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Monitoring Coral Reef Fishes of the MHI

What is Current Status of Fish Monitoring MHI?

2 programs in MHI: D-J and WHAP

‘Dingle-Johnson’ Surveys

- 24 sites statewide (MLCDs, FMAs)
  - 250 yd transects, variable width
  - 2-4 transects per site per year

WHAP

- 23 sites in West Hawaii (MLCDs, FMAs, open areas)
  - 25*4m transects
  - 4 transects per site, sites surveyed 6 times per year

Precision and Power of current monitoring programs

- **'Precision'** = error in estimation of population size
  ('standard error'/mean)

- **Statistical 'Power'** i.e. ability to detect differences
  (power 0.8, alpha 0.1)

(a) Dramatic short-term change
(50% pop size?)

(b) Small ongoing changes over medium time-scales
(power to detect ongoing 5% p.a. decline).

Power & precision of existing data: D-J

DINGLE-JOHNSON (250yd*20') Taxa	Precision (n=4)	Min Effect (n=4)	5% decline p.a. within 10 years
Chaetodon quadrimaculatus	55%	>200%	16
P. multifasciatus	55%	>200%	16
Acanthurus leucopareius	60%	~250%	18
Ctenochaetus strigosus	80%	>300%	23
Caranx melampygus	90%	>300%	25
Chlorurus sordidus	200%	>800%	>50
Scarus rubroviolaceus	340%	>1400%	?
Other groupings			
All Fish Combined	25%	~100%	7
Acanthuridae	30%	>100%	8
Mullidae	35%	~150%	10
Balistidae	65%	~250%	19
Scaridae	70%	~300%	20

Power calculations based on 80% power to detect differences at alpha of 0.1

Power & precision of existing data: WHAP

WHAP (25m*4m) Taxa	Precision (n=6)	Min Effect (n=6)	5% decline p.a. within 10 years
Key Aquarium Species			
Ctenochaetus strigosus	20%	75%	7
Chaetodon multicinctus	20%	75%	7
Zebrasoma flavescens	30%	>100%	10
Naso lituratus	33%	125%	11
Halichoeres ornatissimus	40%	>150%	14
Acanthurus achilles	70%	>250%	24
Chaetodon quadrimaculatus	70%	>250%	24
Other Aquarium Groupings			
All Aquarium Fish	12%	45%	3
Ornamental Surgeonfish	20%	75%	7
Ornamental Butterflyfish	20%	75%	7
Ornamental Wrasse	20%	75%	7
Ornamental Angelfish	40%	>150%	14
'Resource' Groupings			
Labridae	20%	75%	7
Cephalopholis argus	40%	>150%	14
Scaridae	50%	~200%	18
Holocentridae	70%	>250%	24
Mullidae	100%	~400%	36
Lutjanidae	125%	~500%	43
Lethrinidae	150%	>500%	50
Caranx melampygus	300%	>1000%	?
Kyphosidae	320%	>1000%	?

Summary – current monitoring programs

Power and precision rather limited (at level of individual site)

WHAP effective for ornamental species, but majority of non-aquarium species not well sampled

Existing data still very useful

And, good news, longer-term data… after 10+ years period, even high variability data becomes powerful

Alternative approach for sampling non-aquarium species?

Developing new approaches to monitoring of 'resource species'

'Resource fishes' being fishes of economic, ecological, or cultural importance + not aquarium species.

- Targeted monitoring likely to be better than comprehensive approach
  - target larger, mobile, less abundant species (60 taxa)
  - small & cryptic fishes excluded
  - minimum size cut-off
- Multiple short transects better than few long transects
  - increased replication
  - whole transect in single habitat
    - patchy environments – 25m as a standard
- Compatibility with other monitoring methods (e.g. NOWRAMP)
- Dive Safety

Field Trials

4 methods trialed:

Transects

(1) 4m wide belt, all ‘resource fishes’ > 20cm (similar NOWRAMP)

