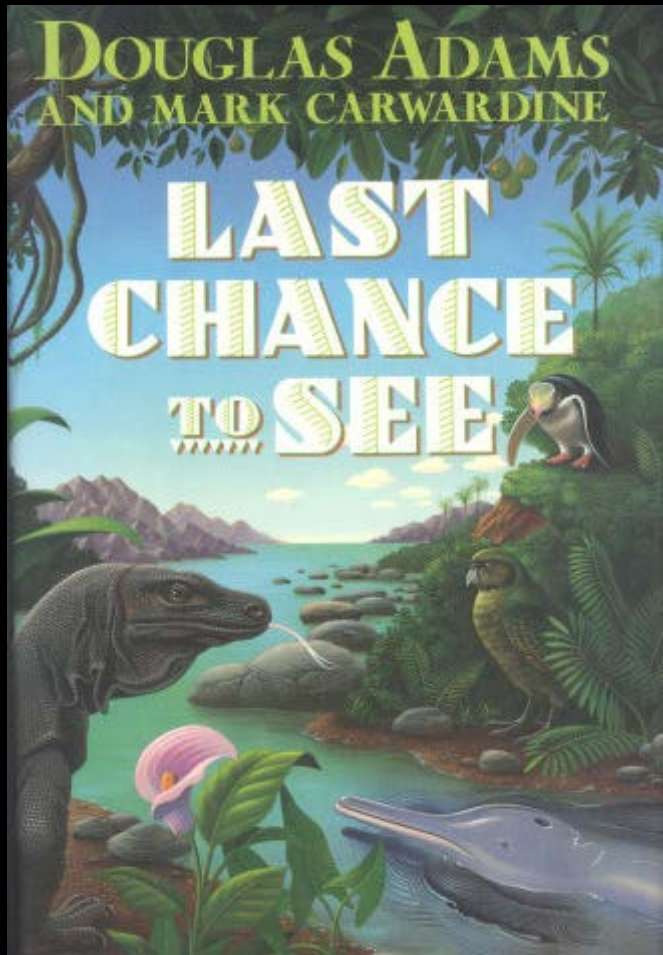
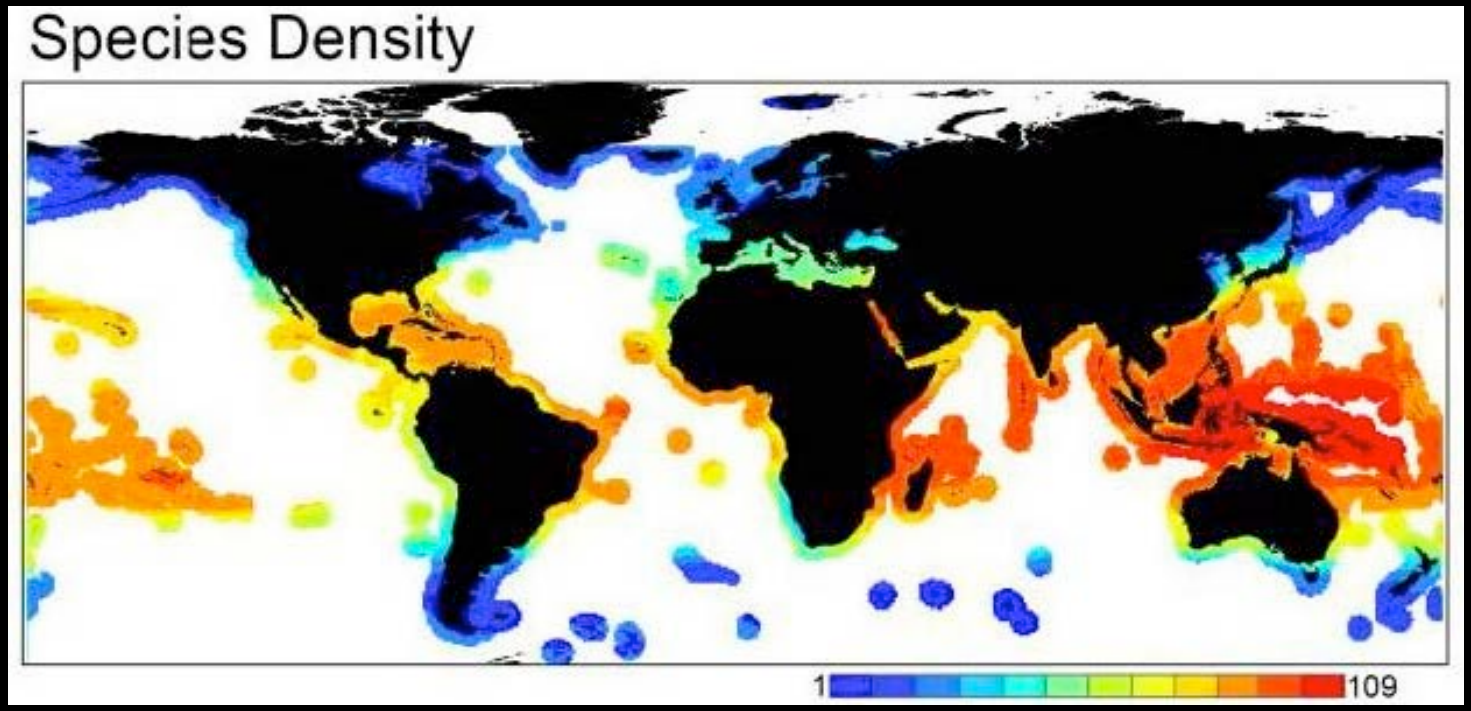
FLMNH-IZ

- Goal: document life on Earth
- Large-scale biodiversity surveys
  - Efficiency through scale
- Triple-document all species
  - specimens
  - photos
  - tissues



