The past, present, and future of Seacliff State Beach: Adapting to long-term sea level rise on California's Central Coast

By

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ABSTRACT

In a display of the increasingly destructive impact of climate change and sea level rise, in January 2023 unusually severe storms hit California's west coast and devastated the infrastructure at Monterey Bay's Seacliff State Beach. Additional severe storms in December 2023 compounded the damage. This article frames the potential application of a new approach for recovery planning along the California coast by examining historical failures, accelerating threats, and the economic and societal factors that create obstacles to long-term success at places such as Seacliff. While each situation differs, the Seacliff State Beach challenge is representative of an ever-widening dilemma faced by many seaside communities. The possibilities for coastal adaptation at Seacliff, based in part on California's innovative state policies, provide an opportunity to consider sustainable and equitable planning approaches for local communities, government, business, and ultimately future generations.

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U.S. President Joe Biden came to California in January 2023 to tour the damage wrought by a brutal series of atmospheric rivers. Standing in front of the crumbling pier at Seacliff State Beach on Monterey Bay, Biden declared: "The country is here for you and with you. We are not leaving till things are built back and built back better than they were before" (AP and KSBW Action News 8 2023). In one sentence the president encapsulated a central challenge of a world confronting climate change: What does it mean to build back "better"? How can communities adapt to the destructive forces increasingly driven by climate change in ways that don't simply restore but demonstrably improve social and environmental conditions?

The president couldn't have picked a better place for framing this question. Even before climate change emerged as a global driver of shoreline change, Seacliff State Beach had experienced at least seven cycles of construction, storm destruction, and rebuilding of beach-level development over its hundred-year history. This cycle of rebuilding has enabled millions and millions of visitors to recreate and enjoy the beach at Seacliff. But it is not without cost. With global sea level rise now threatening the California coast, this history starkly frames the question of what it would mean to build back better. How many more decades will this history be repeated? Is this the right adaptation path and the best that can be expected at Seacliff, even as the Pacific Ocean continues to rise?

In 2021, California State Parks released a Sea Level Rise Adaptation Strategy to guide the management and adaptation of its 128 coastal park units in the face of global sea level rise. At Seacliff, on the heels of the 2023 storm damage, Parks immediately removed the severely damaged Seacliff Pier and launched a vulnerability assessment and adaptation planning process. The next several years of this planning could determine whether the park development on the beach is built back as before, or whether a different adaptation pathway unfolds. As many coastal communities are discovering, how the planning is conducted, who participates in the process, and which questions ultimately are asked and answered will be central to the future direction of Seacliff.

This article seeks to contribute to this unfolding planning effort by summarizing the history of shoreline development at Seacliff State Beach, highlighting lessons learned and framing future adaptation pathways for the park. In so doing, it seeks to open the public conversation about how to build back "better" at Seacliff State Beach — not only so that we might better anticipate the inevitable challenges wrought by continuing storm cycles and rising seas, but also so we might begin to address the trade-offs between protecting the current conditions so many have come to love and enjoy, and the need to provide a sustainable and equitable future at Seacliff for everyone. As a case study, the article also reveals some lessons perhaps relevant to our broader efforts to adapt to climate change along the coast and the possibility of new approaches to manage the intersection between human development and powerful natural forces. The article makes the case for embracing a more holistic management pathway at Seacliff — one that recognizes the full array of geophysical, ecological, economic, social, and cultural dimensions of California's dynamic shoreline.

THE SOCIAL HISTORY OF SEACLIFF STATE BEACH

Building any structure on the active beach is asking for problems. During the winter storms of January 2023, Seacliff State Beach was severely damaged by the co-occurrence of large surf, storm surge, and extremely high tides. While the damage was shocking and deserved the media attention it garnered, it was by no

means the first time this stretch of coast had experienced such impacts. It was simply the latest example of a problem going back a hundred years (Griggs and Fulton-Bennett 1987). Understanding this history, including in a larger historical context, is important for thinking about how to move forward at Seacliff, especially considering climate change.

The shoreline environment and early development at Seacliff

The shoreline of northern Monterey Bay consists of sandy beaches 100 to 200 feet in width during the summer months, backed by coastal bluffs ranging from about 75 to 100 feet in height. The orientation of the coastline here, combined with the dominant direction of wave approach and a large supply of littoral sand from upcoast, has led to the formation of a continuous, wide beach along 15 miles of shoreline from Capitola in the north to Moss Landing, halfway to the bay's southernmost point (Figure 1).

Over the last century the back beach of the five northernmost miles of this 15-mile stretch has been developed with mostly residential structures. But this stretch also includes two California state parks — New Brighton State Beach and Seacliff State Beach — including parking, picnic tables and shelters, restrooms, a visitor center, and an area for 63 recreational vehicles at beach level (Figure 1). Seacliff features an easily accessible section of wide sandy beach (Figure 2). There is also a large open space and parking area with a park entry kiosk on the bluff above. One of the state's most popular beach parks, its annual attendance had reached nearly 2 million visitors by the year 2001. But it wasn't always this way.

The northern Monterey Bay region was occupied by multiple tribal communities for thousands of years before the Spanish arrived in the late 1700s. Collectively referred to as "Costanoan" by the Spanish, and known today as the Ohlone, the numerous tribes in the region were far more diverse than the single common label conveys (Rizzo-Martinez 2022). What is now Seacliff Beach and the surrounding area was part of the Aptos tribe's territory, and the descendants of these multiple tribal communities are now represented in the Amah Mutsun Tribal Band.

The transformation to the current residential and recreational development along the Monterey Bay coast has its roots in the arrival of the Spanish and the mission system, followed by Mexican and then U.S. colonial occupation of California. As with the lands of California's indigenous peoples more broadly, the land of the Aptos was dispossessed via missionization during the Spanish period, and then through various forms of violence and marginalization that continued throughout the Mexican and especially the American period (Lindsay 2015; Rizzo-Martinez 2022).

