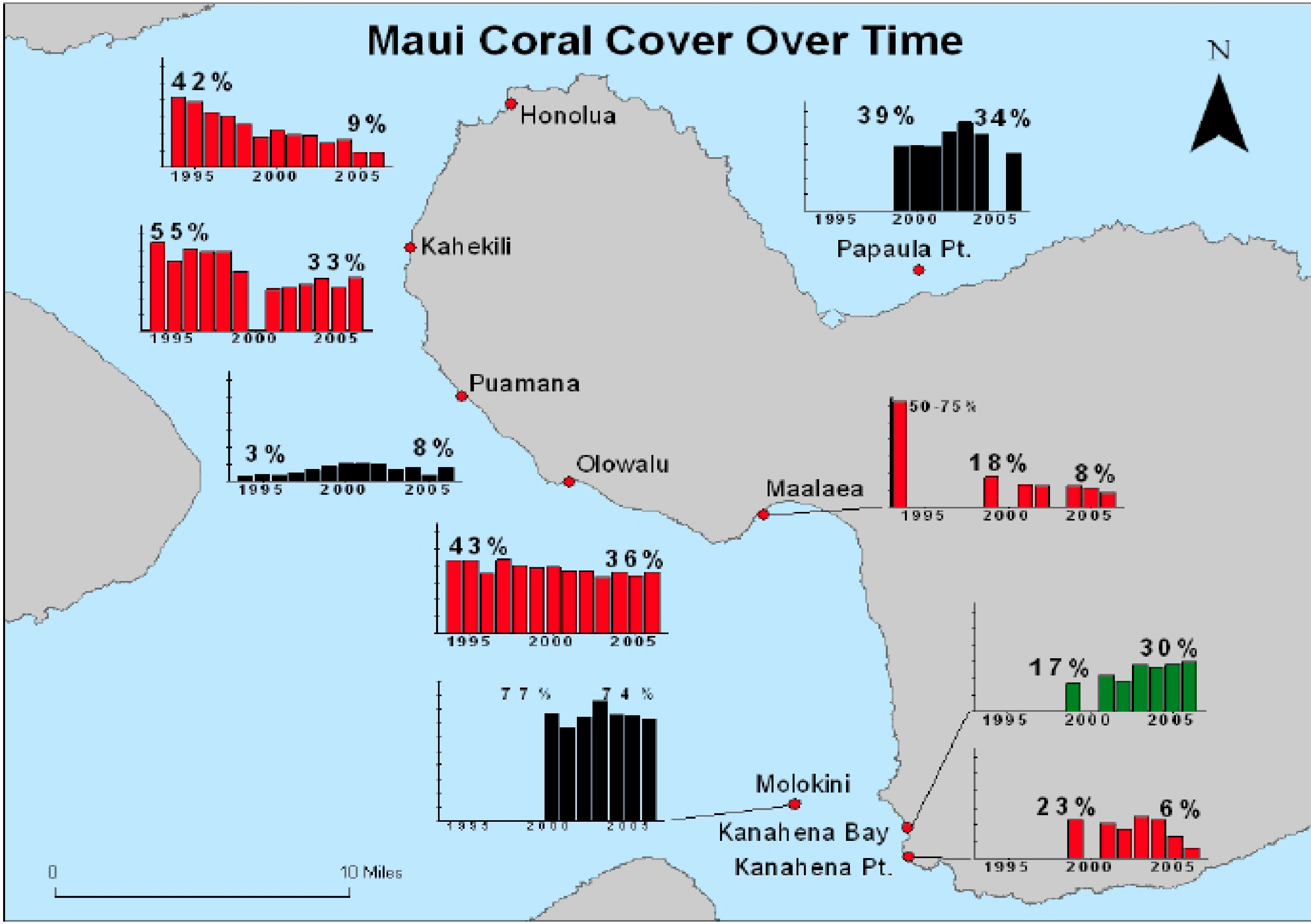
4. Water Quality, Herbivory & Accretion

4. Water Quality, Herbivory & Accretion

Collaborators

Levi Lewis,	SIO,	lead
Jennifer Smith,	SIO,	design, field
Nichole Price,	SIO,	design, field?
Yui Takashita,	SIO,	water chemistry
Emily Kelly,	SIO,	field
Darla White,	DAR	field
Russell Sparks,	DAR	design
Meghan Dailer,	UH?	design



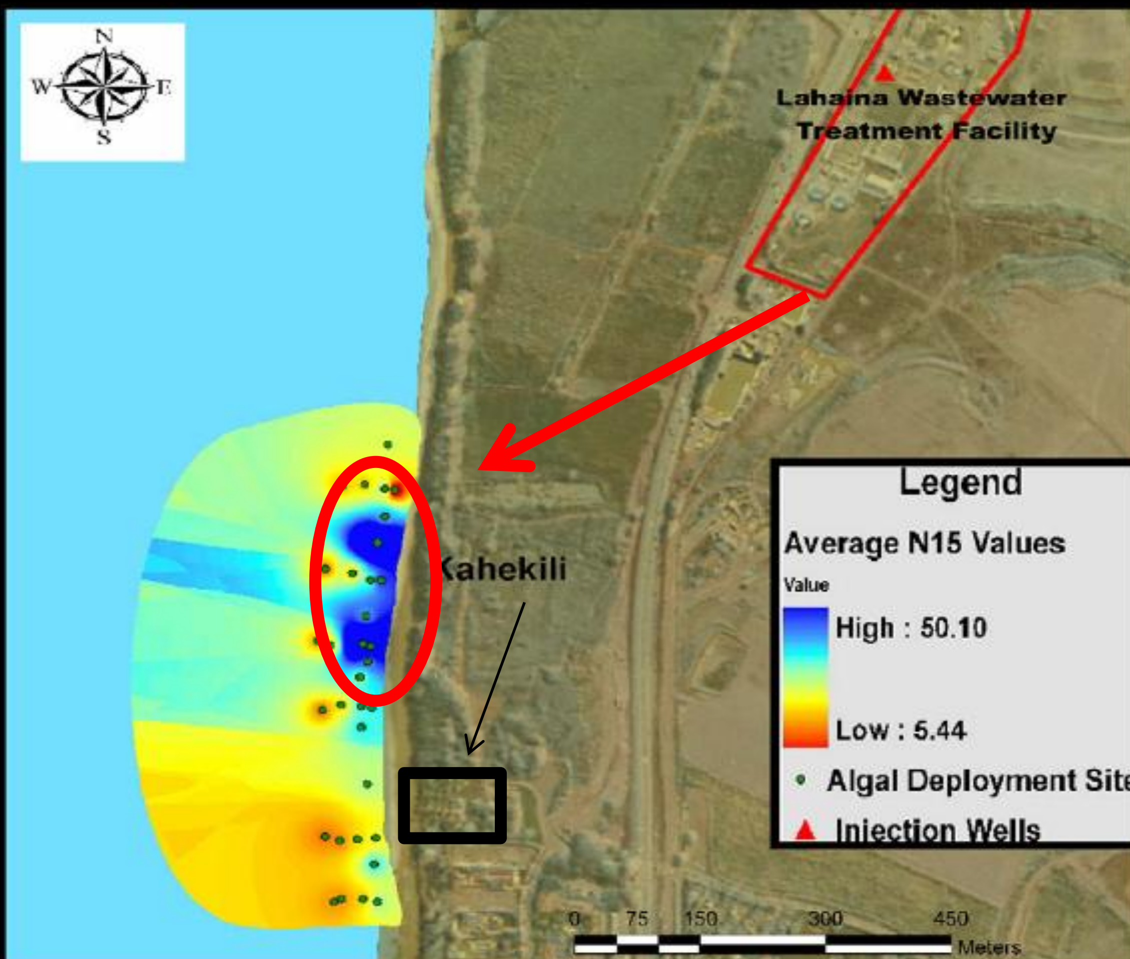
Trends in coral cover at 9 long-term monitoring stations. Red indicates >5% decline over monitoring period, green indicates >5% increase, **black** = no change (<5%)

DAR and HCRI 2008

Using δ^{15}N values in algal tissue to map locations and potential sources of anthropogenic nutrient inputs on the island of Maui, Hawai'i, USA

