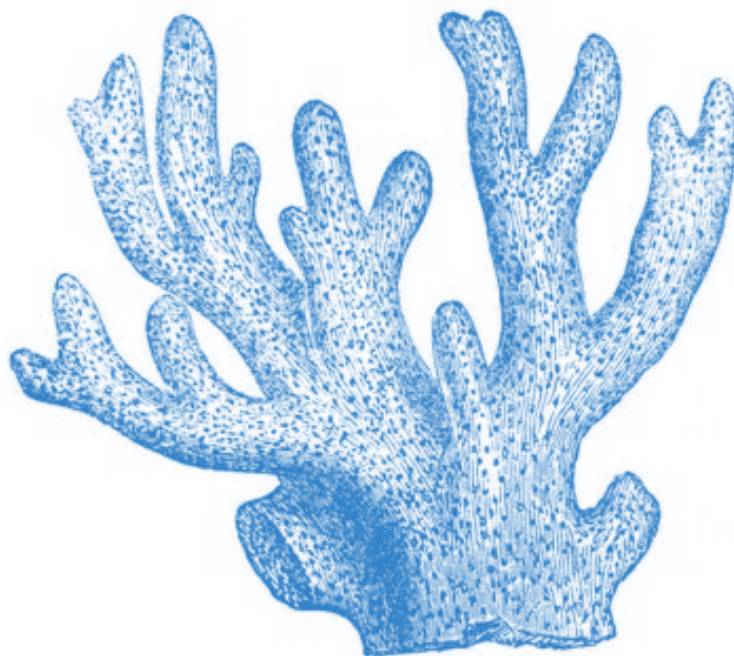
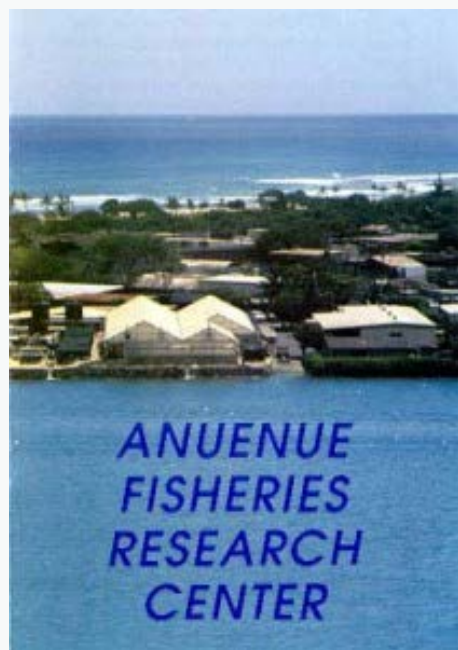


Using a Coral Reef Mitigation Bank and Innovative Coral Restoration Nursery for Off-Site Impacts to Restore Marine Managed Areas



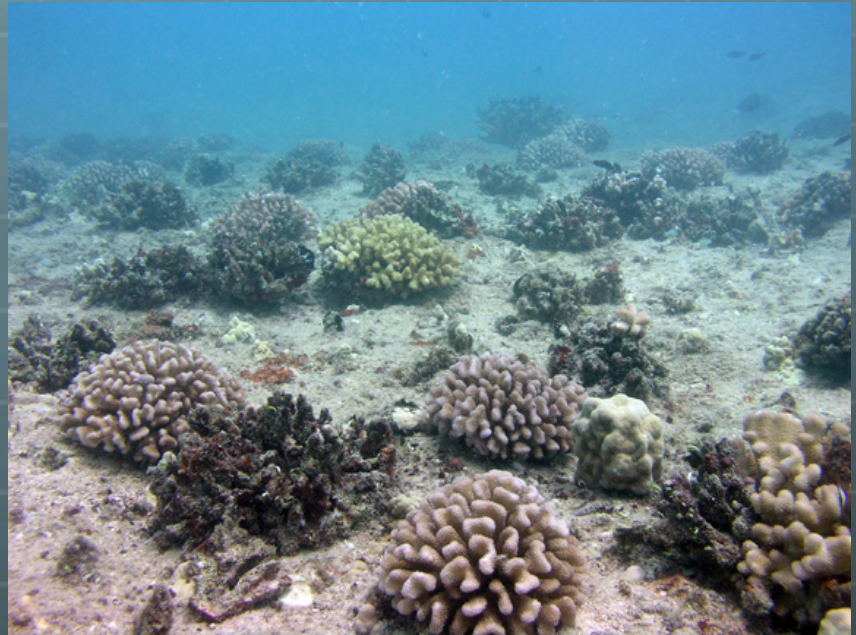
David Gulko, Kate Cullison, Michael Cavazos,
Zac Forsman, Kari Kolton-Zajackowski
Hawai'i Division of Aquatic Resources

Coral Reef Impacts

In the past, as occurs elsewhere in the world, when a RP could be held accountable for impacts to a coral reef in Hawai'i, settlements have often involved the RP conducting their own, limited, compensatory mitigation project.

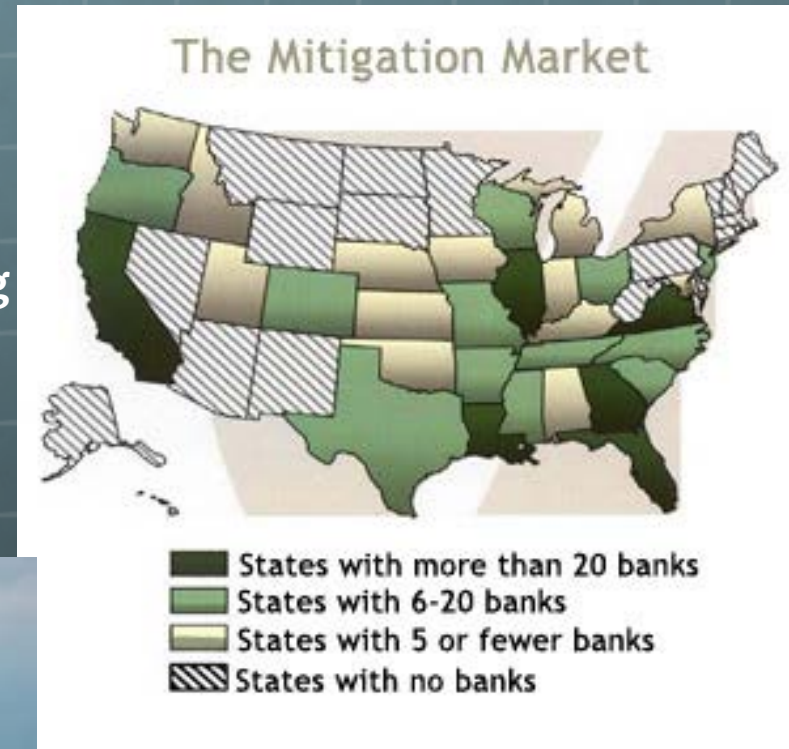
The success rate of these projects has not often been favorable in regards to replacement of lost ecological services and functions or replacement of ecological complexity. It is often extremely costly and time-consuming for the RP.

