



PARLEE BEACH RESEARCH GROUP: BEACH MANAGEMENT PRACTICES

An Annotated Bibliography Assembled by the New Brunswick Department of Environment and Local Government

Legend for Primary Subject

- Dm - Ocean debris (wrack) and seaweed management
- Sb - Sand and Bacteria/Pathogens
- Se - Sand - erosion control/replenishment

Z - Reference addresses multiple issues

	Policies/Guidelines/ Best Practices
	Research papers
	Commentaries, literature reviews or discussion of issues
	Other References

No.	Author/Organization	Title	Overview	Date	Primary Subject
1	AMEC	<u>Final Report Pointe-Du-Chêne Wharf Development Plan Update</u>	In 2006, an unknown quantity of material was dredged from a “U” shaped area around the eastern tip of the main breakwater. The material was deposited at Parlee Beach for beach nourishment.	2012	Se
2	American Institute of Physics (AIP).	<u>The physics of ocean undertow: Creating more robust and sustainable beaches</u>	People standing on a beach often feel the water tugging the sand away from under their feet. This is the undertow, the current that pulls water back into the ocean after a wave breaks on the beach. Large storms produce strong undertows that can strip beaches of sand. By predicting how undertows interact with shorelines, researchers can build sand dunes and engineer other soft solutions to create more robust and sustainable beaches. "Formulation of the Undertow Using Linear Wave Theory," a new paper in the journal Physics of Fluids, clears up some of the controversy in undertow modeling, so planners can assess erosion threats faster and more accurately.	2014	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
3	American Shore and Beach Preservation Association	How Beach Nourishment Works - A Primer	Beach nourishment, the only shore protection method that adds sand to the coastal system, is the preferred method for shore protection today. During a beach nourishment project, large volumes of beach-quality sand, called beach fill, are added from outside sources to restore an eroding beach. Or, a beach is constructed where only a small beach, or no beach, existed. Ultimately, beach nourishment widens a beach and advances the shoreline seaward. Beach nourishment projects are designed and engineered to work like natural beaches, allowing sand to shift continuously in response to changing waves and water levels. Coastal engineers may decide to place beach fill as underwater mounds, directly on the beach, as dunes – or all three. This sand, once placed, is redistributed gradually by natural processes affecting the beach system. Ultimately, the wider, nourished beach, which slopes gently downward below the water, and the taller sand dunes protect the shore by acting as naturally protective buffers.	2007	Se
4	American Society for Microbiology	Border collies chase away beach contamination by chasing away gulls	Border collies are effective at reducing gull congregation on recreational beaches, resulting in lower E. coli abundance in the sand. Gull droppings may be one source of the indicator bacterium Escherichia coli to beach water, which can lead to swim advisories and beach closings. In addition, gull droppings may contain bacteria with the potential to cause human disease, according to a researcher.	2014	Sb
5	Anderson, Marc	Seaweed-lined beaches push Gulf Shores, Orange Beach to bury the issue	While sargassum is a common sight along the Alabama Gulf Coast, over the last few weeks Baldwin County's shoreline has been blanketed with what some are calling an unprecedented amount of the seaweed, prompting officials to act. "In some cases leaving the seaweed on the beaches is a good thing because it's like a sand fence, it helps to build up the beach," Orange Beach Mayor Tony Kennon said. "However, you're balancing a pristine beach that tourists are paying to be on versus a beach that is green and brown with smelly, dead seaweed. So the decision is obvious. You can't leave the seaweed on the beaches." By continuing the practice of burying the seaweed at the mean high-tide line, which is recommended by the state, the cities are actually shoring up the sand. "By us being able to bury it, we're sort of having the best of both worlds," Kennon said. "Bolstering the beach naturally, but at the same time protecting the pristine visual of our white beaches."	2013	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
6	Anderson, S.A. et al.	<u>Enterococci in the New Zealand environment: Implications for water quality monitoring</u>	Faecal enterococci ecology outside the host is of great relevance when using these organisms as indicators of water quality. As a complement to New Zealand epidemiological studies of bathing water quality and health risk, a study of the environmental occurrence of these organisms has been undertaken. Previous studies of enterococci quiescence in marine/fresh waters indicate that they enter a non-growth phase, exposure to sunlight markedly reducing culturability on selective and non-selective media. Enterococci were also found to survive/multiply within specific non-faecal environments. Enterococci on degrading drift seaweed at recreational beaches exceeded seawater levels by 2.4 orders of magnitude, suggesting that expansion had occurred in this permissive environment with resultant potential to contaminate adjacent sand and water.	1997	Dm
7	Armstrong, Scott B. et al.	<u>Indications of a positive feedback between coastal development and beach nourishment</u>	Beach nourishment, a method for mitigating coastal storm damage or chronic erosion by deliberately replacing sand on an eroded beach, has been the leading form of coastal protection in the United States for four decades. However, investment in hazard protection can have the unintended consequence of encouraging development in places especially vulnerable to damage. In a comprehensive, parcel-scale analysis of all shorefront single-family homes in the state of Florida, we find that houses in nourishing zones are significantly larger and more numerous than in non-nourishing zones. The predominance of larger homes in nourishing zones suggests a positive feedback between nourishment and development that is compounding coastal risk in zones already characterized by high vulnerability.	2016	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
8	Barber, Don	Beach Nourishment Basics	The bottom-line for is that nourished beaches hardly ever perform as well as advertised. Nevertheless, in terms of recreational beach use, nourishment is always preferred over "hard" beach stabilization methods, such as building new seawalls or groins. The most important thing to remember is that none of these methods stops erosion. Erosion will continue, but a nourished beach allows continued normal beach use, while a seawall sacrifices a recreational beach to save property or structures behind the beach. We do well to keep in mind that nourishment projects are never proposed where human structures don't exist. This is because on natural beaches, erosion does not endanger the beach itself. Shorelines eroded for thousands of years, yet beaches remained, because they could change their shape and position. Erosion only becomes a problem when we place stationary buildings, parking lots and roads too close to the beach. Thus the best course of action is to crusade against additional development of our beaches and, wherever possible, encourage people to retreat from the beach. If we get out of the way, the beach will take care of itself, and we can continue to enjoy it at a much lower cost.	n.d	Se
9	Bartram, J. and Gareth Rees	Monitoring Bathing Waters - A Practical Guide to the Design and Implementation of Assessments and Monitoring Programmes: Chapter 12	There are two methods of beach cleaning: mechanical and manual. Mechanical cleaning usually involves motorised equipment using a sieve effect that scoops up sand and retains the litter; therefore it is not selective. Litter retention is a function of the sieve. Most sieve machines are coarse grained allowing small items to pass through. The passage of such vehicles over the beach interferes with the beach ecology and the method is costly. In addition this technique cannot be used on pebble beaches. Pressure to clean a beach is intense, especially where authorities wish to promote tourism. The advantages of such mechanical cleanups are that the result is achieved quickly, and large areas can be covered and they can provide an apparently pristine beach for visitors. Mechanical cleanups reduce the need for personal contact thus reducing health risks to individuals.	2000	Dm
10	Beach Cleaner Informational Resource	Balancing Environmental Concerns with Beach Attractiveness	How can beach cleaners be used to clean the beach without disrupting their natural ecosystems? Learn about a few common cleaning method adaptations here. Maintaining beaches that are free of human debris often creates a challenge, because synthetic debris often mixes with natural organic deposits from the ocean, like seaweed. For many beach owners and locations, removing seaweed and other debris at the tide line using mechanical beach cleaners is no problem, and actually, preferred. This creates a pristine beach for visitors to enjoy.	2012	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
11	Beach Raker	City of Cocoa Beach Beach Cleaning Services February 5th, 2015	Seaweed is not removed from the beach during our raking process. We hand pick trash and debris from the wrack line. Then seaweed is incorporated below the wrack line with our seaweed rake to fortify the beach. We believe seaweed is a vital component of the beach ecosystem and helps build up the beach.	2015	Dm
12	Beach Sand Code	Beach sediment sampling and processing guidelines	Beach sedimentary characterization seems to be an easy and straightforward task when compared with the morphological and oceanographic forcing characterization. In most studies the sediment is described by a single parameter, disregarding either the spatial and temporal variability. However, results obtained in the scope of Beach Sand Code project show that sedimentary variability has strong implications in sediment transport estimates, either based on field data or on numerical computations. This implies that sediment sampling should account for this variability. The main objective of this technical note is to develop guidelines for sediment sampling and processing that take into account spatial and temporal scales of beach sediment variability.	2012	Se
13	Beverdorf L. J et al.	The potential for beach sand to serve as a reservoir for Escherichia coli and the physical influences on cell die-off.	Beach sand may act as a reservoir for E. coli. Replication of cells appears to be one possible contributing factor to the persistently high levels, as indicated by both field studies and laboratory studies, and warrants further investigation. Moisture content of sand may also be a determinant of cell persistence in the sand environment.	2007	Sb
14	Bonilla, T. et al.	Prevalence and distribution of fecal indicator organisms in South Florida beach sand and preliminary assessment of health effects associated with beach sand exposure	This study examined the prevalence of fecal indicator organisms in tidally-affected beach sand and in upper beach sand and compared these counts to levels in the water. Since indicator organisms were statistically elevated in sand relative to water, the study also considered the potential health risks associated with beach use and exposure to sand. Fecal coliforms, Escherichia coli, enterococci, somatic coliphages, and F+-specific coliphages were enumerated from sand and water at three South Florida beaches (Ft. Lauderdale Beach, Hollywood Beach, and Hobie Beach) over a 2-year period. Bacteria were consistently more concentrated in 100 g samples of beach sand (2–23 fold in wet sand and 30–460 fold in dry sand) compared to 100 ml samples of water. A pilot epidemiological study was conducted to examine whether the length of exposure to beach water and sand could be correlated with health risk. Logistic regression analysis results provided preliminary evidence that time spent in the wet sand and time spent in the water were associated with a dose-dependent increase in gastrointestinal illness.	2007	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
15	Capital Regional District	<u>Coastal Sediment Processes</u>	The term “coastal sediment processes” refers to the forces that erode, transport and deposit sediment along shorelines. The coastal environment consists of constantly changing conditions, caused by the forces of wind, waves, currents and tides. Beaches are composed of sediment of various sizes, from large boulders to fine sand or mud. Erosion occurs when sediment is removed from a particular location (e.g. by wind, rain or waves); deposition occurs where sediment is added to a location.	nd	Se
16	Caribbean Alliance for Sustainable Tourism	<u>Sargassum A Resource Guide for the Caribbean</u>	Beach goers are going to have a hard time accepting Sargassum for what it is. Many will view it as a nuisance but which doesn't contribute to a pleasant coastal vacation experience, but the fact of the matter is that it is a natural occurrence and is generally Mother Nature at work. This does not mean that we have to sit back and allow it to take over the beaches. It has a variety of uses when tested to ensure non-contamination and can be taken off beaches in a responsible manner, which will be explored further in Mitigation and Management.	2015	Dm
17	CBC	<u>Province assesses storm damage to Parlee Beach</u>	Coastline expert Dominique Berube is still adding up the damage. Most of Parlee Beach disappeared into the ocean destroying 15 years of work. During that time, thousands of truckloads of sand were brought in to protect the beach from natural erosion. Berube says the government has spent more than half a million dollars on the beach program now it's all lost. "According to what we know, we lost 15 metres of dune, which means we probably lost everything that we have done during the last 15 years with the beach nourishment program."	2000	Se
18	Center for Coastal Resources Management	<u>Living Shorelines: Design Options - Beach Nourishment and Restoration</u>	Beach nourishment is placing clean sand on an existing beach to raise its elevation and increase beach width. A wider beach improves storm protection by increasing the distance between the upland bank and waves. Beaches are dynamic shoreline features that are constantly shifting in response to predominant wind and wave direction. Tolerance of these natural changes is required for the practice to be acceptable.	nd	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
19	Charlier, R.H. et al.	<u>Beach protection and restoration Part II: a perspective of “soft” methods</u>	In Part I (Vide previous issue) the authors underscored the world-wide character of coastal erosion and particularly the shrinking of beaches. If nature is the causal agent, man clearly enhances the process. To counter the steady encroachment of the sea upon the land, several protective devices have been placed along the shores. Some of these were even conceived as means to bring about sand accretion in specific sites. The results have been overall disappointing, or of local value only. In this paper beach protection and beach restoration methods that call upon the natural processes are examined. The “soft” approach to the problem includes implanting artificial reefs, placing vegetation, or fences, on dune or beach, and especially artificial beach nourishment.	2007	Se
20	CIRIA	<u>Beach management manual (second edition)</u>	The Beach management manual has been updated to provide beach managers and other stakeholders with authoritative guidance on managing beaches for coastal defence purposes while considering other issues such as the environment and amenity.	2010	Z
21	City of Corpus Christi Parks & Recreation Department	<u>Sand & Shoreline Maintenance Practices</u>	We also address the large amount of seaweed that naturally washes ashore to improve the experience for visitors that is also good for the environment! We leave most of it on the beach until it dies because it provides food for birds, turtles sea life and other wildlife on the beach. Once the seaweed dies, we bury it along the shoreline to build our protective dunes as part of our barrier islands which also help to prevent beach erosion in accordance with our USACE permit.	nd	Dm
22	City of Holdfast Bay (Australia)	<u>Beach Wrack (Seagrass) Removal Policy</u>	The City of Holdfast Bay does not support the removal of beach wrack from its section of the metropolitan Adelaide coast for the following reasons: a. increased exposure to beach erosion b. Vehicular damage to coastal ecosystems c. Aesthetic, nuisance, safety, risk management concerns surrounding seagrass removal process d. Depletion and degradation of near-shore marine environment and e Loss of micro-habitats within beach wrack. Exceptions to this policy may include the removal of waste matter and litter caught up in the beach wrack for reasons of public health and safety. Seagrass may be shifted from some areas for reasons of accessibility, but every attempt should be made to retain the material within the coastal ecological system.	2012	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
23	City of Racine Health Department Laboratory	Racine Beach Grooming Tactics to Reduce Swimming Bans	As a best management practice, the City of Racine, Wisconsin, altered beach-grooming techniques as a means of reducing diffuse (non-point) pollution to Lake Michigan. A 2-year research initiative demonstrated that past practices acted to increase bacterial indicator density in beach sands. Adjustments to the current equipment employed in beach maintenance provided a no cost means of reducing the frequency of dry weather advisories in this community.	2003	Sb
24	Coastal & Marine Union	Coastal Climate Change Adaptive management of beaches and coastal waters	Given the ecological functions of beach wrack, the implementation of recreational beach wrack management strategies that work with rather than against nature is a necessary step towards a more sustainable use of beaches. Leaving beach wrack on beaches will not prevent bathing tourism, as 'natural beaches' are not always covered by heaps of rotting plants. In fact, beach wrack monitoring along the German Baltic Sea revealed significant beach wrack accumulations on less than 10% of all summer days. If 'no cleaning zones' are not practical, technical or organisational adjustments of current management practices can support beach ecosystems functions. Limiting beach wrack removal in the stormy off-season, combined with banning the use of heavy machinery would minimise the impact of beach cleaning on beach erosion. Another efficient option to meet the demand for clean beaches is a selective beach cleaning that removes only manmade litter. By removing only waste and leaving eelgrass and macroalgae, beach users would also get the chance to explore the coastline's natural ecosystem. Selectively cleaned beaches could be used for educational purposes to teach residents and visitors about coastal ecosystems and the value of wrack to coastal fauna and flora. Thus, natural beaches may even pluralise beach uses.	2014	Dm