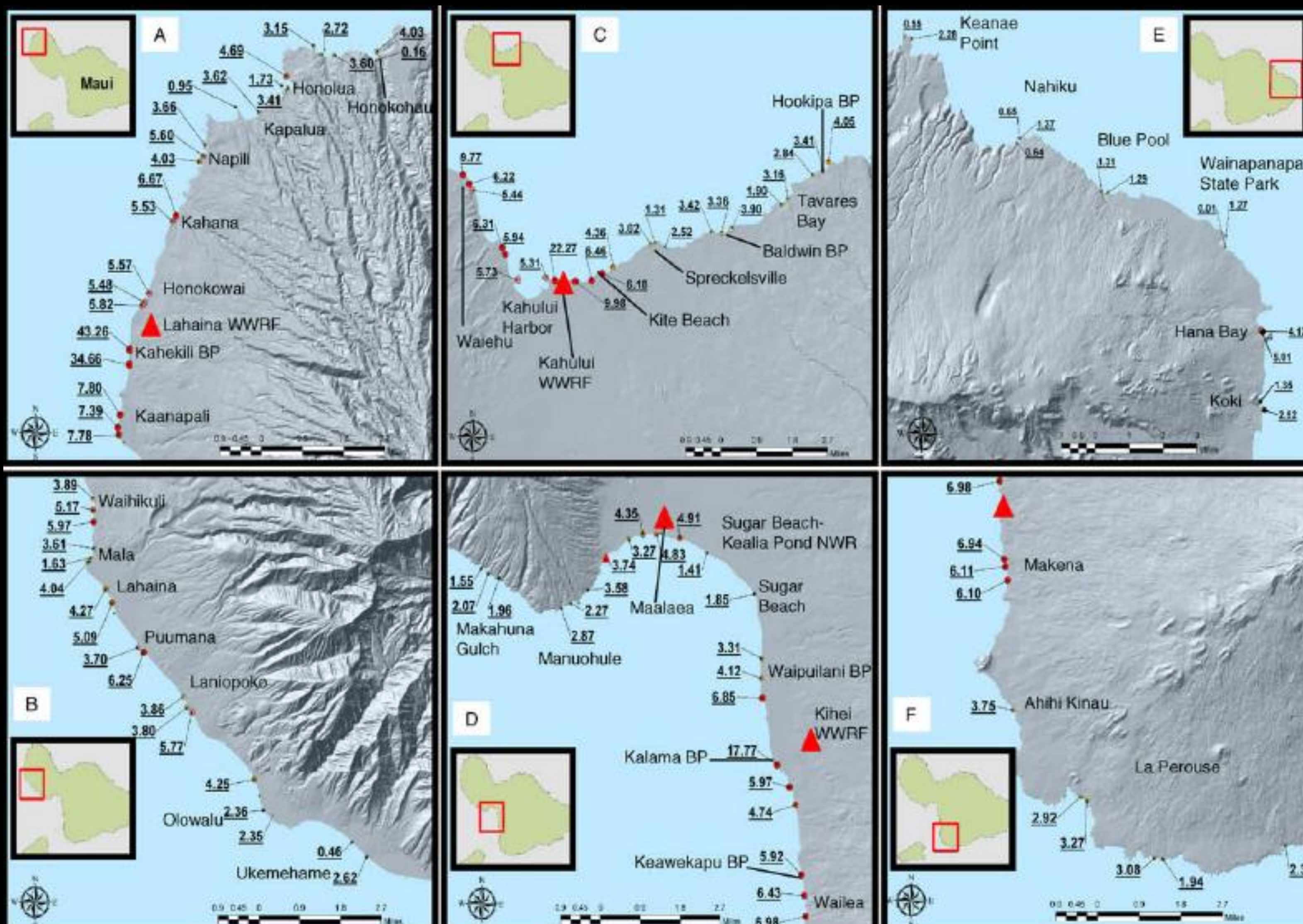
Meghan L. Dailer[a,*], Robin S. Knox[a,c], Jennifer E. Smith[b], Michael Napier[d], Celia M. Smith[a]

[a] University of Hawai'i, Department of Botany, 3190 Maile Way, Honolulu, HI 96822, USA
[b] University of California San Diego, Scripps Institution of Oceanography, 9500 Gilman Dr. Mail Code 0202, La Jolla, CA 92083-0202, USA
[c] Water Quality Consulting, Inc., 728A Kupulau Drive, Kihei, HI 96753, USA
[d] Maui GeoSciences, 755 Kupulau Drive, Kihei, HI 96753, USA



Sewage Injection Wells

- 2,000,000,000 gal/yr
- 30,000 kg N/yr
- X 3 major wells (many smaller)
  - Lahaina
  - Kihei
  - Kahului


A
Maui
3.15
2.72
4.03
0.16
4.69
3.60
1.73
Honolua
Honokohau
3.62
0.95
3.41
Kapalua
3.66
5.60
4.03
Napili
6.67
5.53
Kahana
5.57
Honokowai
5.48
5.82
Lahaina WWRF
43.26
Kahekili BP
34.66
7.80
7.39
Kaanapali
7.78
C
Hookipa BP
4.05
3.41
2.84
9.77
3.16
6.22
1.90
Tavares
Bay
6.44
3.90
1.31
3.42
3.36
6.31
4.26
3.02
2.52
Baldwin BP
5.94
6.46
Spreckelsville
22.27
5.31
5.73
6.18
Kite Beach
9.98
Kahului
Harbor
Waiehu
Kahului
WWRF
E
0.55
2.28
Keanae
Point
Nahiku
0.65
1.27
0.64
Blue Pool
1.31
1.29
Wainapanapa
State Park
0.01
1.27
Hana Bay
4.12
5.01
1.36
Koki
2.52
B
3.89
Waihikuli
5.17
5.97
3.61
Mala
1.63
4.04
Lahaina
4.27
5.09
Puumana
3.70
6.25
Laniopoko
3.86
3.80
5.77
4.25
Olowalu
2.36
2.35
0.46
Ukemehame
2.62
D
4.35
4.91
Sugar Beach-
Kealia Pond NWR
3.27
4.83
3.74
1.41
1.55
3.58
Maalaea
2.07
1.96
2.27
1.85
Sugar
Beach
Makahuna
Gulch
2.87
Manuohule
3.31
4.12
Waipuilani BP
6.85
Kihei
WWRF
Kalama BP
17.77
5.97
4.74
Keawekapu BP
5.92
6.43
Wailea
6.98
F
6.98
6.94
Makena
6.11
6.10
3.75
Ahihi Kinau
La Perouse
2.92
3.27
3.08
1.94
2.39