All parties want something better.



Mitigation Banks

Mitigation Banks have been used successfully for terrestrial wetland restoration in the USA for decades. The concept involves sale of “credits” from a pre-approved “bank” regarding restoration activities conducted within a designated area. These credits can be sold to a Responsible Party (RP) to offset impacts caused by their development or impact activities.



Credits are determined at a mitigation project site based on pre-approved scales of ecological services and functions achieved through either restoration or improvement.

Aquatic Mitigation

A key requirement for a bank is that the property involved be preserved in its restored state over time, a bar difficult to achieve for many submerged marine lands, but not for Marine Protected Areas (MPAs). The State of Hawai'i has developed the first Mitigation Bank specifically for Aquatic Resources, focused on restoring coral reefs.

Hanauma Bay, MLCD

Program Goals

Restore high value reef habitat
(coral numbers and diversity)

Maximize coral colony size

(Survival, Reproduction,
Ecological Services & Functions)

Minimize Additional Impacts

Issues

Source of Coral/Nexus Issues

Natural Hawaiian Coral Growth
Rates (SLOW!!!)

Ecological Service Values

AIS / Health

Time v Cost v Success



Unplanned Impacts



Planned Impacts

Suite of New Tools

- DLNR Aquatic Mitigation Bank (Currently CR)
- DAR Coral Ecological Characterization Tool
- DAR Coral Restoration Nursery



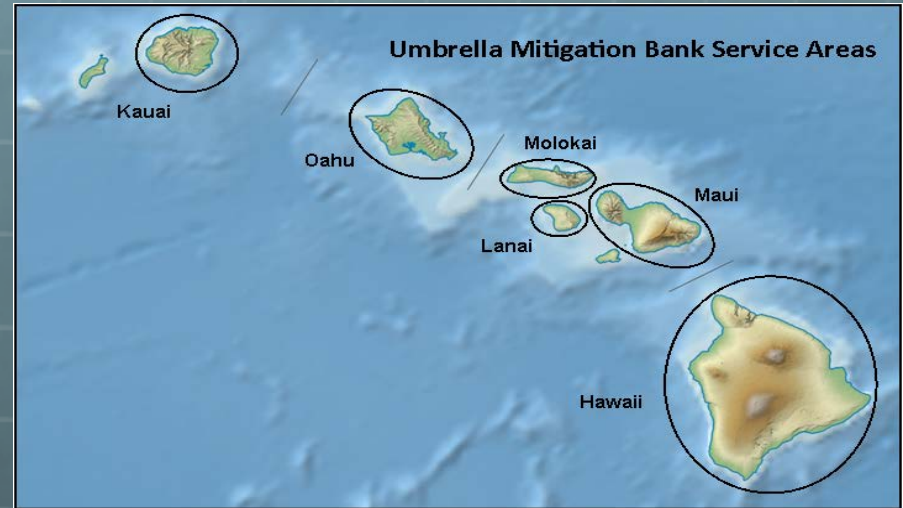
DLNR Coral Reef Mitigation Bank

- Based on unique State of Hawaii Natural Resource Trustee issues:
 - The State is the sole owner of submerged lands
 - Corals are legally protected in Hawaii by DLNR
 - The State manages all Coral Reef MPAs
- DLNR plays a non-decision making role on the Trustee-Advisory Group to USACE for Coral Reef Mitigation Bank issues.