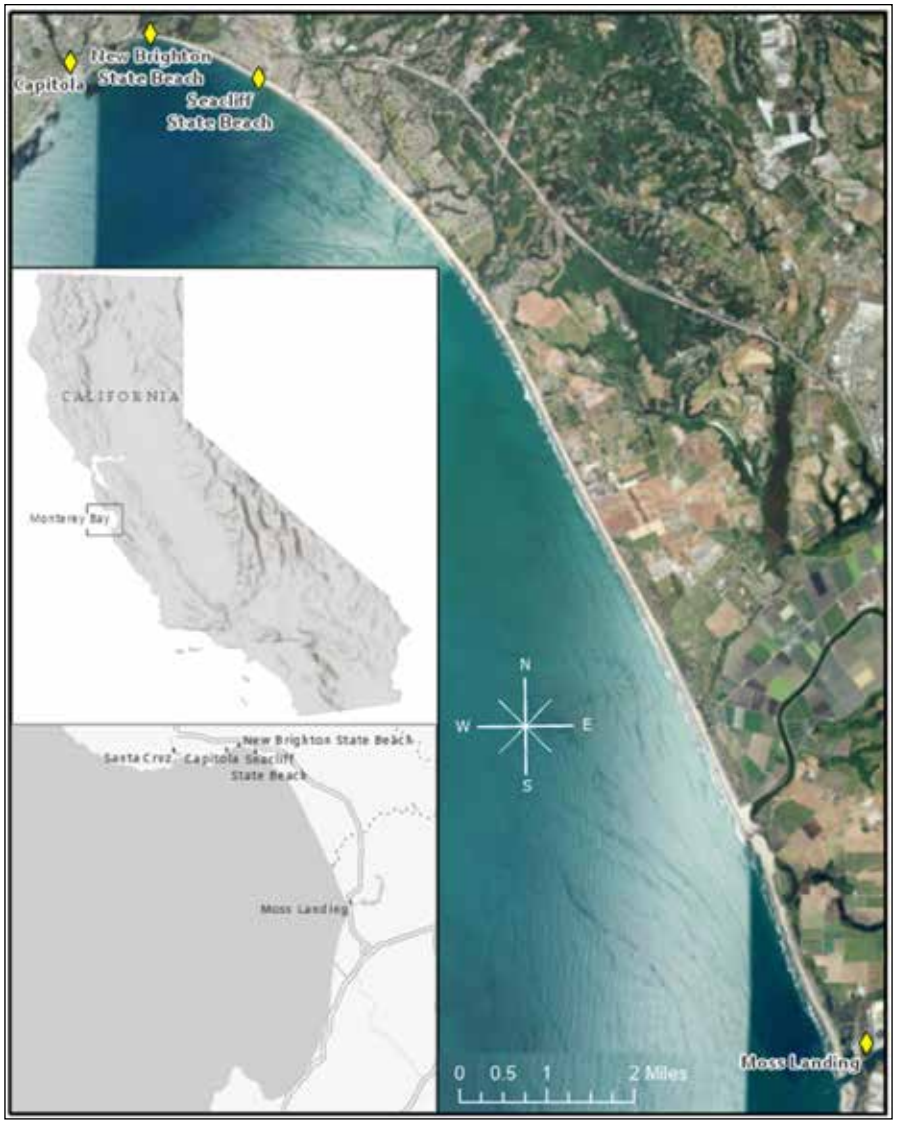


Figure 1. Location map showing Monterey Bay, Santa Cruz, Capitola, Seacliff State Beach, and Moss Landing.

After Mexico became independent from Spain in 1821, much of the land formerly held by the church was transferred to private owners. In 1833, then-governor of California José Figueroa granted 5,500 acres to Rafael Castro as a reward for military service; this became the basis for Rancho Aptos. By the 1870s, Castro had sold most of Rancho Aptos to the sugar baron Claus Spreckels.

It was the conversion of the Monterey Bay shoreline into privately owned, fungible property that enabled the recreational development at Seacliff. The commercial potential of the warm summer weather and generally moderate wave climate at Seacliff, as well as the wide sandy beach, led to the formation of the Seacliff Amusement Corporation in the 1920s.

Sections of the beach were developed into Seacliff Park with grandiose plans that mirrored the plans for the successful resort development of the Santa Cruz Beach Boardwalk nine miles to the northwest on the beach. The corporation promised an esplanade, a pleasure pier, a bathing pavilion, a children's sand garden, a dining hall, a dance pavilion, automobile parking, modern beach "bungalettes"

Figure 2. Northern Monterey Bay coastline at Seacliff State Beach in 1984 following destruction of timber bulkhead in January 1983; all that remained were the support pilings.

Figure 3 (above). Groundbreaking of the Seacliff Amusement Corporation's coastal resort in 1926, including the announcement of a planned 2,000-foot seawall.

Figure 4 (below). Remnants of original concrete seawall supported by steel sheet piles at Seacliff in 1926 after storm damage.

for rent or lease, and a 2,000-foot-long seawall to support and protect all this development (Figure 3).

Seacliff State Beach: Seven seawalls and counting

The modern history of Seacliff State Beach is one of repetitive building, storm destruction, and rebuilding in the same essential configuration at least seven times (this historical summary draws from Griggs and Fulton-Bennett 1987). The original construction on Seacliff Beach placed fill on the back beach for a parking lot in early 1926, and construction began on a curved-face concrete seawall supported on steel sheet piles, which extended for about 2,200 feet along the shoreline. This **first** seawall was about 50-60 feet seaward of the most recent (2023) timber bulkhead. Before the bulkhead was backfilled, however, storms in February 1926 overtopped the new wall resulting in "considerable damage" (Fulton-Bennett 1984). A year later the remainder of this first seawall was destroyed during a southwesterly storm (Figure 4). The builder was not deterred, though, commenting: "The damage from the last unusual storm has disclosed information to us which could not have been obtained any other way. We will take full advantage of the situation and incorporate in our new wall building adequate improvements to the end that a repetition of our recent troubles will be impossible" (Fulton-Bennett 1984).

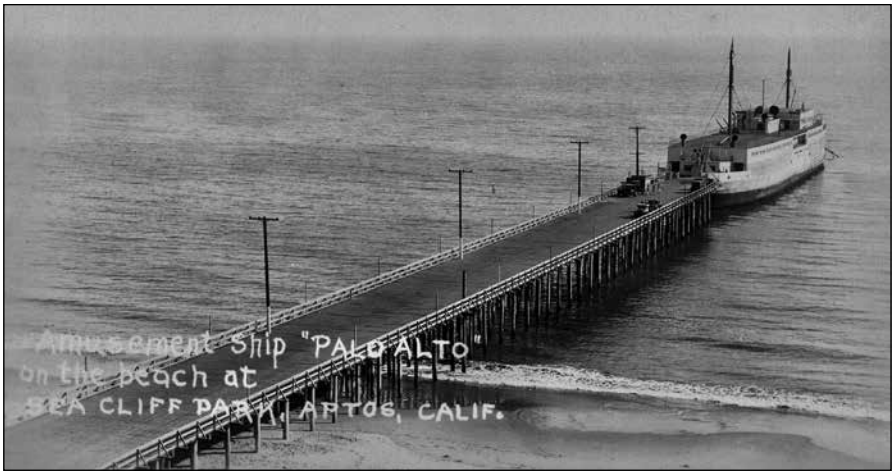


Figure 5. The *Palo Alto* and the connecting pier ~1930.

Figure 6. Seacliff State Beach in January 1941. Structure on left is remnant of seawall built in 1927 and destroyed the following winter. Pilings farther landward are remnants of the timber bulkhead built in 1938 and destroyed in winter of 1940-1941.

Despite the seawall failure, the Seacliff Amusement Corporation invested in other recreational amenities at Seacliff. It positioned a surplus World War I concrete tanker, the *SS Palo Alto,* offshore on the shallow, sandy bottom and extended a wooden pier, creating a popular venue for dinner, dancing, and other entertainment (Figure 5). However, the Great Depression hit the Corporation's parent company hard, and it went bankrupt, ushering in the public ownership of Seacliff by California State Parks (DPR 2023)

Wall #2: Protecting the new state park

The State of California bought the first parcel of beach property at Seacliff in 1931 and created Seacliff State Beach in 1932. Seacliff was one of the earliest state beaches. In 1931, a Wakefield-type timber bulkhead (where timbers are placed vertically) was constructed, extending 2,900 feet along the shoreline. This **second** bulkhead/seawall was slightly landward of the first wall, but still about 40-50 feet seaward of today's timber bulkhead (Fulton-Bennett and Griggs 1986; Griggs and Fulton-Bennett 1987). Waves from the southwest and northwest in December 1931 destroyed portions of the just-completed second wall and wrecked a concession building and bathing pavilion.

By 1938, reports indicated that the timber bulkhead was in poor repair and that additional portions of the wall had been damaged by wave overtopping. That year, three new sections totaling 2,700 feet were built at each end of the wall. By January 1940, however, five gaping holes were noted in the bulkhead, as well as loss of the pilings and planks between them and the collapse of portions of the parking lot (Figure 6). Remnants of the wall can still be seen on the shoreline today during lowered beach levels and extremely low winter tides, adjacent to the remnants of the steel sheet piles from the original wall (Figure 7).

Wall #3: A replacement with enhanced reinforcement doesn't last long

In August 1940, State Parks built a **third** timber bulkhead, this time with additional reinforcing planks known as lagging. Less than six months after construction, though, a severe January storm once again hit the shoreline. Large logs were thrown

Figure 7. Remnants of the steel sheet pile support for the 1926 concrete wall on the right, and the Wakefield timber wall on the left (January 2010).

Figure 8. Remains of a timber bulkhead constructed in 1940 and destroyed in winter of 1940-1941.

over the timber wall and the beach was eroded down to bedrock and landward 75-80 feet, leaving stark remnants of the bulkhead standing considerably seaward of the new shoreline. Much of the upcoast and downcoast ends of the older wall were destroyed (Figures 8 and 9).

Wall #4: More of the same?

