



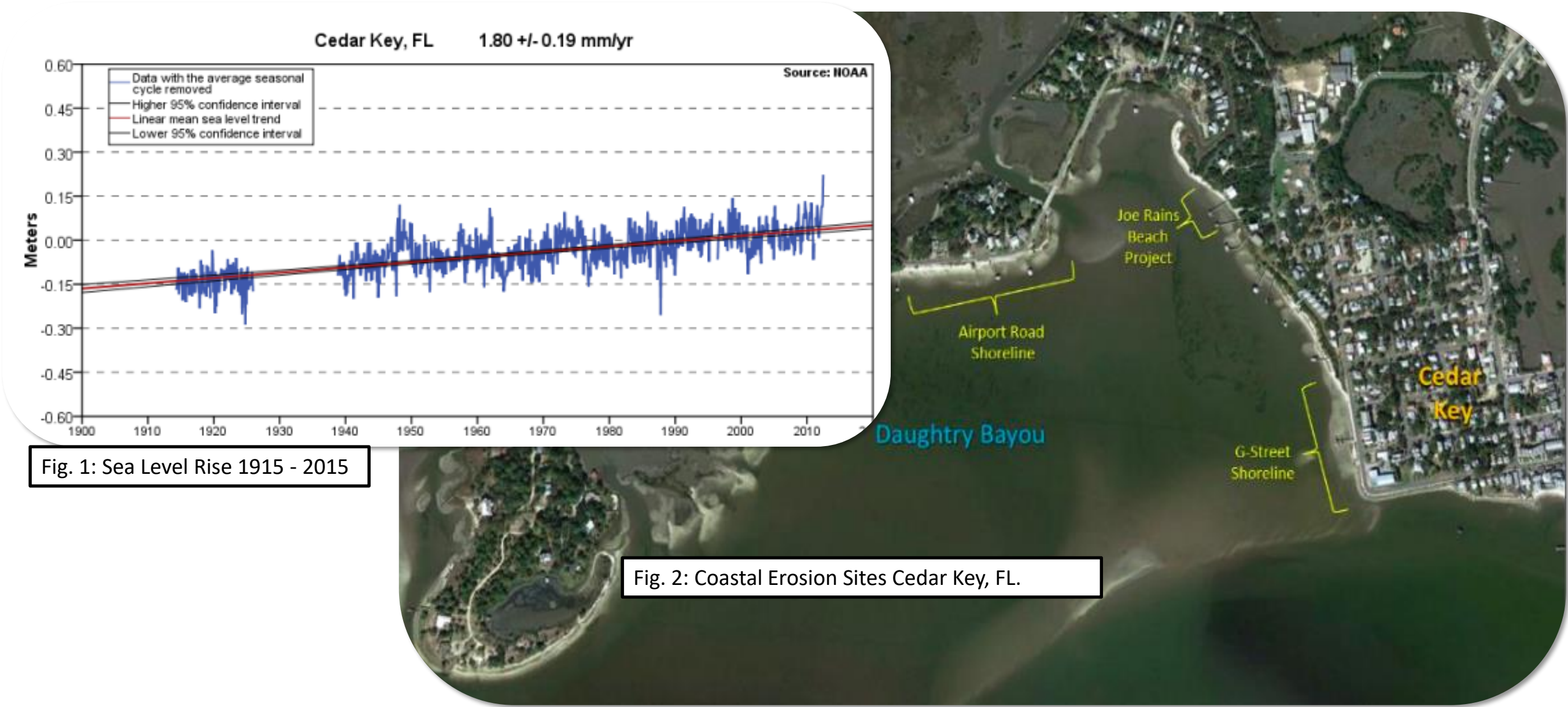
Analysis of Living Shorelines as a Coastal Stabilization Technique for Airport Road, Cedar Key, Florida

