	1959	1996	>1000ha	-2.92	1959	8617.65	[51]
								1996	2930	
344	Kaduk Island	Temperate North Pacific	Korea	1980	1990	<1000ha	undefined	1980	1360	[52]
								1990	0	

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, μ** *(% y^{-1})*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
346	Mississippi Bays	Tropical Atlantic	USA	1969	1992	>1000ha	-9.65	1969	5520	[53]
								1992	600	
350	Upper Laguna Madre	Tropical Atlantic	USA	1967	1999	>1000ha	1.86	1967	11800	[53]
								1988	24900	
								1999	21400	
353	Lemon Bay	Tropical Atlantic	USA	1988	2003	>1000ha	0.34	1988	1055	[54]
								1994	1067	
								1996	1054	
								1999	1049	
								2001	1046	
								2003	1110	
354	Placida, Upper Charlotte Harbor	Tropical Atlantic	USA	1982	2003	>1000ha	2.52	1982	957	[54]
								1988	1416	
								1992	1384	
								1994	1344	
								1996	1460	
								1999	1503	
								2001	1531	
								2003	1625	
355	South Harbor, Upper Charlotte Harbor	Tropical Atlantic	USA	1982	2003	>1000ha	-0.08	1982	3544	[54]
								1988	3710	
								1992	3662	
								1994	3659	
								1996	3648	
								1999	3340	
								2001	3313	
								2003	3488	
356	West Wall, Upper	Tropical	USA	1982	2003	<1000ha	-0.14	1982	665	[54]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
	Charlotte Harbor	Atlantic								
								1988	580	
								1992	490	
								1994	671	
								1996	790	
								1999	699	
								2001	699	
								2003	646	
357	East Wall, Upper Charlotte Harbor	Tropical Atlantic	USA	1982	2003	>1000ha	-0.78	1982	1548	[54]
								1988	1372	
								1992	1361	
								1994	1416	
								1996	1371	
								1999	1452	
								2001	1454	
								2003	1315	
358	Middle Harbor, Upper Charlotte Harbor	Tropical Atlantic	USA	1982	2003	<100ha	-2.32	1982	70	[54]
								1988	50	
								1992	50	
								1994	60	
								1996	76	
								1999	62	
								2001	64	
								2003	43	
359	Myakka River, Upper Charlotte Harbor	Tropical Atlantic	USA	1982	2003	<1000ha	-2.92	1982	218	[54]
								1988	161	
								1992	130	
								1994	189	
								1996	203	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								1999	191	
								2001	185	
								2003	118	
360	Peace River, Upper Charlotte Harbor	Tropical Atlantic	USA	1982	2003	<1000ha	-6.29	1982	397	[54]
								1988	158	
								1992	167	
								1994	196	
								1996	232	
								1999	109	
								2001	138	
								2003	106	
361	Pine Island Sound, Lower Charlotte Harbor	Tropical Atlantic	USA	1982	2002	>1000ha	0.39	1982	9857	[54]
								1999	10483	
								2002	10647	
362	Matlacha Pass, Lower Charlotte Harbor	Tropical Atlantic	USA	1982	2002	>1000ha	-0.77	1982	3247	[54]
								1999	2456	
								2002	2784	
363	San Carlos Bay, Lower Charlotte Harbor	Tropical Atlantic	USA	1982	2002	>1000ha	-1.57	1989	2420	[54]
								1999	1504	
								2002	1768	
364	Caloosahatchee River, Lower Charlotte Harbor	Tropical Atlantic	USA	1982	2002	<100ha	-8.76	1989	242	[54]
								1999	1	
								2002	42	
365	Estero Bay	Tropical	USA	1999	2002	<1000ha	-1.11	1999	1008	[54]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
		Atlantic								
								2002	975	
395	Seabrook Shore	Tropical Atlantic	USA	1956	1987	<100ha	undefined	1956	86	[55]
								1965	0	
								1975	0	
								1987	0	
396	West Bay	Tropical Atlantic	USA	1956	1987	<1000ha	undefined	1956	458	[55]
								1965	117	
								1975	37	
								1987	0	
397	Christmas Bay	Tropical Atlantic	USA	1975	1987	<100ha	-1.92	1975	97	[55]
								1987	77	
398	Christmas Bay	Tropical Atlantic	USA	1971	1987	<1000ha	-9.32	1971	502	[56]
								1987	113	
399	West Bay	Tropical Atlantic	USA	1971	1987	<1000ha	undefined	1971	202.20	[56]
								1987	0	
400	Bastrop Bay	Tropical Atlantic	USA	1971	1987	<100ha	undefined	1971	104.90	[56]
								1987	0	
401	East Matagorda	Tropical Atlantic	USA	1971	1987	<1000ha	2.51	1971	258.90	[56]
								1987	387	
402	Redfish Lake	Tropical Atlantic	USA	1971	1987	<100ha	undefined	1971	0	[56]
								1987	62.80	
403	Keller	Tropical Atlantic	USA	1971	1987	<1000ha	-5.62	1971	168.30	[56]
								1987	68.50	
404	Matagorda	Tropical	USA	1971	1987	<1000ha	-0.93	1971	569.60	[56]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
		Atlantic								
								1987	491	
405	Salt Lake	Tropical Atlantic	USA	1971	1987	<100ha	undefined	1971	0	[56]
								1987	50.80	
406	Powderhorm Lake	Tropical Atlantic	USA	1971	1987	<100ha	undefined	1971	0	[56]
								1987	20.50	
407	Tres Palacios	Tropical Atlantic	USA	1971	1987	<10ha	undefined	1971	0	[56]
								1987	15.60	
408	Funter Bay	Temperate North Pacific	USA	2001	2003	<10ha	-11.47	2001	7.90	[57]
								2002	7.24	
								2003	6.28	
409	Crab Bay	Temperate North Pacific	USA	2001	2003	<10ha	3.29	2001	1.63	[57]
								2002	1.78	
								2003	1.74	
410	Chaik Bay	Temperate North Pacific	USA	2001	2003	<1ha	-2.14	2001	0.10	[57]
								2002	0.09	
								2003	0.10	
411	Nakwasina	Temperate North Pacific	USA	2001	2003	<1ha	5.35	2001	0.52	[57]
								2002	0.46	
								2003	0.58	
412	Sandy Cove	Temperate North Pacific	USA	2001	2003	<1ha	-3.82	2001	0.70	[57]
								2002	0.68	
								2003	0.65	
413	Pirates Cove	Temperate North Pacific	USA	2001	2003	<1ha	4.90	2001	0.18	[57]
								2002	0.20	