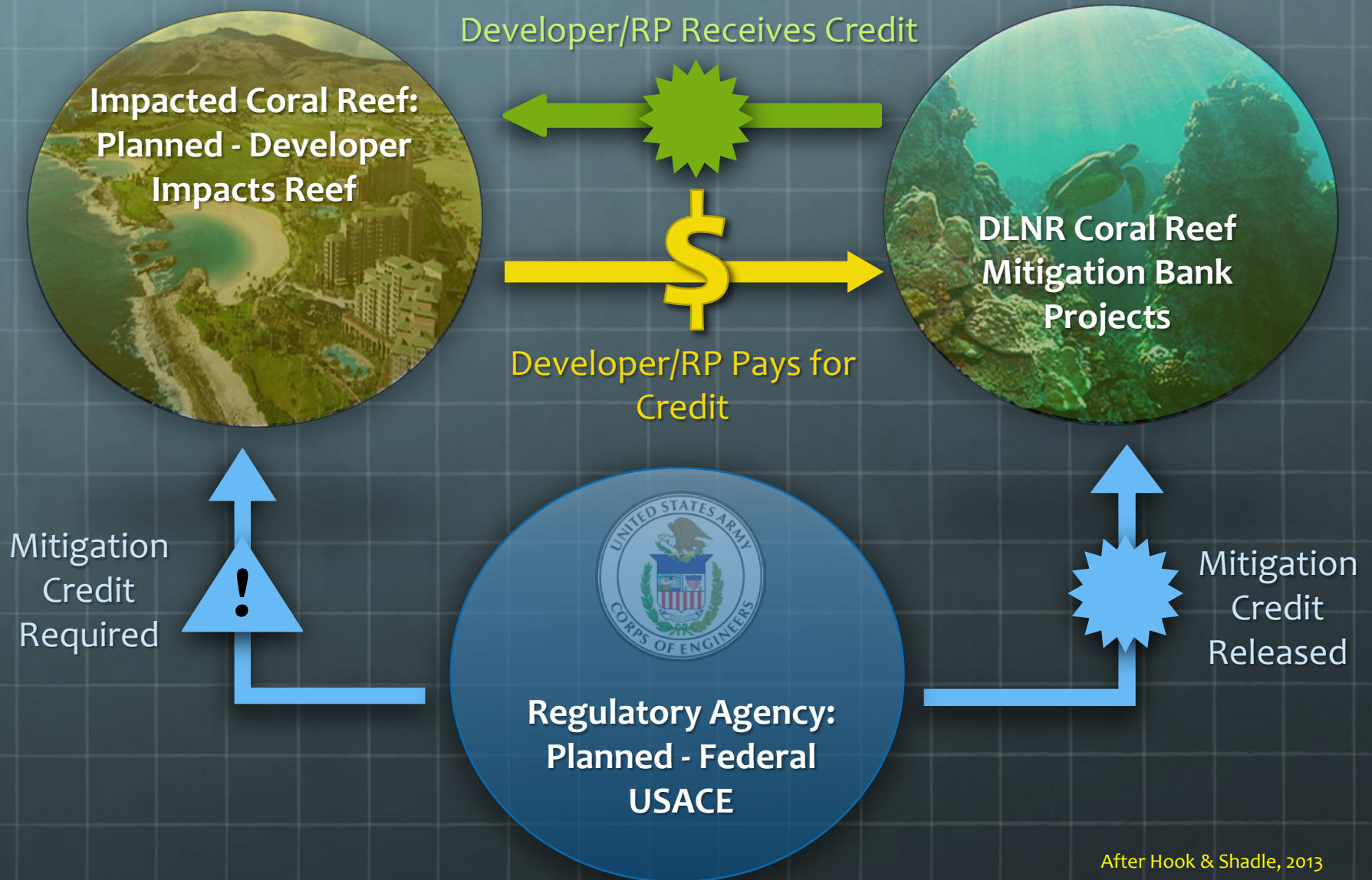


Coral Reef Mitigation Bank – Project Sites

- The eight Main Hawaiian Islands are broken down into multiple Bank Service Areas to maximize nexus issues
- Currently 2 Mitigation Bank Projects:
 - Kaneohe Bay AIS Control & Reef Restoration
 - Waikiki MLCD Reef Restoration
- Both projects make use of corals and expertise from the DAR Coral Nursery and the 'Harbor to Reefs' Coral Project.



Navigating the Hawai'i DLNR Coral Reef Mitigation Bank Process



DAR Coral Ecological Characterization Tool

- Based on USEPA Wetland Functions & Services valuation
- Value is non-currency based
- Utilizes 3 simple assessment factors:
 - Colony Size Range
 - Colony Species
 - Sub-Habitat Type
- Formula:

$$ECV = \text{Sum}[(\text{Form} \times \text{Size} \times R \times e) \times H]$$



Services and Functions

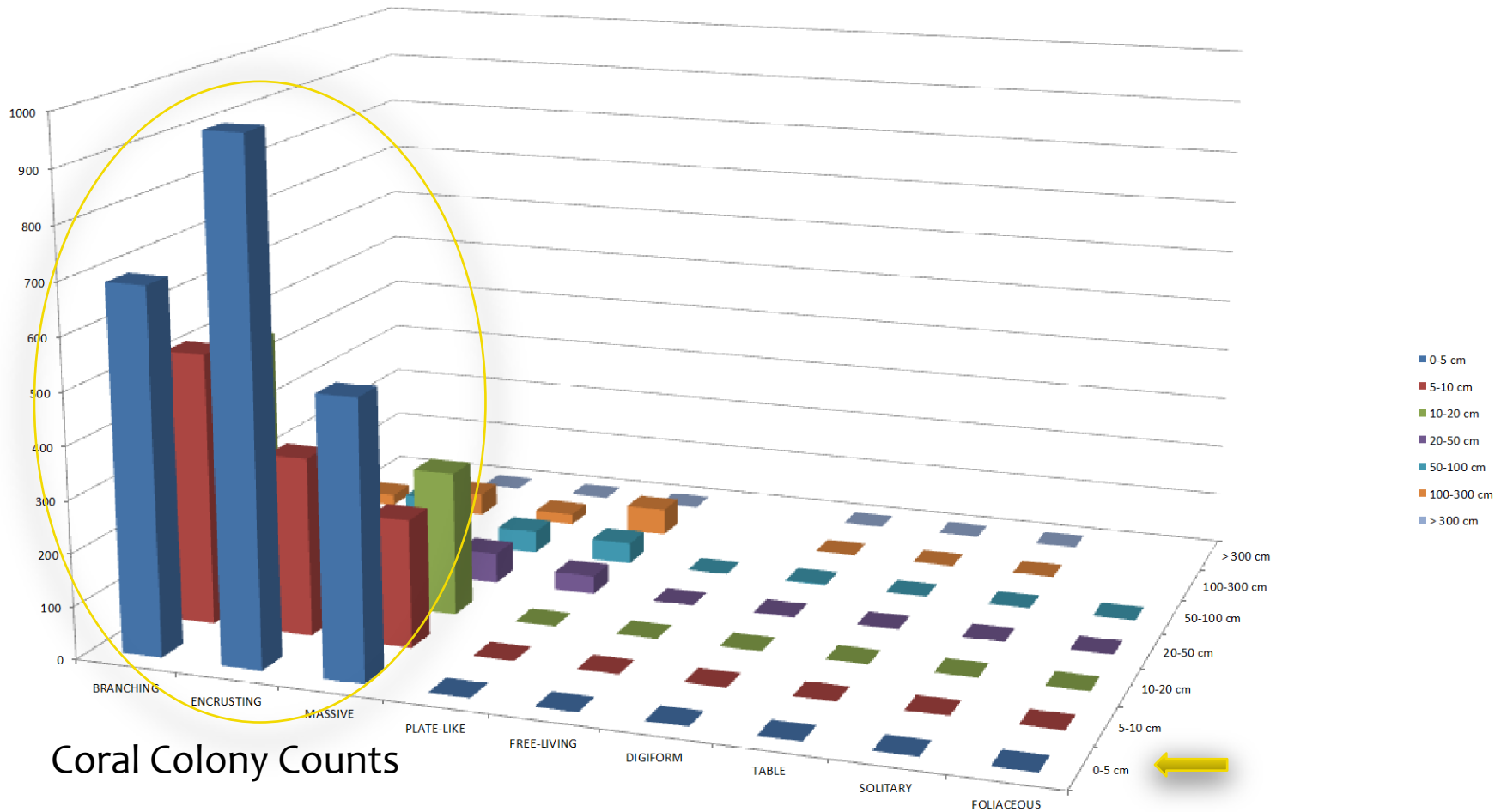
Size Services & Functions		0 - 5 cm	>5 - 10 cm	>10 - 20 cm	>20 - 40 cm	>40 cm - 80 cm	>80 - 160 cm	>160 cm
Regulatory								
Function	Sand Formation	0	0	1	2	5	10	20
	Gas Production	0	1	2	3	5	10	20
	Climate Regulation	0	0	1	2	3	5	10
	Wave Energy Regulation	0	0	1	3	6	15	20
	Nutrient/Carbon Cycling	0	1	2	3	5	10	20
Habitat								
Functions	Ecological/Symbiotic Interactions	0	1	2	4	8	15	20
	Cleaning Stations	0	0	0	2	5	15	20
	Shelter Refuge for flora/fauna (I.e. multiple fish/invertebrates/sea turtles, etc.)	0	1	2	3	5	10	20
	Reproductive Habitat For Fauna	0	0	1	2	5	10	20
	Foraging Habitat for Natural Assemblages	0	1	2	5	10	15	20
	Nursery Functions	0	0	1	3	5	10	20
Production								
Services	Food from System Inhabitants	0	0	0	2	5	10	20
	Medicinal Resources	1	2	2	2	2	2	2
	Ornamental Resources	0	1	2	5	10	15	20
Information								
Services	Aesthetics	0	2	3	5	10	15	20
	Recreation	0	0	1	5	10	15	20
	Cultural Value (Fishing Koas, etc.)	0	0	0	1	3	5	10
	Spiritual Value	2	2	2	2	2	2	2
	Historical Record	0	0	0	1	5	15	20
	Educational Value	1	2	2	3	3	5	5
	Research Value	2	2	2	3	3	3	3
	Other	1	1	1	1	1	1	1
Temporal								
Loss	(Assumes avg growth of 2 cm/yr)	0	3	5	10	25	50	150
Sum		7	22	40	87	166	363	633
Scoring for Assessment		0.5	1	2	5	10	25	50