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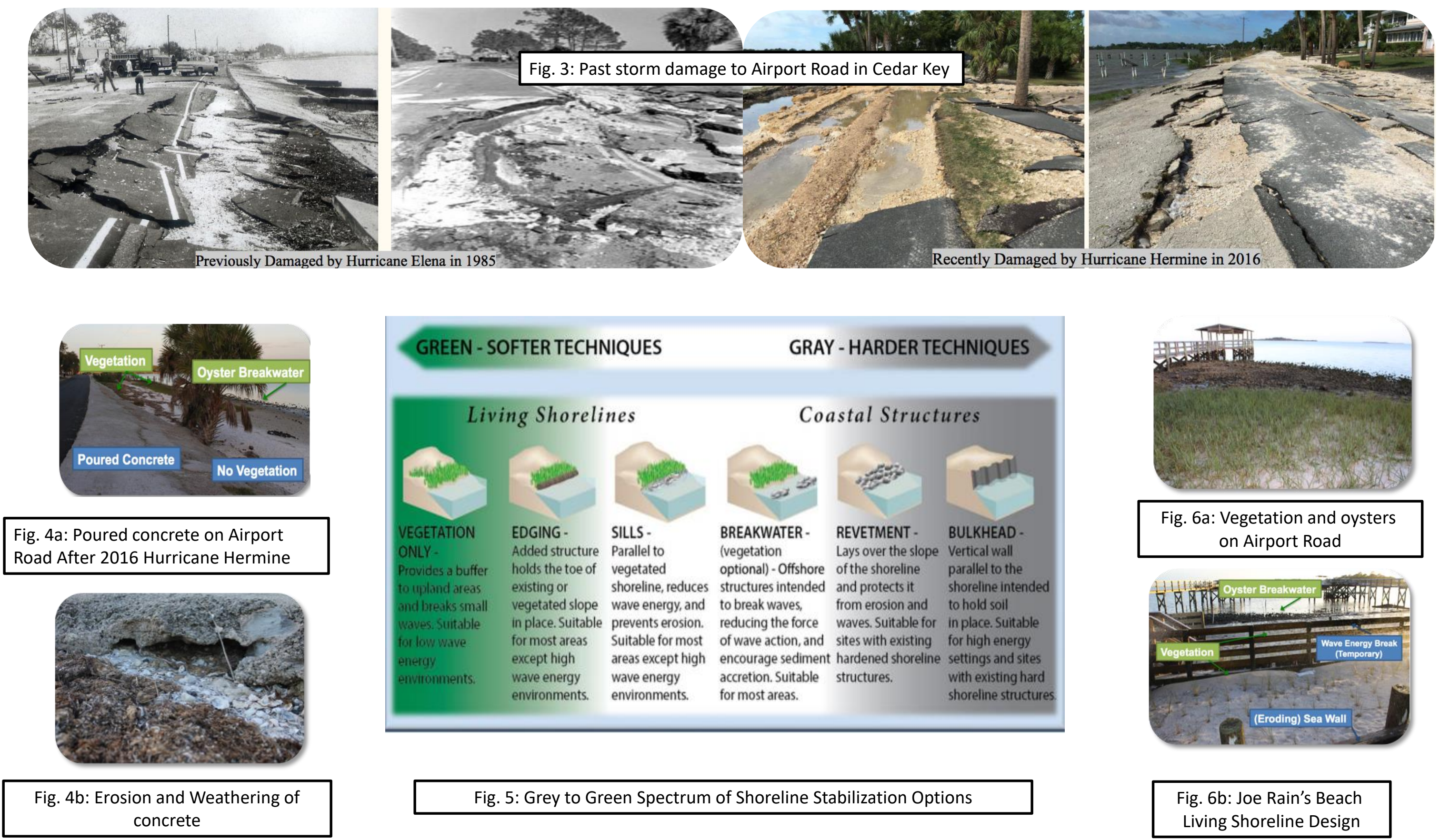
Cedar Key's Erosion Problem



Cedar Key is a small coastal town in the Big Bend Region of Florida. This working waterfront community is economically reliant on tourism and aquaculture. Like many coastal areas, Cedar Key will continue to be impacted by the effects of climate change including sea level rise and increased storm intensity (Fig 1). The community has been exploring shoreline stabilization strategies for three critically eroded areas (Fig 2).