While there are no available records of new seawall construction between 1941 and 1966, a 1948 aerial photograph shows a timber wall along most of the length of Seacliff State Beach, indicating the **fourth** attempt to stabilize the beach with a seawall/bulkhead. In October 1950, waves overtopped this timber wall and damaged the road behind it. Ten years later, in February 1960, southerly and westerly storm waves damaged 26 recreational vehicle parking sites, a restroom, and parking lots.

Six years after the 1960 failures, State Parks constructed two new sections of wooden wall with a total length of 1,700 feet, both upcoast and downcoast of the pier at Seacliff, apparently as part of a park redevelopment project replacing the damaged 1931, 1938, and 1940 walls (Griggs and Fulton-Bennett 1987). Once again, a southerly gale in February 1976 sent storm waves and logs over the new timber bulkhead and washed landward all the way to the base of the cliff. Portions of the wall were undermined and collapsed. Just two years later, in January 1978 (the first large El Niño winter in many years), another storm from the southwest inflicted additional damage to the timber wall (Figures 9 and 10) due to overtopping and impacts of waves and logs (Griggs and Fulton-Bennett 1987). The older upcoast section was not damaged, but the newer downcoast portion failed due to weakened, rotting timber.

Wall #5: Expected to last 20 years, doesn't make it two

Despite the continued failure of timber seawalls and bulkheads, in 1978

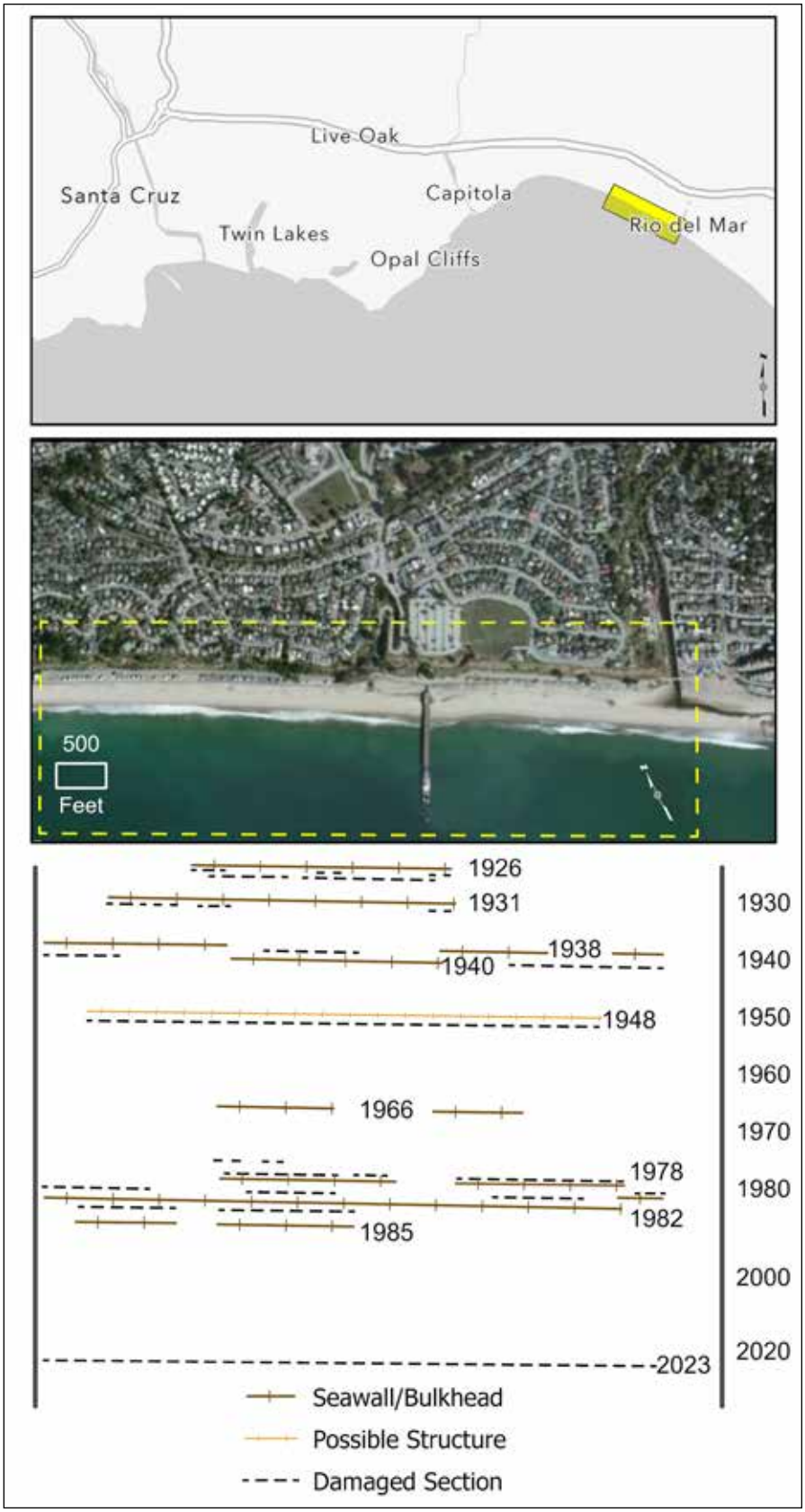


Figure 9. History of seawall/bulkhead construction and destruction from 1926 through 2023 (modified from Griggs and Fulton-Bennett 1987).

Parks rebuilt 2,700 feet of new wooden bulkhead, making it the **fifth** seawall at Seacliff State Beach. State Parks claimed that this new structure would last 20 years, even though it was essentially the same design as the structures that had previously been damaged or destroyed after far fewer years. Not surprisingly, in February 1980, a series of southwest storms severely damaged the new wall; 950 feet were destroyed, and 1,600 feet were damaged, requiring $1.1 million ($4 million in 2022 dollars; Figure 9) in repairs. The road and parking area for 324 cars were heavily damaged. Although emergency riprap was placed behind the remains of the wall and in front of the eroded areas, outflanking and erosion continued (Figure 11). The beach sand was scoured to below the base of the timber lagging, allowing fill to be washed out by the waves. At the upcoast end, up to 65 feet of fill were eroded landward of the wall. In late 1980, additional riprap was placed along the base of the remaining wall (Griggs and Fulton-Bennett 1987).

Wall #6: Stronger, bigger, better?

Four years after the construction of a fifth wall, in November 1982, Parks completed another 2,700-foot-long timber bulkhead along with repairs to the parking area at a total cost at the time of $1.7 million ($5.286 million in 2022 dollars). This was now the **sixth** time a timber seawall/bulkhead had been built along the park's shoreline. The structure was essentially the same as the just-destroyed wall: timber pilings placed on 8-foot centers with timber lagging behind them to support the fill. This time, however, the reconstruction used 3" x 12" lagging—an upgrade from the 2" x 12" lagging used in previous walls — placed on the landward side of the piles that were attached by U-bolts instead of nails. Plus, additional timber lagging was attached to the seaward side of the pilings (Figure 12). These horizontal boards on the seaward side were labeled "sacrificial bumper boards," indicating that when logs or debris impacted the wall in the future, these ocean-facing boards would take the brunt of the impact. Filter cloth was placed behind the wall to prevent wave surge from washing out the added backfill, and the surface was paved over for parking. Two tons of riprap per front foot also were placed along the base of the wall at its upcoast end for added protection.

This sixth construction of a timber wall at Seacliff was again purported to

Figure 10. Storm damage from the 1978 El Niño winter as waves overtopped and battered the timber bulkhead and began to remove the fill with collapse of asphalt.

Figure 11. This image from December 1980 shows damage to timber bulkhead, loss of fill and placement of emergency rock.