DAR Coral Ecological Characterization Tool



DAR Coral Ecological Characterization Tool

Characterization Totals



Coral Colony Counts

DAR Coral Restoration Nursery

- First of its kind in the United States to be entirely focused on fast-growing corals for coral restoration and mitigation purposes
- Managed by the State of Hawai'i and funded through both NRD settlements and the DLNR Mitigation Bank.

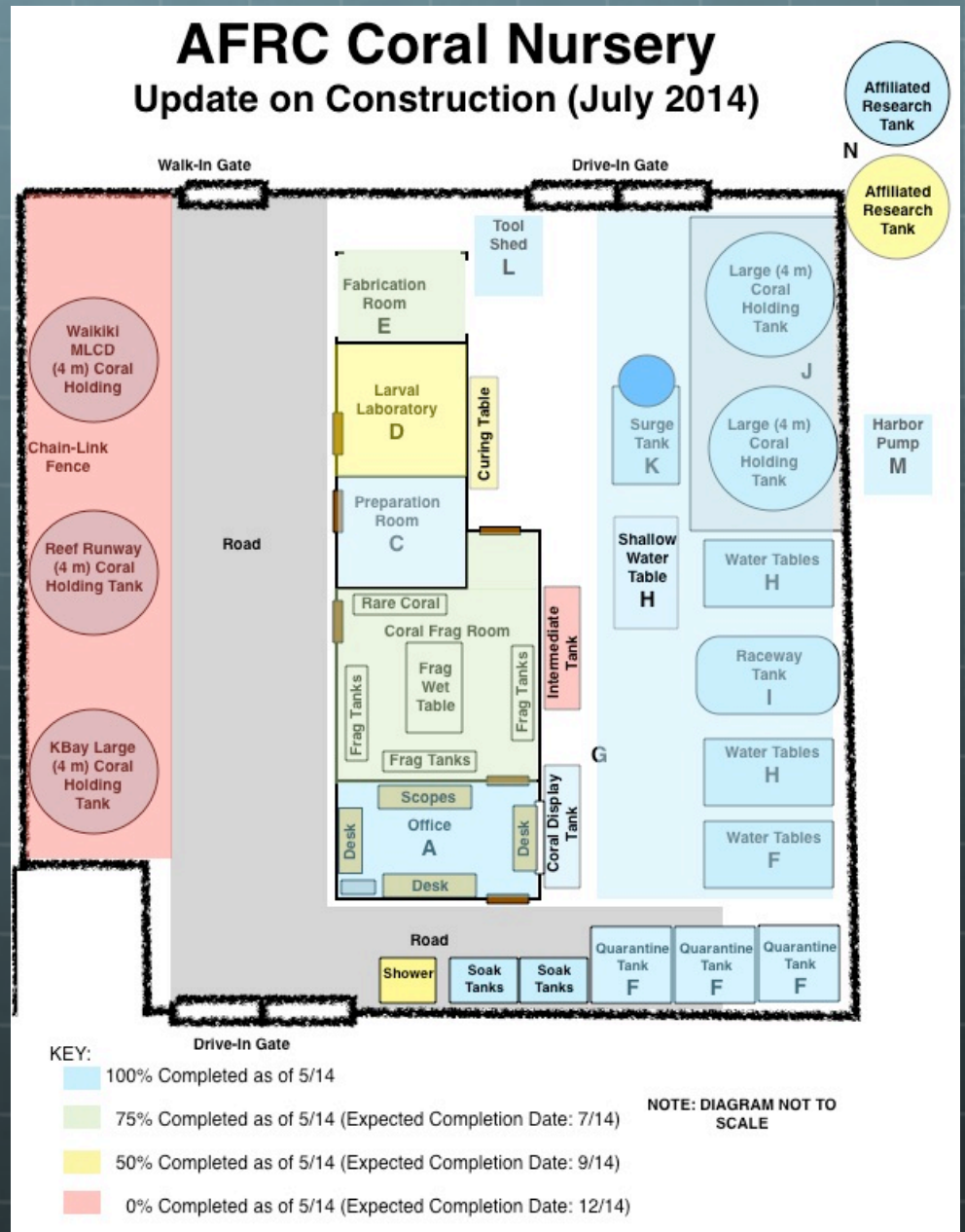


Formal Opening:
March 2015

Nursery Facility Details

- Land-based with secure ocean grow-out area nearby
- 3 Saltwater Sources
- Dedicated facility
- Dedicated staff
 - 1 Coral Restoration Specialist
 - 1 Coral Propagation Specialist
 - 2 Nursery Technicians
- Multiple Projects
 - Harbor to Reef
 - Line Nursery
 - Asexual Planula Seeding
 - Rare Coral Ark (WA, MOC)