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, μ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								2003	0.20	
414	Kromme Estuary	Temperate Southern Oceans	South Africa	1942	1989	<10ha	5.01	1942	1.16	[58]
								1961	6.02	
								1975	6.08	
								1979	6.13	
								1985	9.92	
								1986	9.78	
								1988	11.65	
								1989	12.20	
415	Canal de Ovar	Temperate North Atlantic	Portugal	1984	2003	<1000ha	-23.06	1984	800	[59]
								2003	10	
416	Mosquito Lagoon	Tropical Atlantic	USA	1970	1992	>1000ha	0.94	1970	5496.80	[60]
								1986	5023.80	
								1992	6758.10	
417	Banana River	Tropical Atlantic	USA	1970	1992	>1000ha	-0.18	1970	9052.20	[60]
								1986	6729.30	
								1992	8691.20	
418	Indian River Lagoon	Tropical Atlantic	USA	1970	1992	>1000ha	-1.30	1970	17226.90	[60]
								1986	21905.10	
								1992	12935.30	
419	Barnegat Bay	Temperate North Atlantic	USA	1968	1999	>1000ha	-0.37	1968	6825	[61]
								1979	8053	
								1987	8799	
								1999	6083	
420	Port Hacking	Temperate Southern Oceans	Australia	1950	2000	<1000ha	-1.61	1951.1035	183.46	[62]