(2) **8m** wide belt……. > 20cm

(3) 4m wide belt……. > **10cm**

Stationary Point-Count

(4) 10m radius, all ‘resource’ fishes > 10cm

2 sites in West Hawaii, >100 counts of each type

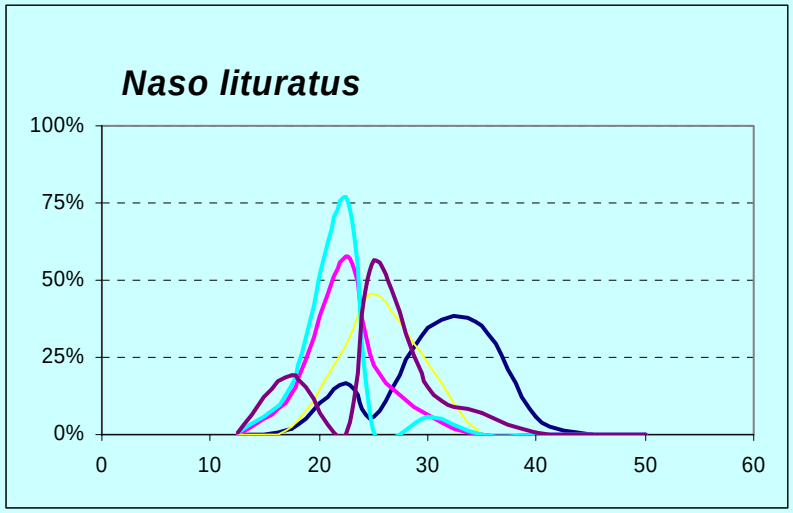
Aims:

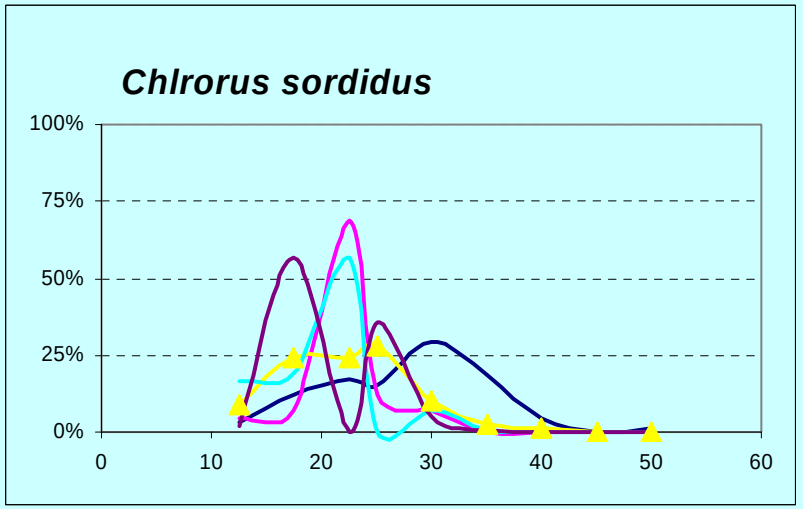
(1) Assess potentially more efficient methods, and

(2) Determine **what is and, crucially, what isn’t** possible

Field Trials – Results 1

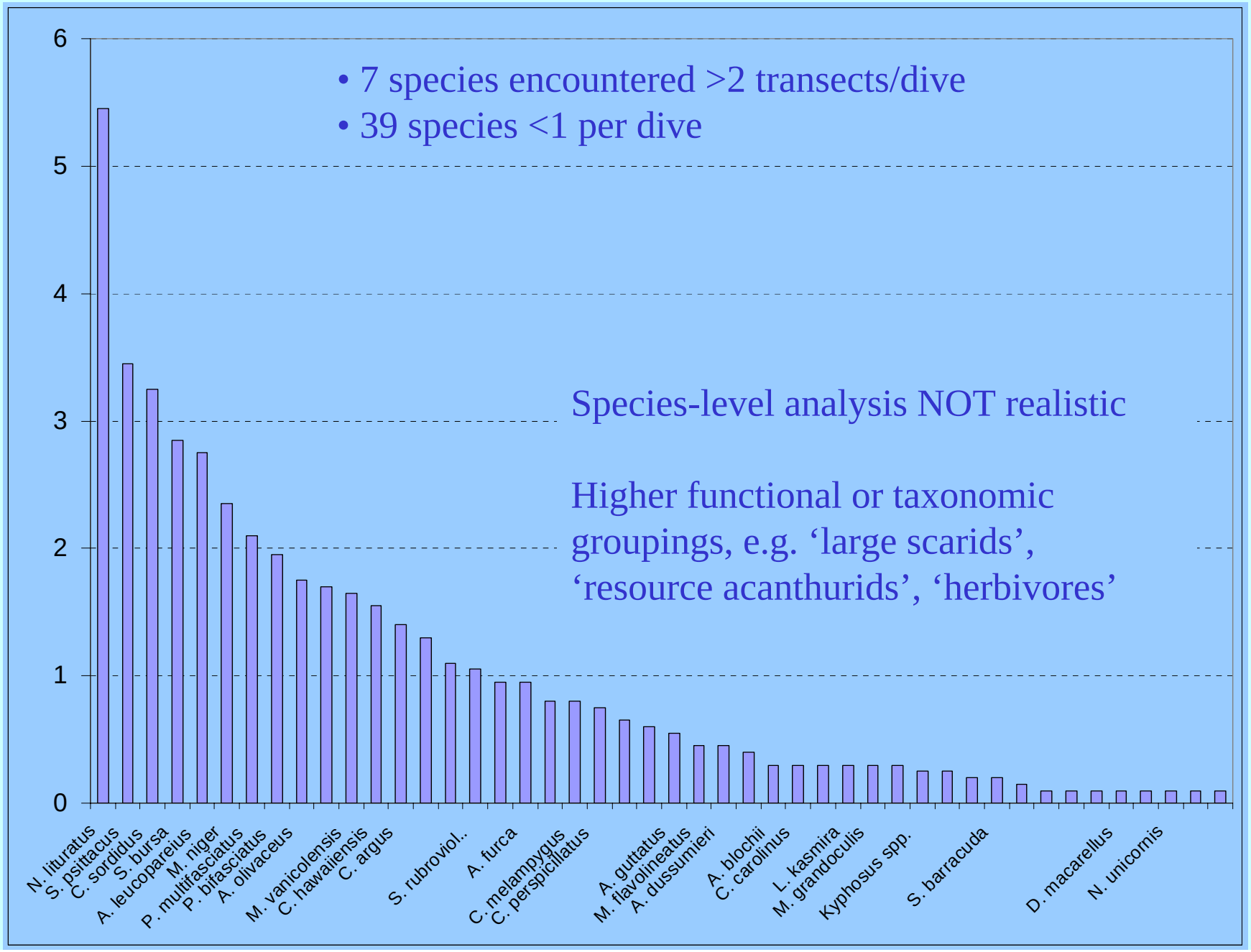
Significant observer variability – both abundance & size





