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Capstone Projects

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An Ocean for Everyone: Creating a Vitural Tour to Expand Access and Awareness

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An Ocean for Everyone

CREATING A VIRTUAL TOUR TO EXPAND ACCESS AND AWARENESS

Final Report

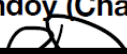
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Executive Summary

Virtual tours represent an underutilized but promising tool for marine conservation, capable of immersing users in protected environments and forging emotional connections that motivate stewardship. This project developed a conservation-focused virtual tour of Matlahuayl State Marine Reserve in La Jolla, documenting a replicable process for the broader field. Over 36 scientific dives with a 12-person team from Scripps Institution of Oceanography, the project collected roughly 21.5 hours of 360-degree underwater video across six major habitats, which was then built into an interactive tour using 3D Vista software and hosted on a dedicated web server. The resulting prototype successfully demonstrates that a high-quality, video-rich conservation virtual tour can be produced and maintained at relatively modest cost, with strong loading performance and mobile responsiveness. Future iterations would benefit from establishing a communication strategy prior to diving to improve footage efficiency, and the methodology is scalable, with smaller tours potentially hosted together on a single server to reduce long-term expenses.

Introduction

The **virtual tour** could be a powerful conservation tool. Virtual tours are commonly used in the real estate, tourism, and construction industries, but they haven't been widely adopted in the conservation field. This project sought to **1)** create a virtual tour with a marine conservation focus and **2)** create a process that mitigates logistical and financial obstacles so it can be replicated across the field.

Virtual tours could be an effective tool for communicating MPA science and other topics in marine conservation because they allow people to be immersed (with 360-degree images) in the environment that's subject to protection or proposed protection. Users experience some level of control and discovery when "exploring" these virtual environments, which can generate higher emotional reactivity.

One of the most powerful methods in marketing is forging a connection between a person's place and identity. Virtual tours can aid in this process by giving people a spatial understanding of marine environments, which can make those environments feel more familiar and more likely to be interpreted as a "home" worth protecting.

Process

The project had three phases:

1. **Underwater Photography:** Collecting 360-degree images for the virtual tour.
2. **Communication Strategy:** Determining what scientific information about the MPA that I wanted to communicate, and how to communicate this information effectively through the language of the virtual tour medium.
3. **Virtual Tour Build:** Creating the virtual tour in software and finding an adequate means to host it online.

This was not the ideal process.

Ideally, I would develop a communication strategy *before* embarking on underwater photography; I would know exactly which scientific topics I wanted to communicate and what video footage I needed to collect to effectively convey that information.

However, the project started in October 2025 and La Jolla had optimal water conditions for diving and underwater photography. I wasn't sure how long these conditions would last and I thought it necessary to complete the photography phase before winter swells. So that we wouldn't miss optimal diving conditions, I started the photography phase before having a strong understanding of what footage I would need. I aimed to get as much coverage as possible so I would have sufficient images to choose from when crafting the virtual tour.

1. Underwater Photography

To create the virtual tour, I needed to collect 360-degree images of the underwater habitats at Matlahuayl State Marine Reserve. Most virtual tours use 360-degree still photos; I needed to collect **video**. It's difficult to capture the beauty and biodiversity of the ocean without also capturing the motion of animals, seaweeds, and marine plants.

We used:

- Insta360 X4 action camera

- Insta360 Invisible Selfie Stick
- 3-pound tripod
- 3 2-pound ankle weights (to anchor down the tripod)
- Diving equipment and medical supplies from the SIO Scientific Diving Office

Once my dive plan was approved by the SIO Scientific Diving Office, we started our scientific dives to collect underwater footage. I worked with a team of 12 scientific divers, all students or alumni of Scripps Institution of Oceanography. Diving took place from November 19 to January 31. We logged 36 dives and collected about 21.5 hours of underwater video.

We collected footage from most of the major habitats at Matlahuayl: rocky reef, giant kelp forest, feather boa kelp forest, seagrass beds, sandy bottoms, and the underwater canyon.

2. Communication Strategy

In the virtual tour I wanted to communicate the scientific objectives of Matlahuayl, while also providing some information on the impacts of California's larger MPA network and why MPAs can be effective in bolstering whole ecosystems when well-designed and enforced.

I received RSG documents from California Department of Fish and Wildlife that provided me with useful information about the objectives of Matlahuayl and the South Coast MPAs.

Ed Parnell, one of the few researchers who has studied the area as an ecological reserve, provided important insights on the history of the MPA and its impact on marine communities.

Matlahuayl has a couple very specific objectives (protecting the canyon and abalone populations) but *protecting biodiversity* is the primary overarching objective. The science communication within the virtual tour (both the videos and also the popup information windows) focus on showcasing the variety of different habitats within the MPA and how their ecologically intertwined with one another; thereby we showcase how a marine

protected area is an effective tool for protecting this collection of interconnected habitats in La Jolla Bay.

I also selected videos that showcase people enjoying the MPA (i.e. kayaking, swimming, diving) to try and dispel the misconception that MPAs are off-limits for recreational use.

WildCoast, Reef Check, and Coastal Defenders were helpful collaborators.

3. Virtual Tour Build

I used **3D Vista** to build the virtual tour. This is a professional-caliber software that's used to make virtual tours in other industries.

The size of the virtual tour (in terms of data) was the biggest challenge.

Most virtual tours use still panoramas with very few 360-degree videos. I wanted this virtual tour to be predominantly video, but was uncertain how many videos we could add without **1)** compromising performance and **2)** requiring a web server that would be too expensive for long-term use.

I also had to make sure the virtual tour would be intuitive on mobile devices. Many users will probably view the tour on their cell phones, so optimizing mobile responsiveness was critically important.

Many of the tools in 3D Vista work well for desktop viewing, but aren't as responsive on mobile devices. I had to create many visual elements (notably the popup windows) outside of the software, requiring extra time and significantly increasing the file size of the virtual tour.

I set up a dedicated server to host the virtual tour. The server has 16GB RAM, which should be enough processing power to run the virtual tour with optimal loading speeds for dozens of viewers at a time. However, I will need to keep monitoring the performance as we market the virtual tour and it receives more traffic.

Final Deliverable

I published a prototype virtual tour that's about 85% complete. The virtual tour is about 40GB and is being hosted on a web server that costs about \$185 per month. The tour seems to have strong performance, but loading times dip when there's poor internet connectivity.

The final version will incorporate feedback given to me by a smaller number of people who have viewed the virtual tour. Notably, I will add a section focusing on Kumeyaay history and indigenous co-management of MPAs.

There will also be a gateway page that provides scientific sources, virtual tour instructions, and some contextual information about the California MPA network.

Key Takeaways

This virtual tour was a successful proof-of-concept. I was able to demonstrate that it's possible to build a conservation-focused virtual tour that utilizes a large number of 360-degree videos, with strong loading times, a replicable methodology, and relatively low cost.

The prototype virtual tour contains 25 360-degree videos and dozens of standard videos and photos. Standing at about 40 GB, the tour costs about \$185 per month to host online. That's a bit expensive over a span of 5-10 years, but dozens of virtual tours could be hosted on the same, mid-tier dedicated web server. Therefore, a virtual tour such as this one would be best-suited for organizations that plan on building them frequently.

However, organizations that cannot spend as much money on dedicated web hosting could simply create smaller tours (about half the size – roughly 20 GB), which could be efficiently hosted on a much more affordable virtual private server (VPS).

To be more efficient, from a logistics and financial standpoint, we could establish a communications strategy *before* underwater photography. That would help the dive team be more intentional about the footage we're seeking so we can collect better footage over a smaller number of dives.