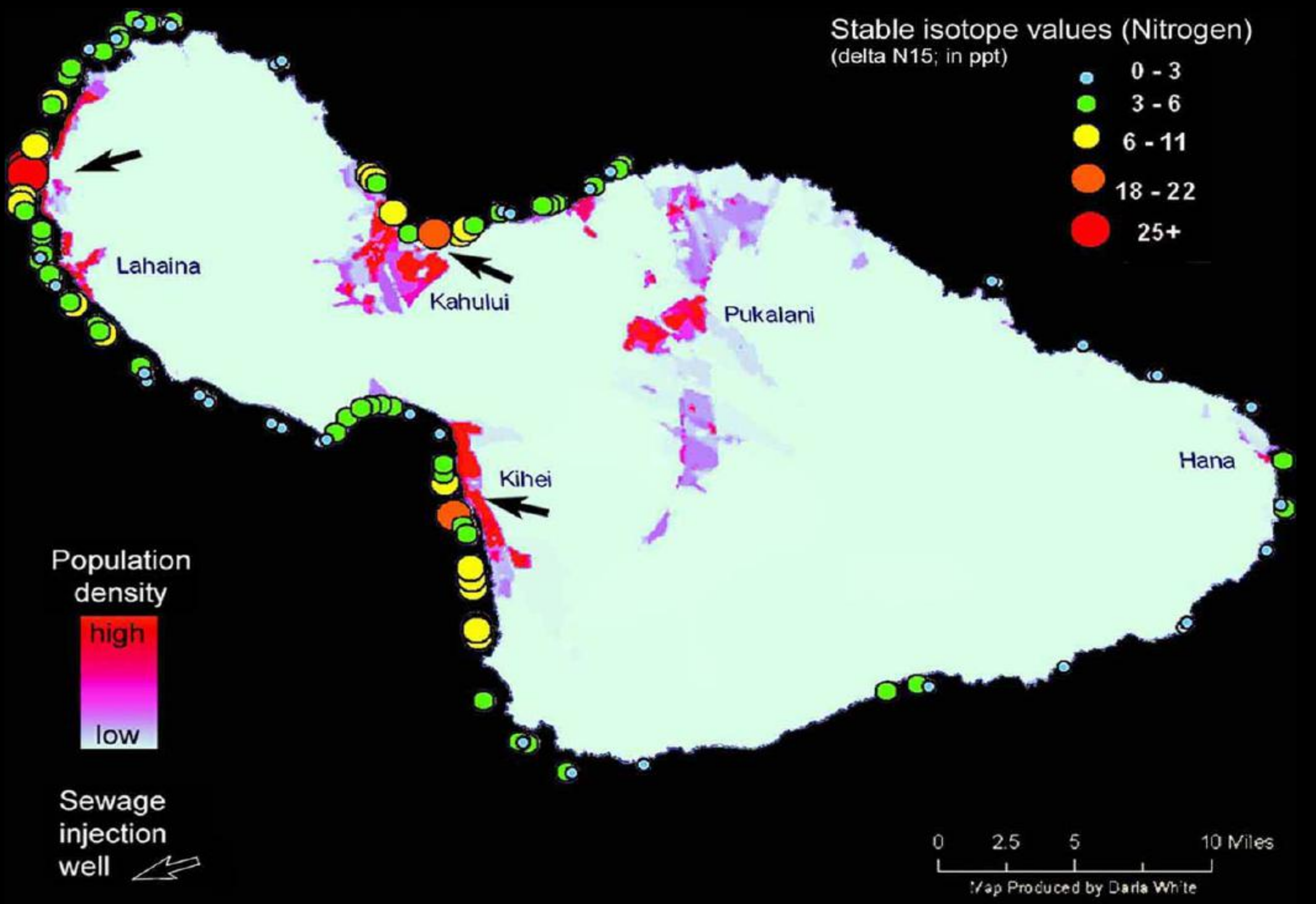


figure courtesy Meghan Dailer

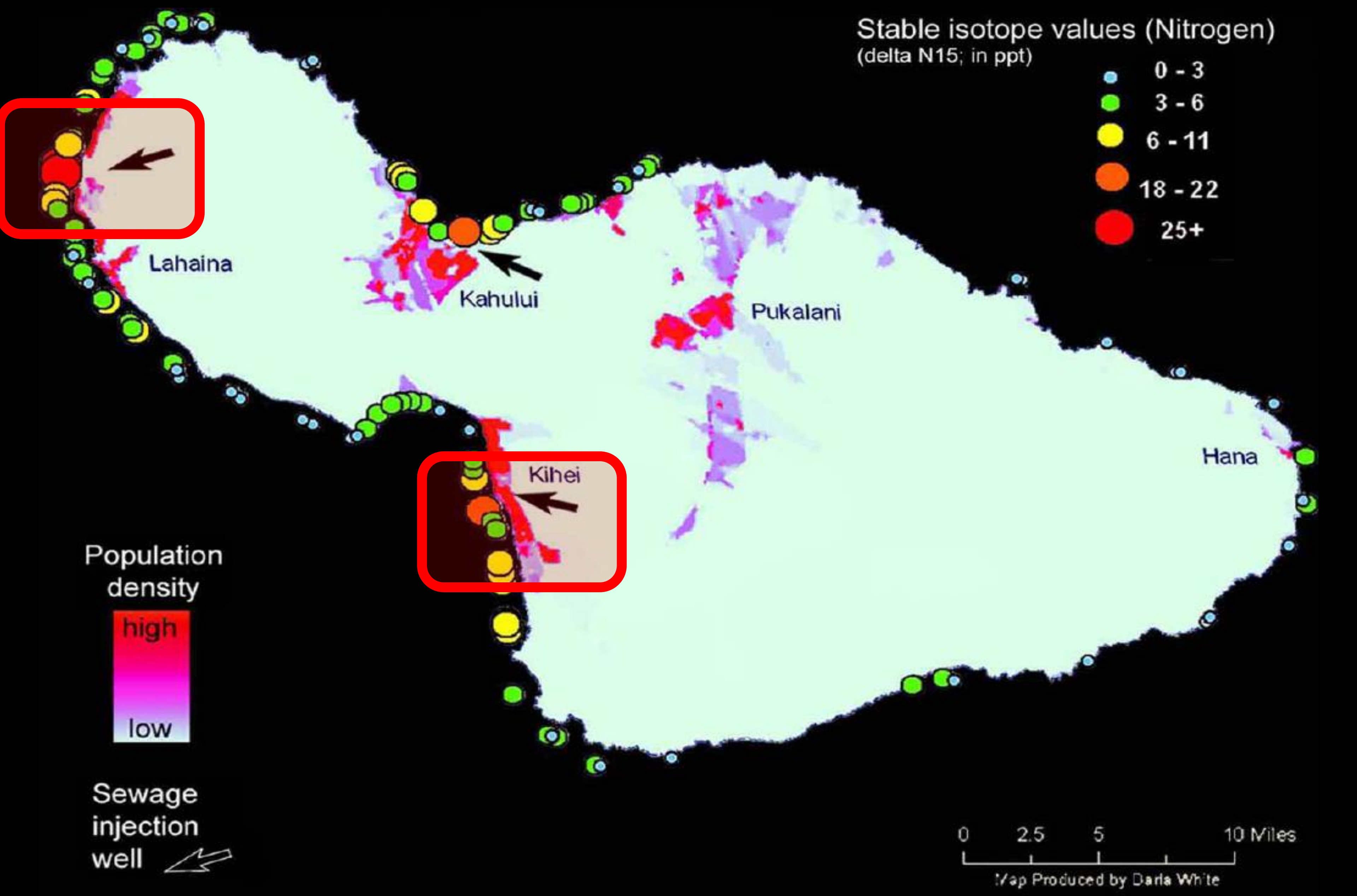
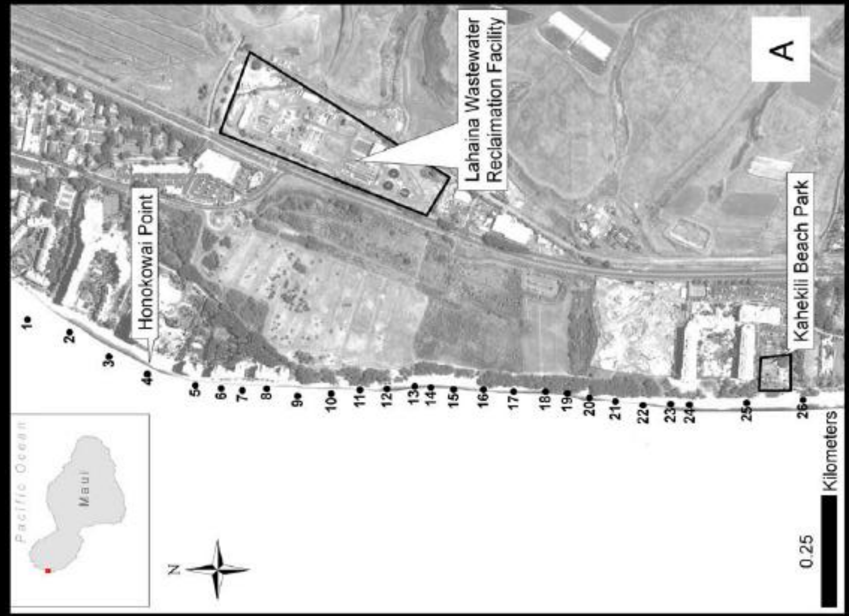
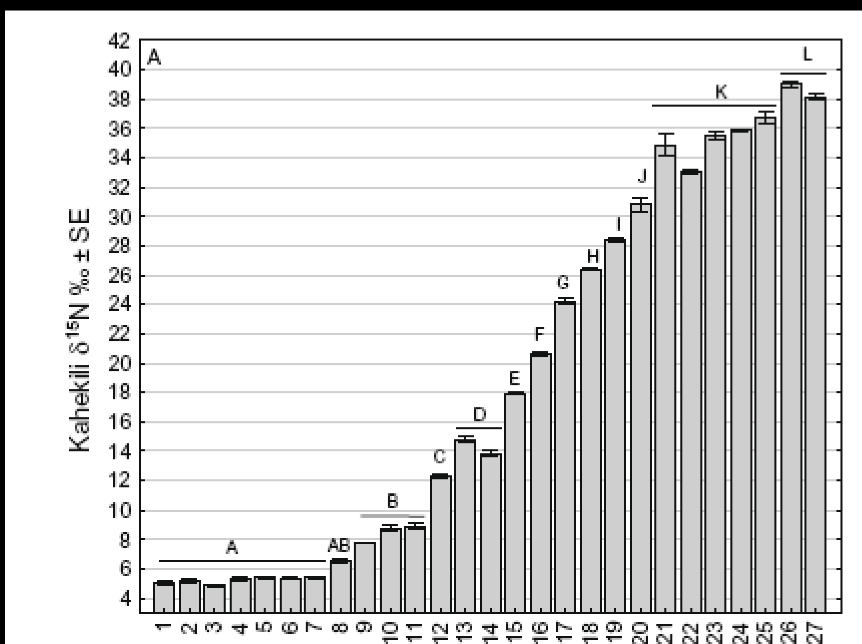
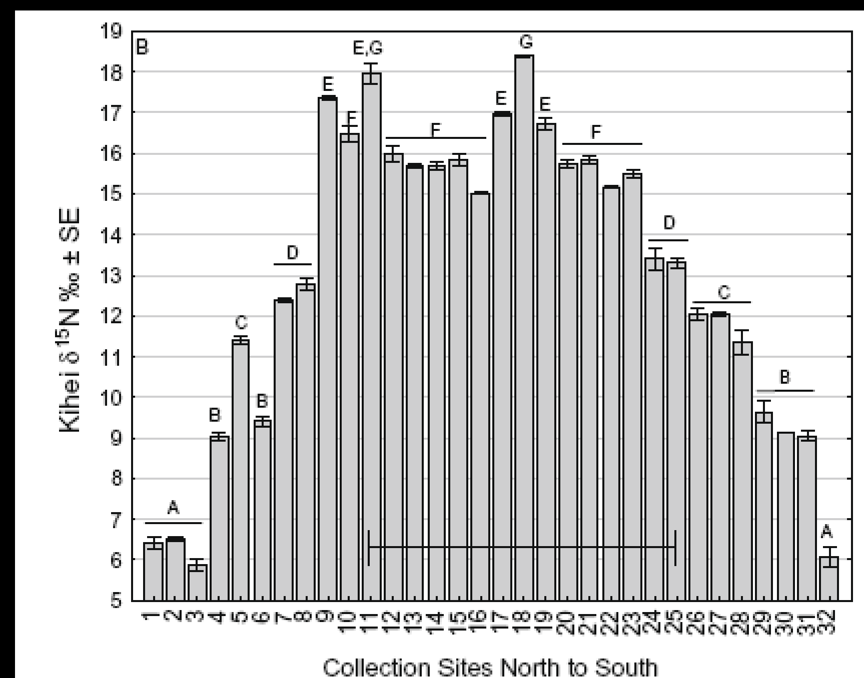