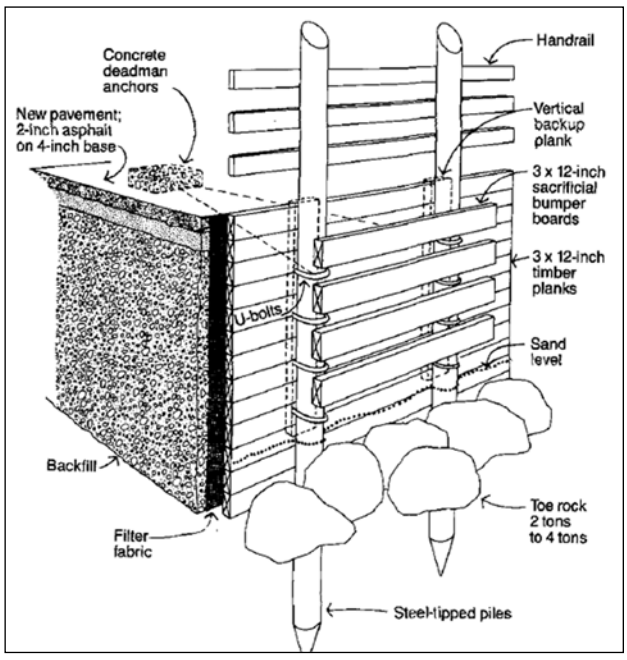


Figure 12. The design of the 1982 timber bulkhead with some minor modifications from earlier walls (Griggs and Fulton-Bennett 1987).

Figure 13. This image shows logs and debris transported by waves in January 1983 that are overtopping and battering the timber wall.

Table 1.

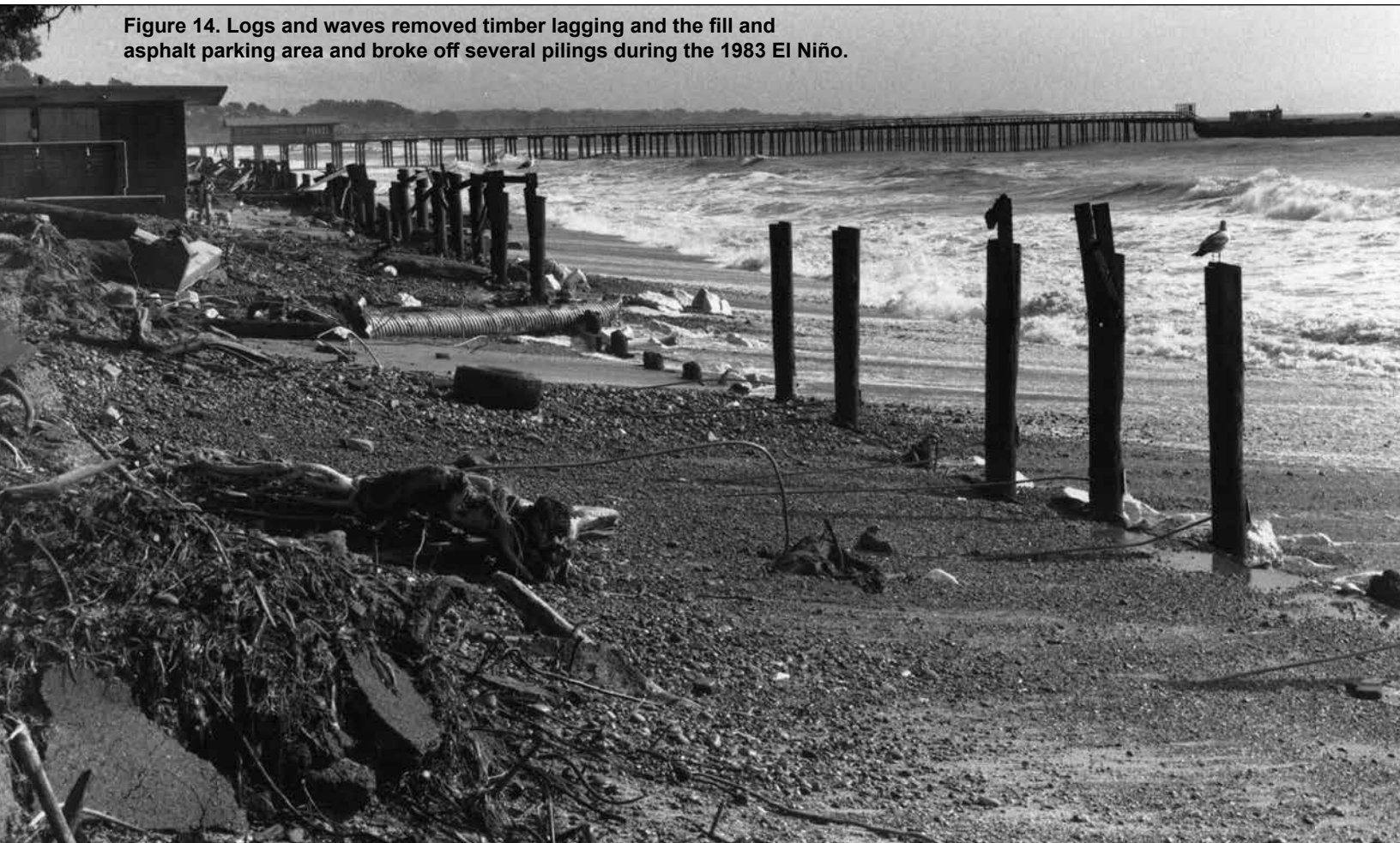
High water levels during 1983 El Nino at four California NOAA tide gauges (27 January 1983).

Tide gauge	Predicted tide (ft MLLW)	Recorded tide (ft MLLW)	Difference (ft)
San Diego	7.4	8.35	+0.95
Los Angeles	6.9	7.96	+1.06
Monterey	6.54	7.95	+1.41
San Francisco	7.1	8.87	+1.77

be able to last 20 years, and it was justified partly on the assumption that that park user fees, including recreational vehicle campers behind the wall, would cover the construction costs over this 20-year anticipated lifetime. Moreover, at a local hearing held by the California State Senate Subcommittee on Natural Resources and Wildlife, the Director of State Parks assured the subcommittee (italics for emphasis): "*If the seawall at Seacliff fails again, my department will not thoughtlessly rebuild the structure. We will consider all alternatives, in light of recent trends and scientific findings. We will confer with experts in the field of sea cliff erosion, and will respond with the best possible solutions, including possible elimination of permanent facilities at beach level.*"

Within two months of completion of the sixth wall, the first of eight major storms that season struck simultaneously with high tides. This was the most damaging El Niño year in a half-century (Storlazzi and Griggs 2000; Storlazzi, Willis, and Griggs 2000), which raised sea levels along the California coast a foot or two above predicted high tides (Table 1). At the closest tide gauge to Seacliff in Monterey, the recorded high tide was 1.41 feet above the predicted tide. Based on the history of coastal damage at Seacliff,

Figure 14. Logs and waves removed timber lagging and the fill and asphalt parking area and broke off several pilings during the 1983 El Niño.



this was a recipe for disaster for the just-completed timber bulkhead.

During the first storm of 1983, the new wooden bulkhead was overtopped with minor damage. Logs and debris littered the parking area and damaged a restroom (Figure 13). Subsequent storms later in January and continuing through February and March inflicted heavy damage to the new timber wall and parking areas. Rafts of large redwood logs were repeatedly driven by the large waves at high tide against and over the timber bulkhead, which broke through the asphalt, battering the lagging loose and allowing the fill behind the wall to wash out — a repeat of the same type of impact from floating debris and failure that had now been occurring for 50 years. Eventually the exposed lagging along 1,400 feet of the 2,700-foot new wall was destroyed along with 55 pilings (Figures 2 and 14). Damage to the bulkhead and parking areas was estimated at $707,000 ($2.1 million in 2022 dollars), or half of the cost of constructing the wall and park improvements completed *just four months earlier*.

Wall # 7: Another rebuild for another 20 years?

Following the 1983 storms, a new Parks director requested funds to rebuild the timber wall at Seacliff State Beach for

Figure 15. This image zooms in on an area where the plastic and filter cloth fail to protect backfill at Seacliff in January 2023.

Figure 16. Logs from nearby rivers and the wreckage of more than 300 feet of nearby pier impacted the timber seawall, destroying portions during 2023 storms at Seacliff State Beach. Note also the remnants of the steel sheet pilings from the original 1926 seawall and the remains of the *SS Palo Alto*.