25	Con-Science	Guidelines on Beach Monitoring for Coastal Erosion	There are a number of reasons for monitoring a beach, as data will help to understand the past, identify present problems, program management intervention, calibrating or validating physical and numerical models, assess the effectiveness of an intervention, understand the impacts of interventions, ensure compliance with consenting conditions and provide evidence that required mitigation has been carried out.	2010	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
26	Cooke, B. et al.	<u>Nourishment practices on Australian sandy beaches: A review</u>	Beach nourishment practices such as artificial nourishment, replenishment and scraping are increasingly used to combat beach erosion but the extent and scale of projects is poorly documented in large areas of the world. Through a survey of beach managers of Local Government Areas and a comprehensive search of peer reviewed and grey literature, we assessed the extent of nourishment practices in Australia. The study identified 130 beaches in Australia that were subject to nourishment practices between 2001 and 2011. Compared to projects elsewhere, most Australian projects were small in scale but frequent. As rising sea levels and growing coastal populations continue to put pressure on beaches a more integrated approach to management is required, that documents the extent of projects in a central repository, and mandates physical and biological monitoring to help ensure the engineering is sustainable and effective at meeting goals.		Se
27	Cooney, B.C. et al.	<u>BEACH NOURISHMENT: Global Perspectives and Local Applications to the North Carolina Coastline</u>	Beach erosion has become a major problem for many coastlines around the world. Scientists and coastal managers have been working on ways to solve the problem of coastal erosion, and these solutions involve both hard structures such as groins and jetties and soft solutions like beach nourishment – projects comprised of borrowing sand and redepositing it on the beach. Beach nourishment has recently become a more popular solution to the problem of erosion; however it has been around for many decades. It is important to realize that erosion is only a problem because people care a great deal about their beaches.	2003	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
28	Crowe, S.E. et al.	<u>Physical and Biological Alterations Following Dredging in Two Beach Nourishment Borrow Areas in South Carolina's Coastal Zone</u>	Dredging of nearshore subtidal sand deposits as a source for beach fill is a common practice in the SE United States, but the long-term effects of this practice on benthic environments are not well documented. Two borrow areas used to nourish the shoreface of Folly Beach, South Carolina, in 2005 (borrow area A) and 2007 (borrow area B) were sampled for sediment characteristics (silt and clay, calcium carbonate, total organic matter content, and sand phi size) and macrobenthic infaunal community composition using a before–after, control–impact design over periods of 8 and 6 years postdredging, respectively. Following dredging, surficial sediment characteristics within both borrow pits shifted toward finer materials and showed little evidence of recovering 8 and 6 years after impact. Borrow site location and the depth at which sediments are mined below grade may be important considerations for improving the sustainable reuse of limited sand resources in many areas and avoiding long-term changes in benthic infaunal community composition.	2016	Se
29	Davies, C.M. et al.	<u>Survival of Fecal Microorganisms in Marine and Freshwater Sediments</u>	The survival of seeded Escherichia coli in marine sediment was studied by using an enumeration method which detected viable but nonculturable bacteria. Throughout the duration of the experiment (68 days), the same proportion of E. coli organisms remained culturable, suggesting that sediment provides a favorable, nonstarvation environment for the bacteria.	1995	Sb
30	De Falco, G. et al.	<u>Management of Beach-Cast Posidonia oceanica Seagrass on the Island of Sardinia (Italy, Western Mediterranean)</u>	P. oceanica banquette removal resulted in a widespread practice applied on 44 beaches (out of 116). The total removed amount for 2004 was estimated at 106,180 m ³ . Heavy machines were generally used to remove banquettes. Relationships between banquette removal and beach characteristics showed that higher quantities removed resulted in low-energy beaches. The amount of sediment subtracted to the beach following removal was evaluated by analyzing sand concentration in banquettes collected at three locations. Mean sediment concentration in banquettes was 92.8 kg m ⁻³ . This value, multiplied for the amount of banquettes removed, allowed us to evaluate the sediment subtracted from each beach between 0.5 and 1725 m ³ . Furthermore, the majority (80%) of the volume removed was dumped in unauthorized areas. Following the findings of the study, some management measures are suggested in order to minimize environmental impact of banquette removal.	2006	Dm
31	Dean R. and T.J. Campbell	<u>Recommended beach nourishment guidelines for the state of Florida and unresolved related issues</u>	The results of a workshop held in August, 1999. Issues were identified which preclude guideline development at this time.	1999	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
32	Dean, Robert G. and Thomas J. Campbell	<u>Beach Nourishment in Springer Handbook of Ocean Engineering</u>	Although beach nourishment is a relatively young technology, some major projects have been in place for 80 years and monitored sufficiently to provide a basis for design and performance prediction with a reasonable degree of confidence. Of the various methods available for shoreline stabilization, beach nourishment is unique in addressing the sand deficit and with the capability to restore the recreational, storm protection, and ecological functions of a natural beach. The quality and quantity of sand placed in beach nourishment are shown to be essential to effective performance. Design and performance prediction methods are reviewed including the analytical method of Pelnard Considère, which provides interrelationships between various design parameters and is an excellent pedagogical tool for both understanding these relationships and guiding the more detailed methods which are evolving toward greater and greater complexity. Legacy projects are defined as those that were nourished many years ago, require very little maintenance, have been documented to the degree that their performance is well established and are generally not recognized as constructed beaches by the typical beach user. Two of these legacy projects are reviewed in some detail as well as several other projects for which the performance is well established. The challenges facing beach nourishment in the future include: rising energy costs, environmental issues, public perception and limited sand resources.	2016	Se
33	Desmarais, T. et al.	<u>Influence of Soil on Fecal Indicator Organisms in a Tidally Influenced Subtropical Environment</u>	The potential regrowth of fecal indicator bacteria released into coastal environments in recreational water bodies has been of concern, especially in tropical and subtropical areas where the number of these bacteria can be artificially elevated beyond that from fecal impacts alone. The task of determining the factors that influence indicator bacterial regrowth was addressed through a series of field sampling and laboratory experiments using in situ densities of Escherichia coli, enterococci, and Clostridium perfringens in river water, sediment, and soil. Results from laboratory experiments revealed a significant amount of regrowth for enterococci and E. coli with the simulation of tides and addition of sterile sediment. Regrowth was not observed for C. perfringens.	2001	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
34	Duarte, C.M.	<u>How can beaches be managed with respect to seagrass litter?</u>	Seagrass meadows produce large amounts of leaf material that is shed and eventually may reach the shore, often building important banks of seagrass litter. These deposits often represent a source of concern for the manager, whenever they accumulate in beaches and shorelines used for recreational purposes. This chapter describes the formation of these litter banks, their role on the littoral systems and discusses possible management options.	2004	Dm
35	Dugan, J. et al.	<u>Ecological Impacts of Beach Grooming on Exposed Sandy Beaches</u>	Kelp and phytoplankton washed ashore by tides and waves support a rich diversity of shore life. On many of the most popular sandy beaches in California, however, local municipalities regularly rake up litter and kelp in a process called beach grooming. The ecological consequences of this process on plants and animals that live and forage in regularly raked areas are evaluated. The information gathered may help guide and improve the state's beach maintenance practices.	2008	Dm
36	Dugan, J. et al.	<u>The response of macrofauna communities and shorebirds to macrophyte wrack subsidies on exposed sandy beaches of southern California</u>	To investigate the influence of marine macrophyte wrack subsidies on community structure, relationships between community attributes, including species richness, abundance, and biomass of macrofauna and abundance of shorebirds, and a variety of factors, including the standing crop of wrack and beach morphodynamics, were examined on 15 exposed sandy beaches on the southern California coast. Significant differences in community structure, including depressed species richness, abundance, and biomass of macrofauna, especially for wrack-associated taxa, were associated with beach grooming and provided strong evidence for the bottom-up effects of wrack subsidies. Grooming also reduced the prey available to vertebrate predators, such as shorebirds. Substantial ecological effects of the large-scale disturbance and removal of organic material, food resources, and habitat are associated with beach grooming.	2003	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
37	Environmental Defence	Statement by Environmental Defence on the loss of the Blue Flag for Sauble Beach	<p>The decision by the Town of South Bruce Peninsula’s council to extend beach raking at Sauble Beach is a step backwards, and shows disregard for the ecological protection of Sauble Beach and its endangered bird life. After 10 years of promoting the Town of South Bruce Peninsula as a leader in environmental best practices, it is with regret that we must revoke the Blue Flag designation for Sauble Beach. Despite the advice of environmental experts, provincial government staff and overwhelming public opposition to habitat destruction at Sauble Beach, council has amended the policy “Raking and Maintenance of the Sand Beach at Sauble Beach.” The change in policy means that raking may take place all the way to the water’s edge, removing important habitat for the Piping Plover, an endangered shorebird which has been nesting at Sauble Beach since 2007. The Plovers have nested in various locations at Sauble Beach, and therefore the majority of the beach from 2nd Street north to the river is protected under the Endangered Species Act (ESA). Therefore raking of this habitat would result in illegal action by the municipality. The amendment to the policy will also result in the destruction of dunes that have been restored to a natural state. Dunes perform an important ecological function, keeping sand in the beach system. The Friends of Sauble Beach have fought for years to restore and protect these dunes, which are a natural feature of the Lake Huron shoreline and should be protected.</p>	2015	Dm
38	Eversole, Dolan	Beach Management Guidelines Makaha Beach Park Makaha Beach, Oahu	<p>The City and County of Honolulu Department of Parks and Recreation (City) and the Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL) have a shared regulatory function for the beach and shoreline area through the overlapping jurisdiction of the state Conservation District which is defined by the certified shoreline and the City’s responsibility to manage the beach park area designated from the high watermark to the private property boundaries . Both agencies have fielded public inquiries regarding the City’s annual beach maintenance practice. Concerns are related to excessive beach grooming that may negatively impact local sediment transport and contribute to seasonal beach erosion down drift. Alternatively if the beach is not maintained unsafe drop off and berm conditions can develop along the parking lot, lifeguard towers and other fixed infrastructure and may lead to increased beach erosion the following erosion cycle if not stemmed with sand pushing.</p>	2010	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
39	Feng, Z et al.	<u>A Predictive Model for Microbial Counts on Beaches where Intertidal Sand is the Primary Source</u>	Human health protection at recreational beaches requires accurate and timely information on microbiological conditions to issue advisories. The objective of this study was to develop a new numerical mass balance model for enterococci levels on nonpoint source beaches. The significant advantage of this model is its easy implementation, and it provides a detailed description of the cross-shore distribution of enterococci that is useful for beach management purposes. The performance of the balance model was evaluated by comparing predicted exceedances of a beach advisory threshold value to field data, and to a traditional regression model. Both the balance model and regression equation predicted approximately 70% the advisories correctly at the knee depth and over 90% at the waist depth. The balance model has the advantage over the regression equation in its ability to simulate spatiotemporal variations of microbial levels, and it is recommended for making more informed management decisions.	2015	Sb
40	Feng, Z. et al.	<u>Wave Energy Level and Geographic Setting Correlate with Florida Beach Water Quality</u>	Percent exceedances based on enterococci and fecal coliform were negatively correlated with both long-term mean wave energy and beach slope. Also, Gulf of Mexico beaches exceeded the thresholds significantly more than Atlantic Ocean ones, perhaps partially due to the lower wave energy. A possible linkage between wave energy level and water quality is beach sand, a pervasive nonpoint source that tends to harbor more bacteria in the low-wave-energy environment.	2016	Sb
41	Finkl, Charles W.	<u>Beach nourishment, a practical method of erosion control</u>	Artificial beach nourishment, the placing of sand onto eroded beaches, is increasingly employed by coastal engineers as an alternative to structural control of shoreline erosion. Man-made beaches approximating natural forms and processes offer greater protection against storms than eroded beaches and provide increased recreational opportunities. It is hoped that maintenance nourishment will keep pace with subsidence and eustatic rise in sea level, primary causes of beach erosion. Even though negative impacts of beach restoration may be short-lived and limited in scope, sound ecological engineering practices require careful monitoring of dredging operations.	1981	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
42	Florida Fish and Wildlife Conservation Commission	Mechanical Beach Cleaning Guidelines	Beach cleaning involves the removal of material left by the tides or beach goers on Florida's sandy shorelines. Stranded seaweed provides an important food source for beach and near-shore food chains, and should be left in place when possible. Human debris can pose a hazard to humans and animals, and should be removed. The use of mechanized beach cleaning equipment is limited during certain times of the year when threatened and endangered sea turtles are nesting. Those beach cleaners willing to commit to special protections for sea turtles can continue to operate and share the beach with Florida's sea turtles	nd	Dm
43	Florida Fish and Wildlife Conservation Commission	Beach cleaning practices to minimize impacts to protected shorebirds	Beach wrack, seaweed and natural debris that washes ashore, benefits wildlife by providing an important food source for migratory birds. Wrack also provides cover for wildlife and helps maintain coastal habitats. It is best for these species if wrack remains on the beach, but this can create a challenge for those who conduct mechanical beach cleaning.	2016	Dm
44	Florida Shorebird Alliance	Guidelines To Minimize Impacts Of Mechanical Beach Raking On Beach-Dependent Bird Species Along The Florida Coast"	Mechanical beach raking to remove man-made debris (litter) and wrack (natural debris such as stranded seaweed, shells, and other marine debris at the high tide line) from Florida's sandy beaches is an activity regulated by the Florida Department of Environmental Protection (FDEP) under the Florida Beach & Shore Preservation Act, Florida Statute 161. Mechanized beach raking practices can pose serious threats to the survival of seabirds and shorebirds that are dependent upon sandy beaches. Therefore, we do not endorse mechanical beach raking practices. However, for areas where this activity is permitted, and is in compliance with the rules and regulations listed below, we provide additional information and guidance to minimize the adverse impacts that beach raking has on beach-dependent bird species, which primarily includes the American oystercatcher, black skimmer, and species of gull, plover, sandpiper, and tern.	nd	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
45	Foteinis, S. et al.	Heavy Metal Distribution in Opportunistic Beach Nourishment: A Case Study in Greece	<p>The existence and distribution of persistent pollutants, such as heavy metals, in coastal sediment used for opportunistic beach nourishment, is a problem that has not received much attention. Here, we assessed the coastal sediments in one restoration project for the occurrence and distribution of heavy metals, by utilizing an Energy Dispersive X-Ray Fluorescence (EDXRF) system. Heavy metal point sources included (i) the effluents of small industries (tanneries), (ii) wastewater treatment plant effluents, and (iii) paint and oil scraps from substandard ship maintenance activities that take place on ports breakwaters. A few neighboring beaches were found to have similar heavy metal concentrations, with mean values of Cu, Zn, and Pb ranging from 80 to 130, 15 to 25, and 25 to 40 mg/kg, respectively. Existing legislation regarding dredging activities in Greece appears insufficient for sustainable and environmentally friendly nourishment. We conclude that before opportunistic beach restoration projects materialize with material borrowed from ports and harbors the quality of the dredged material needs to be assessed.</p>	2013	Se