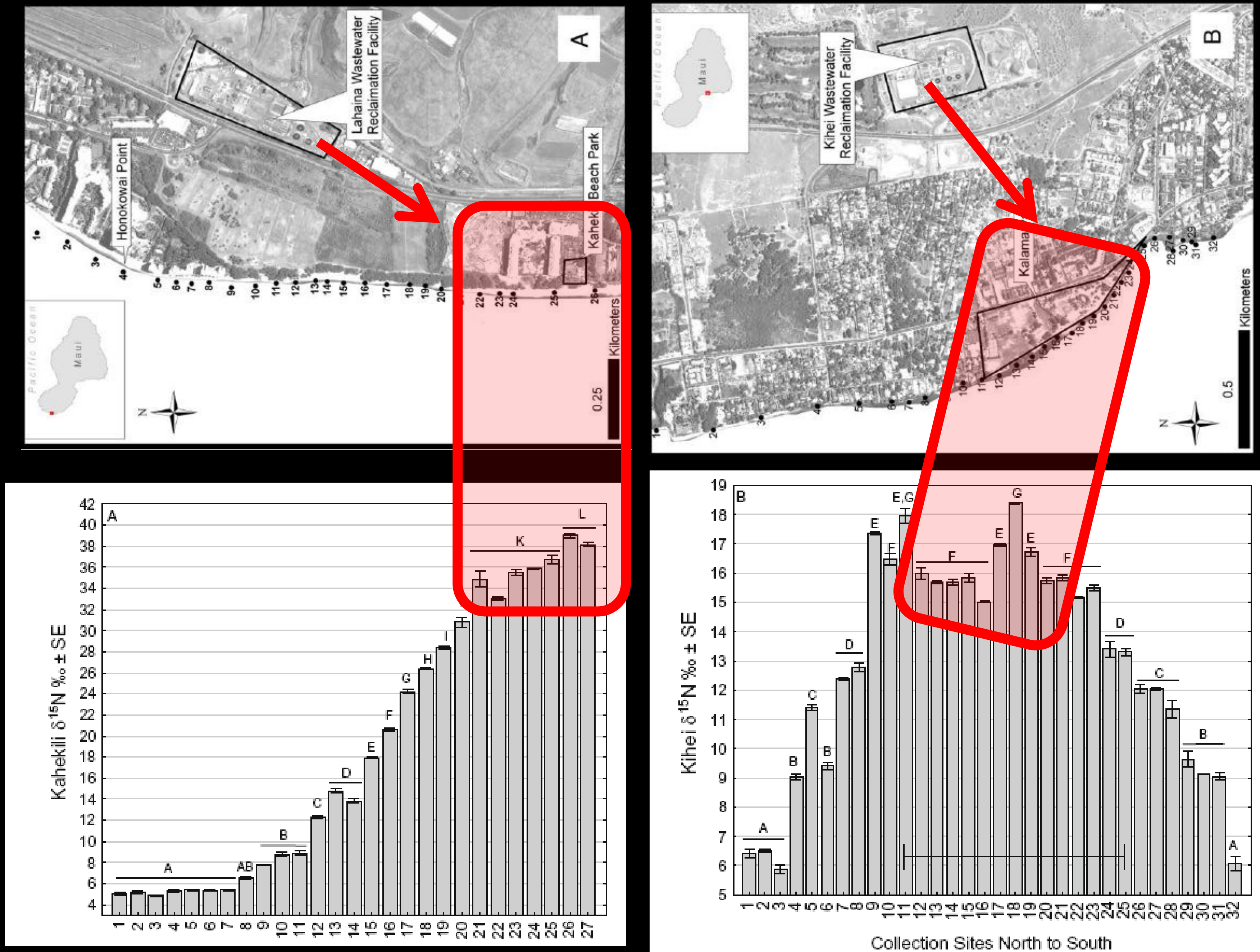
figure courtesy Meghan Dailer


A
Lahaina Wastewater Reclamation Facility
Honokowai Point
Kahekili Beach Park
Pacific Ocean
Maui
N
Kilometers
0.25


B
Pacific Ocean
Maui
Kihei Wastewater Reclamation Facility
Kalama Park
N
Kilometers
0.5


A
Kahekili δ15N ‰ ± SE
A
AB
B
C
D
E
F
G
H
I
J
K
L


B
Kihei δ15N ‰ ± SE
Collection Sites North to South
A
B
C
D
E
E,G
F
G



A
Lahaina Wastewater Reclamation Facility
Honokowai Point
Kahekili Beach Park
Kilometers
0.25
Pacific Ocean
Maui
N
B
Kihei Wastewater Reclamation Facility
Kalama
Kilometers
0.5
Kahekili δ15N ‰ ± SE
Kihei δ15N ‰ ± SE
Collection Sites North to South

- **Tracers indicate strong human influence.**
- **What does this mean biologically?**

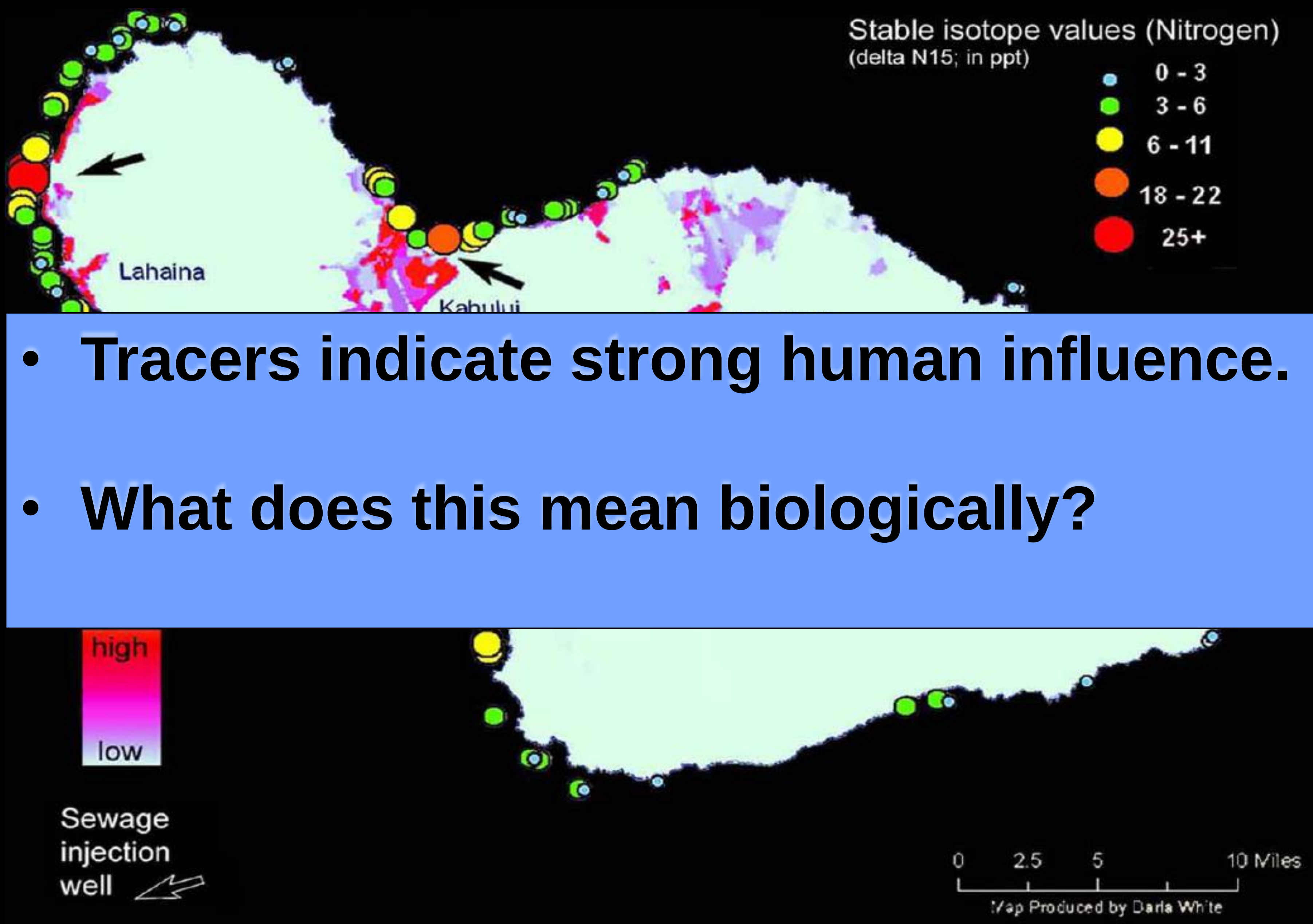
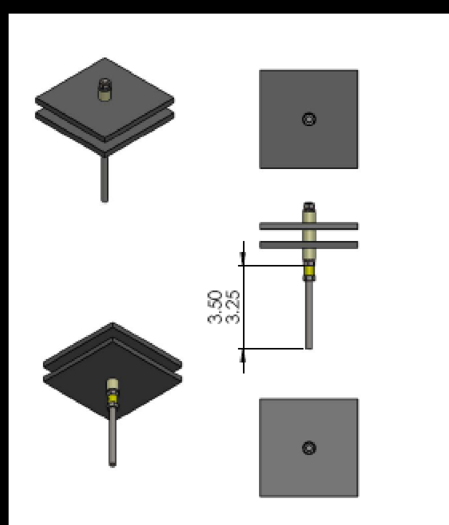