Figure 17. Complete loss of sacrificial bumpers and timber lagging of northern section of 1984 timber wall followed by erosion of fill and removal of asphalt recreational vehicle parking area (January 2023).

the **seventh** time with only minor design modifications, despite the prior commitment to "consider all alternatives, in light of recent trends and scientific findings." The case for reconstruction was based on a high level of usage of the beach area recreational vehicle "camping" sites and parking areas. The State Public Works Board approved the request and reconstruction took place (State of California 1984). With this rebuild, the timber bulkhead had been rebuilt **seven times** in **60 years**, or roughly every 8.5 years on average (Figure 9).

This time the wall finally performed, perhaps beyond expectations. It wasn't until early January 2023 storms ravaged the wall that it was finally largely destroyed (Figures 15, 16, and 17). The conditions were essentially identical to those of 1983: extremely large waves arriving from the southwest at very high tides, along with strong onshore winds. At the highest tide on 5 January, water level at the NOAA tide gauge in Monterey (Station 9413450) reached 7.22 feet — 1.3 feet above the predicted high tide. Heavy rainfall produced flood flows on the upcoast streams, which again brought logs and debris to the coast that, along with wave impact, broke through the timber wall, first battering the "sacrificial bumpers" loose, then the lagging, and finally breaking through the asphalt to allow the wave surge to remove the fill (Figure 18). The problem was compounded by the destruction of more than 300 feet of the Seacliff Pier, which propelled additional debris, including dozens of pilings, into the adjacent sections of seawall.

LESSONS LEARNED?

In the rush to rebuild the wall and replace the parking area and other amenities at Seacliff State Beach to serve visitors and restore revenue, the ineffectiveness of a wood piling and timber bulkhead for providing long-term protection at this location has not been adequately addressed or acknowledged in policy by the State of California. Except for the initial 1926 concrete wall and the 1931 Wakefield wall (remnants of which are still exposed in the winter months at low tides; Figure 5) and some minor modifications in the 1984 wall, each structure has been rebuilt in essentially the same manner. Although a projected lifespan of 20 years has regularly been used for economic calculations and as rationales for reconstruction, none of the seawalls/bulkheads have survived that long until the most recent (1984) bulkhead, which was finally destroyed in the storms of 2023. The lifetime of any individual timber wall at Seacliff State Beach has been primarily a function of how soon after reconstruction the next large storm waves arrive from the southwest coincident with extreme high tides.

It also seems that the bulkheads constructed at Seacliff have had significant deficiencies that have never been remedied, including: 1) the timber lagging has been inadequately attached to the pilings; 2) the timber and pilings have not been strong enough to withstand wave and log impact, so they have been repeatedly damaged or destroyed, leading to loss of fill and the asphalt covering behind the wall; 3) timber and pilings deteriorate over time in salt air and water; and 4) the wall has not been built high enough to prevent overtopping by water, logs, and other debris.

There is evidence nearby that stronger seawall construction can last longer than the timber walls at Seacliff. Immediately

Figure 18. Close-up of pilings showing small nails used to connect lagging to piles, and erosion of fill and loss of asphalt paving. Sacrificial bumpers and lagging have both been torn away.

downcoast, along Beach Drive in Rio Del Mar, a seawall was built in 1984 at the same time as the seventh Seacliff wall. Steel H-piles and six-inch-thick timber lagging placed between the H flanges were used so that the timbers could not move in either direction (Figure 19). The wall also incorporates a rigid concrete overhanging cap. This seawall withstood the 2023 storms without significant structural damage (to the wall) although it was built at approximately the same cost as the Seacliff timber bulkhead. There was still considerable damage to inland residential structures due to overtopping with waves, sand, and debris causing flooding and the destruction of a railing. But the beneficial impact of the wall in preserving the landward roadway and fill, eliminating the need for rebuilding much of the wall after each storm, underscores the importance of evaluating engineering design and functionality in these precarious shoreline applications. Each type of protection has its strengths and weaknesses and must be evaluated, especially considering the deteriorating set of conditions as sea-level rise and storm frequency and severity continue to escalate.

Figure 19. Steel H-piles and 6" x 12" lagging with a concrete cap at Rio del Mar in January 2023. During the January 2023 storms, waves and logs battered the railing, which was embedded into the concrete, resulting in some damage to the concrete in places; yet the wall is still intact and functional nearly 40 years after construction. Sand is being carried back to the beach after waves transported it across Beach Drive and into the first-floor garages and carports.

The future of sea level rise and increasing beach vulnerability

Considering the history of timber bulkhead failure, the seventh round of destruction at Seacliff was foreseeable,

Figure 20. Seacliff State Beach showing the projected shoreline with 1.6 ft (0.5 m) and 3.3 ft (1.0 m) of future sea-level rise.

Figure 21. Inland extent of erosion and asphalt removal from the early January 2023 storms.

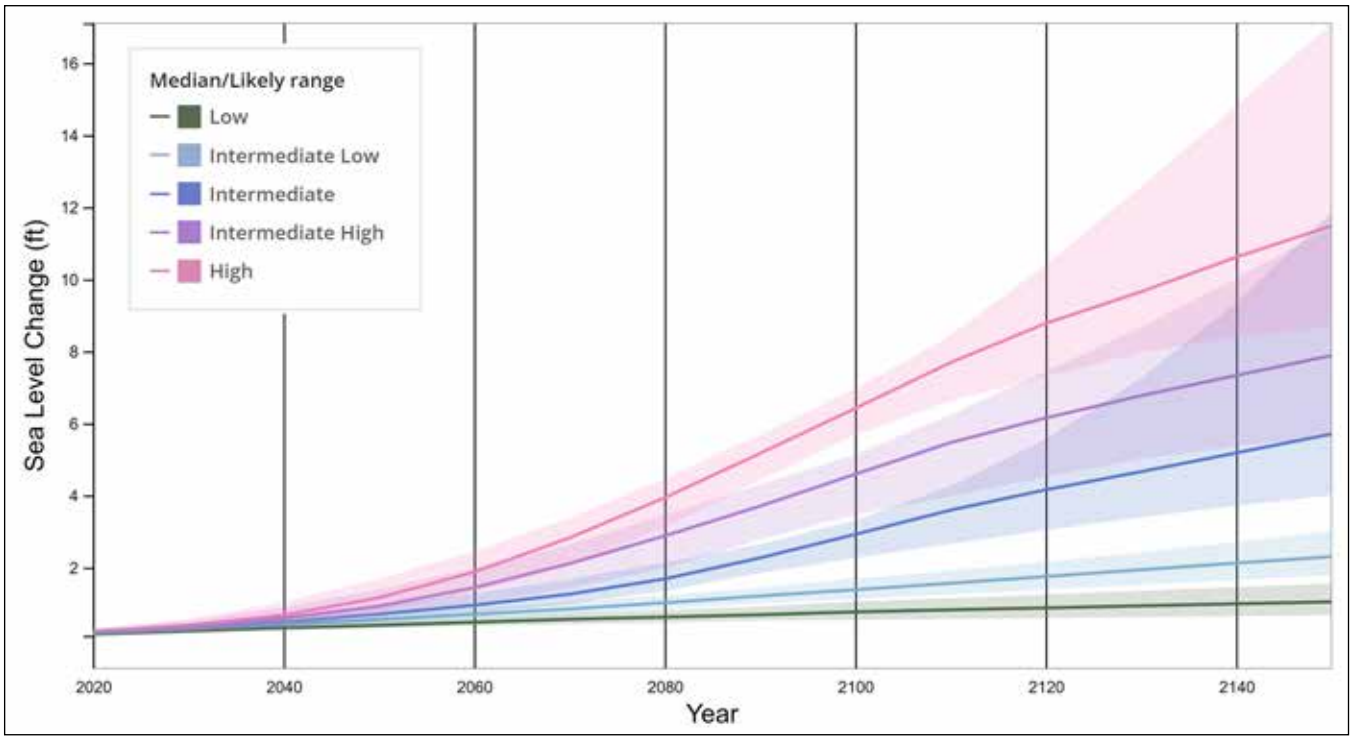


Figure 22. Future sea level projections from the Interagency Sea Level Rise Scenario Tool, based on data from Sweet *et al.* 2022.

but it was also a harbinger of greater challenges to come in a world dealing with climate change. Given our current understanding, the answer to the question that was asked in 1984 about whether to rebuild the seawall, when asked today, is considerably more complex. There is evidence downcoast that stronger wall designs may survive extreme storm events. Investing in such a wall might make sense considering the significant recreational revenues from the park. Even if the same weaker designs continue to be used, perhaps this cost is justified by the revenue stream. It is not apparent that such a cost-benefit analysis has ever been systematically undertaken, but if we could be assured that the beach at Seacliff would stay in a wide, sandy equilibrium condition as a new seawall was built, perhaps the "numbers" would again pencil out in favor of reconstruction — or at least counsel in favor of the construction of a more permanent, stronger seawall. The problem is, we do not have any such reassurance. A traditional economic analysis of this question is beyond the scope of this article, but even so, a consideration of climate change and projected sea level rise suggests that the results of a basic cost/benefit analysis, evaluating the costs of construction against the potential revenue stream from park visitors and related business activity, will be eclipsed by greater forces.