Airport Road

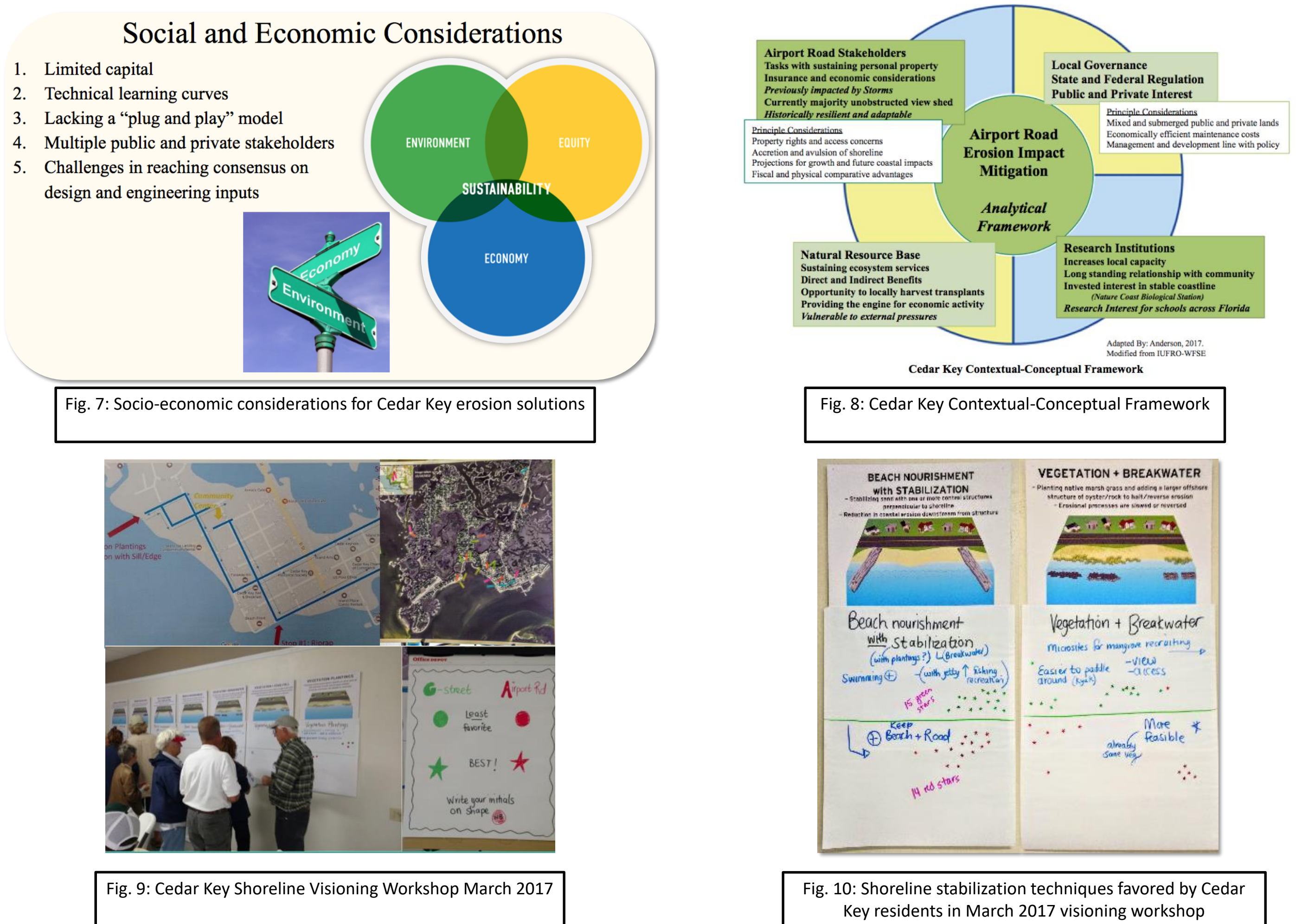


Airport Road has been identified by residents as a location of erosion concern. The road's integrity has been compromised during past storms (Fig 3). Areas of poured concrete placed in response to Hurricane Hermine (Fig 4a) have already begun to erode despite being in place less than three months (Fig 4b), and appears to be more impacted than adjacent areas with vegetation and oyster breakwaters.