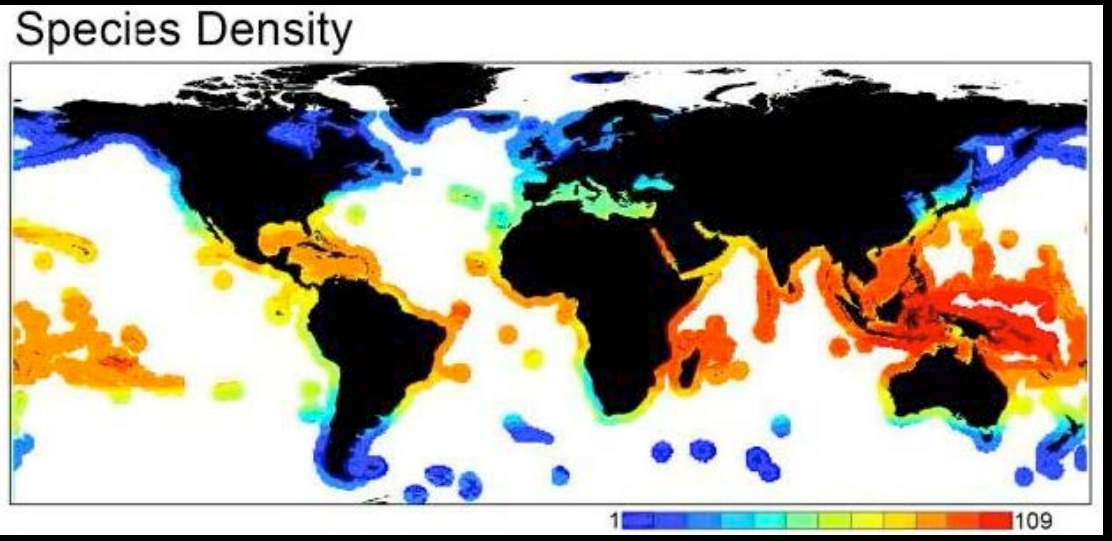
Marine biodiversity

- increases with decreasing latitude
- highest in Indo-West Pacific
- highest on coral reefs



Global fish diversity patterns predicted from quantitative diver censuses at 1,844 sites. a, Species density (a relative measure of species richness) Stuart-Smith et al 2013 Nature 501: 540

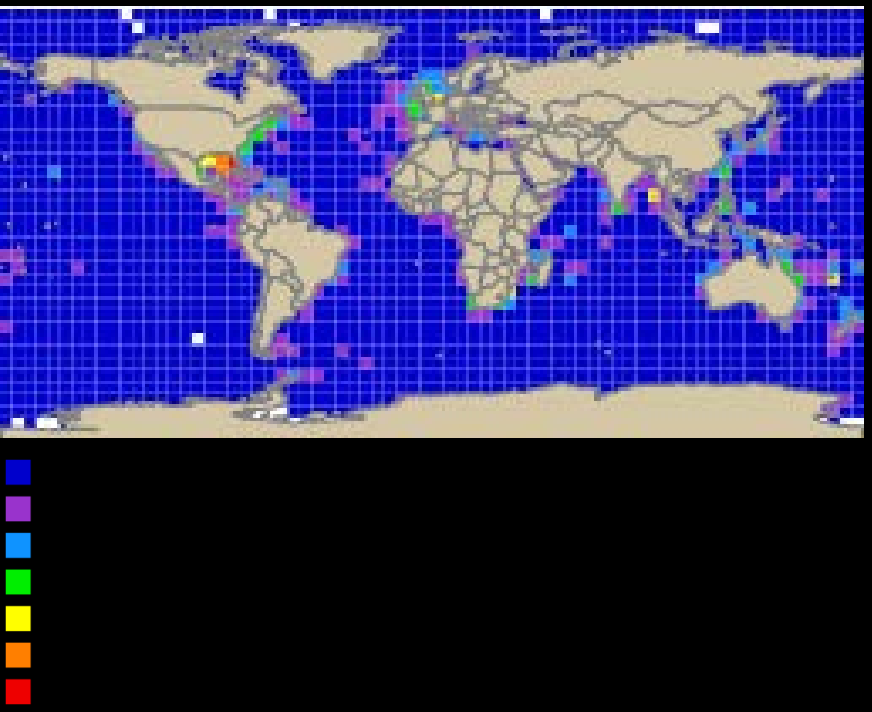
Sampling and knowledge does not track diversity

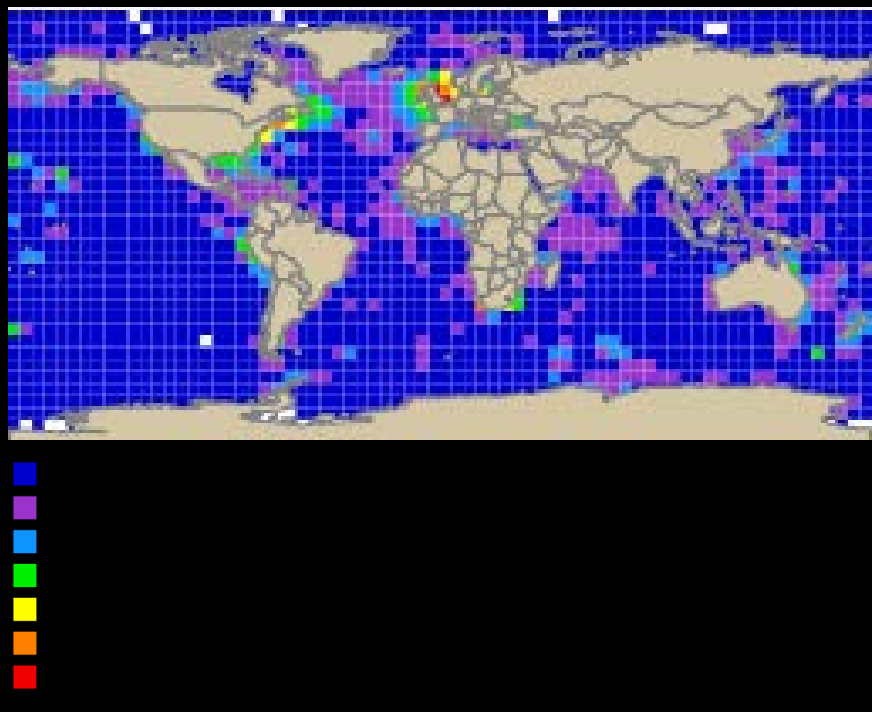


Fish diversity (top)
- Smith et al 2013 Nature 501: 540

Number of marine species (below, left)