Formal Opening:
March 2015



Harbor to Reef Coral Project

Ala Wai Harbor

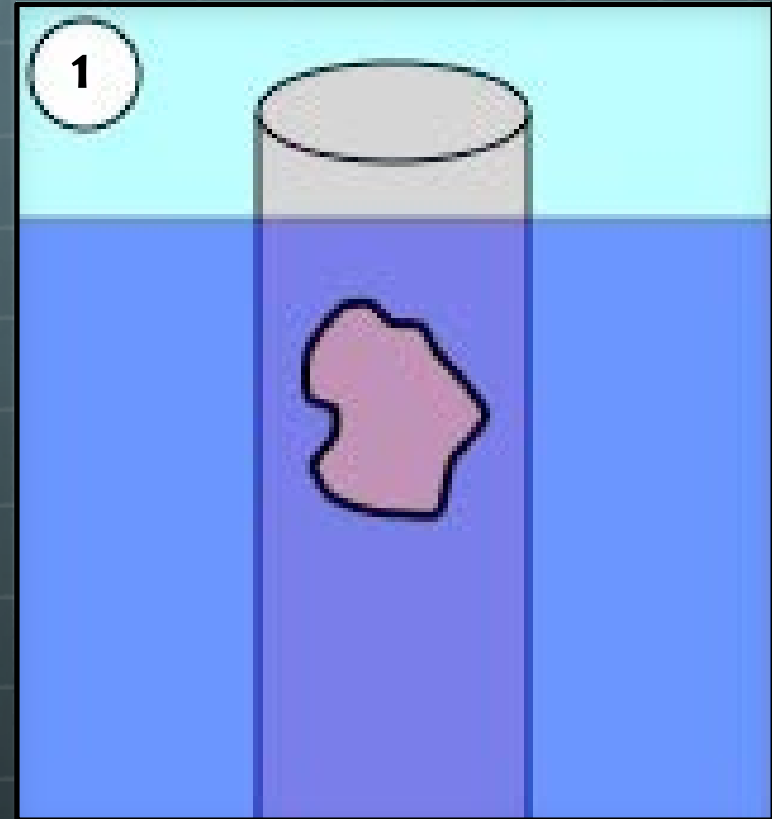
Collection – Phase 1

Size: 20 cm (longest diameter)

Ecol. Characterization Value: 2

Estimated Growth Rate: 1 cm/yr

Time Frame: Month 1 (Day 0)



AIS / Health Evaluation

Harbor to Reef Coral Project

Coral Nursery

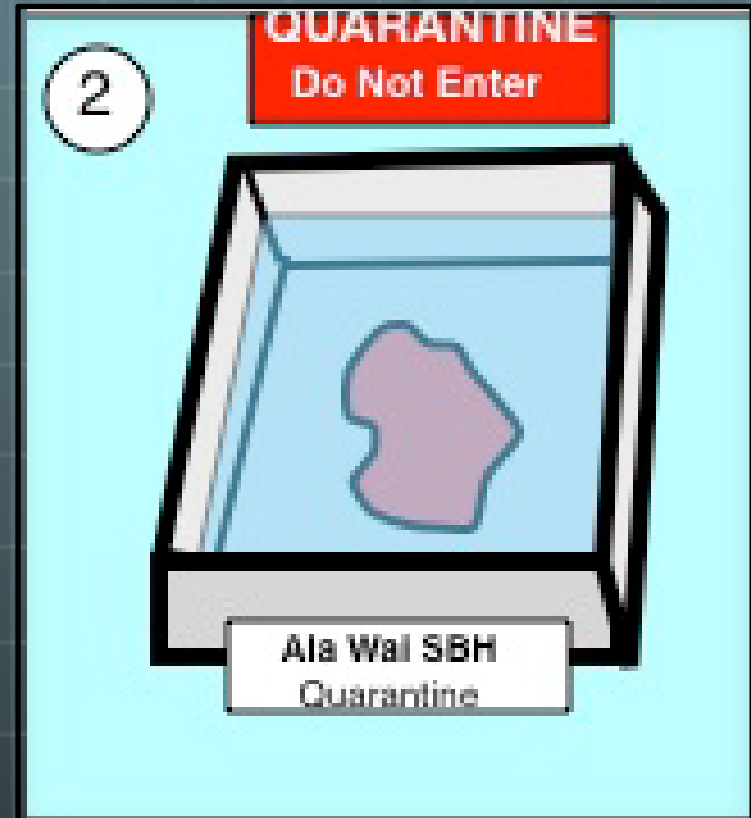
Dedicated Quarantine – Phase 2

Size: 20 cm (longest diameter)

Ecol Characterization Value: n/a

Estimated Growth Rate: 1 cm/yr

Time Frame: Month 1 (Day 1)



AIS / Health Evaluation



Harbor to Reef Coral Project

Coral Nursery

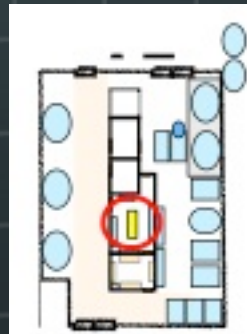
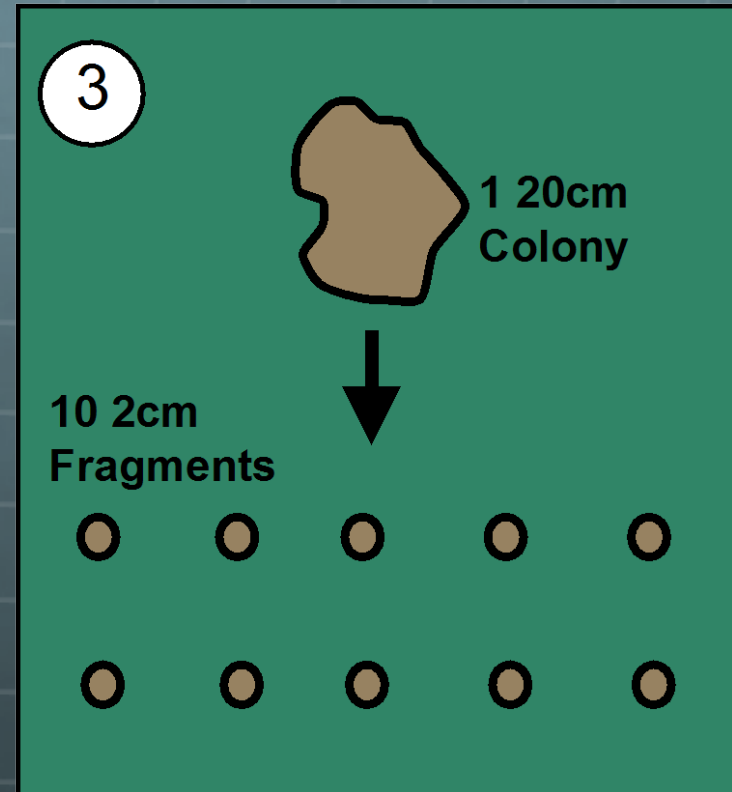
Fragmentation – Phase 3