The general solutions for shoreline stabilization range from grey (man-made) to green (natural) design elements (Fig 5). Living Shorelines are coastal protection projects that may use a mixture of materials like fiber coir logs, oysters, marsh vegetation, and mangroves. Airport Road may be a location that can benefit from a living shoreline design utilizing oysters and local plant species (Fig 6a) much like a similar project in town at Joe Rain's Beach (Fig 6b).



Community Considerations



Cedar Key has many socio-economic factors that are important to consider when forming a solution for the integrity of Airport Road (Fig 7). These dynamics can also be viewed within a framework to understand how society, environment, regulation, and stakeholder preferences shape capacities on Airport Road (Fig 8).

Cedar Key is involved in a participatory decision-making process (Fig 9). This type of process can foster stakeholder buy-in and investment in the final project. In a recent visioning workshop in March 2017, residents identified two shoreline stabilization options that best suited their uses of the Airport Road Site (Fig 10). The most effective solution will be a single project coordinated among multiple stakeholders including property owners along Airport Road.



Impacts and Tradeoffs

Socio-Economic and Development Considerations for Coastal Erosion Mitigation				
Economic Development	"Business as usual" (-) Post-impact remediation (\$15k+) (+) Limited engagement means limited expense	"Grey scale" hardening (+) Initial construction and engineering (+) Routine maintenance and Beach nourishment	"Green scale" hardening (+) Initial construction and engineering (+) Training resource (-) Initial and maintenance investments required (+) Potential for loss of services during weather event (-) 6 mo. establishment time	"Mixed" Grey & Green (+) Initial construction and engineering (+) Training resource (-) Initial and maintenance investments required (+) High rate of ecosystem and biological services (+) More insulated from tidal and storm surge impacts (-) 6 months establishment
Ecosystem Services	As provided by natural accretion and avulsion rates	No added benefits to ecosystem services. Potential negative impacts through evolution.	(+) Greatest rate of ecosystem and biological services (+) Improved function and ecosystem services	(+) High rate of ecosystem and biological services (+) Improved function and ecosystem services
Social Welfare	(-) Minimal impacts	(+) Temporal insulation from storm surge	(+) Vegetated erosion control (+) Stabilization supports fiscal insulation (-) Private investment required	(+) Vegetated erosion control (+) Stabilization supports fiscal insulation (-) Private investment required
Private Property	(-) Fiscal liabilities for damages (-) Insurance Premium Concerns	(+) Temporal insulation from storm surge (-) Costs of installation, maintenance, and nourishment	Administrative Management Physical Maintenance (+) Can obtain vegetation transplants from adjacent public lands	Administrative Management Physical Maintenance (+) Can obtain vegetation transplants and shell midden from adjacent public lands
Public Property	Administrative Management Physical Maintenance	Cost of nourishment inputs		