The best available climate science indicates that projected sea level rise will result in the eventual loss of the beach in front of a fixed structure at Seacliff due to passive erosion or coastal squeeze (Barnard *et al.* 2018; Griggs 2005), perhaps within the next 40-50 years. As Figure 20 illustrates, sea level rise modeling and projections from the U.S. Geological Survey suggest that the beach at Seacliff could be quite narrow in places assuming 1.6 feet (0.5 meters) of sea level rise and ultimately disappear with only 3.3 feet (1.0 m) of sea level rise as the shoreline intersects with a fixed back shore. This projection means that storm waves would be that much closer to the back shore and thus much more powerful in these future conditions. The estimated storm hazard zone with a hundred-year storm is well inland of the recreational vehicle beach parking lot's ocean edge. There is perhaps no better affirmation of this likelihood than an aerial photo of the site from January 2023 which shows the inland impact of protected wave runup (Figure 21).

According to the most recent sea level rise projection curves for the Monterey tide gauge from the NASA Interagency Sea Level Rise Scenario Tool, sea-level rise of 1.6 feet (0.5 meters) could be reached before 2060 under a high emissions scenario and by 2080 under an intermediate emissions scenario (Figure 22). Under a high emissions scenario, 3.3 feet (1.0 m) of sea level rise could happen before 2080 and by 2110 under an intermediate scenario (Sweet *et al.* 2022). In other words, the next hundred years at Seacliff State Beach will be significantly more hazardous than the last. The beach itself may disappear in half the time that Seacliff State Beach has been in existence. The likelihood of this much more challenging future substantially reframes the question of what it would mean to "build back better."

Reimagining Seacliff State Beach with future sea level rise: Obstacles and opportunities for innovative adaptation

With its popular beach access destroyed in early 2023, there were immediate pressures at Seacliff State Beach to reestablish recreational infrastructure and basic public safety, and to begin to accommodate as many visitors as possible in the short run. Emergency responses tend to create momentum towards restoring the previous structures and operations, not towards alternative, perhaps more sustainable longer-term plans. Despite our advances in technology and engineering, our tendency has not been to embrace flexibility or mobility. Rather, we tend to build back the same to "hold the line," instead of building back "better," building back farther landward, or,

at some point, deciding not to build back at all. In this case, State Parks did decide almost immediately not to rebuild the wooden pier that was heavily damaged by the January 2023 storms. Whether Parks decides not to rebuild the other beach-level development, and the seawall protecting, remains to be seen.

The Seacliff State Beach case illustrates how responses to coastal hazards can be dominated by reactive approaches, often repeating prior mistakes. We can see the influence of commerce, as well as a static view of the public benefit of parkland, in the approaches taken over the past one hundred years. At Seacliff, the approach has not been adapted to the changing conditions of sea level rise and climate change; it has remained aligned with the original 1920s impetus to create a popular public attraction at the seashore. As a result, we see continuing beach erosion in front of seawalls, loss of coastal habitat, and damage to infrastructure becoming more frequent and severe. But what would it take to move down a different adaptation pathway?

There are many obstacles to seeking alternative paths in response to climate change and sea level rise, especially when these paths involve managed retreat and private property (Anderson *et al*. 2020). The historic coastal management decision-making process that has resulted in the present situation of serial seawall reconstruction at Seacliff is rooted in a mindset of standing against the forces of the sea despite repetitive, costly losses — along with the risks and hazards that come with such armored shorelines. Contemporary coastal communities often build seawalls to control and stabilize the shoreline, leading to a perpetual struggle to hold back the Pacific Ocean.

Other factors that contribute to the tendency to build back in the same hazardous locations include:

• *Desire to maintain economic benefits*. Pre-existing uses over long periods of time tend to establish economic benefits and incentives, whether public or private, in part due to capital investments. There is a natural inclination to restore whatever benefits existed by reestablishing the commercial, residential, public access, or other advantages.

• *Expectations to maintain the status quo*. Beyond economics there may be public, private, or institutional expectations that serve to propel recovery forward to pre-disaster status quo and usage. In the case of a precious coastline, this often includes unique aesthetic benefits as well.

• *Insurance subsidies*. Although perhaps not operating within the State Park system the same way it does in the private sector, the notion of financing being available to rebuild what is lost—even if rebuilding in inherently risky places — has been identified by many as a perverse incentive working against reducing risk (e.g., Craig 2019; Peralta and Scott 2024).

• *Institutional resistance*. Since alternate approaches tend to require longer lead times for planning, permitting, and implementation, there is a systemic resistance that tends to limit the likelihood of recovery plans that involve departures from existing uses. Even though restoration that replicates the prior status may ultimately be more costly when viewed in terms of the risks of long-term vulnerability to repeated destruction, it still may be less costly in the short run, and quicker, due to the administrative processes involved.

OPPORTUNITIES FOR A NEW ADAPTATION PATH AT SEACLIFF

Notwithstanding such obstacles to alternative adaptation paths, the State of California is leading with forward-looking climate adaptation efforts, through legislation, agency policy, and funding. At Parks, the agency has recognized the threat and the need for a new approach:

> *With nearly one half of the State Park System in the coastal zone, State Parks recognizes sea level rise as a threat to resources, public access, and the ability to carry out its mission. Many coastal units are already experiencing the impacts of flooding and erosion, and all are at increasing risk. In recent years, State Parks has adopted requirements that new projects consider the impacts of sea level rise and has implemented a small number of adaptation projects. These efforts laid the groundwork for building coastal resilience.*
>
> *While these existing policies have encouraged consideration of sea level rise impacts in projects and planning,* ***a more comprehensive approach that includes lessons learned and rapidly evolving science and policy is essential to respond to sea level rise.*** (California State Parks 2020a, p. 7) (emphasis added).

Accordingly, Parks has prepared a Sea Level Rise Adaptation Strategy that frames out an innovative direction with six core principles: Integration, Science, Partnerships, Balance, Alignment, and Awareness. Together, these principles may be the recipe for moving past the status quo rebuilding cycle at Seacliff.

The "Integration" principle acknowledges that the agency will be incorporating sea level rise policies, assessments, and concerns into its planning and projects:

> Projects and plans will be informed by statewide sea level rise policies and approaches, as well as by the latest emerging science. Sea level rise vulnerability assessments will need to be completed to inform these decisions, as well as adaptive management approaches. [p. 9]

The second principle, "Science," is related and indicates that "State Parks will translate best available science into practicable, long-term solutions."

At Seacliff, Parks has embraced both integration and science by launching a vulnerability assessment and study that could be a first step in completing an adaptation strategy intended to establish a new, more sustainable course for recreational development, environmental protection, and community response to a significantly changing sea and landscape. This could be an ideal process not only for addressing the implications of projected sea level rise for beach resources at Seacliff but also for reconsidering the cycle of rebuilding. In particular, the Parks strategy identifies specific assessment tools "needed to support sea level rise adaptation work by State Parks." Notably, this includes a "coastal economics analysis tool" that could "assess the costs and benefits of the range of feasible management alternatives relative to such factors as market and nonmarket value of the affected assets, revenue generation, affected businesses, and access" (California State Parks 2020a).