Number of marine records (below, right)
- in OBIS, http://www.iobis.org/maps





Large-scale sampling of biodiversity

All Taxon Biodiversity Inventories – efficiency through scale

- Teams
- 100’s to 1000’s of species
- Efficiency essential
- Triage at all levels
- High throughput at all levels
  - including photography

FLMNH-IZ ATBIs

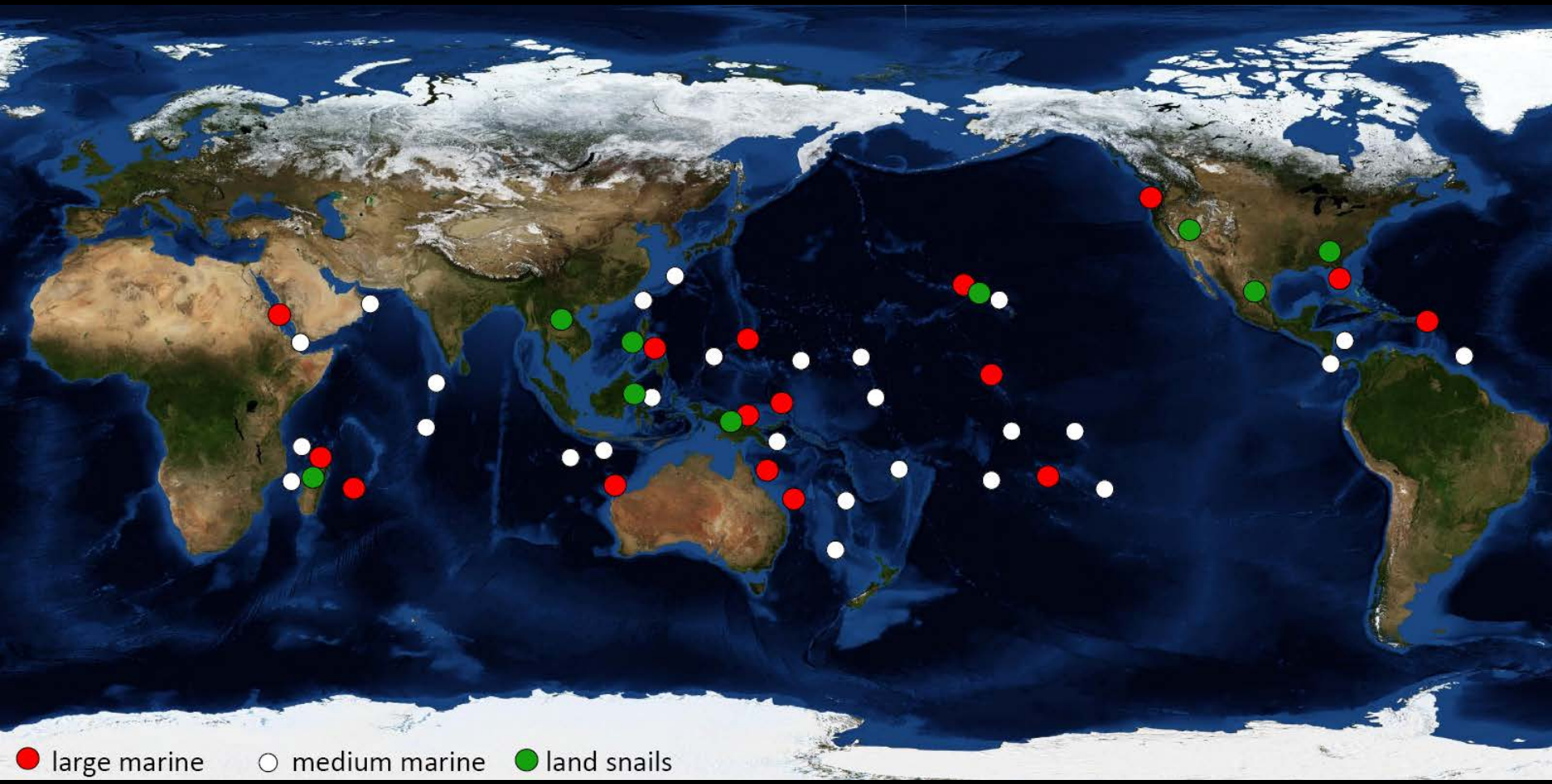


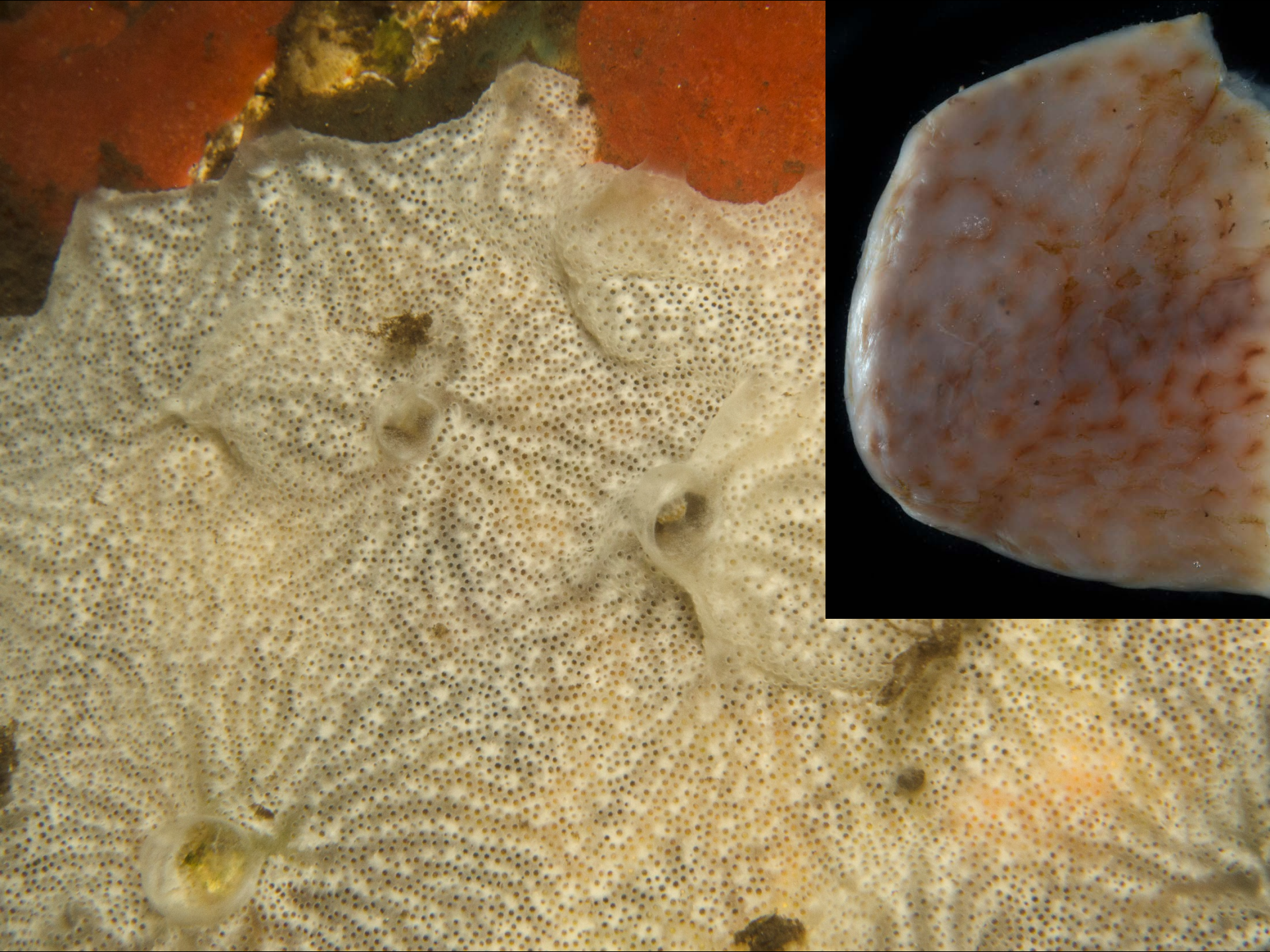
Photo triage

- Impacted by collection → in situ
  - e.g. corals, sponges, trees
- Impacted by death → live
  - e.g. shrimp, snails
- Impacted by fixation → fresh
  - most soft bodied organisms; color
- Moves too much → relax / restrain
  - e.g. shrimp, fish
- Retains information w/ preservation → anywhere
  - e.g. shells, fossils

In situ photography

- Underwater time limited – do when needed
- Habitat
- Can’t collect
  - too big (can subsample tissue)
  - protected
  - photo record only
- Lose information when collected
  - contraction
  - collapse
  - too big to photo efficiently
  - in situ observation, behavior…


IKEA



Tracking in situ photos

- Take notes / use labels if convenient – often not
- Record what photoed quickly after
- Voice notes
- Mark on field sheets
  - F – “field photograph”
- Associate photo & specimen in database quickly

Date:		Project:		Entered by:		
Field #	Station #	Morphospecies	Photo	Tissue	Voucher	Notes
BBDT		(lowest taxon level)	✓/N	✓/N	✓/N	(count, microhab, assoc, fix...)
1561	27	Eunicidae	✓		✓	1x
1562	27	— " —	✓		✓	1x
1563	27	Syllidae long thin orange	✓		✓	1x
1564	27	— " —	x	x	✓	4x → EtOH