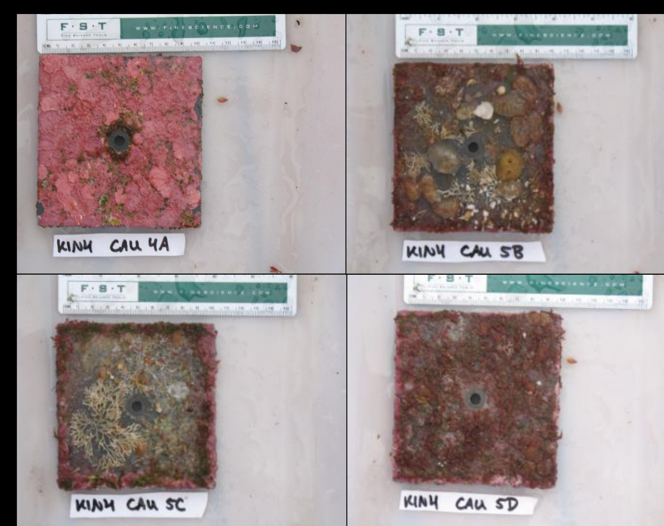
figure courtesy Meghan Dailer

General Approach

A. Use “calcification/accretion units” (CAUs) to explore succession & accretion adjacent to, and distant from, areas affected by sewage injection wells (Dailer 2010); and in habitats that are protected/unprotected from fishing.

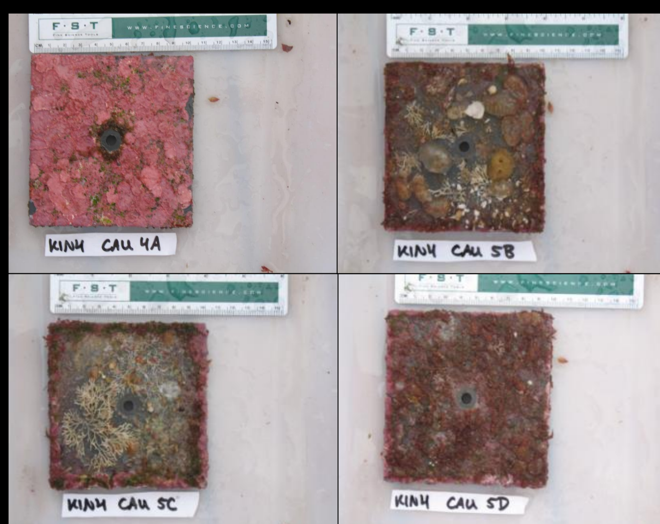
B. Use caged and “free range” CAUs to explore the effects of herbivory.

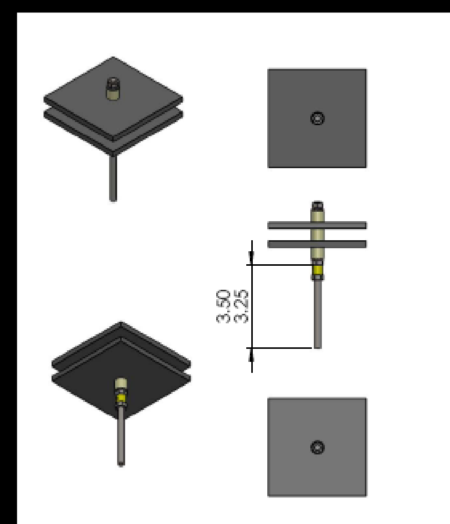


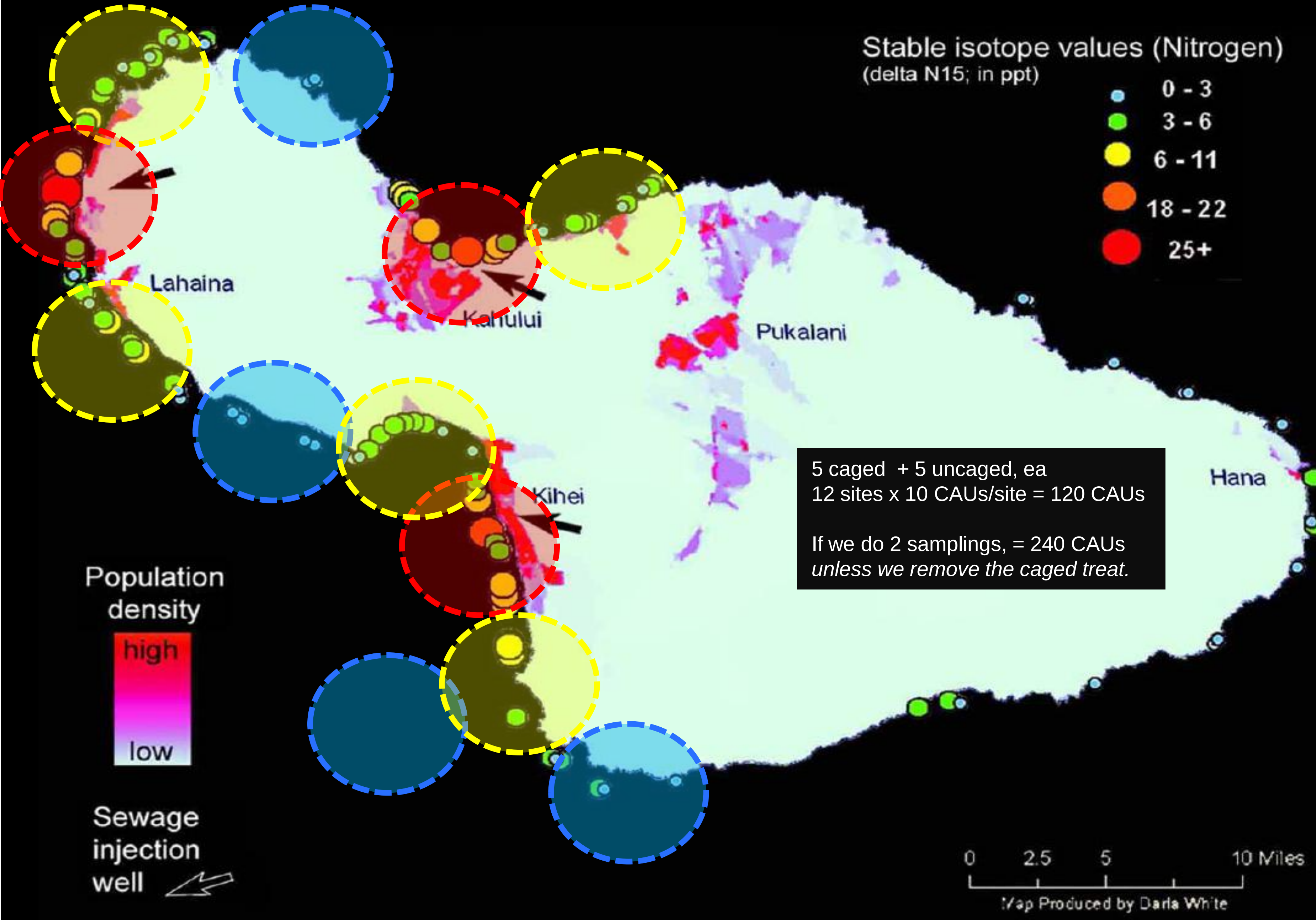


General Approach

1. Stratify CAUs by (a) proximity to inj. wells and (b) *protected status*
2. Cage ½ of CAUs using ½ in. clear plastic mesh
3. Assess water chemistry parameters & herbivore densities
4. Collect CAUs @ 3 mo. and 12 mo.
5. Evaluate succession (*in situ photographs?*) & accretion (std. methods)
6. Use regression model to asses most important factors