46	G. Guannel, G and H. T. Özkan-Haller	Formulation of the undertow using linear wave theory	<p>The undertow is one of the most important mechanisms for sediment transport in nearshore regions. As such, its formulation has been an active subject of research for at least the past 40 years. Still, much debate persists on the exact nature of the forcing and theoretical expression of this current. Here, assuming linear wave theory and keeping most terms in the wave momentum equations, a solution to the undertow in the surf zone is derived, and it is shown that it is unique. It is also shown that, unless they are erroneous, most solutions presented in the literature are identical, albeit simplified versions of the solution presented herein. Finally, it is demonstrated that errors in past derivations of the undertow profile stem from inconsistencies between (1) the treatment of advective terms in the momentum equations and the wave action equation, (2) the expression of the mean current equation and the surface shear stress, and (3) the omission of bottom shear stress in the momentum equation.</p>	2014	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
47	García, E.	<u>Impacts of Beach Wrack Removal due to Grooming</u>	The decision of whether or not to groom beaches has been an important and controversial management issue for most beach reserve managers. Grooming is the removal of kelp wrack that naturally washes up onto the shore of most beaches. Although future studies should be done to test the correlation between kelp wrack presence and variables such as bird activity, the presence of kelp wrack does seem to heavily affect how much biodiversity is present on the beach, especially in terms of invertebrates. Concluding from the above results, the more beach wrack is present, the more invertebrates and also birds were present on the beach. The data presented in this paper is a good starting off point for managers because it allows them to weigh the pros and cons of grooming or not grooming a beach in terms of their goals regarding biodiversity. However, use of this data will most likely differ from site to site because even an ungroomed beach could potentially still have less diversity if other factors such as tourism or other disturbances negatively affect species	2017	Dm
48	Gast, R. et al.	<u>Impact of erosion and accretion on the distribution of enterococci in beach sands</u>	Bacterial pathogens in coastal sediments may pose a health risk to users of beaches. Although recent work shows that beach sands harbor both indicator bacteria and potential pathogens, it is not known how deep within beach sands the organisms may persist nor if they may be exposed during natural physical processes. In this study, sand cores of approximately 1 m depth were collected at three sites across the beach face in Kitty Hawk, North Carolina before, during and after large waves from an offshore hurricane. The presence of DNA from the fecal indicator bacterium Enterococci was detected in subsamples at different depths within the cores by PCR amplification. Erosion and accretion of beach sand at the three sites also was determined for each sampling day. The results indicate that ocean beach sands with persisting enterococci signals could be exposed and redistributed when wind, waves, and currents cause beach erosion or accretion.	2011	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
49	Gheskiere, T. et al.	<u>Are strandline meiofaunal assemblages affected by a once-only mechanical beach cleaning?</u> <u>Experimental findings.</u>	The increasing usage of sandy beaches as recreational resources has forced regional authorities of many tourist countries to remove all litter of fabricated origin and natural wrack from the beach. Consequently, a variety of heavy equipment has been developed during the last decades and is now used almost daily at many beaches. A field experiment, following a 'before-after-control-impact' (BACI) design, was conducted at the strandline of De Panne (Belgium) to investigate the impacts of mechanical beach cleaning on the strandline-associated meiofaunal assemblages, focussing on the free-living nematodes. Natural strandline assemblages were exposed to a one-off 5 cm deep mechanical beach cleaning and observed for 24 h. Differences between cleaned plots and those from control plots in terms of decreased percentage of organic matter, decreased total abundance and changed community structure were noticed from immediately after the experimental cleaning onwards and recovered to initial values after the following high water. Any impacts due to cleaning on species richness, Pielou's evenness and taxonomic diversity were shown to be minor in relation to the daily changes. Recolonization in the cleaned sediments is assumed to occur from the underlying sediments initiated by the elevated water table during the rising tide.	2006	Dm
50	Gijitz	<u>Brilliant Seaweed Recycling Plan Turns Waste to Clean Fuel</u>	If you've ever taken a stroll along an oceanside beach, chances are you've come across the rather unappealing piles of rotting seaweed. On tourist beaches, the seaweed is usually scooped up periodically and taken to a landfill. There are several problems with this method, though. First, the seaweed takes along a lot of sand and salt water with it, making it extremely heavy and taking up tons of space in the landfills. Secondly, the sand that is removed incidentally along with the seaweed has to be periodically replaced – usually with sand trucked in from somewhere else. And finally, the seaweed is usually way too salty to do anything useful with it. But researchers at the University of Alicante in Spain have come up with a rather ingenious way to solve the seaweed problem: a machine that cleans the plant matter, leaves the salt water and sand where it is, and then uses the seaweed as a source of power. Their system would reduce the volume of the gathered seaweed by as much as 80 percent by removing everything unnecessary: water, salt and sand.	2013	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
51	Gilburn A.	<p><u>Mechanical grooming and beach award status are associated with low strandline biodiversity in Scotland</u></p>	<p>Beach grooming and beach award status are both shown to be associated with low macroinvertebrate taxon richness in Scotland. Previous studies in California have revealed that mechanical raking to remove wrack from sandy beaches has negative ecological consequences for coastal ecosystems. In the current study the presence and absence of eight common taxa that inhabit beached wrack on sandy beaches in Scotland was assessed at 60 sites, 24 of which were groomed and 29 of which were in receipt of a beach award. On average 4.86 of the eight taxa were found to be present on ungroomed beaches, whereas only 1.13 taxa were present on groomed beaches. Thus, beach grooming seems to be having a major effect on the biodiversity of beach macroinvertebrates in Scotland. Fewer macroinvertebrate taxa were also found on award (1.5) compared to non-award (4.38) beaches. It was also revealed that award beaches were much more likely to be groomed than non-award beaches, with 69% of award beaches surveyed being groomed compared to only 6% of non-award beaches. This pattern is surprising as the awarding bodies discourage the removal of seaweed and regulations state that beached wrack should only be removed if it constitutes a nuisance. It is concluded that award status, not nuisance level, has the main factor driving most beach grooming and that this has resulted in the substantial loss of macroinvertebrate biodiversity from award beaches in Scotland. In conclusion it is shown that beach grooming has a substantial negative impact upon strandline macroinvertebrate biodiversity in Scotland and that grooming is much more likely to occur on award beaches.</p>	2012	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
52	Gopalakrishnan, S. et al.	<u>Decentralized Management Hinders Coastal Climate Adaptation: The Spatial-dynamics of Beach Nourishment</u>	Climate change threatens to alter coastline erosion patterns in space and time and coastal communities adapt to these threats with decentralized shoreline stabilization measures. We model interactions between two neighboring towns, and explore welfare implications of spatial-dynamic feedbacks in the coastal zone. When communities are adjacent, the community with a wider beach loses sand to the community with a narrower beach through alongshore sediment transport. Spatial-dynamic feedbacks create incentives for both communities to nourish less, resulting in lower long-run beach width and lower property values in both communities, a result that parallels the classic prisoner's dilemma. Intensifying erosion—consistent with accelerating sea level rise—increases the losses from failure to coordinate. Higher erosion also increases inequality in the distribution of benefits across communities under spatially coordinated management. This disincentive to coordinate suggests the need for higher-level government intervention to address a traditionally local problem. We show that a spatially targeted subsidy can achieve the first best outcome, and explore conditions under which a second-best uniform subsidy leads to small or large losses.	2016	Se
53	Gorzelany, J. F. and Walter G. Nelson	<u>The effects of beach replenishment on the benthos of a sub-tropical Florida beach</u>	Changes in the benthic fauna of the near-shore zone were examined before and after a beach replenishment project on the central Florida east coast. Results indicated that the near-shore sand beach community is relatively species rich, although abundance is dominated by only two species of bivalves, the coquina clams <i>Donax variabilis</i> and <i>Donax parvula</i> . Strong gradients of increased species richness and abundance were found, with values increasing at the more seaward sites for both control and nourishment locations. This distributional pattern was unchanged by beach nourishment. Comparison of mean number of individuals per core across dates and among transects (two-way analysis of variance) showed no indication of significant negative effects of beach nourishment. Similar analysis for mean number of species per core also failed to show significant negative effects. Negative biological effects of beach nourishment may have been minimized in the present case due to a seasonal offshore movement of the dominant coquina clams. The close match of mean fill grain size to ambient grain size and an apparent lack of substantial fill movement into the biologically more diverse offshore areas may also have diminished biological damage.	1987	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
54	Government of Western Australia	Beach-cast Wrack Management Plan	This document details the management strategies to be implemented by OPR to ensure mobilisation and accumulation of beach wrack as a result of port construction and operation are disposed of in an appropriate manner.	2011	Dm
55	Greene, Karen	Beach Nourishment: A Review of the Biological and Physical Impacts	Since the frequency of beach nourishment projects is expected to increase in the future, it is worthwhile to review the current level of knowledge regarding impacts and to identify areas where information is lacking. This paper outlines the basic issues surrounding beach nourishment: 1) coastal erosion and possible management approaches; 2) how beach nourishment is carried out; 3) federal and state activities; 4) the environmental effects at the mine site and the target beach; 5) research needs; and 6) recommendations for improving monitoring studies. Some of the issues discussed in the mine site section may also be applicable to the target beach section (and vice versa) in instances where habitat and species are the same.	2002	Se
56	Guernsey Government - Environment	Beach Management	<p>The Environment Department has to achieve a sensitive balance in trying to meet the expectations of people - both locals and visitors - and to sustain the needs of wildlife. There are diverse views regarding beach management, including the clearance of litter and seaweed. The demands of various industries, including tourism, can put pressure on the fragile marine ecosystem and our policies try to reflect this.</p> <p>Tractor-drawn machines and other mechanical cleaning methods which remove seaweed, shells and driftwood affect insect habitats. This method removes the top 10-15cm of beach and reduces the numbers of invertebrates by up to 90%. This is detrimental to food sources for sea birds and to other seashore ecology (e.g. through compaction). Mechanical beach cleaning can also destabilise sandy beaches which in stormy conditions can leave the island's coastal defences vulnerable as sand and sediment is more likely to be washed away from the base of sea walls. The British Wildlife Trusts support the cleaning of beaches by hand to conserve the beach ecosystem.</p>	2015	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
57	Halliday, E. and R.J. Gast	<u>Bacteria in Beach Sands: An Emerging Challenge in Protecting Coastal Water Quality and Bather Health</u>	This paper reviews the current state of knowledge regarding the abundance and distribution of fecal indicator bacteria and pathogens in beach sands of diverse climatological regions, and at beaches subjected to varied levels of anthropogenic impact. In all regions fecal indicator bacteria are nearly ubiquitous in beach sands, and similar relationships emerge among fecal indicator abundance in dry sand, submerged sands, and water. Taken together, these studies contextualize a potential public health issue and identify research questions that must be addressed in order to support future policy decisions.	2011	Sb
58	Hanley, M.E. et al.	<u>Shifting sands? Coastal protection by sand banks, beaches and dunes</u>	As part of the EU-funded THESEUS project we investigated the critical drivers that determine the persistence and maintenance of sandy coastal habitats around Europe's coastline, taking particular interest in their close link with the biological communities that inhabit them. The successful management of sandy beaches to restore and sustain sand budgets (e.g. via nourishment), depends on the kind of mitigation undertaken, local beach characteristics, and on the source of 'borrowed' sediment. We found that inter-tidal invertebrates were good indicators of changes linked to different mitigation options. For sand dunes, field observations and manipulative experiments investigated different approaches to create new dune systems, in addition to measures employed to improve dune stabilisation. THESEUS provides a 'toolbox' of management strategies to aid the management, restoration, and creation of sandy habitats along our coastlines, but we note that future management must consider the connectivity of sub-littoral and supra-littoral sandy habitats in order to use this natural shoreline defence more effectively.	2013	Se
59	Hanson, H. et al.	<u>Beach nourishment projects, practices, and objectives—a European overview</u>	The uses of beach fill in the countries of the European Union are highlighted and discussed with respect to the general situation, project type and objectives, design and evaluation procedures, legal framework, and financial aspects. As expected, significant differences were found among the investigated countries. In general, the study shows that it would be very profitable for south European countries to learn about the Dutch and German practices, particularly regarding the long-term coastal management and the regular monitoring of the coastal morphology. On the other hand, recent Dutch experience has shown that their legal system is a bit rigid, leading sometimes to renourishments that are less necessary to reach the global objective.	2002	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
60	Hawaii Department of Land and Natural Resources	Instructions for General Application - small scale beach nourishment projects	Purpose: To provide a viable alternative to shoreline hardening through the development and enhancement of a beach nourishment and restoration program, encouraging landowners to consider beach nourishment over hard shoreline armoring. Provide a streamlined application process for Small-Scale Beach Nourishment (SSBN) and restoration projects by consolidating the permit processing functions solely within the Department of Land and Natural Resources.	2005	Se
61	Health Canada	Guidelines for Canadian Recreational Water Quality – Third Edition	Routine monitoring of sand samples for the presence of faecal indicators would not be considered practical and is thus not recommended. For beach managers and operators, barriers to reduce the extent of faecal contamination can include the physical removal of litter that may attract animals to the area and the installation of physical barriers designed to discourage wildlife. Examples of such barriers can include animal-proof refuse containers, fences and gull nets. Jurisdictional regulations restricting access for pets on public beaches present another potential control mechanism. Physical manipulations of the sand environment have also been proposed as a potential action to help minimize faecal contamination and reduce its transport to swimming waters. Deep mechanical grooming without levelling was effective in reducing sand levels of E. coli at a Racine, Wisconsin, beach, particularly in wet sand. Targeted beach grading to increase the steepness of the slope of a beach has been suggested as another action that can improve water quality. A more steeply sloped beach reduces the area vulnerable to wave swash and permits more rapid sand drying through improved drainage. Pre-emptive beach postings or swimming advisories restricting recreational water activities for short periods immediately after rainfall events present another potential barrier. Larger-scale management options for beaches will require a comprehensive review of the contamination inputs and watershed characteristics and the identification of specific options to minimize or control the sources of faecal contamination and to reduce the transfer of pollution to the swimming area.	2012	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