1565	24	Strombus costatus	F		✓	1x
1566	29	Pyura?	F	✓	✓	1x 1st photo squirt, red on dock piling
1567	29	Ascidia curvata?	↓	↓	↓	1x dirty clear 2nd photo on side of piling
1568	29	Herdmania pallida?	↓	↓	↓	1x red, siphons open — " —
1569	29	Ascidia	↓	↓	↓	1x small, squeezed, short siphon — " —
1570	29	Didemnum perlucidum	↓	↓	↓	1x ~20 cm colony — " —
1571	29	Didemnidae white	↓	↓	↓	1x 1st Didemnid photod — " —
1572	29	Botryllus nigrum?	↓	↓	↓	1x — " —
1573	29	~~Diplosoma~~? Lissoclinum abdominale	↓	↓	↓	1x ID: R. Rocha — " —
1574	29	Hydroida	↓	↓	↓	1x — " —
1575	29	Veretillidae	↓	↓	↓	1x — " —
1576	29	~~Muricidae~~ Fasciolariidae	↓	↓	↓	2x — " —
1577	29	Paguridae	↓	↓	↓	2x — " —
1578	29	Plicopurpura depressa / Plagusia depressa	✓		✓	2x — " —
1579	29	Mithrax / Sympagurus cf. spinicheliform	✓		✓	2x — " —
1580	29	~~red second ascidian~~	F	✓	✓	1x — " —
1581	29	Muricidae	x	✓	✓	1x — " —
1582	29	Isostichopus				1x brown, 2 seen like this under mangrove
1583	29	Paguridae				common in silt — " —
1584	29	Cerithiidae	x	✓	✓	common in silt 1x → DNA — " —
1585	28	Nerita	x	✓	✓	abundant - high intertidal
1586	28	Batillariidae?	X	✓	✓	1x → DNA; abundant - high — " — to supratidal
1587	28	Planaxidae	x	✓	✓	1x → DNA — " — — " — under rocks
1588	28	Sesarmidae				common ~~on~~ on land nearshore
1589	28	— " —				occasional — " —
1590	28	~~Grapsidae?~~ Panopeidae				2x under rocks high IT / supratidal
1591	26	Gastrochaenidae	x	x	✓	
1592	30	Holothuria mexicana	F	✓	✓	
1593	|	Melanella — on →	F	✓	|	3x — 1 → DNA 2 → voucher
1594		Epicystis crucifer	F	✓	|	