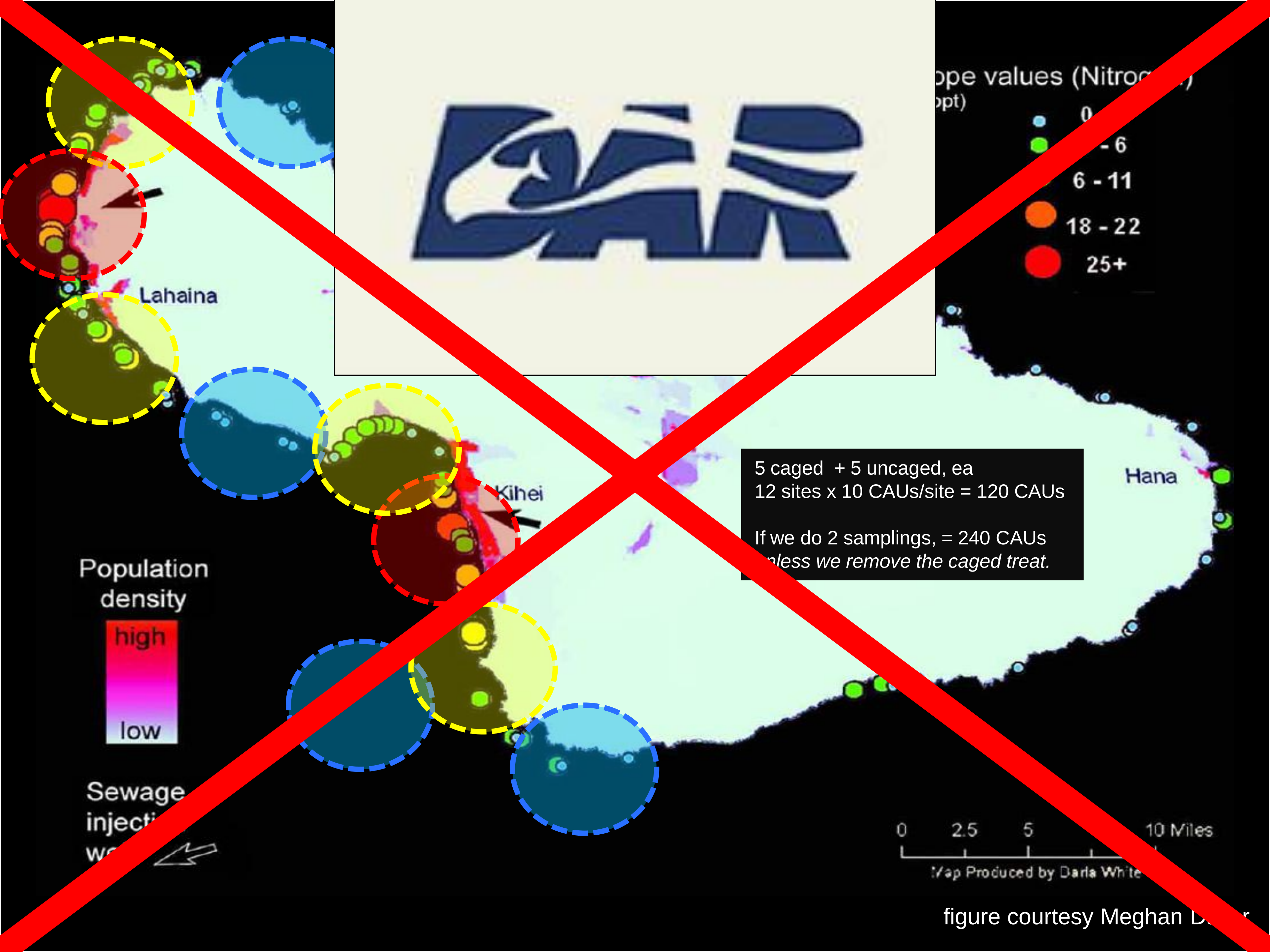




5 caged + 5 uncaged, ea
12 sites x 10 CAUs/site = 120 CAUs

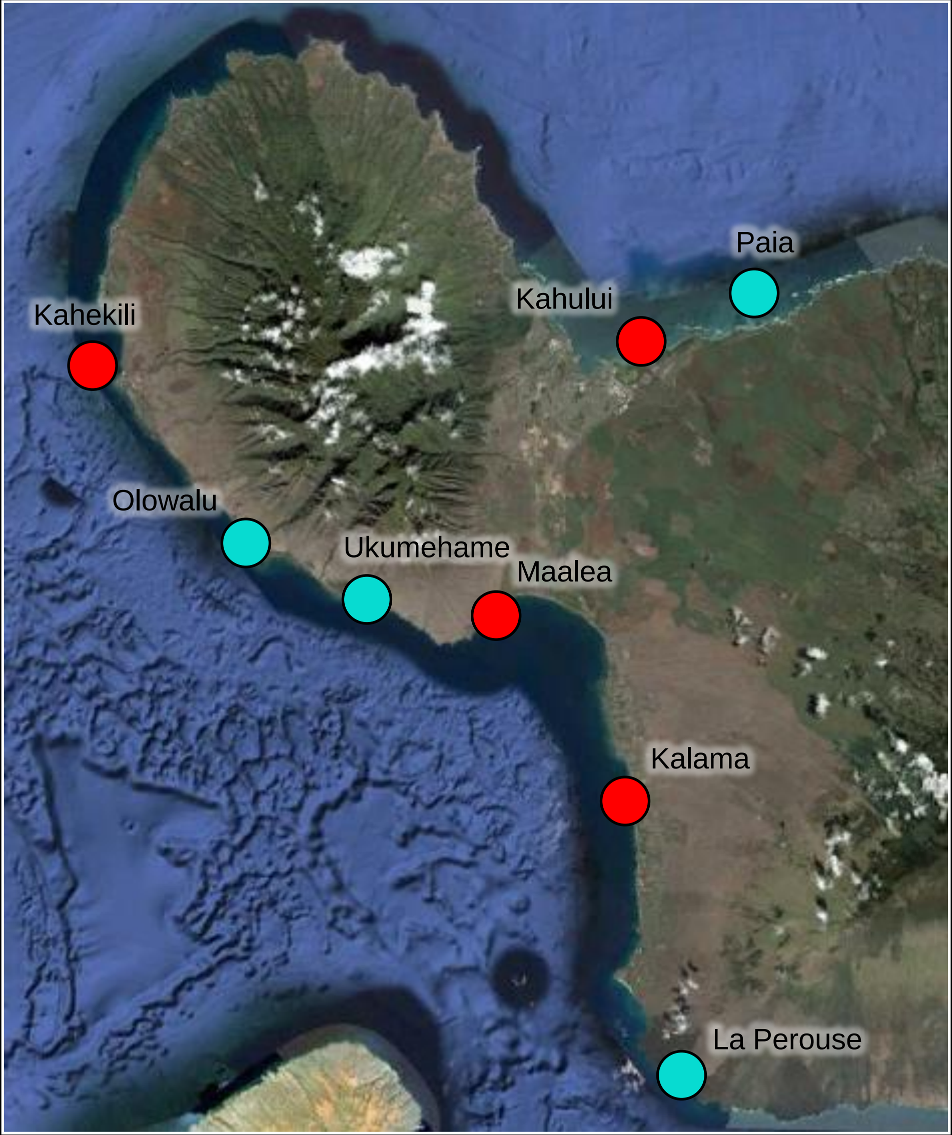
If we do 2 samplings, = 240 CAUs
unless we remove the caged treat.

figure courtesy Meghan Dailer



6 - 11
18 - 22
25+
Lahaina
Kihei
Hana
5 caged + 5 uncaged, ea
12 sites x 10 CAUs/site = 120 CAUs
If we do 2 samplings, = 240 CAUs
nless we remove the caged treat.
Population density
high
low
Sewage
0 2.5 5 10 Miles
Map Produced by Darla White
figure courtesy Meghan