62	Health Canada	Guidelines for Canadian Recreational Water Quality – Third Edition 9.0 Faecal contamination and beach sand	<p>Currently, there is no conclusive evidence of a relationship between contact with beach sand and illness among recreational water users, and no guideline values can be established for concentrations of the recommended indicators for recreational waters for faecal contamination in beach sand. Routine monitoring of sand samples for the presence of faecal indicators would not be considered practical and is thus not recommended. Certain circumstances may warrant testing of sand and sediment samples, such as during investigations of potential waterborne disease outbreaks or when conducting an Environmental Health and Safety Survey.</p> <p>1. Beach sand and related environments may provide a more favourable environment for microorganisms of faecal origin, which may permit them to survive for longer periods than in the adjacent water. Physical factors such as wave action, storm surges, tidal activity and high swimmer load can result in the transference of microorganisms from foreshore and nearshore sand and sediments to swimming waters.</p> <p>2. Currently, there is no conclusive evidence to indicate a link between microorganisms in beach sand and illness among beach users. Further research is needed to determine the relationships between faecal indicator bacteria and the possible presence of faecal pathogens in beach sand, as well as the potential implications to human health.</p> <p>3. Barriers that collectively reduce risk of exposure for beach users could include public education campaigns, improved beach sanitation practices, appropriate sand grooming practices and actions designed to discourage the activities of animals (birds and other wildlife) within the beach area.</p>	2012	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
63	Heaney C.D. et al.	<u>Fecal Indicators in Sand, Sand Contact, and Risk of Enteric Illness Among Beachgoers</u>	<p>We analyzed 144 wet sand samples and completed 4999 interviews. Adjusted odds ratios (aORs) were computed, comparing those in the highest tertile of fecal indicator exposure with those who reported no sand contact. Among those digging in sand compared with those not digging in sand, a molecular measure of <i>Enterococcus</i> spp. (calibrator cell equivalents/g) in sand was positively associated with gastrointestinal (GI) illness (aOR 2.0 95% confidence interval (CI) 1.2–3.2) and diarrhea (2.4 1.4–4.2). Among those buried in sand, point estimates were greater for GI illness (3.3 1.3–7.9) and diarrhea (4.9 1.8–13). Positive associations were also observed for culture-based <i>Enterococcus</i> (colony-forming units/g) with GI illness (aOR digging 1.7 1.1–2.7) and diarrhea (2.1 1.3–3.4). Associations were not found among nonswimmers with sand exposure. Conclusions: We observed a positive relationship between sand contact activities and enteric illness as a function of concentrations of fecal microbial pollution in beach sand.</p>	2012	Sb
64	Heaney, C.D.	<u>Contact with beach sand and risk of illness</u>	<p>Recently, numerous studies of fecal contamination of beach sand have shown that beach sand can harbor higher concentrations of fecal indicator organisms than nearby recreational waters. Although fecal pathogens have also been isolated from beach sand, the risk of illness associated with beach sand contact and fecal indicator organism concentrations in sand is unclear. During 2003-2005 and 2007, beach visitors at 7 U.S. beaches were enrolled in the study and asked about sand contact the day of their beach visit. Ten to 12 days later participants were telephoned to answer questions about health symptoms experienced since the visit. At 2 study beaches in 2007, beach sand was analyzed for concentrations of the fecal indicators <i>Enterococcus</i>, <i>Bacteroides</i>, <i>B. thetaiotaomicron</i>, and F+-specific coliphage. We completed a total of 27,365 interviews at 4 freshwater and 3 marine water beaches. After controlling for age, sex, water contact, race/ethnicity, and beach, digging in the sand was positively associated with gastrointestinal (GI) illness. Stronger associations were observed among those getting sand in their mouth for GI illness. There was variability in the effect by beach. This study demonstrated a positive relationship between sand contact activities and GI illness as a function of microbial sand quality.</p>	2008	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
65	Herdandez, R. et al.	<u>Effects of full-scale beach renovation on fecal indicator levels in shoreline sand and water</u>	Overall, this study supports that beach renovation activities contributed to improved sand and water quality resulting in a 50% decrease of observable enterococci loads due to upgrades to the stormwater infrastructure. Of interest was that the change in the sand mineralogy also coincided with changes in biofilm levels. More work is needed to evaluate the relationships between beach sand mineralogy, biofilm characteristics, and the retention of fecal indicator bacteria in sand.	2014	Sb
66	Hernandez, R. et al.	<u>Effects of Full-Scale Beach Renovation on Fecal Indicator Levels in Shoreline Sand and Water</u>	Recolonization of enterococci, at a non-point source beach known to contain high background levels of bacteria, was studied after a full-scale beach renovation project. The renovation involved importation of new exogenous sand, in addition to infrastructure improvements. The study's objectives were to document changes in sand and water quality and to evaluate the relative contribution of different renovation activities towards these changes. Overall, this study supports that beach renovation activities contributed to improved sand and water quality resulting in a 50% decrease of observable enterococci loads due to upgrades to the stormwater infrastructure. Of interest was that the change in the sand mineralogy also coincided with changes in biofilm levels. More work is needed to evaluate the relationships between beach sand mineralogy, biofilm characteristics, and the retention of fecal indicator bacteria in sand.	2014	Se
67	Hill, H.W. et al.	<u>The effects of storms and storm-generated currents on sand beaches in Southern Maine, USA</u>	Storms are one of the most important controls on the cycle of erosion and accretion on beaches. Current meters placed in shoreface locations of Saco Bay and Wells Embayment, ME, recorded bottom currents during the winter months of 2000 and 2001, while teams of volunteers profiled the topography of nearby beaches. Coupling offshore meteorological and beach profile data made it possible to determine the response of nine beaches in southern Maine to various oceanographic and meteorological conditions. The beaches selected for profiling ranged from pristine to completely developed and permitted further examination of the role of seawalls on the response of beaches to storms. Current meters documented three unique types of storms: frontal passages, southwest storms, and northeast storms. In general, the current meter results indicate that frontal passages and southwest storms were responsible for bringing sediment towards the shore, while northeast storms resulted in a net movement of sediment away from the beach.	2004	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
68	Hilles A. et al.	<u>Is Gaza Sandy Shoreline Region Contaminated with Human Gastrointestinal Parasites?</u>	The study was implemented to test if the sandy shoreline of Gaza city is contaminated with human gastrointestinal parasites or not and to determine the types of intestinal parasites and the extent of contamination. A total of 104 sand samples (52 dry sand and 52 wet sand) were analyzed during the summer season period. Samples were collected from the study area of about 12km along the seashore region of Gaza City. Dry samples and wet sand samples were analyzed using water-sedimentation technique and a light microscope. The results showed that the percentage of the parasitic contamination was 40.4% of the wet sand samples and 34.6% of the dry sand samples along the shoreline region of the Gaza City.	2013	Sb
69	Hinds, C. et al.	<u>Sargassum Management Brief Golden Tides: Management Best Practices for Influxes of Sargassum in the Caribbean with a focus on clean-up</u>	The purpose of this management brief is to enable government officials, coastal managers, beach caretakers and coastal residents to get ahead of the “golden tides” by providing up-to-date information on the recent ‘sargassum influxes’ (arrival of unprecedented mass quantities of sargassum seaweed) in the Caribbean region; and, importantly, by offering guidance on how best to sustainably manage the seaweed, based on lessons learnt to date. This first brief focuses on the immediate problem of clean-up, after mass strandings of the weed. Others will be developed that focus on potential commercial uses of the weed and on adaptation measures suitable for fishers and other vessel operators.	2016	Dm
70	Hutchinson, O.	<u>Guidelines Prepared for Removal of Sargassum</u>	Manager of the Ecosystems Management branch of NEPA, Andrea Donaldson, who also spoke at the ‘Think Tank’, explained that using heavy equipment or machines to remove the seaweed could lead to severe damage to the beach. “We ask that it be raked. Heavy duty vehicles can cause more impact on the beach. A number of beaches may be sea turtle nesting sites, nesting beaches for birds or crocodiles and these machines will compact or aid in destroying the beach,” she noted. She further advised that the heavy duty machines will take away not only the sargassum , but also the very sand being protected. She said using the rake allows for removal of the seaweed without the sand.	2015	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
71	Imamura, Gregory J. et al.	<u>Wrack promotes the persistence of Indigenous enterococci and Escherichia coli a in marine sands and seawater</u>	This study examines the relationship between beach wrack, FIB, and surrounding water and sediment at marine beaches along the California coast. Surveys of southern and central California beaches were conducted to observe environmental wrack-associated FIB concentrations. FIB concentrations normalized to dry weight were the highest in stranded dry wrack, followed by stranded wet and suspended 'surf' wrack. Laboratory microcosms were conducted to examine the effect of wrack on FIB persistence in seawater and sediment. Indigenous enterococci and Escherichia coli incubated in a seawater microcosm containing wrack showed increased persistence relative to those incubated in a microcosm without wrack. FIB concentrations in microcosms containing wrack-covered sand were significantly higher than those in uncovered sand after several days. These findings implicate beach wrack as an important FIB reservoir. The presence of wrack may increase water and sediment FIB levels, altering the relationship between FIB levels and actual health risk while possibly leading to beach closures. Further work will need to investigate the possibility of FIB growth on wrack and the potential for pathogen presence.	2011	Dm
72	Kaczor, K.	<u>Seaweed Accumulation on Maine's Coastal Beaches</u>	When seemingly excessive mounds of seaweed cover valued coastal beaches during Maine's short summer season, there are critical factors to consider when mapping the course of action: water quality, public health, aesthetics, tourist economies, ecosystem health, and the laws that are meant to preserve the integrity of these environments. During the busy summer months, beach management approaches may also consider phenology (seasonal changes of plants and animals) while balancing the potential risks to public health and tourist economies. Managing seaweed accumulation on Maine's beaches is a beach-specific weighing game with no one-size-fits-all solution.	2015	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
73	Kelly, J.	<u>Assessing the spatial compatibility of recreational activities with beach vegetation and wrack in New Jersey: Prospects for compromise management</u>	This study examines the prospects for compromise management to support greater natural resources on recreational beaches by analyzing the spatial dimensions of key natural resource indicators (beach vegetation and wrack) with peak recreational uses in New Jersey, one of the most intensively developed shorelines in North America. Given the current level of impacts to vegetation and wrack on recreational beaches, major gains in these and other natural resources can therefore be made across the shoreline without substantial impacts to existing pedestrian or vehicular recreational uses. Greater ecological benefits and ecosystem services may be obtained by applying these types of compromise management solutions to recreational ocean beaches in the future.	2016	Dm
74	Kinzelman, J.	<u>Improving Surface Water Quality through Beach Sand Manipulation Technical Meeting</u>	Sand has been suggested to contain populations of E. coli which persist and can, under certain environmental conditions, multiply. These organisms come from a variety of environmental sources. These organisms provide a bacterial load on our recreational waters, causing unsafe swimming conditions. Swimming in unsafe water can cause disease. Alternative grooming practices need to be evaluated.	2009	Sb
75	Kinzelman, J. et al.	<u>Evaluation of Beach Grooming Techniques on Escherichia coli Density in Foreshore Sand at North Beach, Racine, WI</u>	Current beach management practice involves daily mechanical grooming of the nearshore sand for aesthetics and removal of hazardous debris. However, this practice has not been evaluated in terms of its effects on E. coli loading to beach sand and potential introduction to contiguous swimming water. In this study, we tested E. coli responses to three treatments: mechanical groomer, daily and twice weekly hand raking, and a control (no raking/grooming). A randomized block design consisted of replicated treatments and one control (10 each), for a total of 40 blocks sampled daily for 10 days. Foreshore sand samples were collected by hand coring to an average depth of 10 cm. Median E. coli recovered were 73 (mechanically groomed), 27 (hand-raked daily), 32 (hand-raked twice weekly), and 22 (control) colony-forming units (CFU) per gram dry weight sand. E. coli counts in sand that was groomed were significantly higher than hand rakings and control ($p < 0.0001$), and there was no significant difference between control and raking treatments ($p < 0.01$). This study demonstrates the beach management implications related to grooming efficacy and the importance of understanding non-point sources of bacterial contamination.	2003	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
76	Kinzelman, J.L. and S. McLellan	<u>Success of science-based best management practices in reducing swimming bans—a case study from Racine, Wisconsin, USA</u>	In Racine, Wisconsin, USA, research conducted to identify pollution sources guided the development of better beach management practices such as ecologically appropriate beach modifications, improved mechanical beach grooming strategies, and the redesign of a major storm water outlet (including installation of a constructed wetland area). Resulting improvements have reduced bathing water quality advisories from 66% of days during the swimming season in 2000 to 5% or less in four consecutive years (2005–2008). These improvements to Racine beaches facilitated Blue Wave certification from the Clean Beaches Council (Washington, DC); thereby restoring public confidence, increasing beach use by the residents and tourists, and expanding the role of the beachfront in the local economy.	2009	Sb
77	Kinzelman, J.L. et al.	<u>The effect of two mechanical beach grooming strategies on Escherichia coli density in beach sand at a southwestern Lake Michigan beach</u>	This study explored the influence of mechanical beach grooming on in situ populations of Escherichia coli at a southwestern Lake Michigan beach to determine if an alteration in current beach management practices would serve to reduce the number of dry weather advisories in this community. Preliminary studies conducted during 2001 demonstrated that professional grooming significantly increased Escherichia coli content in beach sands relative to non-groomed or hand raked plots ($p < 0.001$). This data also suggested that deeper grooming might reduce differences between groomed and non-groomed areas. Subsequently, two mechanical grooming techniques were compared at Racine, WI in 2002: groomed to a depth of 5 to 7 cm with leveling of beach sands and groomed to a depth of 7 to 10 cm without leveling. Escherichia coli content between treatments were significantly correlated ($p < 0.009$). The density of the bacterium in deeper groomed/unleveled sands was significantly lower in visibly moist or wet but not dry sands ($p = 0.038$). In 2003, the manner in which beach sands were maintained using the mechanical beach groomer was altered and a follow-up study conducted. A 30 percent reduction in the number of poor water quality advisories due to dry weather events was achieved as a result of these measures.	2010	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
78	Kishimoto, R., and G. Baker	<u>Pathogenic and Potentially Pathogenic Fungi Isolated from Beach Sands and Selected Soils of Oahu, Hawaii</u>	Fungi capable of causing mycoses in man are known to occur in many types of soils and natural habitats, but their occurrence in Hawaii has not been studied comprehensively to date. Two known sources served as the basis for this initial Hawaiian survey: 1) sands taken from beaches of low and high swimmer-density and, 2) soils associated with avian droppings. A total of 361 sand samples representing Oahu's supratidal and intertidal zones was screened. More pathogenic or potentially pathogenic fungi were isolated from areas where the swimmer-density was very high and, conversely, few were isolated from low swimmer-density areas.	1969.06	Sb
79	Leewis, L. et al.	<u>Does beach nourishment have long-term effects on intertidal macroinvertebrate species abundance?</u>	Seventeen sandy beaches – nourished and controls – were sampled along a chronosequence to investigate the abundance of four dominant macrofauna species and their relations with nourishment year and relevant coastal environmental variables. We found no negative long term consequences of beach nourishment on the abundance of the sampled species, and all species seemed to have recovered within one year. <i>S. squamata</i> even profited from beach nourishments, confirming its opportunistic nature. Previous studies focussed on species richness and total abundance, but we found responses to the environment to be species specific. This shows the importance of knowing the autecology of the macro-invertebrate fauna of a sandy beach to mitigate impact effects. Moreover, slope and sediment characteristics (including sorting and skewness) of a beach nourishment should be matched with the original beach.	2012	Se