In situ photography
considerations

- Isolation
- Illumination
- Color / white balance
- Underwater photography

Isolation - background

Illumination

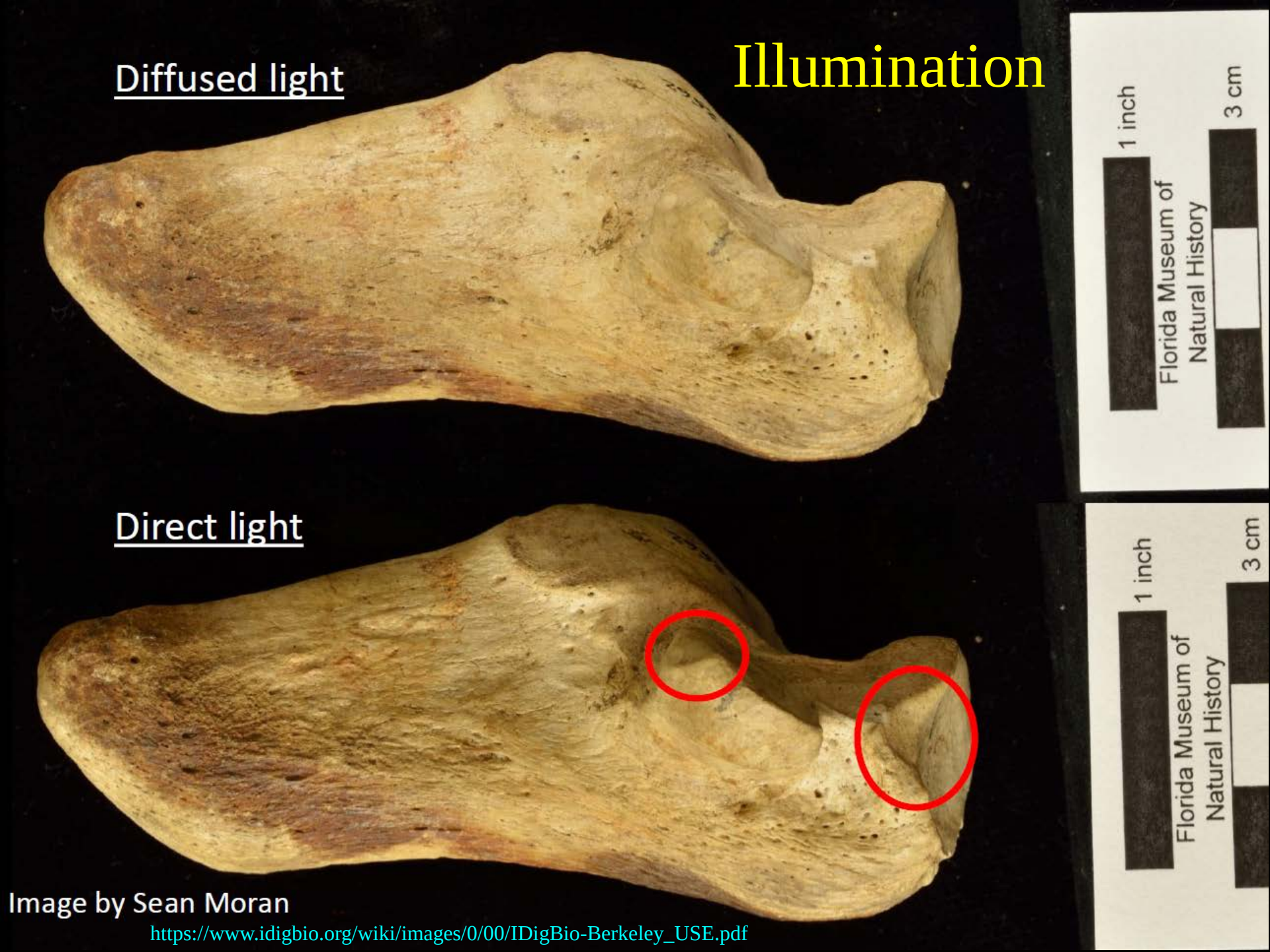
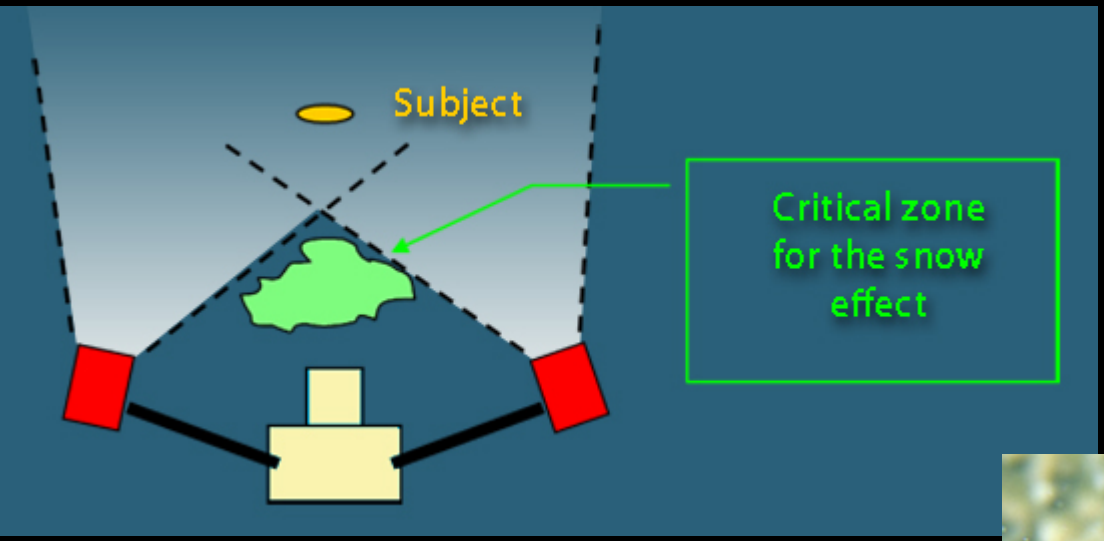