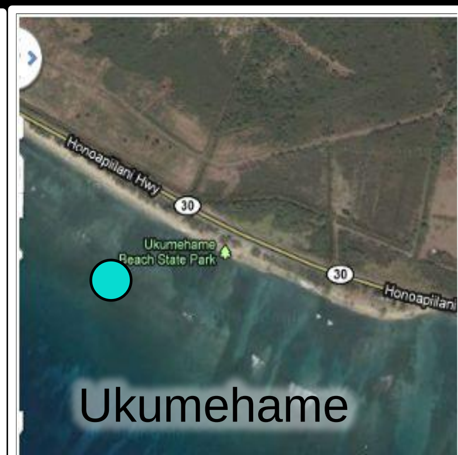
DRAFT Deux



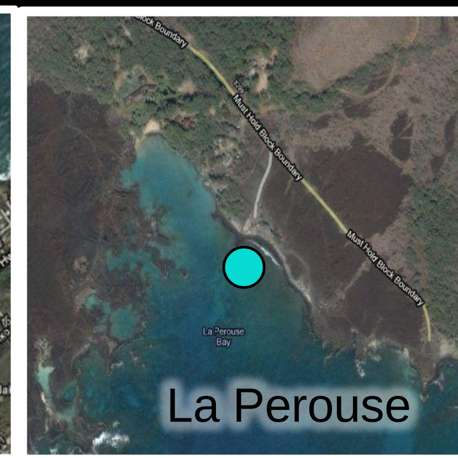
- Reduced to 4 regions
  - Southwest
  - Southcentral
  - Southeast
  - Northcentral
- Paired “high” & “low” impact areas
- 20 CAUs (½ caged)
- No MPAs included (all low herb?)
- ½ collected @ 10 wks
- ½ collected @ 12 mo.

DRAFT Deux


Olowalu
Honoapiilani Hwy
30

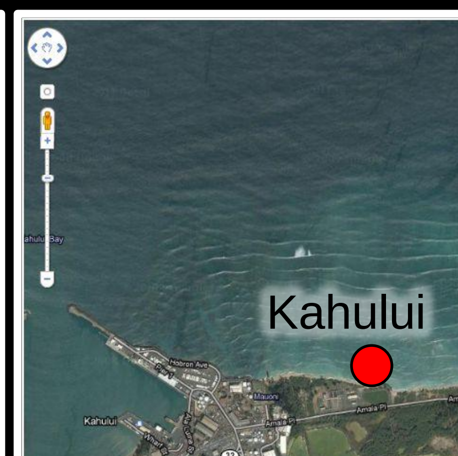

Ukumehame
Ukumehame Beach State Park
Honoapiilani Hwy
30

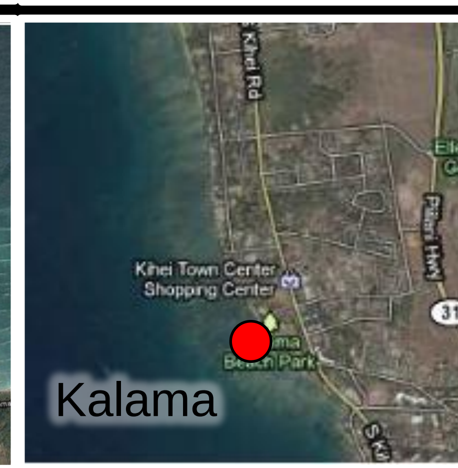

Paia
Paia Bay
Lower Paia Park


La Perouse
La Perouse Bay

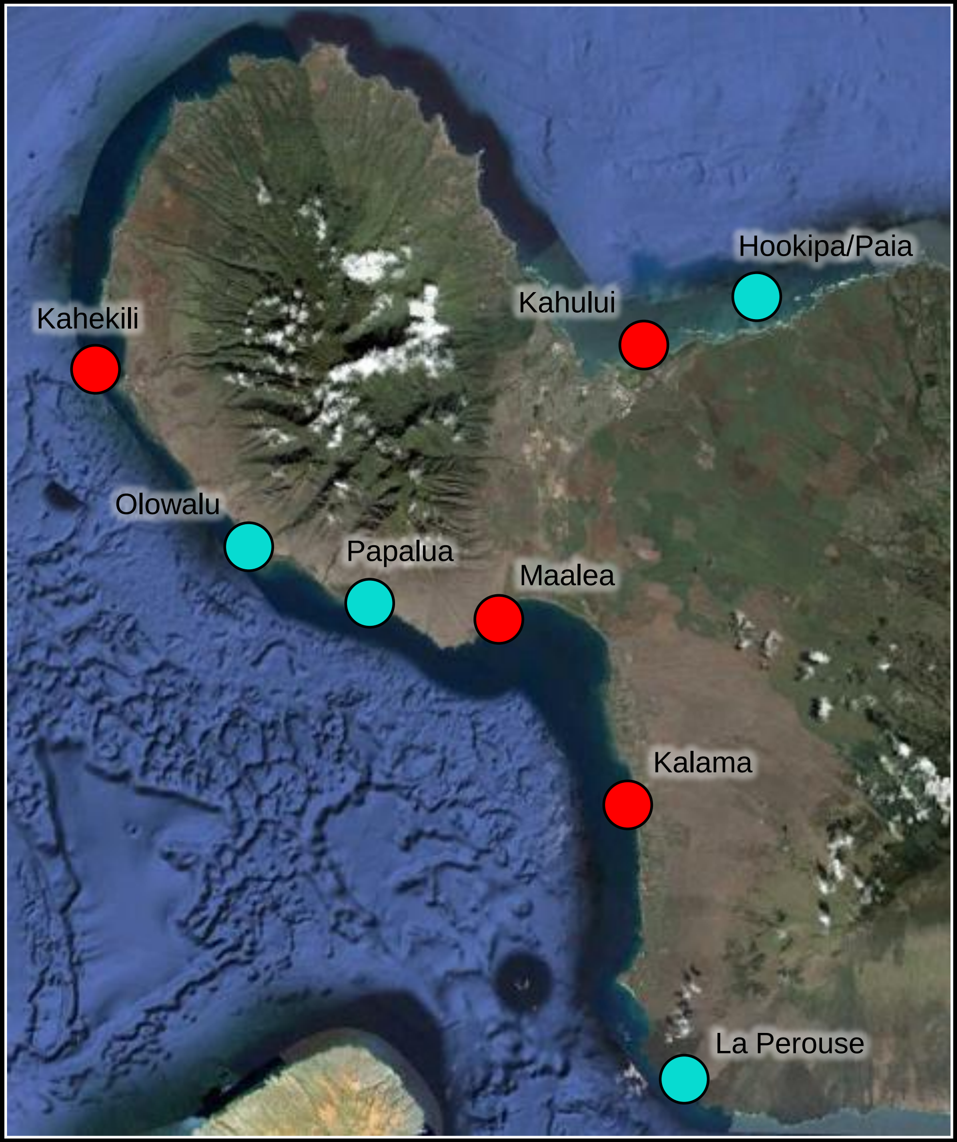

Kahekili
Duke's Beach House Maui
Honoapiilani Hwy
30


Maalea
Honoapiilani Hwy
30


Kahului


Kalama
Kihei Town Center Shopping Center
Kihei Rd
31

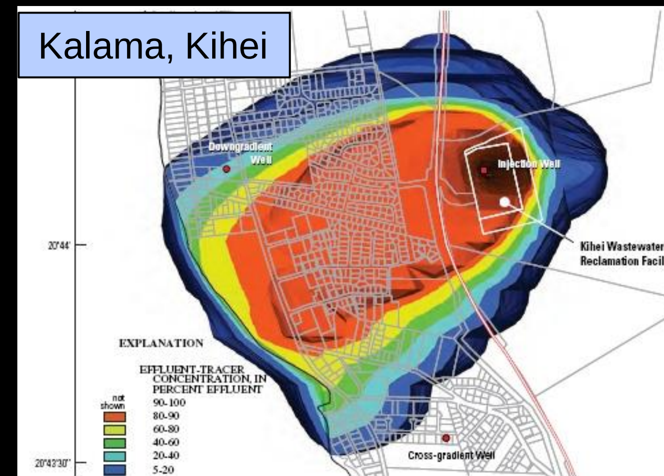
DRAFT Deux



- Regression Design (N=12→8)
  - *(too many columns, too few rows?)*
  - pH (2 units, 3-7 d, time stratified)
  - Nutrients (weekly bottles N/P)
  - Salinity (weekly YSI)
  - Temperature (cont. Hobo)
  - Flow (1 wk. plaster clod cards)
  - Light (cont. Hobo)
  - Fish/No Fish (cages)
- ANOVA Design (N=4)
  - *(lose power to compare factors?)*
  - compare all parameters (# one-ways)