80	López-Mosquera, M et al.	<u>Composting fish waste and seaweed to produce a fertilizer for use in organic agriculture</u>	The fishing sector produces large amounts of waste in fish markets and processing industries. These by-products are mainly used in the manufacture of fish meal. However, there are other potentially valuable uses. One low-investment possibility is the elaboration of agricultural products by composting the fish remains with other marine materials such as seaweed. The main purpose of this work was to obtain a fertilizer suitable for use in organic agriculture, by composting a mix of seaweed and fish waste.	2011	Dm
81	Ludden, J.	<u>Debate Over Rebuilding Beaches Post-Sandy Creates Waves</u>	For a half-century, the U.S. Army Corps of Engineers has been in the beach business, dredging up new sand as shorelines wash away. Federal disaster aid for Superstorm Sandy could provide billions more for beach rebuilding, and that has revived an old debate: Is this an effective way to protect against storms, or a counterproductive waste of tax dollars?	2013	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
82	Macreadie, P. et al.	<u>Converting beach-cast seagrass wrack into biochar: A climate-friendly solution to a coastal problem</u>	Excessive accumulation of plant 'wrack' on beaches as a result of coastal development and beach modification (e.g. groin installation) is a global problem. This study investigated the potential for converting beach-cast seagrass wrack into biochar as a 'climate-friendly' disposal option for resource managers. Wrack samples from 11 seagrass species around Australia were initially screened for their biochar potential using pyrolysis techniques, and then two species – <i>Posidonia australis</i> and <i>Zostera muelleri</i> – underwent detailed analyses. Both species had high levels of refractory materials and high conversion efficiency (48–57%) of plant carbon into biochar carbon, which is comparable to high-quality terrestrial biochar products. <i>P. australis</i> wrack gave higher biochar yields than <i>Z. muelleri</i> consistent with its higher initial carbon content. According to ¹³ C NMR, wrack predominantly comprised carbohydrates, protein, and lignin. Aryl carbon typical of pyrogenic materials dominated the spectrum of the thermally-altered organic materials. Overall, this study provides the first data on the feasibility of generating biochar from seagrass wrack, showing that biocharring offers a promising climate-friendly alternative to disposal of beach wrack in landfill by avoiding a portion of the greenhouse gas emissions that would otherwise occur if wrack was left to decompose.	2017	Dm
83	Marlowe, Howard	<u>Beach Nourishment: A Guide for Local Government Officials</u>	Beach nourishment works. Over the past five decades, dozens of beaches on the East and West Coasts have been nourished successfully. Nevertheless, there are some who oppose spending taxpayer dollars on the restoration of America's coastal parks. To understand their criticism, we must first examine the benefits our nation derives from its thousands of miles of sandy shoreline. From that base of knowledge and context, concerns of anti-nourishment advocates can be discussed.	nd	Se
84	Massachusetts - Executive Office of Energy and Environmental Affairs	<u>Best Management Practices for Beach Nourishment Projects in Massachusetts</u>	Proponents of beach nourishment projects in Massachusetts are required to determine beach conditions and stability, characterize the physical and chemical properties of the material to be dredged, as well as the physical properties of the material on the receiving beach. Keep in mind that the most important factors for beach nourishment projects is the grain size distribution of the source material as compared to the native beach material, and the location of the project in relation to sensitive coastal receptors.	2007	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
85	Massachusetts Department of Environmental Protection	Beach Nourishment: Mass DEP's Guide to Best Management Practices for Projects in MA	Proponents of beach nourishment projects in Massachusetts are required to determine beach conditions and stability, characterize the physical and chemical properties of the material to be dredged, as well as the physical properties of the material on the receiving beach. Keep in mind that the most important factors for beach nourishment projects is the grain size distribution of the source material as compared to the native beach material, and the location of the project in relation to sensitive coastal receptors.	2007	Se
86	Massachusetts Office of Coastal Zone Management	Managing Seaweed Accumulations on Recreational Beaches	Because seaweed is a natural and important part of the coastal ecosystem, it should be left in place whenever possible. When seaweed management is deemed necessary, however, local conditions and management considerations must be fully understood and addressed before selecting appropriate techniques. Because there is no one-size-fits-all approach for all beaches, CZM recommends developing a seaweed management strategy or policy, ideally as part of a comprehensive beach management plan for all public beaches. When removing seaweed accumulations from a beach, the lowest impact techniques available should be used, such as hand removal or hand raking. Whether hand raking, rake-type machines, or other heavy machinery is used, the following general guidelines should be followed...	2013	Dm
87	Mazerolle, Brent	Storm Surges are Unavoidable - Professor	The Chene Bank is where wind and waves send Parlee Beach's sand each year, Every year in November trucks and trailers haul it back.	2011	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
88	Morton, J.K. et al.	<u>Potential Small- and Large-Scale Effects of Mechanical Beach Cleaning on Biological Assemblages of Exposed Sandy Beaches Receiving Low Inputs of Beach-Cast Macroalgae</u>	Mechanical beach cleaning occurs worldwide on heavily urbanised beaches to remove litter and decomposing macroalgae from impacting tourism and recreation. This study investigated the potential small- (100 s of metres) and large-scale (kms) ecological impacts of beach cleaning in a region receiving low inputs of macroalgae with a focus on: levels of total nitrogen and nitrate; abundances of bacteria, meiofauna, macrofauna and ocypodid crabs; and assemblages of meiofauna and macrofauna. Results indicated that beach cleaning was not having an impact. Given beach cleaning occurred only weekly to twice-weekly on small sections of a few beaches, and that collected beach-cast macroalgae in the study region is relocated on the same beach for degradation, it is likely that nutrients are redistributed from surrounding areas to cleaned sites and that potential physical impacts to biota are short-term and sustainable. Impacts of beach cleaning may be evident in regions that experience more extensive beach cleaning operations or on beaches with high inputs of beach-cast macroalgae. This study also highlights the importance of comparing sites at the same location to investigate the effects of beach cleaning, as ecological differences among distant locations may incorrectly be attributed to beach cleaning but may actually be driven by differences in their physical characteristics.	2015	Dm
89	Muka, Samantha	<u>Building Beaches: Beach Nourishment in the United States</u>	If you've been or are planning to go to a beach this summer, whether on the Great Lakes, West, Atlantic or Gulf coasts, there's a good possibility that you will be walking on a beach built through beach nourishment. Beach nourishment involves dredging sand from a "borrow area" offshore, pumping it onshore, and sculpting beaches that both mimic and enhance the original shoreline. Building up beaches has a long history in the United States and there are many competing interests involved in nourishment projects. Understanding these competing interests, and the pros and cons of nourishment, is increasingly important as oceans become more dynamic as a result of climate change and eat away at our shorelines.	2015	Se
90	National Oceanic & Atmospheric Administration	<u>State, Territory, and Commonwealth Beach Nourishment Programs A National Overview</u>	Section 1 of this report provides an overview of the problem of beach erosion, various means of addressing this problem, and discusses issues regarding the use of beach nourishment. Section 2 of the report provides an overview of state, territorial, and commonwealth coastal management policies regarding beach nourishment and attendant funding programs. Appendix B provides individual summaries of all 33 beach nourishment programs and policies.	2000	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
91	National Oceanic and Atmospheric Administration	<u>National Beach Nourishment Database</u>	This database features information on nearly 400 projects that have placed nearly 1.5 billion cubic yards of sand along the continental U.S. coastline. The database includes the number of nourishment events, oldest project, newest project, known total cost, total volume, and known length. Pie charts for each project also indicate whether the project was a federal beach nourishment, a regional sediment management placement of dredged navigation sand on the beach, or other type of project such as state, local, or privately sponsored.	nd	Se
92	National Research Council (U.S.)	<u>Beach Nourishment and Protection</u>	Beaches are essential storm barriers. They protect natural and developed areas and provide valuable recreational resources. But beaches are dynamic, often eroding in winter and accreting in summer, moved by waves, currents, and wind. Many beaches are naturally eroding, their shoreline position moving shoreward over time. Various strategies are used in an effort to manage shorelines to satisfy socioeconomic needs. Fixed structures, such as seawalls, groins, and shore-parallel breakwaters, have been used for many years to create a barrier between land and sea. But they can interrupt the alongshore flow of sand, exacerbating erosion problems in some instances and creating new ones in others. Beach nourishment, which involves the addition of sand in designed contours to extend a beach and the nearshore shallows seaward, has grown in acceptance as a shore protection and beach restoration measure in the United States, Europe, and Australia.	1995	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
93	National Research Council (U.S.)	<u>Beach nourishment and Protection</u>	<p>Beach Nourishment and Protection provides a sound technical basis for decision-making, with recommendations regarding the utility of beach nourishment, the appropriate role of federal agencies, responsibility for cost, design methodology, and other issues.</p> <p>This volume</p> <ul style="list-style-type: none"> •Examines the economic and social role of beaches, the history of beach nourishment projects, and management strategies for shore protection. •Discusses the role of the U.S. Army Corps of Engineers and other federal agencies, with a close-up look at the federal flood insurance program. •Explores the state of the art in project design and prediction of outcomes, including the controversy over the use of traditional and non-traditional shore protection devices. •Addresses what is known about the environmental impacts of beach nourishment. •Identifies what outcomes should be targeted for continued monitoring by project officials. 	1995	Se
94	National Research Council (U.S.)	<u>Mitigating Shore Erosion Along Sheltered Coasts</u>	<p>This report reviews options available to mitigate erosion of sheltered coasts; explores why certain decisions are made regarding the choice of erosion mitigation options; provides critical information about the consequences of altering sheltered shorelines; and, provides recommendations about how to better inform decisions in the future.</p>	2007	Se
95	National Research Council (U.S.)	<u>Beach Nourishment and Protection (1995) Chapter: 4 Beach Nourishment Project Design and Prediction</u>	<p>A comprehensive technical basis for decision-making with reference to beach nourishment.</p>	1995	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
96	Nelson, Walter	Guidelines for Beach Restoration Projects Part I - Biological Engineering	A general review of data on the effects of beach nourishment on the sand beach macrofauna suggests that minimal biological effects result from beach nourishment. Some mortality of organisms may occur where grain size is a poor match to existing sediments, however recovery of the beach system appears to be rapid. Turtle nesting may be negatively affected due to sand compaction for a period of about one year. Because available studies specifically analyzing biological effects of beach nourishment are few and often have design or analysis flaws, further biological monitoring of beach nourishment should be continued until adequate data for deciding whether monitoring is necessary can be made. Standardized biological monitoring approaches for beach nourishment are proposed.	1985	Se
97	Nestor, I et al.	Detection of enteroviruses in seawater and beach sand	In the years from 1975 to 1978 investigations were carried out to detect enteroviruses in the sea-water and in the sand of the beaches of the Rumanian Black Sea coast, in zones with and without waste water discharge. The quantities of enteroviruses found in the seawater and in the sand of the beaches were lower than those verified in other countries. For the identification of viruses we used two concentration methods simultaneously (polyelectrolyte PE60 Monsanto USA and brewer's yeast cells) as well as two methods of isolation (in cell cultures and with newborn mice). The incidence of enteroviruses depended on the season, with no viruses present in the sea-water and in the sand of the beaches during the periods considered to be outside the holidaying season. The discharge of purified sewage into the sea was not attended by considerable viral contamination of the sea-water and of the beaches.	1984	Sb
98	New Brunswick Department of Tourism and Parks	2004-2005 - Annual Report	Special Purpose account was created in 2004-2005 to cover the annual maintenance costs of beach nourishment at Parlee Beach due to storm damage and beach erosion. (approx. \$500,000)	2005	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
99	New Zealand Ministry of Fisheries	<u>Beach-cast seaweed: a review</u>	Beach cleaning was also listed as a threat to sandy coastlines in some parts of Europe, the disappearance of macrofauna and birds that prey on the macrofauna being of particular note (Weslawski et al. 2000). In a review of sandy shorelines and the threats facing these ecosystems in the future, beach cleaning was highlighted as having mostly detrimental effects on these systems (Brown & McLachlan 2002). These authors noted that cleaning not only removes debris left behind by human visitors, but also kelp, wrack, and other dead or stranded biota, thus depriving beach ecosystems of valuable nutritional input. In addition to the effects on infauna, the removal of seaweed could affect beach morphology, as much sand is removed along with the debris. In Puerto Madryn, Argentina, between 2500 and 12 000 t wet weight seaweed per year is removed for cosmetic purposes, and it is estimated that between 100 and 400 m3 of sand are removed as part of this process, accelerating erosion and changing the topography of the beaches (Piriz et al. 2003).	2005	Dm
100	Nordstrom K.F. et al	<u>Reestablishing Naturally Functioning Dunes on Developed Coasts</u>	Common beach management practices reduce the ecological values of coastal dunes. Mechanical beach cleaning eliminates incipient dunes, habitat for nesting birds, seed sources for pioneer dune colonizers and food for fauna, and artificially small, stabilized foredunes reduce the variability in microenvironments necessary for biodiversity. Recent initiatives for reducing coastal hazards, protecting nesting birds, and encouraging nature-based tourism provide incentive for the development of a restoration program for beaches and dunes that is compatible with human use. Suggested changes in management practice include restricting or rerouting pedestrian traffic, altering beach-cleaning procedures, using symbolic fences to allow for aeolian transport while preventing trampling of dunes, and eliminating or severely restricting exotic species.	2000	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
101	Nordstrom, K.F. and Mark N, Mauriello	<u>Restoring and Maintaining Naturally-Functioning Landforms and Biota on Intensively Developed Barrier Islands Under a No-Retreat Alternative</u>	Changes to beaches and dunes in New Jersey reveal that hard-protection structures are not the final phase in evolution of landforms on an eroding, developed coast. Beach nourishment provides the basis for restoration of landforms and biota, and for recovery of lost environmental heritage. Landform evolution is linked to changes in federal and state policies and programs that are triggered by damaging storms. The economic value of beaches and dunes as shore protection is crucial to willingness to construct them, but natural values are an important by-product that increases acceptability of future restoration programs. Stable funding for shore protection is key to creating and preserving restored habitat, as are prevention of beach raking (required, in places, by the need to protect nesting birds) and resistance to demands for new construction. Achievable dune-restoration outcomes are identified in selected municipalities.	2001	Se
102	North Carolina Department of Environmental Quality	<u>Beach Nourishment</u>	Sand used for beach nourishment must be similar in quality and grain size to sand in the area being nourished. Pursuant to 15A NCAC 07H .0312 TECHNICAL STANDARDS FOR BEACH FILL PROJECTS, sediment samples must be taken from both the borrow site and recipient beach to determine if the sediment source is compatible. The cited rule provides an objective definition of sediment compatibility for beach fill projects, and outlines specific protocols for sampling the beach scheduled to receive nourishment and the proposed borrow site in order to correctly characterize the material found there.	nd	Se
103	Northern Ireland - Environment and Heritage Service	<u>Environmentally Sustainable Seaweed Harvesting in Northern Ireland</u>	This document outlines the Environment & Heritage Service (EHS) position on seaweed harvesting in Northern Ireland and was produced through a process of stakeholder engagement. EHS Position on Beach Cleaning I EHS promotes the retention of driftweed on beaches because of its valuable role in sand dune development and as a habitat and food source for animals. I EHS will refuse consent for beach cleaning operations/activities that are likely to have a significant adverse impact upon the feature interests for which a designated site was declared. I EHS advises that driftweed should be left to decay on beaches and a nature conservation organisation should be consulted if it is considered that it constitutes a nuisance. I EHS would support the development of beach zonation plans for beaches which are regularly cleaned.	2007	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