Site reference number *(database)*	**Site name**	**Global seagrass bioregion**	**Country**	**Year study started**	**Year study ended**	**Area category**	**Specific rate of change, μ** *($\% y^{-1}$)*	**Year of data record**	**Area recorded** *(Ha)*	**Data source** *(publication number*)*
								1961.0279	140.73	
								1976.8587	72.79	
								1984.9471	99.50	
								1999.0406	81.85	
421	Bahia San Quintin	Temperate North Pacific	Mexico	1987	2000	>1000ha	-1.11	1987	2390	[63]
								2000	2069	
422	Back Sound & southern Core Sound	Temperate North Atlantic	USA	1985	1988	>1000ha	-1.92	1985	7030	[64]
								1988	6637	
423	South Sound, Grand Cayman	Tropical Atlantic	British West Indies	1971	1992	<1000ha	1.75	1971	121.36	[65]
								1992	175.36	
435	Turnbull Creek	Tropical Atlantic	USA	1943	2003	<100ha	-1.19	1943	117.16	[66]
								1965	151.45	
								1974	116.35	
								1986	59.82	
								1989	124.17	
								1992	91.66	
								1993		
								1994	125.36	
								1995		
								1996	92.32	
								1997		
								1998		
								1999	33.76	
								2000		
								2001		
								2002		
								2003	57.28	
437	Western Port Bay	Temperate Southern	Australia	1973	1999	>1000ha	-2.14	1973	23000	[67]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, µ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
		Oceans								
								1984	5900	
								1994	9300	
								1999	13200	
438	Port Phillip Bay-Kirk Pt	Temperate Southern Oceans	Australia	2000	2005	<100ha	12.07	2000	16.30	[68]
								2005	29.80	
439	Port Phillip Bay-Pt Richards	Temperate Southern Oceans	Australia	2000	2005	<100ha	-23.16	2000	83.40	[68]
								2005	26.20	
440	Port Phillip Bay-Blairgowrie	Temperate Southern Oceans	Australia	2000	2005	<10ha	-25.50	2000	5.94	[68]
								2005	1.66	
441	Western Port-Rhyll	Temperate Southern Oceans	Australia	1999	2005	<100ha	0.21	1999	16	[68]
								2005	16.20	
442	Western Port-Scrub Point	Temperate Southern Oceans	Australia	1999	2005	<1000ha	0.06	1999	108.10	[68]
								2005	108.50	
443	Corner Inlet - Lewis Channel	Temperate Southern Oceans	Australia	1998	2005	<1000ha	-3.88	1998	194.10	[68]
								2005	147.90	
444	Corner Inlet - Duck Point	Temperate Southern Oceans	Australia	1998	2005	<1000ha	-0.15	1998	136	[68]
								2005	134.60	
445	Corner Inlet - Granite Island	Temperate Southern Oceans	Australia	1998	2005	<1000ha	0.21	1998	240.60	[68]

Site reference number *(database)*	Site name	Global seagrass bioregion	Country	Year study started	Year study ended	Area category	Specific rate of change, µ *(% y^{-1})*	Year of data record	Area recorded *(Ha)*	Data source *(publication number*)*
								2005	244.10	
446	Portinho da Rabida	Temperate North Atlantic	Portugal	1983	2005	<100ha	-38.71	1983	30	[69]
								2005	0.01	
483	Buck Channel Island	Tropical Atlantic	US Virgin Islands	1971	1999	<1000ha	4.22	1971	133	[70]
								1999	434	

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Table S2.