Image by Sean Moran

https://www.idigbio.org/wiki/images/0/00/IDigBio-Berkeley_USE.pdf

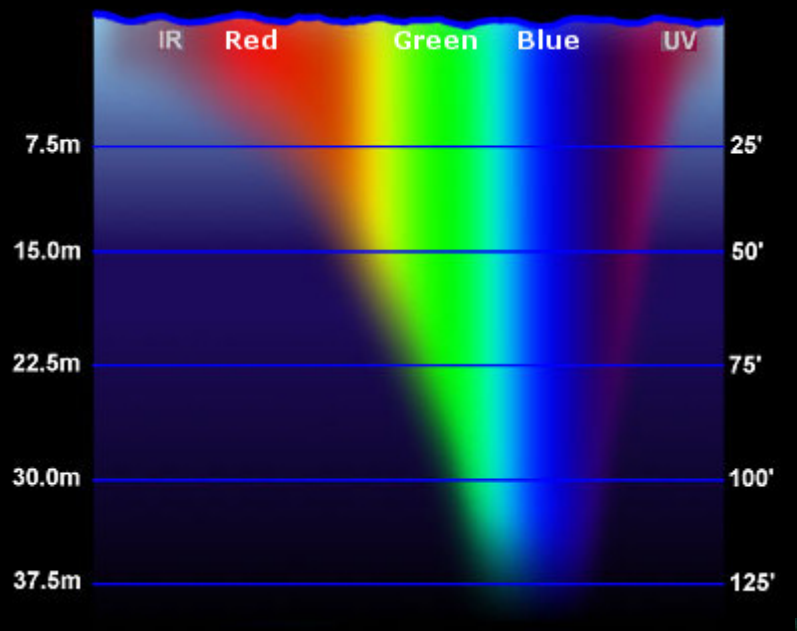
Strobe positioning important underwater

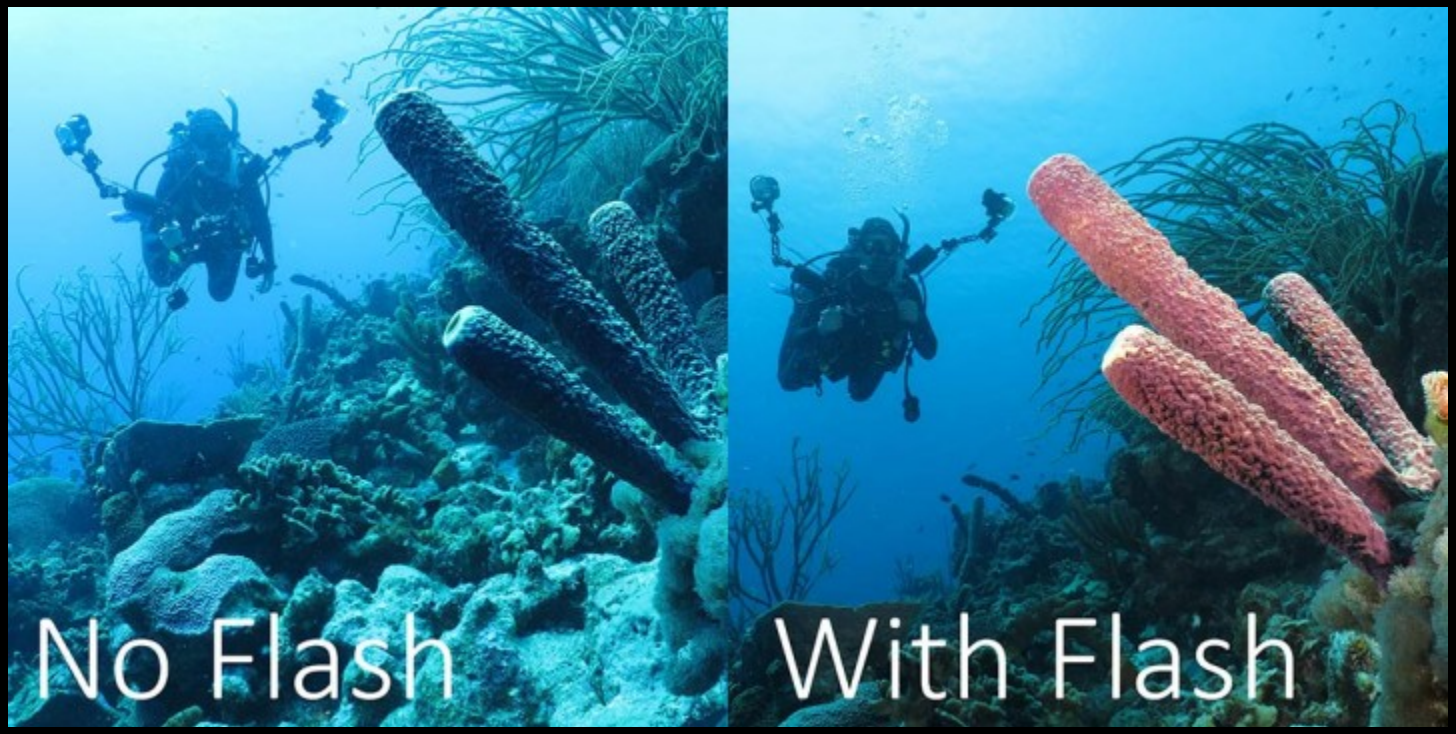


http://johnrander.chez-alice.fr/gestion_eclairage_en.html

Underwater photography

- light attenuation impacts color
- need strobe
- macrophoto easy
- challenging to illuminate large organism / habitat





http://fisheyephoto.com/underwater-camera-rental/

Lab photography

- High throughput (many 100s per day)
- Efficient setup and tracking
- Dedicated photographer – “fed” specimens
- Photo tank, strobes, background
- Clean water
- Specimen label (scale, color scale)
- Hand held (steadied by fingers)


BMBM-0889
BMBM-0889.DNA

Lab photography

- Background choice – isolation
  - natural / uniform
  - black / light
- Epi- vs. trans-illumination
- Orientation

Eulimidae: echino-vampires

Photo: S Middleton

Macrophotography
aperture & depth of field

- Small aperture (high f stop)
  - Greater depth of field
  - Lower resolution
- Large aperture (low f-stop)
  - Lower depth of field
  - Greater resolution (at optimal f-stop for lens)
- Compromise: ~f18

How not to photograph

- Specimen: view/completeness/condition
- Setup/image: focus, immersion, glare, obstructions/dirt

Photomicrography

- SLR on dissecting scope
- Wireless strobes to freeze movement
- Camera tethered to computer to shoot
- Angled clear glass dish
- Background – velvet / dark field / transillumination