104	Oldham, C. et al.	<u>A preliminary exploration of the physical properties of seagrass wrack that affect its offshore transport, deposition, and retention on a beach</u>	<p>The transport, deposition, and decomposition of seagrass wrack facilitate significant marine subsidies of material, energy, and organisms to the terrestrial environment. Over the past decade we have improved our understanding of the on-beach decomposition of seagrass wrack and its impact on beach and island communities; however, there is a paucity of research on the transport processes that supply wrack to the beaches. The physical properties of wrack affect its buoyancy and therefore transport, but these properties vary with species, the condition of the wrack when it was formed, the time since the wrack was generated and its ambient environment in the sediment, the water column, at the water surface or on the beach. Understanding how wrack physical properties vary under a range of conditions is needed to predict wrack transport, yet these properties have not previously been reported. We modified classical parameterizations of particle transport to identify knowledge and data gaps for wrack transport processes. We present a preliminary exploration, for <i>Posidonia sinuosa</i> leaves and <i>Amphibolis antarctica</i> stems and leaves, of settling velocities of wrack fragments, critical shear stresses required for their resuspension, bulk physical characteristics of wrack accumulations on beaches (e.g., bulk density, porosity), and physical properties of key wrack components (e.g., tissue density, tensile strength). We also determined how these properties change with tidal state and submergence</p>	2014	Dm
105	Oldham, C. et al.	<u>Seagrass wrack dynamics in Geographe Bay, Western Australia.</u>	<p>This study aimed to improve knowledge of seagrass wrack dynamics in Geographe Bay to inform the development of seagrass management approaches. Ultimately, the objective should be to minimise the need for artificial wrack removal from the beach on the western side of the western training wall at Port Geographe.</p>	2010	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
106	Palm Beach County Board of County Commissioners	<u>Beach Wrack What Is It?</u>	<p>Many times beach wrack is removed for aesthetic reasons creating an imbalance in the beach/dune ecosystem, especially the food chain.</p> <p>Removing beach wrack not only harms animals that live day to day on the beach, but also migrating birds that depend on these food and shelter stops as they make their long journey. Only remove manmade items (trash, plastics, fishing line, beach toys, etc.) off the beach and keep the natural wrack for a healthy beach.</p> <p>Protect Our Home - DON'T rake the wrack!</p>	nd	Dm
107	Palmero, C.	<u>Beach sand – key player in coastal beach water management</u>	<p>After hearing the word “beach”, many people automatically think of sunbathing, long walks near the sea, building sand castles and throwing Frisbees – recreation at its finest. Beaches are one of the most visited ecosystems for human recreation and are of high importance for regional economies, in many cases especially for tourism. Beaches and recreational bathing waters are highlighted by the World Health Organization (WHO) as important for health and wellbeing. But did you know that beaches, and in particular the beach sand itself, also plays a vital part in coastal beach water management? Worldwide public use of water for recreational purposes and recreational activities that involves water have increased over the years. But this also means that recreational exposure to pathogens in the water environment also increases.</p>	2015	Sb
108	Papadakis, J.A. et al.	<u>Bather-related microbial and yeast populations in sand and seawater</u>	<p>A significant correlation appears between the number of swimmers present on the beach and <i>S. aureus</i> counts in water samples; the correlation is stronger at the more popular beach. In sand samples <i>S. aureus</i> counts correlate with the number of swimmers present on the beach only at the more popular beach. Yeasts of human origin correlate with the number of swimmers on the more popular beach, both in water and sand samples.</p>	1997.04	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
109	Peterson, C. and Melanie J. Bishop	<u>Assessing the Environmental Impacts of Beach Nourishment</u>	With sea levels rising under global warming, dredge-and-fill programs are increasingly employed to protect coastal development from shoreline erosion. Such beach “nourishment” can bury shallow reefs and degrade other beach habitats, depressing nesting in sea turtles and reducing the densities of invertebrate prey for shorebirds, surf fishes, and crabs. Despite decades of agency-mandated monitoring at great expense, much uncertainty about the biological impacts of beach nourishment nonetheless exists. A review of 46 beach monitoring studies shows that (a) only 11 percent of the studies controlled for both natural spatial and temporal variation in their analyses, (b) 56 percent reached conclusions that were not adequately supported, and (c) 49 percent failed to meet publication standards for citation and synthesis of related work. Monitoring is typically conducted through project promoters, with no independent peer review, and the permitting agencies exhibit inadequate expertise to review biostatistical designs. Monitoring results are rarely used to scale mitigation to compensate for injured resources. Reform of agency practices is urgently needed as the risk of cumulative impacts grows.	2005	Se
110	Peterson, C.H. and M. Bishop	<u>Assessing the Environmental Impacts of Beach Nourishment</u>	With sea levels rising under global warming, dredge-and-fill programs are increasingly employed to protect coastal development from shoreline erosion. Such beach “nourishment” can bury shallow reefs and degrade other beach habitats, depressing nesting in sea turtles and reducing the densities of invertebrate prey for shorebirds, surf fishes, and crabs. Despite decades of agency-mandated monitoring at great expense, much uncertainty about the biological impacts of beach nourishment nonetheless exists. A review of 46 beach monitoring studies shows that (a) only 11 percent of the studies controlled for both natural spatial and temporal variation in their analyses, (b) 56 percent reached conclusions that were not adequately supported, and (c) 49 percent failed to meet publication standards for citation and synthesis of related work. Monitoring is typically conducted through project promoters, with no independent peer review, and the permitting agencies exhibit inadequate expertise to review biostatistical designs. Monitoring results are rarely used to scale mitigation to compensate for injured resources. Reform of agency practices is urgently needed as the risk of cumulative impacts grows.	2005	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
111	Phillips, M.C. et al.	<u>Relationships Between Sand and Water Quality at Recreational Beaches</u>	Studies have shown sustained populations of enterococci within sediments of beaches but comprehensive surveys of multiple tidal zones on beaches in a regional area and their relationship to beach management decisions are limited. We sampled three tidal zones on eight South Florida beaches in Miami-Dade and Broward counties and found that enterococci were ubiquitous within South Florida beach sands although their levels varied greatly both among the beaches and between the supratidal, intertidal and subtidal zones. The supratidal sands consistently had significantly higher ($p < 0.003$) levels of enterococci (average 40 CFU/g dry sand) than the other two zones. Results indicate a connection between levels of enterococci in beach water and sands throughout South Florida's beaches and suggest that the sands are one of the predominant reservoirs of enterococci impacting beach water quality. As a result, beaches with lower levels of enterococci in the sand had fewer exceedances relative to beaches with higher levels of sand enterococci.	2011	Sb
112	Pinto, K.C. et al.	<u>Microbiological quality assessment of sand and water from three selected beaches of South Coast, São Paulo State, Brazil</u>	This study aimed to assess the sanitary quality of water, and wet and dry sand from three beaches located in the South Coast region of São Paulo State, Brazil, selected taking into account the frequency of tourists and the water quality (good, fair and poor). Thirty-six water samples each of wet and dry sand and seawater were collected monthly over a period of one year and analyzed for fecal indicator bacteria (FIB: thermotolerant coliforms, <i>Escherichia coli</i> , and enterococci), presumptive <i>Staphylococcus aureus</i> , <i>Pseudomonas aeruginosa</i> , <i>Candida albicans</i> and dermatophytes. The results revealed FIB concentrations more elevated in dry sand followed by wet sand and water. <i>P. aeruginosa</i> and presumptive <i>S. aureus</i> were detected with a similar frequency in water and sand samples, but maximum concentrations and geometric means were higher in dry sand. <i>C. albicans</i> was detected only in water samples whereas the dermatophyte <i>Microsporum sp.</i> was isolated exclusively from dry and wet sand samples. This evaluation showed also that the environment had a significant influence on <i>P. aeruginosa</i> but not on presumptive <i>S. aureus</i> concentrations. According to threshold values proposed in the literature for <i>E. coli</i> and enterococci dry sand densities, none of the beaches would be considered of sufficient quality for recreational activities.	2012	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
113	Rippy, M.A. et al.	<u>Beach Nourishment Impacts on Bacteriological Water Quality and Phytoplankton Bloom Dynamics</u>	A beach nourishment with approximately 1/3 fine-grained sediment (fines; particle diameter < 63 µm) by mass was performed at Southern California's Border Fields State Park (BFSP). The nourishment was found to briefly (<1 d) increase concentrations of surf zone fecal indicator bacteria (FIB) above single sample public health standards (104 MPN (100 ml)-1), but had no effect on phytoplankton. Contamination was constrained to the nourishment site: waters 300 m north or south of the nourishment were always below single sample and geometric mean (≤ 33 MPN (100 ml)-1) standards. Nourishment fines were identified as a source of the fecal indicator Enterococcus; correlations between fines and enterococci were significant (p < 0.01), and generalized linear model analysis identified fines as the single best predictor of enterococci. Microcosm experiments and field sampling suggest that the short surf zone residence times observed for enterococci (e-folding time 4 h) resulted from both rapid, post-placement FIB inactivation, and mixing/transport by waves and alongshore currents. Nourishment fines were phosphate-rich / nitrogen-poor, and were not correlated with surf zone phytoplankton concentrations, which may have been nitrogen limited.	2013	Se
114	Royal Resorts	<u>Seaweed and Beach Cleaning in the Mexican Caribbean</u>	The local authorities, hotel associations and Mexican environmental agencies SEMARNAT and CONANP are working with local biologists, and experts from the Universidad Autónoma de México on a statewide cleaning and disposal plan for the seaweed. Once the salt has leached out of seaweed it can be composted and it makes an excellent fertilizer. In Puerto Morelos, some of the seaweed removed from the beaches is already being deposited in an old quarry and it could eventually be used in the parks and gardens. In other areas of the Mexican Caribbean, although not in Cancun, the seaweed is being buried in the dunes and the soil formed will boost plant growth. Seaweed anchors the sand and helps protect the shoreline from erosion. When seaweed is left to decompose naturally on the sand, it actually contributes to the growth of the beach. Sargassum is consumed in other parts of the world or given to farm animals as part of a dietary supplement and it is believed to have healing properties. These uses may also be studied as part of the disposal program.	2015	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
115	Russell, Todd	Fecal indicator bacteria on sand and wrack at marine beaches [electronic resource] : impacts on microbial water quality	Non-fecal reservoirs of FIB have been identified that have no clear connection to human fecal contamination, such as river sediments, sands and decaying aquatic plants (wrack). The second research chapter in this dissertation presents a two year microbial source tracking (MST) study aimed at identifying the sources of the high FIB concentrations observed at Cowell Beach in Santa Cruz, CA. Cowell Beach consistently has the worst summertime microbial water quality of any beach in California. Local agencies had been unable to identify the source of this pollution but believed that a non-fecal source, namely wrack, was responsible. Potential sources investigated included a river, a storm drain, a wharf, a harbor, sand, wrack and contaminated groundwater. The microbial pollution was identified as originating from a shoreline source, ruling out the river, storm drain, wharf and harbor as relevant sources. Based on a 24 h study and near-shore modelling results, two separate sources were identified as being dominant, sand for ENT and contaminated groundwater for EC. Wrack was found to be only a minor source, contributing less than 2% of the FIB compared to the dominant sources.	2014	Dm
116	Russell, Todd et al.	Impacts of Beach Wrack Removal via Grooming on Surf Zone Water Quality	Fecal indicator bacteria (FIB) are used to assess the microbial water quality of recreational waters. Increasingly, nonfecal sources of FIB have been implicated as causes of poor microbial water quality in the coastal environment. These sources are challenging to quantify and difficult to remediate. The present study investigates one nonfecal FIB source, beach wrack (decaying aquatic plants), and its impacts on water quality along the Central California coast. The prevalence of FIB on wrack was studied using a multibeach survey, collecting wrack throughout Central California. The impacts of beach grooming, to remove wrack, were investigated at Cowell Beach in Santa Cruz, California using a long-term survey (two summers, one with and one without grooming) and a 48 h survey during the first ever intensive grooming event. FIB were prevalent on wrack but highly variable spatially and temporally along the nine beaches sampled in Central California. Beach grooming was generally associated with either no change or a slight increase in coastal FIB concentrations and increases in surf zone turbidity and silicate, phosphate, and dissolved inorganic nitrogen concentrations. The findings suggest that beach grooming for wrack removal is not justified as a microbial pollution remediation strategy.	2104	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
117	Sabino, R. et al.	Routine screening of harmful microorganisms in beach sands: Implications to public health	The expert group at the "Microareias 2012" workshop recommends that 1) beach sand should be screened for a variety of pathogens harmful to human health, and sand monitoring should then be initiated alongside regular water monitoring; 2) sampling and analysis protocols should be standardized to allow proper comparisons among beach locations; and 3) further studies are needed to estimate human health risk with exposure to contaminated beach sand. Much of the manuscript is focused on research specific to Portugal, but similar results have been found elsewhere, and the findings have worldwide implications.	2013	Sb
118	Science Daily	Saving Sand: South Carolina Beaches Become A Model For Preservation	The main objective of this 7-year study, done in cooperation with the South Carolina Sea Grant Consortium, was to improve projections of coastal change by determining the geologic features and ocean processes that control sediment movement along the coast. "As a result of this work, we were able to identify offshore sand sources that could be used for future beach replenishment without causing a bigger erosion problem elsewhere," said Barnhardt. Controlling beach erosion will likely become more difficult as a result of climate change with its attendant sea-level rise and increase in the number and intensity of storms. This is particularly true in places like South Carolina that have a broad, low-elevation coast and a sand shortage. Although they studied only a limited segment of beach, their work is a model for beach preservation that can apply elsewhere.	2009	Se
119	Scottish National Heritage	A guide to managing coastal erosion in beach/dune systems - Summary 7: BEACH NOURISHMENT	Beach nourishment (also known as beach recharging) involves the importing of sand or gravel to make good losses due to erosion. If the source of material is local and related by coastal processes to the eroding area then this approach is known as recycling. Nourishment schemes can vary from a few truckloads to repair a blow out or other small eroded area up to multi-million pound schemes requiring sea delivery of sand dredged from the seabed.	2000	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
120	Seamatter	<u>Study of the current situation of the management of algae and seaweed deposition wastes from the coast</u>	The primary objective of the SEAMATTER-LIFE project is to highlight the untapped potential of marine plant debris deposited on beaches. This natural resource is usually treated as waste, a practice that has environmental implications on a local scale and which could be improved through the incorporation of new coastal zone management criteria. Exploitation of this material would entail the implementation of a management model which incorporated new functions related to industrial processes, implying a reformulation of the same within the framework of sustainability. This report discusses the problem posed by the accumulation of seaweed and seagrass on beaches, and addresses the environmental, social, economic, legal and administrative aspects affecting Spanish municipalities. The results provide an analysis of current practice as regards treatment of this debris, including collection, transportation, storage and disposal of the waste. The environmental cost of these practices and the pertinent legislation is also discussed, and a number of recommendations are presented for reducing the environmental impact caused by the removal of marine plant debris.	2013	Dm