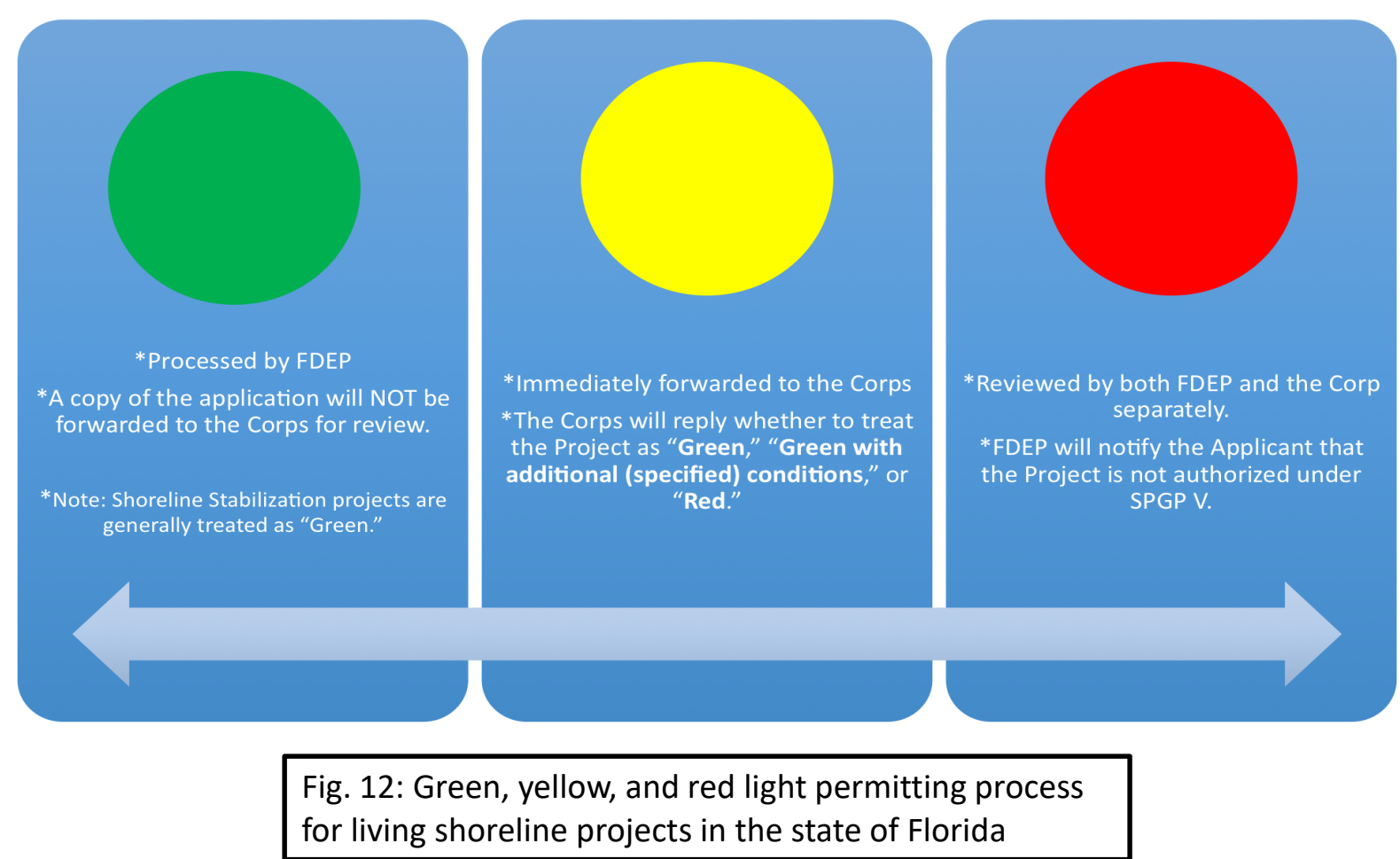
(+)= Considered to be positive outcomes, (-)= Considered to be challenges or demonstrated concerns

While living shorelines may take longer to establish they often provide effective coastal protection for longer periods of time than grey infrastructure, while providing or maintaining additional ecosystem services (Fig 11). Oysters and salt marsh vegetation may reduce wave energy while allowing sediment to accrete (Garvis 2012, Möller et al. 2014). Mangroves may additionally cut down storm surge (McIvor et al. 2012). All three provide positive benefits such as sequestering carbon and fostering local biodiversity.

Some components of living shoreline designs, such as mangroves, may provide superior storm and sea level rise protection but may impact desired uses of an area such as access and viewshed. An adaptive plan allowing for active management of mangroves may be desirable at Airport Road.