Size: 10 x 2 cm (longest diameter)

Ecol. Characterization Value: n/a

Estimated Growth Rate: 1 cm/yr

Time Frame: Month 2 (Day 35)



Harbor to Reef Coral Project

Coral Nursery

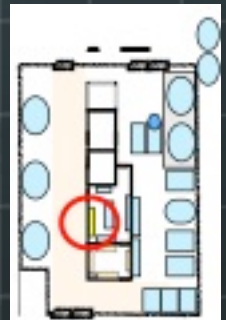
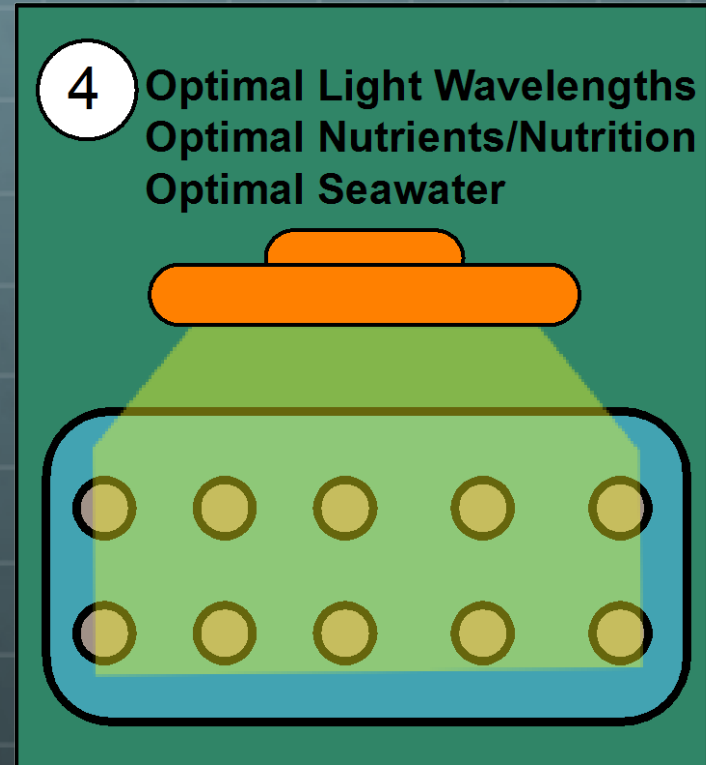
Fast-Growth Frag Room – Phase 4

Size: 10 x 3 cm (longest diameter)

Ecol. Characterization Value: n/a

Estimated Growth Rate: 6 cm/yr

Time Frame: Month 4 (Day 125)



Harbor to Reef Coral Project

Coral Nursery

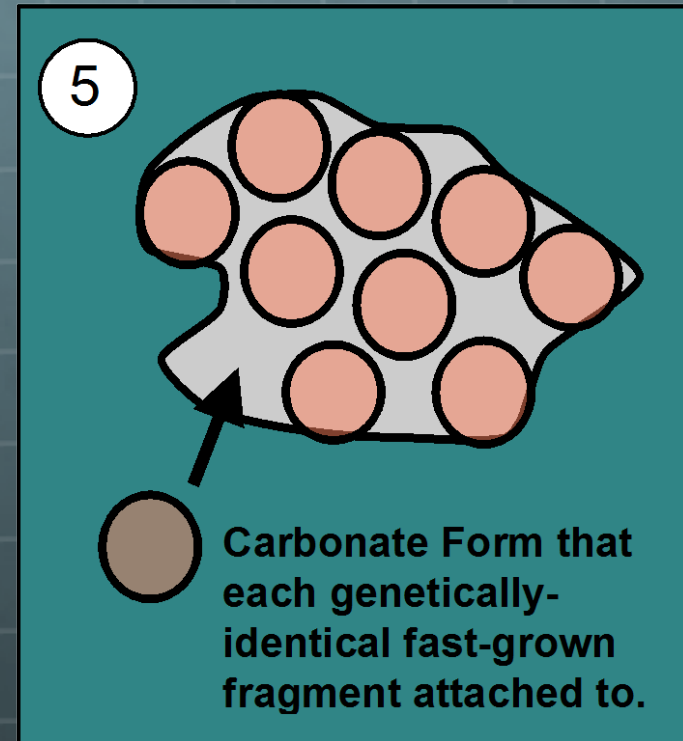
Re-Aggregation – Phase 5

Size: 10 x 4 cm (longest diameter)

Ecol Characterization Value: n/a

Estimated Growth Rate: 1 cm/yr

Time Frame: Month 8 (Day 250)