Data categories	**μ median** *(% rate change per year)*	**N** *(μ median)*	**μ mean** *(% rate change per year)*	**N** *(μ average)*	**μ s.e.** *(standard error on mean)*	**net area** *(Ha)*	**Average length of study** *(years)*
Overall							
<1930	-0.76	2	-0.76	2	0.14	-14730	82.5
1930-1940	2.50	11	2.26	11	1.07	-14165	27.9
1940-1950	-0.42	27	0.09	27	1.11	-15916	27.7
1950-1960	-0.42	59	1.36	58	1.12	-28566	22.1
1960-1970	-0.79	92	-1.64	89	0.99	-25955	17.7
1970-1980	-0.84	140	-2.90	129	1.10	-42532	15.8
1980-1990	-0.32	236	-0.02	223	1.06	-333863	11.4
1990-2000	-0.29	275	-1.26	265	1.92	-319670	8.6
Decreasing							
<1930 decreasing	-0.76	2	-0.76	2	0.14	-14730	82.5
1930-1940 decreasing	-0.89	3	-1.80	3	1.04	-14880	20.0
1940-1950 decreasing	-1.82	13	-3.83	13	1.31	-16667	28.3
1950-1960 decreasing	-1.82	28	-3.40	27	0.80	-34280	27.3
1960-1970 decreasing	-3.03	49	-5.85	46	1.51	-47575	20.5
1970-1980 decreasing	-4.46	69	-7.75	65	1.96	-66348	17.0
1980-1990 decreasing	-5.53	98	-9.23	94	1.12	-371465	14.7
1990-2000 decreasing	-7.67	115	-15.90	109	3.43	-348830	9.5
Increasing							
<1930 increasing	no records						
1930-1940 increasing	4.49	7	4.35	7	0.91	721	15.8
1940-1950 increasing	4.49	11	4.89	11	1.14	786	15.4
1950-1960 increasing	4.82	20	8.57	20	2.29	4923	11.7
1960-1970 increasing	4.26	21	5.98	21	1.38	20880	10.4
1970-1980 increasing	4.34	37	4.76	30	0.69	23039	14.2
1980-1990 increasing	6.38	75	12.42	66	2.48	35749	8.8
1990-2000 increasing	8.45	72	19.07	68	3.83	28823	7.9
No detectable change							
<1930 no detectable change	no records						
1930-1940 no detectable change	-0.13	1	-0.13	1	-	-6	41.6

Data categories	**μ median** *(% rate change per year)*	**N** *(μ median)*	**μ mean** *(% rate change per year)*	**N** *(μ average)*	**μ s.e.** *(standard error on mean)*	**net area** *(Ha)*	**Average length of study** *(years)*
1940-1950 no detectable change	-0.13	3	-0.50	3	0.37	-35	35.3
1950-1960 no detectable change	0.06	11	-0.06	11	0.17	791	23.9
1960-1970 no detectable change	-0.06	22	-0.12	22	0.11	740	17.8
1970-1980 no detectable change	-0.10	34	-0.38	34	0.19	777	15.6
1980-1990 no detectable change	0.03	63	0.67	63	0.30	1853	10.9
1990-2000 no detectable change	0.07	88	1.15	88	0.28	337	8.4

Supporting Information

Waycott et al. 10.1073/pnas.0905620106

SI Text

Supplementary information includes (*i*) assumptions and source data for estimation of global seagrass ecosystem services, (*ii*) description of data sources for the analyses, (*iii*) calculation method for decadal seagrass change, (*iv*) assessment of potential bias from the increase in seagrass observational effort over time, and (*v*) contribution numbers for authorship team.

Ecosystem Services. The global value of ecosystem services for seagrasses is presented as estimated by Costanza et al. (1). These authors give a total estimated value of US \$3.8 $\times$ 10^{12} to global nutrient cycling in coastal shelf ecosystems, defined as seagrass and algae beds. We have used 50% of this value as the relative contribution of seagrass beds vs. algae beds. Using US \$1.9 $\times$ 10^{12} for nutrient cycling provided globally by seagrass ecosystems and our reported 35% loss of seagrass area since 1980, US \$665 billion has been lost in this ecosystem service alone. Other estimates of ecosystem service values are based on specific case studies as indicated and are not intended as global estimates of seagrass values.

Data Sources. There were 4 publication categories among the 70 sources incorporated into the final seagrass trajectories database: journal articles (n = 55), published reports (n = 10), verified databases (n = 2), and theses (n = 3). When different sources covered the same site and time period (e.g., reviews, reinterpretation of primary data, extensions of data sets), only a single data source was included in the final database. On average, a delay of 5 years (range: 0–16 years) was observed from the date of the last data point collected to the year of publication. Therefore, the data available at the time of this analysis (data compiled in 2006) may represent only 30% of the data for the decade (2000–2010). A complete list of data included in the final analysis is included in Table S1. In some cases, numerical estimates of seagrass area were not included in a data source and area estimates were inferred from graphical presentation using DataThief III (B. Tummers, DataThief III, 2006).