121	Shibata T. et al,	<u>Monitoring marine recreational water quality using multiple microbial indicators in an urban tropical environment</u>	The microbial water quality at two beaches, Hobie Beach and Crandon Beach, in Miami-Dade County, Florida, USA was measured using multiple microbial indicators for the purpose of evaluating correlations between microbes and for identifying possible sources of contamination. The indicator microbes chosen for this study (enterococci, Escherichia coli, fecal coliform, total coliform and C. perfringens) were evaluated through three different sampling efforts. These efforts included daily measurements at four locations during a wet season month and a dry season month, spatially intensive water sampling during low- and high-tide periods, and a sand sampling effort. Beach sands within the wash zone tested positive for all indicator microbes, thereby suggesting that this zone may serve as the source of indicator microbes. Ultimate sources of indicator microbes to this zone may include humans, animals, and possibly the survival and regrowth of indicator microbes due to the unique environmental conditions found within this zone.	2004	Sb
122	Sierra Club Massachusetts	<u>Beach "Nourishment": Research & Advocacy White Paper</u>	The goal of this white paper, undertaken as a joint project of the Sierra Club Marine Action Team and the Massachusetts Chapter, is to help the Chapter develop a position consistent with Sierra Club policy and practice on beach nourishment, using specific examples representative of the issues.	2015	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
123	Solo-Gabriele, Helena M. et al.	<u>Beach sand and the potential for infectious disease transmission: observations and recommendations</u>	Recent studies suggest that sand can serve as a vehicle for exposure of humans to pathogens at beach sites, resulting in increased health risks. Sampling for microorganisms in sand should therefore be considered for inclusion in regulatory programmes aimed at protecting recreational beach users from infectious disease. Here, we review the literature on pathogen levels in beach sand, and their potential for affecting human health. In an effort to provide specific recommendations for sand sampling programmes, we outline published guidelines for beach monitoring programmes, which are currently focused exclusively on measuring microbial levels in water. We also provide background on spatial distribution and temporal characteristics of microbes in sand, as these factors influence sampling programmes. First steps toward establishing a sand sampling programme include identifying appropriate beach sites and use of initial sanitary assessments to refine site selection. A tiered approach is recommended for monitoring. This approach would include the analysis of samples from many sites for faecal indicator organisms and other conventional analytes, while testing for specific pathogens and unconventional indicators is reserved for high-risk sites. Given the diversity of microbes found in sand, studies are urgently needed to identify the most significant aetiological agent of disease and to relate microbial measurements in sand to human health risk.	2016	Sb
124	Southern California Coastal Water Research Project	<u>The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches</u>	This source identification manual provides guidance for cost-effectively identifying sources of fecal contamination within a watershed. The manual is based on a hypothesis-driven and tiered approach, in which the user implements the least expensive options first and more expensive tools only when sufficient uncertainty warrants their use.	2013	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
125	Speybroek, J et al.	<u>Beach nourishment: an ecologically sound coastal defence alternative? A review</u>	Even though beach nourishment is generally considered as an environment-friendly option for coastal protection and beach restoration, sizeable impacts on several beach ecosystem components (microphytobenthos, vascular plants, terrestrial arthropods, marine zoobenthos and avifauna) are described in the literature, as reviewed in this paper. Negative, ecosystem-component specific effects of beach nourishment dominate in the short to medium term, with the size of the impact being determined by (1) activities during the construction phase, (2) the quality and (3) the quantity of the nourishment sand, (4) the timing, place and size of project, and (5) the nourishment technique and strategy applied. Over the long term the speed and degree of ecological recovery largely depend on the physical characteristics of the beach habitat, mainly determined by (1) sediment quality and quantity, (2) the nourishment technique and strategy applied, (3) the place and the size of nourishment and (4) the physical environment prior to nourishment.	2006	Se
126	Stauble, D and G Hoel	<u>Guidelines for Beach Restoration Projects Part II - Physical Engineering</u>	This paper outlines detailed studies that have been performed on recently completed projects to assess the fill sediment redistribution and profile response. This compilation of data has shed new light on project behavior, identified important monitoring criteria and provided a calibration of the standard design criteria. Present detailed field studies of sand beach organisms together with experimental studies of burial tolerances of important species have provided much of the data needed for biological impact planning for these projects. The recommended guidelines developed from this study should provide new insight for design and permitting of future projects.	1986	Se
127	Stauble, Don	<u>A Review Of The Role Of Grain Size In Beach Nourishment Projects</u>	This paper will provide a review of guidance on the various methods now in use to identify suitable material for beach nourishment and how to determine the volume of fill material required to provide a stable fill. Recommendations are provided to assess the relative compatibility of alternative borrow sources for beach nourishment and procedures for estimating fill volume requirements to provide the desired beach width. Two basic approaches are commonly used that apply grain size parameters to characterize the native (pre-nourished beach) and borrow area sediment in calculation of the overfill ratio and to apply the concepts of the equilibrium beach profiles in determining needed fill volumes.	2005	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
128	Tasmania Government	Guidelines G-6.4 Tasmanian Coastal Works Manual Seagrass & seaweed removal from beaches	<p>Avoid disturbance to wildlife. Take care to identify any shorebird nests before works commence. Ensure breeding shorebirds are not disturbed during extreme weather as eggs and chicks will die if left unattended during the heat of day or in cold weather. Schedule works for early or late in the day. Only collect dried seagrass above the low tide mark. If removing dried seagrass from site, minimise the amount of sand removed from the beach. Do not alter dune profile. Do not dump seagrass on dunes, coastal vegetation or in other waterways, drains and gutters. Avoid use of machinery and keep vehicle movements on the beach to a minimum. Use of smaller lightweight machinery is preferred. Vehicles should not be used on shorebird breeding beaches. Consider damage to foreshore areas when creating access for vehicles. Re-deposit and re-spread collected seagrass, or mix with sand and bury, at another location further along the beach. If material must be removed offsite ensure it is protected from blowing during transport.</p>	nd	Dm
129	Terwilliger Consulting	Best Management Practices For Shoreline Stabilization To Avoid and Minimize Adverse Environmental Impacts	<p>Where shoreline stabilization is proposed, BMPs are presented in sections for dune, beach, nearshore, offshore, inlet and estuarine habitats, and an adaptive management framework is presented for project management (i.e., operations and maintenance) and issues relating to climate change and rising sea level. A glossary is included for key words and an extensive bibliography summarizes the scientific literature that provided scientific background and data in the development of these BMPs as conservation measures.</p>	2009	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
130	Thanet District Council (UK)	Seaweed removal guidelines	<p>When picked up from the beach this is classified as 'waste'. This means that disposal of the seaweed must be with their approval and is usually at a licensed waste disposal site or other site with a WML exemption. Seaweed can therefore only be taken to the following places: 1. Landfill It is illegal to landfill liquid waste so before taking it to landfill we have to dry the seaweed out first. To dry out the seaweed and then take it to landfill you can expect to pay in the region of £100 - £150 per tonne including the transportation costs. Seaweed in Thanet deposits in very high amounts, sometimes in the region of 6,000 - 7,000 tonnes, so this would be a very costly option. 2. Incineration Again the seaweed has to be dried out and total costs for this option would be around £100 per tonne including transport to Allington. 3. Approved Farmers field Due to the soil conditioning qualities of seaweed, farmers can use seaweed as a compost.</p>	nd	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
131	Thoren, K.	<u>A MST Approach to Investigate Fecal Indicator Bacteria in Bioaerosols and Bathing Water</u>	<p>The purpose of this study was to test the levels of persistence of Fecal Indicating Bacteria (FIB) of enterococci, Escherichia coli, and Human-source Bacteroidales, within the intertidal “swash zone” and the deeper waist zone in which people commonly bathe and play. In addition, the study sought to determine if these bacterial contaminants may also be found in aerosols at the beach.</p> <p>Measuring solar insolation in relation to bacterial persistence in seaweed wrack was used to determine if sunlight plays a role in modifying concentrations of FIB at the beach. Light intensity measured by a solar photometer and air quality measured by aerosol plate counts and qPCR Microbial Source Tracking (MST) was compared to varying locations where the beach samples were collected. Results from water samples demonstrate that bacteria measured using plate counts and qPCR were indeed higher within the swash zone than in the waist zone. This is in contrast with the way that the EPA currently measures and determines the public safety of beach waters. They commonly measure the waist zone, but disregard the swash zone. Results from beach bio-aerosol samples showed a wide variety of fungi and bacteria in the beach air, and qPCR MST analysis of these bio-aerosols showed the presence of FIBs such as enterococci on several of the aerosol collection plates. This emphasizes the need to collect samples from the entire beach instead of just measuring at an isolated area, and that exposure to microbial contaminants may include bathing water, beach sand, seaweed wrack, and bio-aerosols.</p>	2016	Dm
132	Thorson, Bruce	<u>Beach Grooming : Raking beach life from the sand</u>	<p>Grooming is especially popular on beaches that are exceptionally popular. That is, where large numbers of people gather and tend to leave plastic bottles, bags, and food wrappers in their wake. The proponents of beach grooming argue this positive side of the practice: cleaning up the beach. Detractors of beach grooming often cite three main problems. First, the raking aerates the sand, drying it out and making it more prone to being blown away. Second, it can tear up seeds and small plants that might otherwise help to stabilize dunes. Finally, and of most concern for our isopods, raking can disturb or destroy the habitat of everything from birds and turtles to the near countless number of tiny beach dwellers, such as the isopod.</p>	2016	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
133	Town of Hull (MA, USA)	Beach Management Committee FAQ	Seaweed is removed only from the area between mean high water and ten feet seaward of the dune. Seaweed maybe removed with hand rakes or, if the accumulation is large enough, with machinery. In addition, the BMP now allows the DPW to push seaweed into the water on an outgoing tide. This option was added because the Town has very little remaining space in the landfill and, removal of seaweed from the beach tends to remove significant quantities of sand despite best efforts to separate sand from seaweed. The BMC has investigated alternative options for excess seaweed but, to date, no viable alternative has been found.	nd	Dm
134	Town of Hull (MA, USA)	North Nantasket Beach Management Plan	This beach management plan (BMP or Plan) is, first and foremost, one that addresses natural resource functions and values. Its purpose is to define how the Town of Hull will manage North Nantasket Beach in accordance with the Massachusetts Wetlands Protection Act so that it may protect and maximize its wetland values while providing access and preserving its recreational value.	2012	Z
135	Town of Scituate	Town of Scituate Public Swim Beach Seaweed Removal Policy	The purpose of this policy is to establish the protocol for removing seaweed and other debris from guarded public beaches during the summer swimming season. The policy must balance the desires of citizens to use the beaches for recreation purposes with the environmental impact of modifying the natural processes of beach dynamics and foraging habitat for shorebirds and wildlife. Method of seaweed removal: The DPW will obtain an Order of Conditions from the Conservation Commission for this beach cleanup activity on public land. • The primary means of removal will entail using small machines with finger-like grapples to minimize sand removal. • A secondary means of removal will be using front-end loaders. A determination will be made of the approximate quantity of sand removed, and the beach will be re-nourished with an equal quantity of beach-compatible sand. • The removed material will be disposed of at the Bourne landfill or other approved sites.	2012	Dm

No.	Author/Organization	Title	Overview	Date	Primary Subject
136	Trembanis, A.C. et al	<u>Comparison of Beach Nourishment along the U.S. Atlantic, Great Lakes, Gulf of Mexico, and New England Shorelines</u>	The U.S. national beach nourishment experience is summarized for the East Coast barrier islands, the Gulf of Mexico, New England, and the Great Lakes. A total of 1,305 nourishment episodes on 382 beaches are recorded at a total estimated cost of approximately \$1.4 billion (\$2.5 billion in 1996 dollars). The volumes of sand needed for subsequent nourishment episodes on individual beaches do not decrease, despite contrary assumptions in the shoreface-profile-of equilibrium concept that subsequent nourishment volumes should diminish. In light of the historical experience of beach nourishment identified in this study, individual state and local coastal communities should re-evaluate their plans for future beach nourishment programs.	2010	Se
137	U.S. Environmental Protection Agency	<u>Final Report: Prevalence and Survival of Microorganisms in Shoreline Interstitial Waters: A Search for Indicators of Health Risks</u>	There are clues in the literature that, when taken together, suggest that the microbiological quality of beach sand may constitute a health risk to bathers, particularly children who spend time in the “swash zone” and in wet sand. Current beach monitoring practices only monitor organisms in the water, yet sand has the potential to accumulate bacteria through filtration and favor the survival of indicator organisms through growth in protected microhabitats. As a first step, we examined the temporal variation of a range of microbial indicators in sand (wet and dry) and water. The study examined traditional fecal indicators (enterococci, E. coli, and fecal coliforms) as well as non-traditional indicators (coliphage, P. aeruginosa, C. perfringens, Vibrio sp., and Staphylococcus aureus).	2003	Sb
138	United States Geological Survey	<u>Coastal Change Along the Shore of Northeastern South Carolina—The South Carolina Coastal Erosion Study</u>	The U.S. Geological Survey, in cooperation with the South Carolina Sea Grant Consortium, conducted a 7-year, multidisciplinary study of coastal erosion in northeastern South Carolina. Shoreline behavior along the coast of Long Bay is dictated by waves, tidal currents, and sediment supply that act within the overall constraints of the regional geologic setting.	2009	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
138	University of California - San Diego	<u>Beach replenishment may have 'far reaching' impacts on ecosystems</u>	Biologists who examined the biological impact of replenishing eroded beaches with offshore sand found that such beach replenishment efforts could have long-term negative impacts on coastal ecosystems. "We found rather long lasting declines in invertebrate abundances due to replenishment," said Joshua Kohn, a professor of biology who headed the study, which was published this week in the journal Estuarine, Coastal and Shelf Science. "These invertebrates are what shorebirds eat when they poke their bills in the sand. They are also food for small inshore fish." "Such reductions may have far reaching consequences for sandy beach ecosystems," the researchers warn in their paper, "as community declines can reduce prey availability for shorebirds and fish."	2016	Se
140	University of Miami Rosenstiel School of Marine & Atmospheric Science	<u>New tool better protects beachgoers from harmful bacteria levels</u>	An international team, led by researchers at the University of Miami (UM) Rosenstiel School of Marine and Atmospheric Science, has developed a new, timelier method to identify harmful bacteria levels on recreational beaches. The new model provides beach managers with a better prediction tool to identify when closures are required to protect beachgoers from harmful contaminants in the water. The new method provides beach health managers with an easily accessible computer model to predict harmful bacteria levels from all potential pollution sources. The team optimized and validated their model using a 10-day monitoring dataset from the popular Virginia Beach in Miami, Florida. The predictive model uses information on waves, tides, rainfall and solar radiation to more accurately predict harmful bacteria concentration and movement along the shore allowing for improved beach management decision-making.	2015	Sb