Analyses

1. Proximity to Sewage Injection Wells
   - Water chemistry
   - calcification/accretion/succession

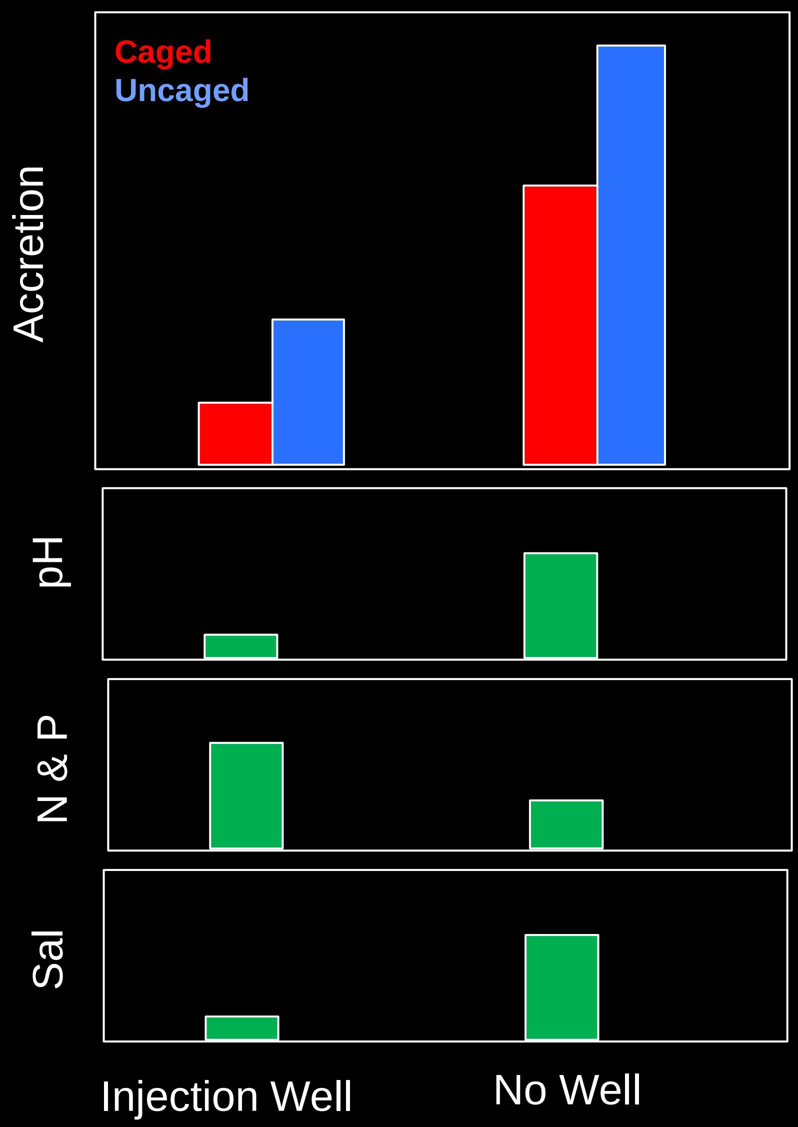


Dunt, C. 2007

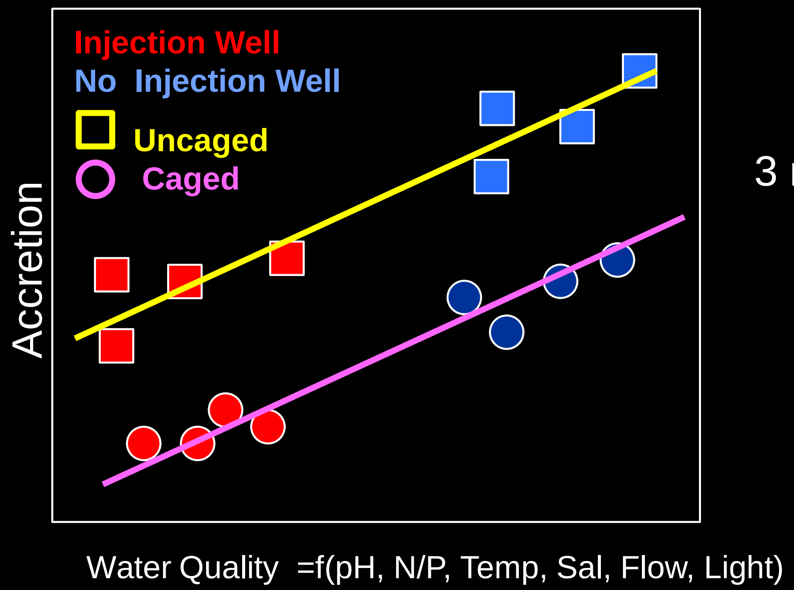
2. Effects of Herbivory
   - caged/uncaged

3. Data Generated
   - overall settlement & accretion rates in Maui (can be compared to Line Islands?).
   - high-res shall reef water chemistry & effect of injection well proximity
   - effects of water quality & herbivory on benthos
   - further inference of ecological effects of injection wells (Dailer 2010)

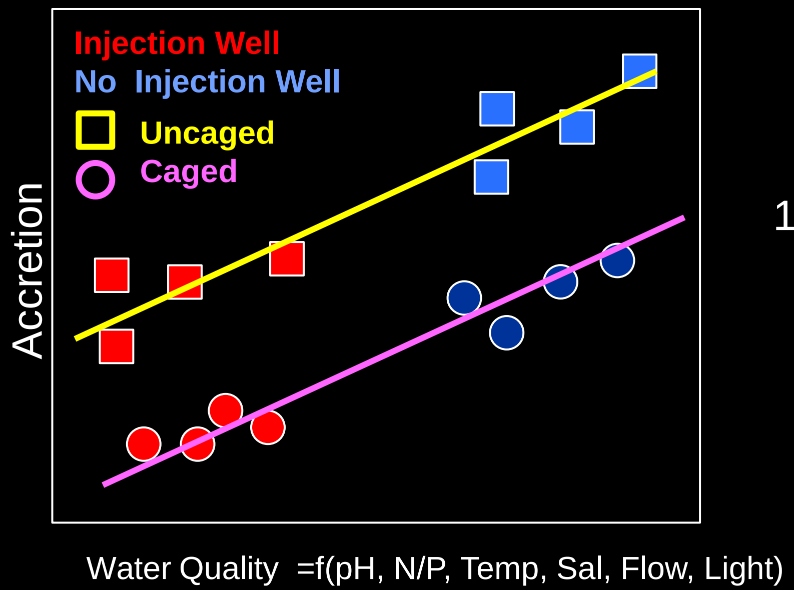
Analyses



Analyses



3 mo.



12 mo.

Summer Schedule

DIVE ASSISTANTS

June: Jacki T.

July: Leah S.

August : Javi C.

Sept: Amanda N.

June 8	**Levi & Jacki arrive in HI**
June8-20	Setup urchin diversity experiments
June 20	**Yui arrives**
June 20-July 5	setup CAU experiment, begin water chem samples
June 28	**Yui touring Maui (departs 7-4)**
July 5	**Jacki departs**
July 5-10	**NEED DIVER**, Water Chem & CAU experiment
July 10	**Leah Arrives**
July10-July 31	Grazing assays, invert series, water chemistry, experiment maintenance
Aug 1	Emily departs, **Javi transitions to my project**
Aug 1-30	Grazing assays, invert series, water chemistry, experiment maintenance
Aug 30	**Javier departs, Amanda Netburn arrives**
Aug 30-Sep 10	Grazing assays, invert series, water chemistry, experiment maintenance
Sep 10-20	Collect data & remove urchin diversity experiment
Sept 20-30	Collect CAUs, pack up house, ship samples home
Sept 30	**Levi & Amanda N. return to SD**

Acknowledgements

Many thanks to:

- Jennifer Smith
- Stuart Sandin
- Emily Kelly
- Nichole Price
- Forest Rohwer
- Darla White
- Russell Sparks
- Currie Dugas
- Jacki Tran
- Javier Cuetos-Bueno
- Leah Segui
- Amanda Netburn
- Yui Takeshita
- Smith&Sandin Lab
- Russell & Eloise Duff
- Laura Fain
- SIO Students & Staff

Funding from:

- San Diego Fellowship
- NSF-IGERT Fellowship
- Hawaii Coral Reef Initiative
- NRC Ford Foundation Fellowship
- Padi Minigrant
- Center for Marine Biodiversity & Conservation
- Friends of Scripps


It’s Go Time
GoPro

Don't Inject – Redirect!

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About

DIRE Coaltion

The DIRE Coalition is a group of Maui organizations, residents and visitors committed to protecting our precious coral reefs and ocean and to wise use of scarce water resources. DIRE stands for Don't Inject, Redirect. The DIRE Coalition advocates reclaiming and using our treated wastewater for irrigation, stream restoration, green belts and fire prevention, rather than injecting it into wells were it migrates to the ocean, promotes algae growth, and suffocates our reefs. Why