Decadal Analysis. Decadal trajectories (% rate of change, μ) were assessed for sites with data traversing more than 1 decade as depicted in Fig. S3. The data analysis incorporated up to 2 data points for each site within each decade; if there were more than 2 records within a decade, only the earliest and latest records were included in analyses. For example, in site A of Fig. S3, the record in the middle of the 1970s would be omitted from analyses. The net areas for site A of Fig. S3 would be +131 (*i* of Fig. S3) for the 1960s and −109 (*ii* of Fig. S3) for the 1970s.

In more complex trajectories in which data were collected over several intervening decades, as shown for site B of Fig. S3, areas at the boundaries of each decade were interpolated based on μ (% rate of change), as shown by circles above. The "boundary" areas were then used to estimate the net change for that decade. When a record was not at the boundary of that decade, the net area was calculated as the sum of the 2 areas on each side of the record; thus, net area was calculated only once for each site in each decade. When there were trajectories leading into a decade, within a decade, and out of a decade, all 3 were included in the calculation of μ as a best estimate of the trend across included data, as in site C of Fig. S3.

Observational Effort. Efforts to assess the general status and trends of seagrass meadows have expanded in recent decades; for example, local communities are increasingly involved in the monitoring of their seagrass meadows (2). This increase is largely attributable to the onset of regional and global monitoring programs (2) promoted by increasing evidence of the value of seagrass meadows as sensitive indicators of overall coastal ecosystem health (3). Most of the early (before 1980) observations of seagrass trajectories were made as part of problem-driven research, whereas the majority of the recent data since then derive from large-scale monitoring efforts. Synthetic studies (4–6) have pointed to seagrass losses occurring soon after human settlement, well before the advent of any quantitative seagrass assessment or even full recognition of its intrinsic value. In addition, monitoring initiated after a large-scale decline often leads to observations of small-scale seagrass changes (increases and decreases). In such cases, the overall trajectory for a location where monitoring starts after a loss will not be reflected by monitoring data. In the context of our analysis, the synthesis of data from all time periods, irrespective of study motivation, location, or scale, will provide the best, albeit conservative, overall interpretation of global trends.

Contribution Numbers for Author Institutions. Institutional contribution numbers are as follows: School of Marine Science at the Virginia Institute of Marine Science, College of William and Mary, 3020; University of Maryland Center for Environmental Science, 4302; Bodega Marine Laboratory, University of California at Davis, 2461; Southeast Environmental Research Center at Florida International University, 434; Jackson Estuarine Laboratory, University of New Hampshire, 477; Dauphin Island Sea Laboratory, 398; Marine and Tropical Sciences Research Facility, James Cook University projects 1.1.1 and 1.1.3.

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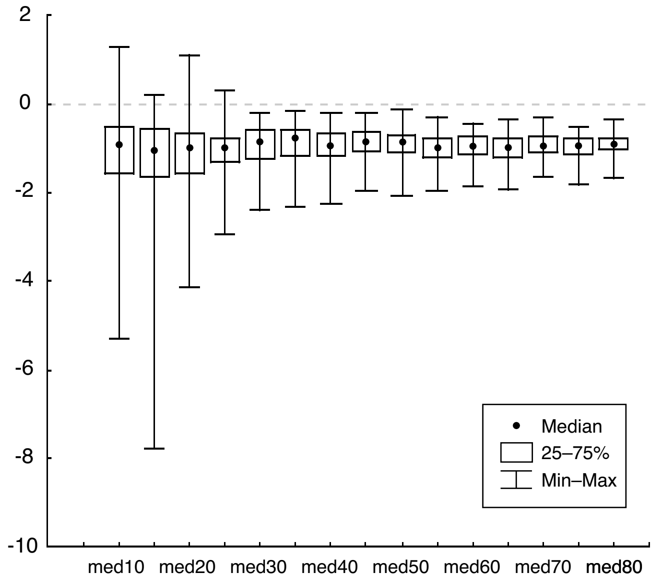

Fig. S1. Box and whisker plot of the overall estimate of the median of μ, including an increasing number of randomly selected samples. Error bars indicate the 25% and 75% quartiles for median estimates across 100 replicate resampling runs.

