Impacts of coastal protection structures take place over decades

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Griffith University researchers have analyzed decades of surveys documenting the environmental response to coastal protection structures at an iconic stretch of the northern New South Wales beaches, finding

that some impacts can take years to eventuate.

Published in *Marine Geology*, researchers from the Coastal & Marine Research Centre and the School of Engineering & Built Environment assessed six surveys throughout 1967 to 2020 to observe the morphological and sand volume changes to the Letitia Spit—south of the Tweed River—in response to the construction of the river training walls around 1962-1964 and an artificial sand bypassing system implemented in 2001.

This coastal area in New South Wales, that also borders the southern Gold Coast, has been under the influence of management actions over the last 100 years, with the first rudimentary rock wall built in the Tweed River in the 1890s.

The beaches north and south of the Tweed River are popular locations, particularly for surfers, and the Tweed River entrance is a busy thoroughfare for recreational and commercial vessels.

Ph.D. candidate Ana Paula da Silva and the research team found that while the beach in the immediate updrift (south) of the Tweed River coastal interventions responded within months to a couple of years to the introduction of the entrance training structures, the extension of those impacts further south along the Letitia Spit coastline was gradual and took decades.

Overall, for Fingal Beach—at the southern end of Letitia Spit—the impacts were largely reduced and there is no evidence over the period of the study of morphological changes extending south of Fingal Head.

About two to three decades were necessary for Letitia Spit to reach the maximum capacity for sand accumulation on the beach caused by the training wall obstruction of the littoral (nearshore zone) drift, whereas

the subsequent erosional state occurred following the commencement of the artificial bypassing and continued for only about one decade before the new beach equilibrium was reached.

"The beaches are normally under what we call dynamic equilibrium: they fluctuate around an 'average' position in response to the variability in hydrodynamic factors—like tidal cycles and wave climate—and sediment supply," Silva said.

"These oscillations will lead to the natural phases of erosion and accretion in a beach, which might happen seasonally and/or interannually—that will vary from place to place. But the important thing is: in the same way the beach erodes at times, it accretes at others. It is a natural change that is mostly naturally reversible.

"So, when something external interacts with the natural beach dynamics, like new coastal structures, the complex and integrated system that sustains the beach equilibrium needs to adapt."

In the case of Letitia Spit, construction of the training walls in the 1960s blocked the sand movement to the north and caused Letitia Spit to go into a persistent accretion trend that lasted until the 1990s.

If the beach is in a constant trend for so long, it is not in dynamic equilibrium and it cannot reverse the situation by itself.

"It is interesting that decades are a long time for us, for coastal management and for community needs; but it is actually a short time for some natural processes," Silva said.

"It is easier for us to understand if we think about the erosion trend, which was happening on the southern Gold Coast while Letitia Spit was accreting. By itself, it would be very hard for the Southern Gold Coast

beaches to accrete again and find an ideal dynamic equilibrium, at least on a timescale relevant for the community needs.

"It is also relevant to understand that despite Letitia Spit being so largely accreted (which might seem good from one's perspective), this was not a natural circumstance, it happened because of the new training walls. Therefore, with any change in the beach conditions the accretion trend could 'easily' flip to an erosion trend.

"The introduction of the artificial sand bypassing restarted the littoral drift to the north, and consequently some upper beach erosion occurred as the excess of sand accumulated on Letitia Spit was transported away. Currently, the beach has returned to its natural dynamic equilibrium and it is in a similar condition to the first few years following the training walls' construction."

This study raises attention to the value of long-term beach monitoring on both sides of the implemented coastal structure.

"Our findings offer valuable scientific information to share with coastal managers and the local community showing that there is a strong need to keep monitoring these beaches for decades to follow their evolution after implementing any intervention," Silva said.

More information: A.P. Silva et al, Updrift morphological impacts of a coastal protection strategy. How far and for how long?, *Marine Geology* (2021). DOI: 10.1016/j.margeo.2021.106625

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