Harbor to Reef Coral Project

Coral Nursery

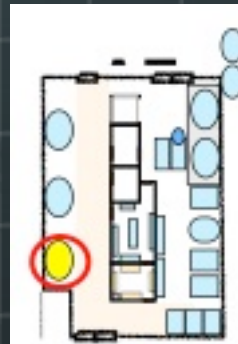
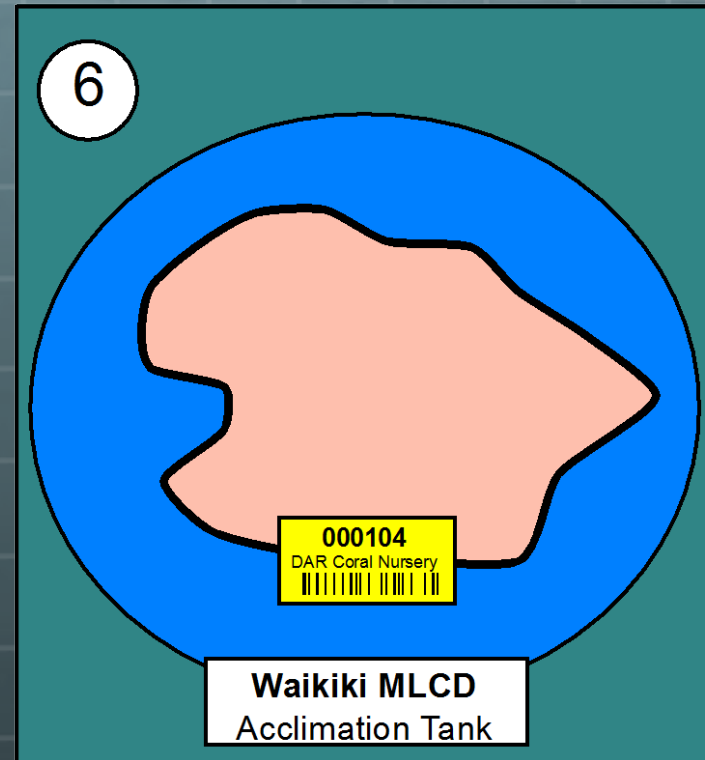
Acclimation Tank – Phase 6

Size: 40 cm (longest diameter)

Ecol. Characterization Value: n/a

Estimated Growth Rate: 1 cm/yr

Time Frame: Month 10 (Day 300)



Harbor to Reef Coral Project

Waikiki MLCD

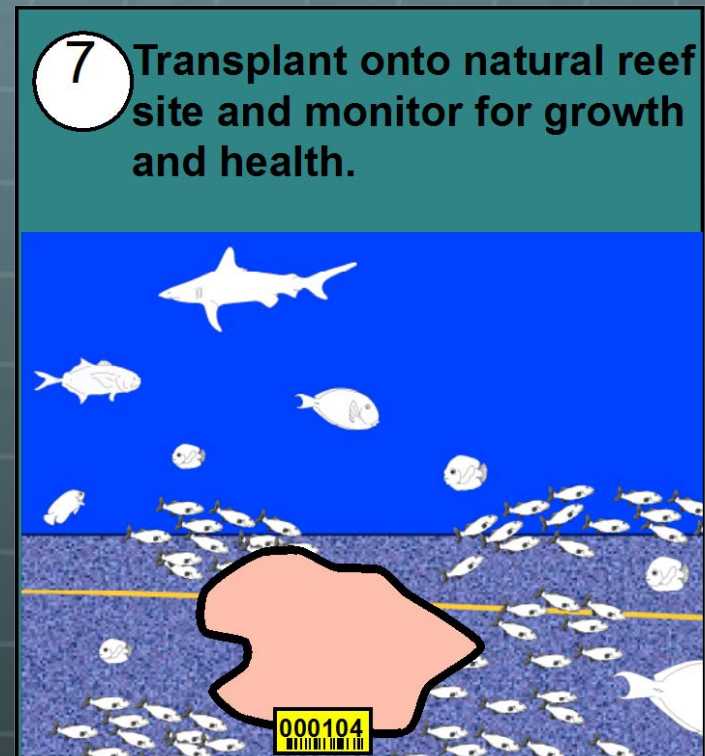
Coral Restoration Site – Phase 7

Size: 40 cm (longest diameter)

Ecol. Characterization Value: 15

Estimated Growth Rate: 1 cm/yr

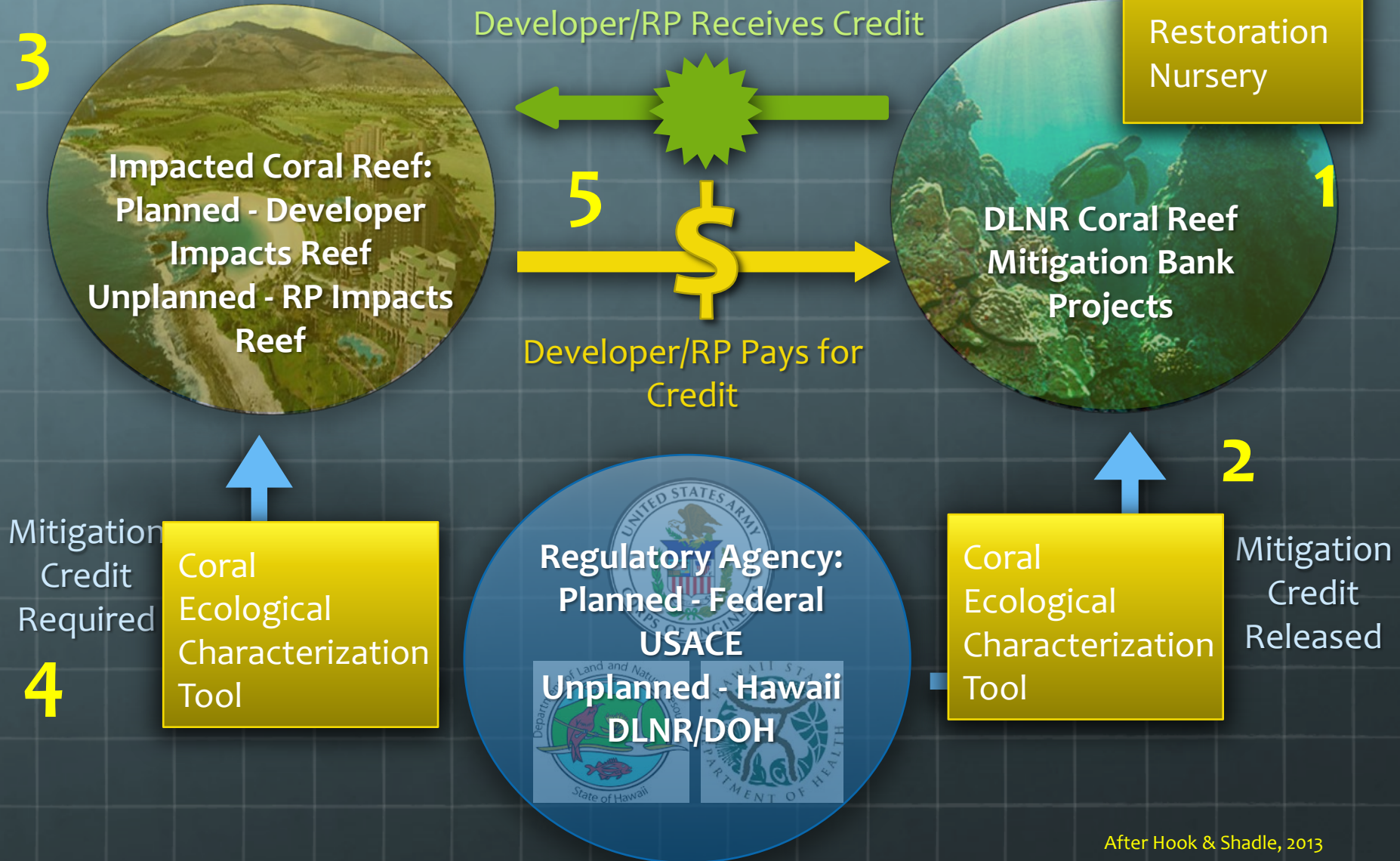
Time Frame: Month 13 (Day 370)