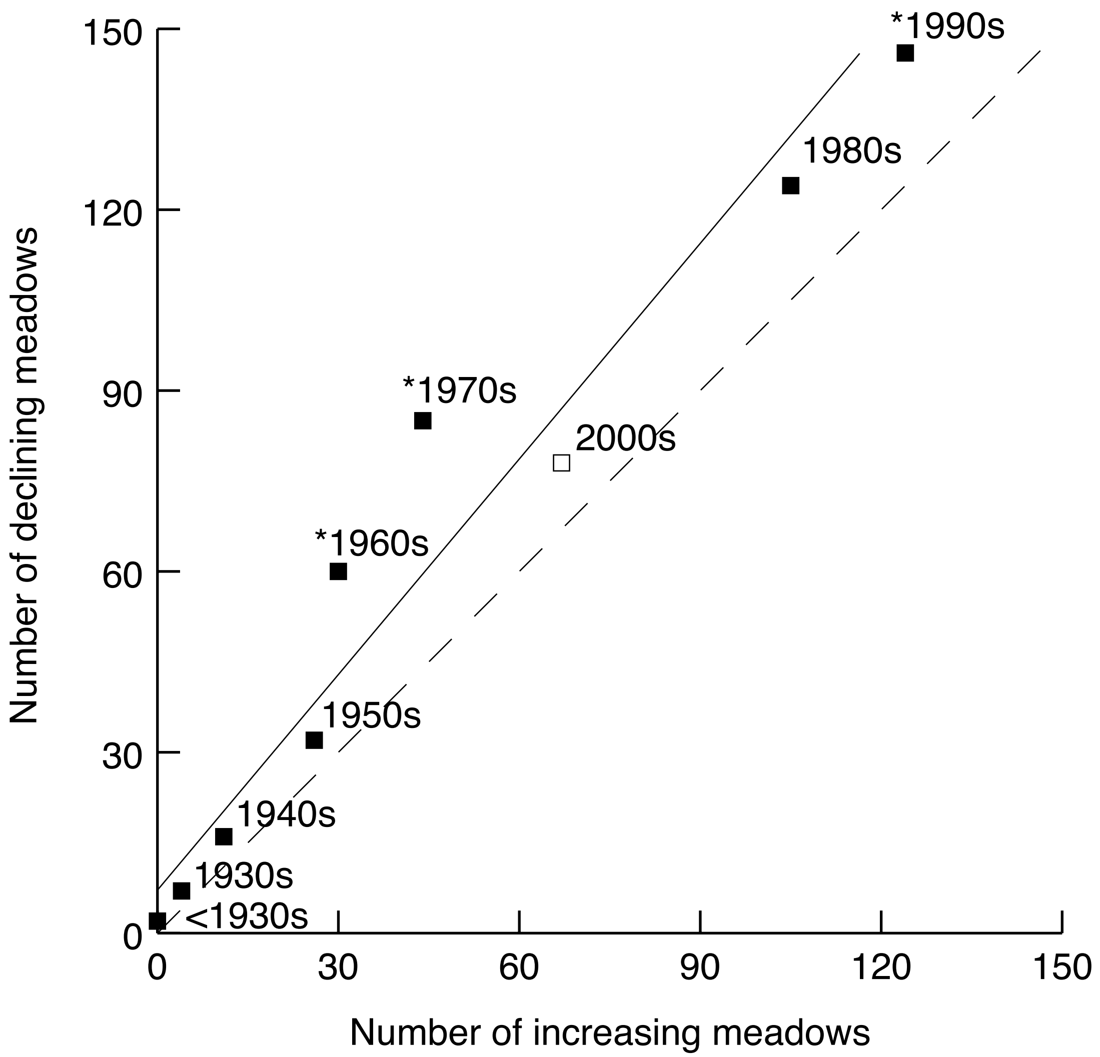

Fig. S2. Plot of relationship between number of sites experiencing decreases in area and increases in area by decade. Dashed line represents the 1:1 relationship expected if the distribution is random, and decades marked with an asterisk (*) exhibited a significant χ^2 value ($P < 0.05$, df = 2). The overall trend was significant (Wilcoxon signed pair ranked test, $P = 0.002$).