Size-cut offs unreliable

Field Trials – Results 2:Encounter Rates



Comparison, these methods vs WHAP/DJ

Precision, based on equivalent effort:

Grouping	4m>10cm	Stat PC	WHAP	D-J
Including Schools				
All 'Resource' Fish	21%	16%	17%	
Scarids	14%	20%	52%	54%
Resource Acanthurids	26%	33%	42%	31%
Planktivores	39%	50%		58%
Schooling Mullidae	50%	75%		43%
Not Including Schools				
All 'Resource' Fish	11%	9%		
Scarids	12%	14%		
Resource Acanthurids	16%	9%		
Non-Aq. Acanthurids	28%	21%	-	
Large Scarids	30%	36%	80%	62%
Carangidae	89%		-	70%
Other groupings				
Other Mullidae	18%	16%		39%
Naso lituratus	14%	9%	36%	39%
Monotaxis grandoculis	72%	53%	181%	-
Chlorurus sordidus	17%	16%	49%	155%
Acanthurus olivaceus	36%	29%	85%	147%
Cephalopholis argus	29%	19%	45%	-

Limits to monitoring data (from single-site)

		10 Survey Dives per location		
CoV	**Example Fish Groups**	**Minimum Detectable Change***	**Precision**	**Years to detect 5% change p/a***
0.3- 0.4	All Resource Fish (NS) All Scaridae Small Scarids *Naso lituratus*	35-50%	10-15%	6-7
0.5 – 0.8	All Resource Fish Resource Acanthurids (NS) Balistidae Non-schooling Mullidae Herbivores *Chlorurus sordidus* *Sufflamen bursa*	55-95%	15-25%	8-10
0.9 – 1.2	Resource Acanthurids Non-Aq Acanthurid (NS) Mullidae Large Scarids *Cephalopholis argus* *Melichthys niger*	100-140%	25-40%	11-13
1.3 – 1.8	Lutjanidae Non-Aquarium Acanthurids Schooling Mullidae Piscivores *Acanthurus leucopareius*	150-210%	40-60%	13-15
> 1.8	Kyphosidae Carangidae *Monotaxis grandoculis*	> 210%	> 60%	15+

*** alpha 0.1, power 0.8**

Field Trial - Conclusions

- Can improve on what we have done to date

- Severe limitations to reef fish monitoring
  - pool into taxonomic/ functional groups.
  - pool sites by location/management regime
  - allow data to build up over several years
  - several groups (jacks, schooling goatfish) - data indicative at best.

  Small-to-moderate change at single-site over short time period unlikely to generate statistically significant results

- Alpha of 0.2 or higher – balance of probability rather than statistically significant results must be basis for decision making

- Focus on single or few habitats

Finally… Next steps

(1) Integrate quality-control into monitoring program
(e.g. observer training, measurement of observer variability)

(2) Explicitly specify monitoring objectives

Key factors – (management? location? population density?)

Key species/groupings + degree of change that DAR wants/needs to be able to detect.