The third principle of the Parks sea level rise adaptation framework, "Partnerships," states that "Parks will work collaboratively with local, state, and federal agencies; nonprofit partners;

community organizations; and California Native American Tribes to create and sustain an aligned response to sea level rise." At Seacliff, Parks has initiated public engagement, including an online survey, as part of the "vulnerability assessment and adaptation alternatives study." The study is expected to be completed in 2024 and will be used to "evaluate options and opportunities moving forward" (California State Parks 2023b). Hopefully this engagement will include the broader set of social interests that may benefit from the Parks system, not simply the surrounding neighborhoods of Seacliff. As Park's strategy recognizes: "[T]here are many sharing the California coastline with State Parks, including other state agencies, organizations, businesses, homeowners, visitors to the coast, and more" (California State Parks 2020a).

The idea of integrating tribal concerns into the adaptation plan resonates with the fourth principle, "Balance": "State Parks will work to balance the need for coastal access while protecting recreational, natural, and cultural resources in a holistic response to sea level rise." A balanced adaptation planning process would require incorporating indigenous perspectives into management practices not merely symbolically but, rather, as a recognition of legitimate claims to both place and stewardship rights.

"Balance" also requires due consideration of natural shoreline systems, particularly the beach. As discussed earlier, sea level rise projections suggest an eventual loss of beach at Seacliff if Parks maintains its seawall strategy. If a sandy beach is to be part of the desired outcome over the longer run, then development on the beach will need to be reconsidered and likely relocated absent some other way to maintain sand on the beach. The Parks strategy recognizes this proposition generally, stating:

As coastal park units are impacted by sea level rise, State Parks will assess and plan for continued public access, which could also include the relocation, retrofit, or removal of current access points and recreational areas to support future access to the coast. Sea level rise, erosion, and coastal flooding will be evaluated prior to the placement of new visitor-serving facilities, as well as the maintenance of existing facilities. Nature-based green infrastructure that conserves natural processes, resilient infrastructure that accommodates sea level rise, and managed retreat — where necessary — will generally be preferred alternatives to hard armoring in the long-term management of coastal park unit (Parks p. 12-13.)

As an example of one possibility for rethinking Seacliff State Beach's infrastructure, there is a large parking area and an adjacent, undeveloped field on the marine terrace at the top of the bluff that could conceivably provide considerable parking for a new approach to accessing the beach (Figure 23). Because this facility is owned by the State of California, it should be far easier to make decisions on adapting to the inevitable future and move back from this vulnerable edge, than were this back beach area developed with private homes. Now is the opportunity to find more adaptive and sustainable solutions to coexist with the Pacific Ocean while still providing public access to the beach at, or near, this location. Perhaps what is needed, at this point, is to build *farther back*, and do that better.

The "Alignment" principle — "*State Parks will align its approach with Coastal Act provisions to improve the coastal permitting and compliance process*" — also resonates with the direction framed by Balance. The Coastal Act is a broad yet strong law, seeking balance between social and environmental interests along the coast but doing so within the constraints of the environment and with a keen eye for future generations (Lester 2013). Alignment with the Coastal Act underscores the need to better anticipate future environmental changes and social needs and to break out of the "reactive" and often emergency-driven response that has characterized Seacliff's history. Whatever actions the state takes in the immediate term to address the storm damage at Seacliff should not prejudice more fundamental redevelopment that would be devised through a deliberate and holistic planning process focused on the needs of the environment and future generations.

The Coastal Commission has provided comprehensive guidance for addressing sea-level rise that, under the Alignment principle, should directly inform planning at Seacliff (California Coastal Commission 2018). In particular, it suggests ways to consider adaptation of a development footprint over time and in phases. This could be a way to break out of the cycle of reactive rebuilding of the status quo. Instead, State Parks might consider a sequence of actions. For example, Parks might build back the beach-level development but only for a short period of time while the plan and infrastructure necessary for relocating the development to the blufftop is developed, funded, and ultimately implemented.

State Parks' sixth principle, "Awareness," states it "will increase public awareness and understanding of sea level rise through education and engagement with visitors." This resonates with the partnership principle and counsels for a robust and transparent public engagement process in the planning for what comes next at the park. Experiences in other communities in California suggest that this engagement should continue from start to finish — from considering the values and interests that could shape the park, to identifying the community values and amenities that are vulnerable to future environmental change, to strategizing about how to respond to these vulnerabilities (Lester *et al.* 2023). Part of a "holistic" planning process, then, is to assure that the community is meaningfully engaged in the entire decision-making process, that its interests, expectations, and input are considered and that decisions are not just technical or bureaucratic.

CONCLUSIONS: DISCOVERING THE ADAPTATION PATHWAY FOR SEACLIFF'S NEXT HUNDRED YEARS

New circumstances require new ideas, and will we improve our chances of long-term success only by revisiting each situation with a fresh view of our fundamental values and purposes and how they affect our use, interactions and experience of the coast in any location considering changing circumstances. The modern, post-colonial development history at Seacliff State Beach is one of reaction and restoring the status quo — literally a line in the sand. Seven times over 97 years, the protective structures at Seacliff have been built and then destroyed — sometimes within a year of rebuilding. To take a fresh view, this cycle must be broken. Now is the time to ask if beach-level parking, whether for cars or recreational vehicles, is essential or cost effective and worth the price-tag of an **eighth** reconstruction. Climate change and sea level rise demand that we embrace a new paradigm of environmental change, building back in

Figure 23. Seacliff State Beach in 2013 showing the large blufftop parking area and empty field to the right that could be used for visitor parking. The pier was damaged and then demolished following the January 2023 storms. (California Coastal Records Project, Kenneth and Gabrielle Adelman).

ways that will adapt land uses and human behavior to the future changes, such as a rising Pacific Ocean, that we may have little ability to change.

One starting point is to ask how the future of Seacliff State Beach can better meet and reflect the environmental and social needs of the *entire* community. After decades of reactive responses that have largely maintained a problematic status quo, perhaps now is the time to reimagine the possibilities for land use at Seacliff. State Parks is well positioned to play a key role in undertaking such a reexamination because it recognizes the challenge that sea level rise presents and has embraced important guiding principles to help frame the planning and redevelopment of the park. Adaptation planning is complex, though, particularly over the longer time frames that thinking about sea level rise requires. The built environment at Seacliff is also complicated by the juxtaposition of private and public interests and competing public interests. If the decision is made to relocate beach-level recreational vehicle camping, what will happen to the access road behind the camping area that currently serves private residential development on the beach immediately upcoast of the park? If the decision is made to maintain a beach, how will this be accomplished? Will it require the long-run retreat of bluff-top development to allow cliff erosion to continue? Trade-offs will be required too. If more space is needed to facilitate Native cultural traditions, perhaps space for camping will need to be reduced. Or maybe some of the beach will need to be sacrificed to allow for continued recreational development at beach level. These types of questions all raise difficult technical, legal, and political issues that must be addressed if we are rethinking adaptation at Seacliff in earnest.

Along the California coast today, approaches grounded in flexibility generally do not dominate decision-making processes — and neither does the idea that the coast is a dynamic, changing force. There are obvious reasons why this is the case, including sunk capital, extensive urban coastal development and infrastructure, and other factors discussed above. However, Seacliff provides an opportunity to incorporate more flexibility into future redevelopment pathways. The State Parks strategy provides a clear basis for such an approach. Seacliff State Beach is thus one location where such rethinking may be possible, and it could be a model for how we approach other stretches of the coast.

It may be that rebuilding the seawall and maintaining the beach-level development at Seacliff is the right strategy for now. But if it is, this should be decided in the context of considering potential alternative pathways for the long-term. It seems unlikely that maintaining the line in the sand is the right answer for future

generations, especially if the community desires a sandy beach at Seacliff. The adaptation planning process will need to engage the community and integrate technical assessment and best available science with the possible adaptation pathways for the next 50 to 100 years. Much of this depends, ultimately, on what kind of coast stakeholders seek to maintain and protect for the future. Only by thinking ahead in this way will we be able to discover what it means to build back "better" at Seacliff State Beach.