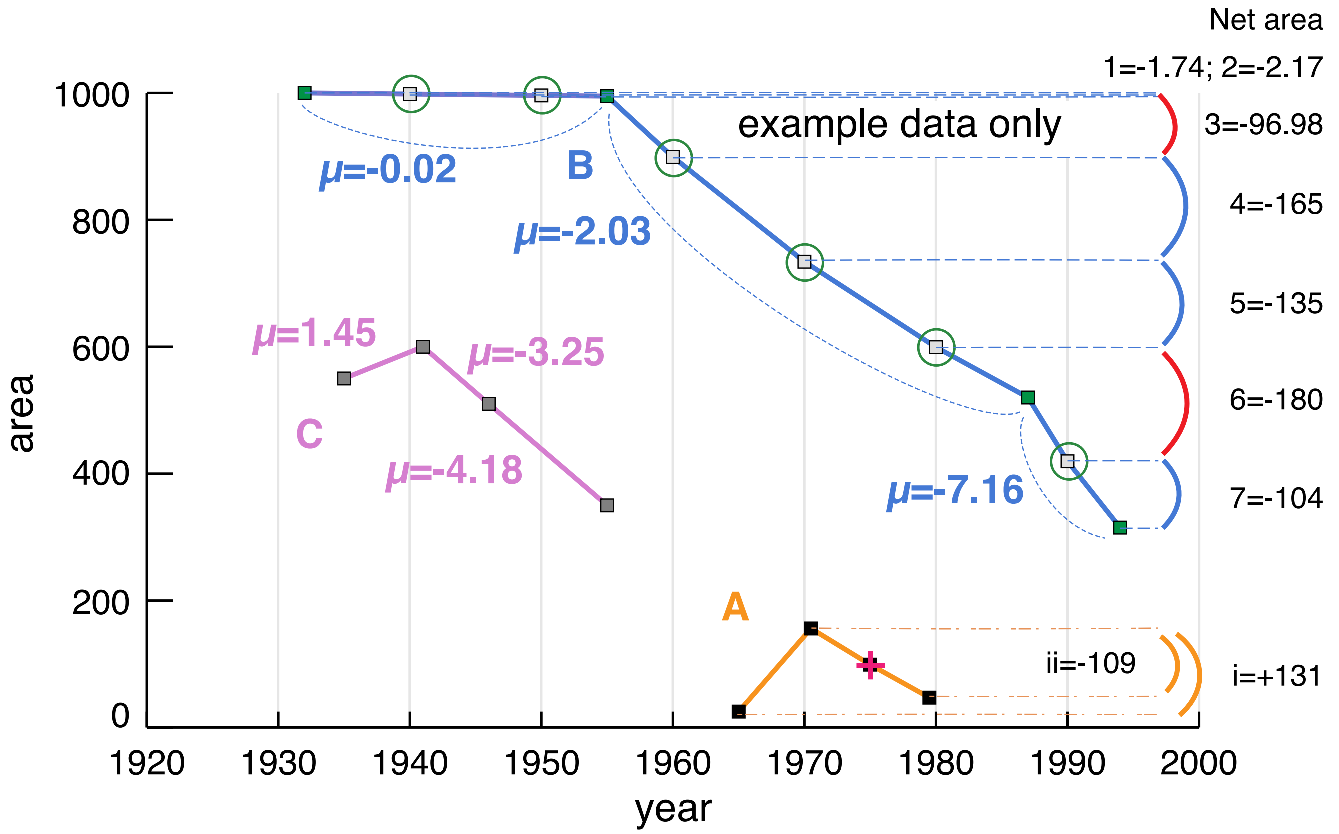

Fig. S3. Calculation of decadal trajectories. Values are for illustrative purposes only. Time is divided into decades starting with January 1 at the beginning of a decade (e.g., January 1, 2000). Area is presented as hectares. The rate of change, μ, is calculated as outlined in *Materials and Methods*. Shaded boxes are data points included in decadal analysis, and circled open boxes are inferred area estimates based on the within-decade values calculated from μ. A, B, and C represent different sites.

Other Supporting Information Files

Table S1
Table S2