Combining techniques to document / tell story

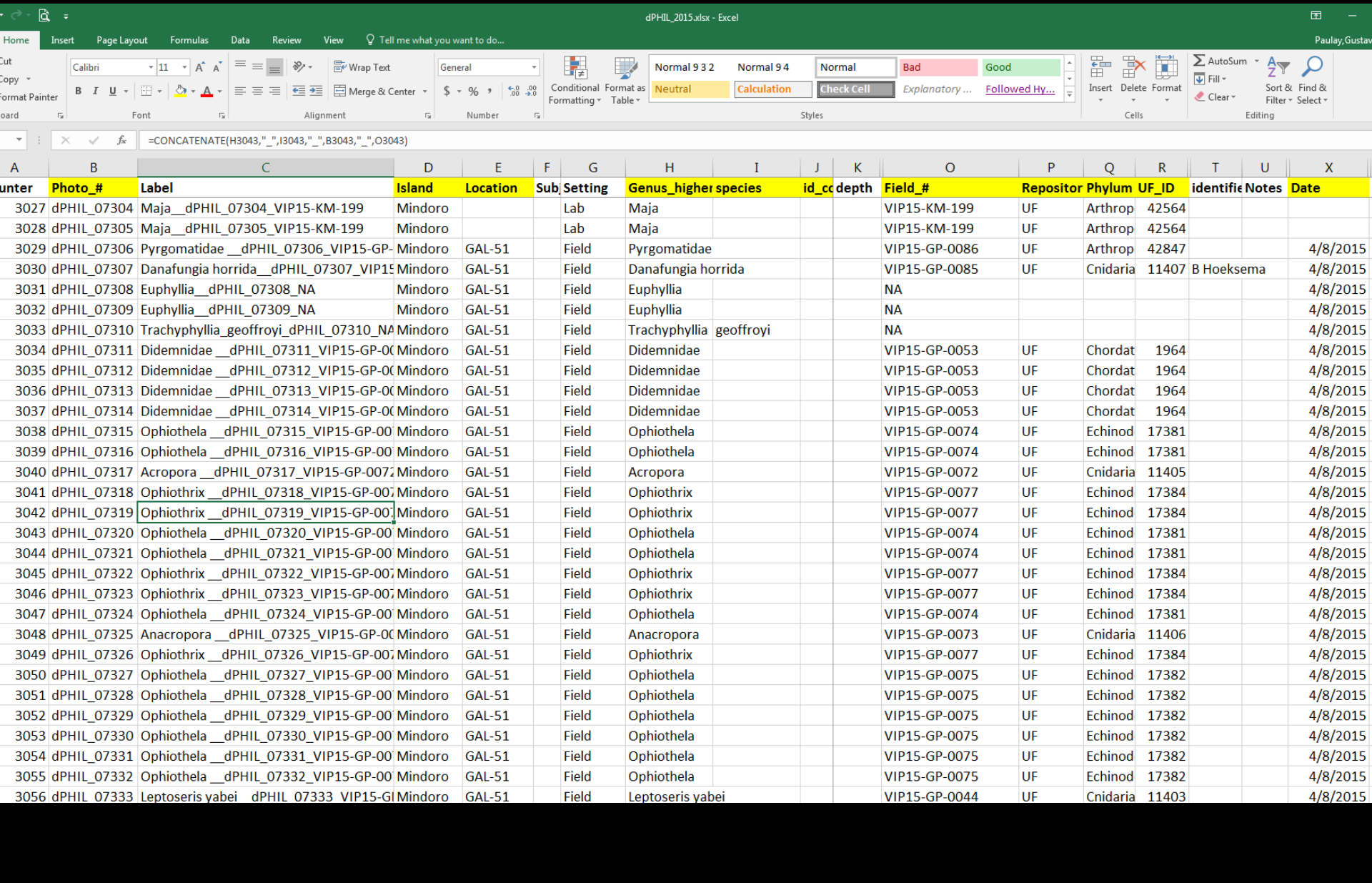
Photo tracking

- Photo label
- Delete unwanted duplicates
- Rename image files with unique identifier
- Associate photo number and specimen number in spreadsheet
- Archive
- Post-process selected images
  - save as low compressions jpg
  - save with different unique identifier
  - dFL-01234.jpg → dFL-01234a.jpg

Photo tracking – field photos

- Handle as lab photos, but also:
- Database quickly
- Note on field sheet
- Avoid photographing same species in succession