Navigating Policy

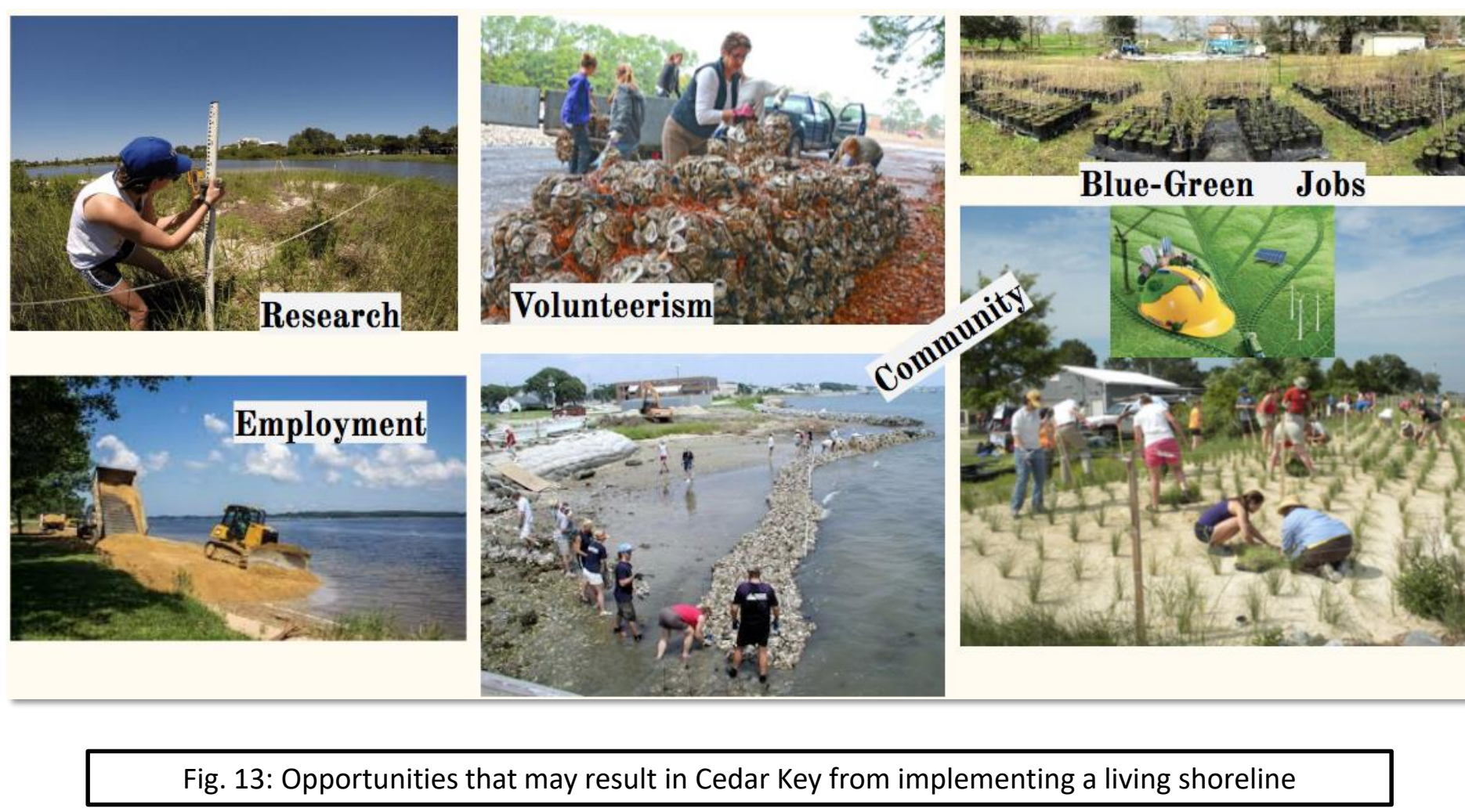


Permitting for living shorelines can be a complicated process. However the Army Corp of Engineers coordinates with the State of Florida using a green, yellow, and red light permitting system (Fig 12). Projects considered small in size and environmental impact can be reviewed and approved at the state rather than the federal level.

Possible financing could include both private and public sources, and mechanisms like collection of homeowner or tourist taxes, development of homeowner associations, or application for RESTORE funds associated with penalties paid after the Deepwater Horizon spill.



Project Opportunities



Recommendations

- Decision-making:**
- Continue participatory process
 - Reach out to airport road property owners

- Implementation:**
- Collaborate with UF IFAS/Sea Grant, and permitting/legal experts during design process
 - Determine areas of greatest concern

- Implementation (continued):**
- Identify adjacent vegetated areas that can be mimicked in a living shoreline design
 - Establish biological and sociological (use and access) monitoring
 - Tap into existing partnerships for resources such as volunteer labor that will decrease project costs and increase social investment



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