AIS / Health Evaluation

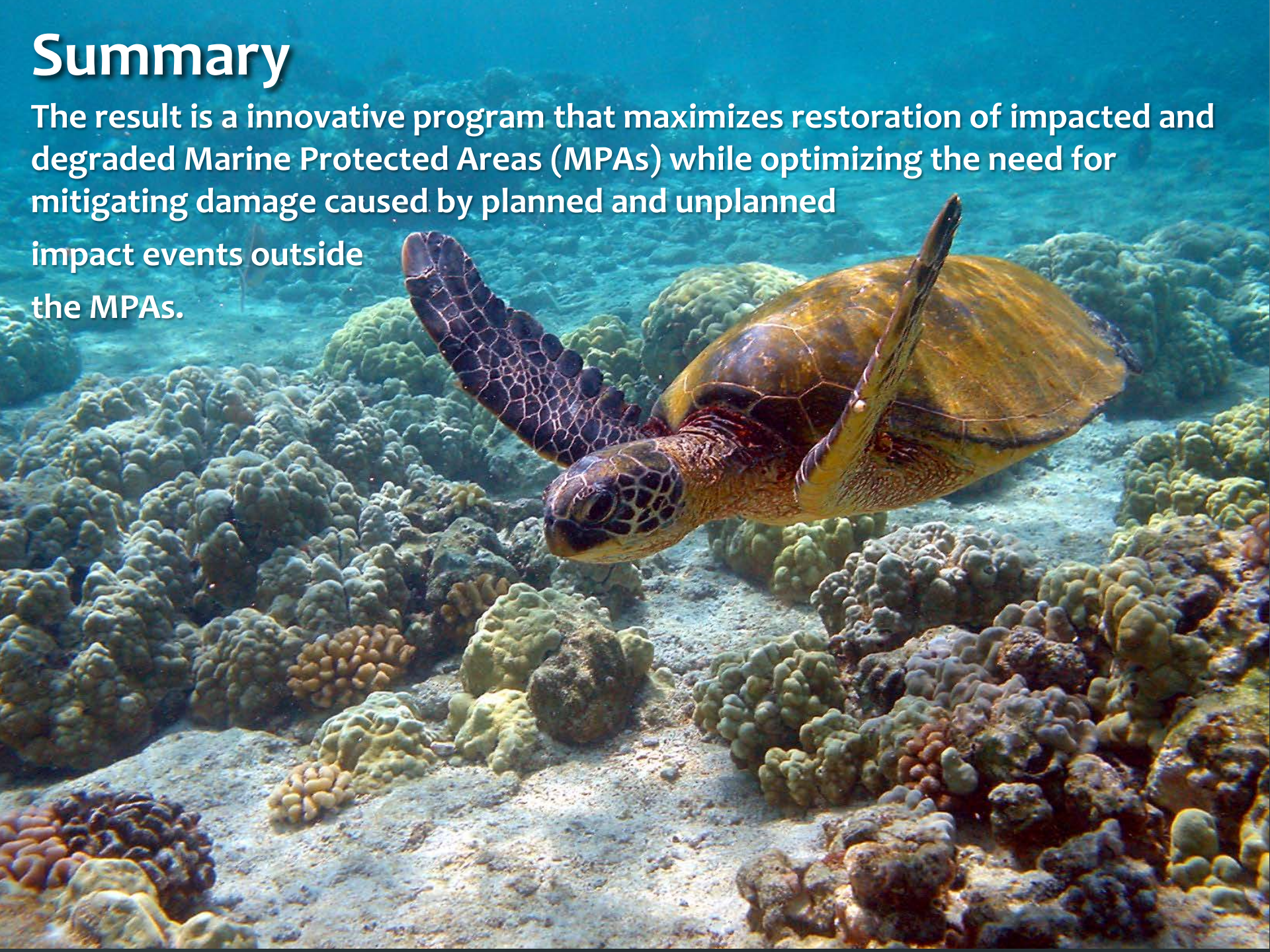
Hawaiian Coral Growth Process	Expected Growth Rate (20 cm colony to 40 cm colony)	Advantages / Disadvantages
In-Situ (Natural Environment)	1 cm/yr 20 years	<ul style="list-style-type: none"> • High Ecological Service Value • Slow Growth Rate • High Risk until Size Refuge
In-Situ (Harbor)	1 cm/yr 20 years	<ul style="list-style-type: none"> • Low Ecological Service Value • Slow Growth Rate • High Risk Environment
In-Water Nursery	1+ cm/yr 15 – 20 years	<ul style="list-style-type: none"> • Medium Low Ecological Service Value • Slow Growth Rate • Medium High Risk until Size Refuge
DAR Coral Nursery	Approx. 4 - 6 cm/yr frags plus recombine to form 40 cm 1+ year	<ul style="list-style-type: none"> • High Ecological Service Value • Fast Growth Rate • Can be designed for optimal needs • Low Risk until Size Refuge

Navigating the Hawai'i DLNR Coral Reef Mitigation Bank Process



Summary

The result is a innovative program that maximizes restoration of impacted and degraded Marine Protected Areas (MPAs) while optimizing the need for mitigating damage caused by planned and unplanned impact events outside the MPAs.





QUESTIONS?