141	University of Pennsylvania	<u>Invasive sedge protects dunes better than native grass, study finds</u>	The invasive species <i>Carex kobomugi</i> , or Asiatic sand sedge, was first found along the East Coast of the United States at New Jersey's Island Beach State Park in 1929. The species is aggressive, outcompeting native vegetation and reducing local biodiversity. In many places, land managers have made great efforts to remove it. But a new study published in the Journal of Applied Ecology and led by University of Pennsylvania doctoral candidate Bianca Charbonneau finds that the invasive plant does have one advantage over its native counterpart, <i>Ammophila breviligulata</i> , or American beach grass: the invasive is better at preventing erosion of dunes during big storms.	2017	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
142	University of Twente	40,000 waves improve sand transport models	Over the past few years, Joep van der Zanden has created perfectly identical waves – 40,000 times – in a large ‘wave flume’ (channel). Using advanced measurements, he investigated the effect of these waves on the sand at the bottom of the flume. The results of his work included a detailed description of the effect of breaking waves on the movement of water and on the shifting sands of the seabed. The knowledge obtained in this way is essential if we are to improve existing models and, ultimately, make beach nourishment operations more efficient. One of his research findings was that the turbulent flow structures caused by breaking waves pick up more sand than had previously been assumed. The sand on the seabed moves slowly towards the beach, while any sand that is stirred upwards tends to move away from the coast. Ultimately, it is the interaction between these two processes that determines how much extra sand is deposited on the beach.	2016	Se
143	University of Ulster	Iconic beach resorts may not survive sea level rises	A leading coastal scientist has warned that some of the world’s best known beach resorts may not survive projected sea level rises and that problems caused by changing sea levels are compounded by a lack of political will and short-term coastal management initiatives. All around the world, people are responding to the threat of rising sea level by building concrete walls to protect valuable beachfront property. When sea level rises, the beach wants to move, generally further landward, but the wall stops it so eventually, the beach gets squeezed out. When the rising water reaches this protective wall, as it inevitably does, the beach is drowned	2013	Se
144	US Army Engineer Waterways Experiment Station	Guidelines for Surveying Beach Nourishment Projects	This Technical Note presents guidance for surveying beach nourishment projects. The information has applicability to any measurement or monitoring program involving open-coast hydrographic beach profile surveys.	1993	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
145	Vanden Eede, S et al.	<u>Assessing the impact of beach nourishment on the intertidal food web through the development of a mechanistic-envelope model</u>	1. Beach nourishment, the placement of sand onto a sediment-starved stretch of coast, is widely applied as a soft coastal protection measure because of its reduced ecological impact relative to hard coastal protection. In order to predict effects on the intertidal sandy beach ecosystem, we developed a simulation model that integrates species envelope-based projections for the dominant macrobenthos species and mechanistic food web modules for higher trophic levels. 3. After validation, we demonstrated that unlike nourishment slope, sediment grain size strongly determines beach-level species richness and production, with strong deterioration in species richness after nourishment with coarse sediment	2014	Se
146	Velonakis, E. et al.	<u>Present status of effect of microorganisms from sand beach on public health</u>	Microorganisms are significant components of beach sand. According to the research, all kind of microorganisms have been isolated from beach sand; certain genera and species are potential pathogens for humans and animals. In resort areas, especially during the summer, certain infections (e.g. gastroenteritis and dermatitis) are usually related to polluted bathing water. Lately, the interest of scientists is also focused on the potential association of some of the above diseases with the beach sand. Relatively, recent epidemiological studies in the USA revealed positive correlation between time spent at the beach and gastroenteritis. New parameters such as wind blowing and beach users' density are also introduced for discussion in association with the sand microbial load. Regarding the preventative measures, the microbiological quality of beach sand can be improved by raising the general level of hygiene, as well as by using simple methods, such as sweeping and aeration of the sand, together with constant beach supervision.	2014	Sb
147	Washington Department of Fish and Wildlife	<u>Marine Shoreline Design Guidelines</u>	The Marine Shoreline Design Guidelines (MSDG) were developed to provide a comprehensive framework for site assessment and alternatives analysis to determine the need for shore protection and identify the technique that best suits the conditions at a given site. There are many guidelines and manuals for the design of 'protection' techniques for the more typical open coast, but prior to the MSDG, there was almost no guidance that reflected the variety of conditions found in Puget Sound. For this reason the MSDG were created to inform responsible management of Puget Sound shores for the benefit of landowners and our shared natural resources.	2014	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
148	Welch, M. et al.	<u>A Literature Review of the Beneficial Use of Dredged Material and Sediment Management Plans and Strategies</u>	This report identifies lessons learned from the body of existing literature on dredge sediment beneficial uses. It also examines the constructive role collaborative processes can play in development of sediment management plans. The authors reviewed approximately 100 documents and reports for this project. Seventeen of those were reviewed in detail based on their relevance in identifying sediment beneficial uses and/or the use of collaborative processes in the development of sediment management plans. A number of these documents were sediment management plans and strategies for specific projects and programs in other locations. The report presents findings and lessons for the consideration of regional stakeholders in development of sediment disposal plans.	2016	Se
149	Whitman, Richard and Meredith B. Nevers	<u>Foreshore Sand as a Source of Escherichia coli in Nearshore Water of a Lake Michigan Beach</u>	This research presents evidence that foreshore beach sand (i) plays a major role in bacterial lake water quality, (ii) is an important non-point source of E. coli to lake water rather than a net sink, (iii) may be environmentally, and perhaps hygienically, problematic, and (iv) is possibly capable of supporting an autochthonous, high density of indicator bacteria for sustained periods, independent of lake, human, or animal input.	2003	Sb
150	Williams, Z.C. et al.	<u>Coupled economic-coastline modeling with suckers and free riders</u>	Shoreline erosion is a natural trend along most sandy coastlines. Humans often respond to shoreline erosion with beach nourishment to maintain coastal property values. Locally extending the shoreline through nourishment alters alongshore sediment transport and changes shoreline dynamics in adjacent coastal regions. If left unmanaged, sandy coastlines can have spatially complex or simple patterns of erosion due to the relationship of large-scale morphology and the local wave climate. Using a numerical model that simulates spatially decentralized and locally optimal nourishment decisions characteristic of much of U.S. East Coast beach management, we find that human erosion intervention does not simply reflect the alongshore erosion pattern. Spatial interactions generate feedbacks in economic and physical variables that lead to widespread emergence of “free riders” and “suckers” with subsequent inequality in the alongshore distribution of property value. Along cusped coastlines, such as those found along the U.S. Southeast Coast, these long-term property value differences span an order of magnitude. Results imply that spatially decentralized management of nourishment can lead to property values that are divorced from spatial erosion signals; this management approach is unlikely to be optimal.	2013	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
151	Willmott, H. and Tony Smith	Effects Of Mechanical Cleaning, and Its Cessation, on the Strandline Fauna at Sand Bay	Seven years of mechanical beach cleaning to improve amenity at Sand Bay ceased in 2000. This was in response to previous research on this site that highlighted the deleterious effects of strandline removal on invertebrate life, habitats, embryo sand dunes and colonizing plants. This paper examines effects of the cessation of cleaning on strandline fauna at Sand Bay as determined by comparison of studies done by Hazel Willmott (from April 1 to July 16 in 1999) and Tony Smith (from June 14 to August 15 in 2002, and from May 31 to December 31 2003). Results showed little annual change in amphipod numbers of three species between equivalent dates in 1999 and 2002; but numbers increased dramatically in late summer of both 2002 and 2003. The data from the survey in 2003 are being extended by continuing fieldwork; this should enable differences in the population dynamics of the amphipod species to be elucidated.	nd	Dm
152	Woods Hole Group	Beach Management Plan for Town of Sandwich Beaches	The purpose of this Beach Management Plan is to outline and highlight current conditions and practices, as well as identify recommendations and additional management activities that the Town of Sandwich can incorporate into its existing beach management framework. Combined, the recommendations and activities outlined in this plan allow for public recreational opportunities in a safe and enjoyable environment, while bolstering protection of the existing dune and beach system, wildlife habitat, and other important ecological features, which are integral parts of these coastal resources.	2013	Z
153	Wooldridge, Tyler et al.	Effects of beach replenishment on intertidal invertebrates: A 15-month, eight beach study.	Beach replenishment is an increasingly popular means to remediate coastal erosion, but no consensus exists regarding how long replenishment affects sandy beach intertidal invertebrates, key components of beach ecosystems. We monitored the intertidal invertebrate community for fifteen months following a replenishment project at eight beaches, each with replenished and control sections, across San Diego County. Nearly all taxa showed major declines in abundance immediately following replenishment. As this and other recent studies have revealed longer times for the recovery of intertidal invertebrates than previously observed, longer study periods and more cautious estimates regarding the magnitude, variability, and duration of impacts of beach replenishment for management decision-making are warranted.	2016	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
154	World Health Organization	<u>Guidelines for safe recreational water environments VOLUME 1: COASTAL AND FRESH WATERS</u> Chapter 6: <u>Microbial aspects of beach sand quality</u>	Microorganisms are a significant component of beach sand. Bacteria, fungi, parasites and viruses have all been isolated from beach sand. A number of genera and species that may be encountered through contact with sand are potential pathogens. Accordingly, concern has been expressed that beach sand or similar materials may act as reservoirs or vectors of infection (Nestor et al., 1984; Roses Codinachs et al., 1988; Mendes et al., 1997), although transmission by this route has not been demonstrated in epidemiological studies. In this chapter, the incidence, dispersion and fate of microorganisms in beach sand are reviewed, as are potential management actions.	2003	Sb
155	Wright et al.	<u>The inter-tidal zone is the pathway of input of enterococci to a subtropical recreational marine beach</u>	Efforts were made to evaluate the source of enterococci levels at a recreational beach. Four monitoring efforts were implemented which included tidal studies, hourly sampling, runoff sampling, and spatially intensive sediment sampling. Spatially intensive sediment sampling indicated that enterococci concentrations consistently decreased away from the inter-tidal zone, both seaward and landward. During dry conditions, the highest concentrations in the water were observed during high tide (71±48 CFU/100 mL) and lower concentrations were observed during low tide (4±3 CFU/100 mL). Runoff was characterised by very high levels (11,700 CFU/100 mL). Results from these monitoring efforts collectively showed that the source of enterococci to the study beach is geographically located within the inter-tidal zone. Wash-in from the inter-tidal zone through tidal action and runoff plays a major role in controlling enterococci levels within the water column. Such results are significant in identifying the source and transport mechanisms of enterococci, which can subsequently be used as part of a modelling effort aimed at predicting enterococci levels at recreational beaches.	2011	Sb
156	Yamahara, K.M. et al.	<u>Growth of Enterococci in Unaltered, Unseeded Beach Sands Subjected to Tidal Wetting</u>	Enterococci are indicator bacteria used to assess the risk of acquiring enteric disease from swimming in marine waters. Previous work identified beach sands as reservoirs of enterococci which can be transported from the sand to the sea, where they may instigate beach advisories. The present study establishes that naturally occurring enterococci can replicate in beach sands under environmentally relevant conditions.	2009	Sb

No.	Author/Organization	Title	Overview	Date	Primary Subject
157	Yamahara, K.M. et al.	<u>Beach sands along the California coast are diffuse sources of fecal bacteria to coastal waters.</u>	Fecal indicator bacteria (FIB) are nearly ubiquitous in California (CA) beach sands. Sands were collected from 55 beaches along the CA coast. Ninety-one percent of the beaches had detectable enterococci (ENT) while 62% had detectable E. coli (EC) in their sands. The presence of a putative bacterial source (such as a river), the degree of wave shelter, and surrounding land use explained a significant ($p < 0.05$) fraction of the variation in both ENT and EC densities between beaches. Sand characteristics including moisture content, organic carbon, and percent fines, significantly ($p < 0.05$) influenced only EC densities in beach sand. We assayed 34 of 163 sand samples for salmonellae, but did not detect this bacterial pathogen.	2007	Sb
158	Yamahara, K.M. et al.	<u>Occurrence and Persistence of Bacterial Pathogens and Indicator Organisms in Beach Sand along the California Coast</u>	This report documents the presence of fecal indicators and bacterial pathogens in sand at 53 California marine beaches using both culture-dependent and -independent (PCR and quantitative PCR [QPCR]) methods. Fecal indicator bacteria were widespread in California beach sand, with Escherichia coli and enterococci detected at 68% and 94% of the beaches surveyed, respectively.	2012	Sb
159	Young, Robert and Andrew Coburn	<u>Beach nourishment in the USA, the history, the impacts, and the future</u>	Currently, the primary tool being used at the local, state, and federal level in the USA to adapt to rising sea level, and to reduce potential storm damage is the addition of sand to the coastal system in the form of engineered beaches and dunes (commonly referred to as beach nourishment or beach replenishment). At the Program for the Study of Developed Shorelines, we have built a comprehensive database of all beach dredge and fill projects in the USA. The database tracks a history of beach projects that date back to 1923 with continual updates as new projects are implemented today. The projects in the database represent the movement of over 950 million cubic meters of sand covering over 3700 km of shoreline. This massive program of shoreline stabilization is being carried out with little long-term vision or planning, and no consideration for the cumulative environmental impacts of mining and placing so much sand. It is no exaggeration to say that a significant portion of the US East and Gulf Coasts are now completely artificial constructs, with engineering replacing natural processes. Along many shorelines, beach nourishment has become unsustainable as sand sources diminish. In addition, the cost of moving the sand has increased dramatically as communities scramble to build beaches and dunes. This program is not sustainable into the future, but there has been no widespread recognition of this reality, nor any move towards sensible retreat from the coast.	2017	Se

No.	Author/Organization	Title	Overview	Date	Primary Subject
160	Zhang, Q. et al.	<u>Impact of indigenous microbiota of subtidal sand on fecal indicator bacteria decay in beach systems: a microcosm study</u>	The objective of this study was to use microcosms to determine whether subtidal beach sand can enhance the decay of fecal bacteria and identify underlying mechanisms. The decay patterns of exogenous <i>Enterococcus faecalis</i> cells in laboratory beach microcosms for three beaches in Hawaii were determined, and beach sand indigenous microbiota was identified to be the major factor correlating to bacterial decay rates. Subsequent experiments observed that higher indigenous microbiota corresponded to faster bacterial decay. Comparison between the two major beach system components (beach sand and seawater) indicated that the indigenous microbiota in beach sand played a significant role in bacterial decay. Manipulating two important beach characteristics (sand-to-water ratio and sand particle size) that relate to indigenous microbiota abundance also resulted in different bacterial decay rates. The significant contribution of beach sand and its indigenous microbiota to fecal bacteria decay identified a positive function of beach sand in beach water quality management, which supports the inclusion of beach sand in beach quality management.	2015	Sb
161	Zhu, X. et al.	<u>A water quality modeling study of non-point sources at recreational marine beaches</u>	A model study was conducted to understand the influence of non-point sources including bather shedding, animal fecal sources, and near shore sand, as well as the impact of the environmental conditions, on the fate and transport of the indicator microbe, enterococci, at a subtropical recreational marine beach in South Florida. Bather shedding resulted in minimal impacts (less than 1 CFU/100 ml), even during crowded holiday weekends. In addition, weak current velocity near the beach shoreline was found to cause longer dwelling times for the elevated concentrations of enterococci, while solar deactivation was found to be a strong factor in reducing these microbial concentrations.	2011.04	Sb