UPDATE

Less than a year after the January 2023 storms described in this article, Seacliff State Beach and the surrounding coastline was again subjected to unusually severe storms in December 2023. The resulting infrastructure damage, including flooding of nearby areas, was lessened in part due to the fact that the primary infrastructure, including the seawall, had not yet been repaired or rebuilt from the earlier storms. This prospect of increasing frequency and severity of storms stands as a further indication of the urgency for new and more robust approaches to planning for sustainability.

REFERENCES

Anderson, K., 2005. *Tending the wild: Native American knowledge and the management of California's natural resources*. October 2013, University of California Press.

Amah Mutsun Land Trust, 2023. "Restoring indigenous knowledge and practices to Popeloutchom — our ancestral lands." https://www.amahmutsunlandtrust.org.

AP and KSBW Action News 8, 2023. " 'The country is here for you': President Biden vows to help Central Coast rebuild after storms." https://www.ksbw.com/article/biden-tours-damage-in-capitola-aptos-speaks-to-press/42580082.

Braje, T.J., and Rick, T.C., 2013. "From forest fires to fisheries management: anthropology, conservation biology, and historical ecology." *Evolutionary Anthropology: Issues, News, and Reviews*, 22(6), 303-311. https://doi.org/10.1002/evan.21379.

Bromirski, P.D., 2023. "Climate-Induced Decadal Ocean Wave Height Variability from Microseisms: 1931-2021." *J. Geophysical Research: Oceans*, 128:8. https://doi.org/10.1029/2023JC019722.

Barnard, P.L., Erikson, L.H., Foxgrover, A.C., Limber, P.L., O'Neill, A.C., and S. Vitousek, 2018. "Coastal Storm Modeling System (CoSMoS) for Central California, v3.1" (ver. 1h, March 2021). U.S. Geological Survey data release. https://doi.org/10.5066/P9NUO62B.

California Coastal Commission, 2018. *California Coastal Commission Sea Level Rise Policy Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits*. California Coastal Commission, San Francisco, California. 307 pp. https://documents.coastal.ca.gov/assets/slr/guidance/2018/0_Full_2018AdoptedSLRGuidanceUpdate.pdf.

California Department of Parks and Recreation (DPR), 2023a. "Seacliff State Beach FAQs." https://www.parks.ca.gov/?page_id=31227.

California Department of Parks and Recreation (DPR), 2023b. "California State Parks Seeks Public Input to Provide Climate-Resilient Facilities at Seacliff and New Brighton State Beaches," https://www.parks.ca.gov/News-Release/1208.

California State Parks, 2020a. *Sea Level Rise Adaptation Strategy*. https://www.parks.ca.gov/?page_id=30540.

California State Parks, 2020b. *Sea Level Rise Adaptation Strategy: Fact Sheet*. https://www.parks.ca.gov/?page_id=30540.

Craig, R.K., 2019. "Coastal adaptation, government-subsidized insurance, and perverse incentives to stay," *Climatic Change*, 152(2), 215-226. https://link.springer.com/article/10.1007/s10584-018-2203-5.

Fulton-Bennett, K.W., 1984. *An Assessment of Coastal Protection Structures between San Francisco and Carmel, California*, Master of Science in Earth Science, University of California Santa Cruz.

Fulton-Bennett, K. W., and G. B. Griggs, 1986. *Coastal Protection Structures and their Effectiveness*, Joint Publication California State Department of Boating and Waterways and Institute of Marine Sciences, University of California Santa Cruz, Santa Cruz, CA. https://repository.library.noaa.gov/view/noaa/34843.

Griggs, G., 2005. "The impacts of coastal armoring," *Shore & Beach* 73(1), 13-22.

Griggs, G.B., and K.W. Fulton-Bennett, 1987. "Failure of Coastal Protection at Seacliff State Beach, Santa Cruz County, California," *Environmental Management* 11:175-182. https://link.springer.com/article/10.1007/BF01867196.

Lester, C., Manley, C., Dinh, Y., Rozal, S., Cooper, A., Winters, L., Munster, K., Bok, T., and N. Wrubel, 2023. *Planning for Sea Level Rise on California's Coast: Status, Trends, and Recommendations*, Ocean and Coastal Policy Center, Marine Science Institute, University of California, Santa Barbara, California.

Lightfoot, K.G., Cuthrell, R.Q. Hylkema, M.G., Lopez, V., Gifford-Gonzalez, D., Jewett, R.A., Grone, M.A., Sanchez, G.M., Nelson, P.A., Apodaca, A.J., Gonzalez, A., Field, K., Brown, J., Sigona, A., and P.V.A. Fine 2021. "The Eco-Archaeological Investigation of Indigenous Stewardship Practices on the Santa Cruz Coast." *J. California and Great Basin Anthropology* 41(2), 187-205. https://www.santacruzmuseum.org/wp-content/uploads/2022/11/lightfootetal2021theeco-archaeologicalinvestigationofindigenousstewardshippractices.pdf.

Lightfoot, K.G. and O. Parrish, 2009. *California Indians and their environment: An introduction* (No. 96). University of California Press, 2009.

Lindsay, B. C., 2015. *Murder State: California's Native American Genocide, 1846-1873*. University of Nebraska Press. 456 pp.

Marino, E., 2015. *Fierce Climate, Sacred Ground: An Ethnography of Climate Change in Shishmaref, Alaska*. University of Alaska Press. 122 pp.

National Geodetic Survey, 2023. "2023 NOAA NGS Aerial Imagery for Situational Awareness: Central California." https://www.fisheries.noaa.gov/inport/item/69185.

Nerem, R.S., Beckley, B.D., Fasullo, J.T., and G. T. Mitchum, 2018. "Climate-change–driven Accelerated Sea-level Rise Detected in the Altimeter Era." PNAS 115:2022-2025. Point Blue Conservation Science and U.S. Geological Survey. Our Coast Our Future (OCOF). Web application, Petaluma, California. www.ourcoastourfuture.org (accessed 1October 2023) https://doi.org/10.1073/pnas.1717312115.

Ocean Protection Council, 2023. *Tribal Engagement Strategy*. 17 pp. https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20230124/OPC-Tribal-Engagement-Strategy-508.pdf

Peralta, A., and J.B. Scott, 2024. "Does the National Flood Insurance Program Drive Migration to Higher Risk Areas?" *J. Association of Environmental and Resource Economists,* 11(2), 287-318.

Rizzo-Martinez, M., 2022. *We Are Not Animals: Indigenous Politics of Survival, Rebellion, and Reconstitution in Nineteenth-Century California*. University of Nebraska Press. 536 pp.

Storlazzi, C.D., and G.B. Griggs, 2000. "The Influence of El Niño-Southern Oscillation (ENSO) Events on the Evolution of Central California's Shoreline." *Geological Society of America Bulletin*, 112:236-249.https://doi.org/10.1130/0016-7606(2000)112%3C236:IOENOE%3E2.0.CO;2.

Storlazzi, C.D., Willis, C.M., and G.B. Griggs, 2000. "Comparative Impacts of the 1982-83 and 1997-98 El Niño Winters on the Central California Coast." *J. Coastal Research* 16(4), 1022-1036.

Sweet, W.V., Hamlington, B,D, Kopp, R.E., Weaver, C.P., Barnard, P.L., Bekaert, D., Brooks, W., Craghan, M., Dusek, G., Frederikse, T., Garner, G., Genz, A.S., Krasting, J.P., Larour, E., Marcy, D., Marra, J., Obeysekera, J., Osler, M., Pendleton, M., Roman, D., Schmied, L., Veatch, W., White, K.D., and C. Zuzak., 2022. *Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines*, National Oceanic and Atmospheric Administration, Silver Spring, MD. 111 pp. https://aambpublicoceanservice.blob.core.windows.net/oceanserviceprod/hazards/sealevelrise/noaa-nos-techrpt01-global-regional-SLR-scenarios-US.pdf.