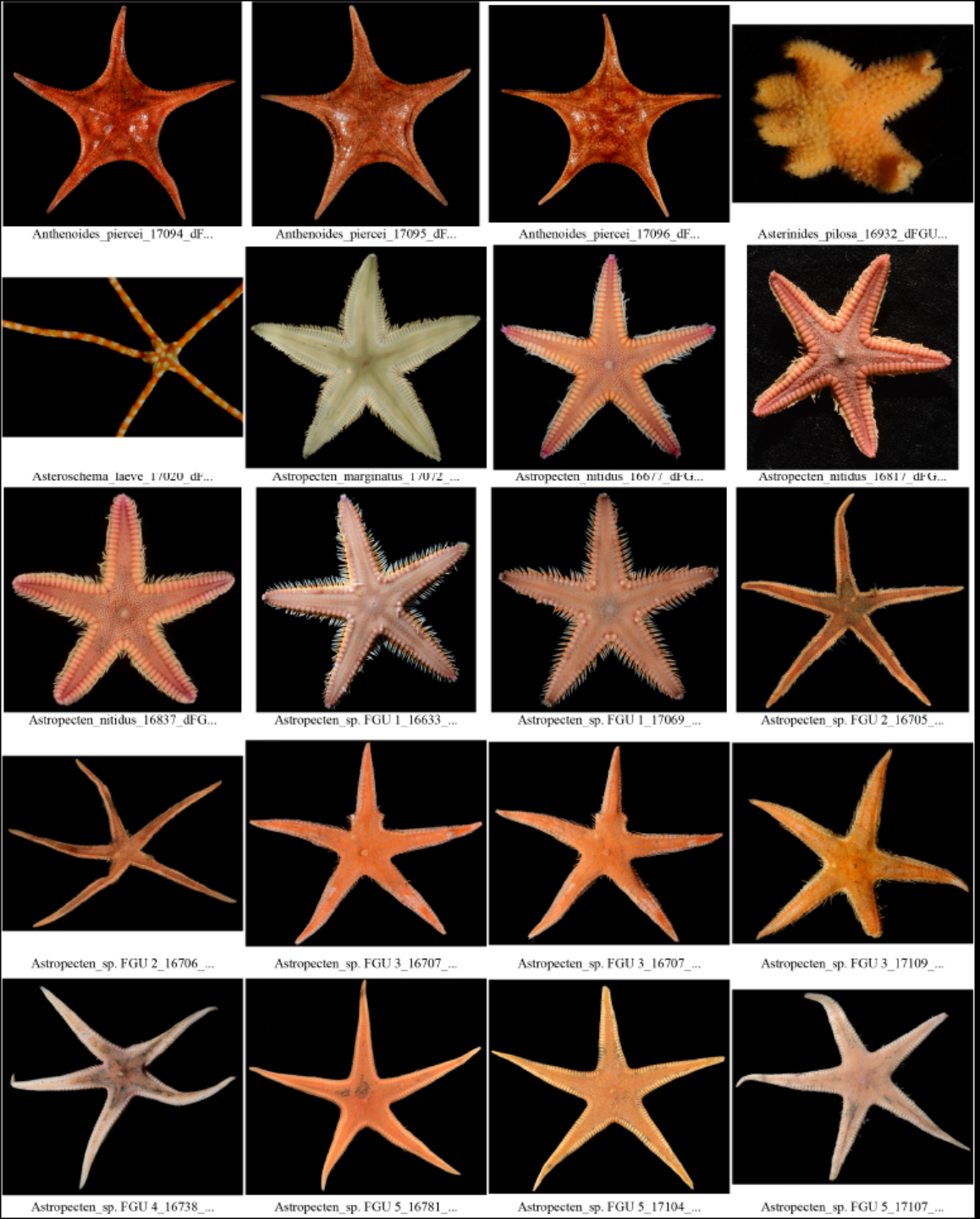
Photo tracking



A	B	C	D	E	F	G	H	I	J	K	O	P	Q	R	T	U	X
unter	Photo_#	Label	Island	Location	Sub	Setting	Genus_higher	species	id_cc	depth	Field_#	Repositor	Phylum	UF_ID	identifie	Notes	Date
3027	dPHIL_07304	Maja__dPHIL_07304_VIP15-KM-199	Mindoro			Lab	Maja				VIP15-KM-199	UF	Arthrop	42564			
3028	dPHIL_07305	Maja__dPHIL_07305_VIP15-KM-199	Mindoro			Lab	Maja				VIP15-KM-199	UF	Arthrop	42564			
3029	dPHIL_07306	Pyrgomatidae __dPHIL_07306_VIP15-GP-	Mindoro	GAL-51		Field	Pyrgomatidae				VIP15-GP-0086	UF	Arthrop	42847			4/8/2015
3030	dPHIL_07307	Danafungia horrida__dPHIL_07307_VIP1	Mindoro	GAL-51		Field	Danafungia	horrida			VIP15-GP-0085	UF	Cnidaria	11407	B Hoeksema		4/8/2015
3031	dPHIL_07308	Euphyllia__dPHIL_07308_NA	Mindoro	GAL-51		Field	Euphyllia				NA						4/8/2015
3032	dPHIL_07309	Euphyllia__dPHIL_07309_NA	Mindoro	GAL-51		Field	Euphyllia				NA						4/8/2015
3033	dPHIL_07310	Trachyphyllia_geoffroyi_dPHIL_07310_NA	Mindoro	GAL-51		Field	Trachyphyllia	geoffroyi			NA						4/8/2015
3034	dPHIL_07311	Didemnidae __dPHIL_07311_VIP15-GP-0(	Mindoro	GAL-51		Field	Didemnidae				VIP15-GP-0053	UF	Chordat	1964			4/8/2015
3035	dPHIL_07312	Didemnidae __dPHIL_07312_VIP15-GP-0(	Mindoro	GAL-51		Field	Didemnidae				VIP15-GP-0053	UF	Chordat	1964			4/8/2015
3036	dPHIL_07313	Didemnidae __dPHIL_07313_VIP15-GP-0(	Mindoro	GAL-51		Field	Didemnidae				VIP15-GP-0053	UF	Chordat	1964			4/8/2015
3037	dPHIL_07314	Didemnidae __dPHIL_07314_VIP15-GP-0(	Mindoro	GAL-51		Field	Didemnidae				VIP15-GP-0053	UF	Chordat	1964			4/8/2015
3038	dPHIL_07315	Ophiothela __dPHIL_07315_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0074	UF	Echinod	17381			4/8/2015
3039	dPHIL_07316	Ophiothela __dPHIL_07316_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0074	UF	Echinod	17381			4/8/2015
3040	dPHIL_07317	Acropora __dPHIL_07317_VIP15-GP-007	Mindoro	GAL-51		Field	Acropora				VIP15-GP-0072	UF	Cnidaria	11405			4/8/2015
3041	dPHIL_07318	Ophiothrix __dPHIL_07318_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothrix				VIP15-GP-0077	UF	Echinod	17384			4/8/2015
3042	dPHIL_07319	Ophiothrix __dPHIL_07319_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothrix				VIP15-GP-0077	UF	Echinod	17384			4/8/2015
3043	dPHIL_07320	Ophiothela __dPHIL_07320_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0074	UF	Echinod	17381			4/8/2015
3044	dPHIL_07321	Ophiothela __dPHIL_07321_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0074	UF	Echinod	17381			4/8/2015
3045	dPHIL_07322	Ophiothrix __dPHIL_07322_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothrix				VIP15-GP-0077	UF	Echinod	17384			4/8/2015
3046	dPHIL_07323	Ophiothrix __dPHIL_07323_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothrix				VIP15-GP-0077	UF	Echinod	17384			4/8/2015
3047	dPHIL_07324	Ophiothela __dPHIL_07324_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0074	UF	Echinod	17381			4/8/2015
3048	dPHIL_07325	Anacropora __dPHIL_07325_VIP15-GP-0(	Mindoro	GAL-51		Field	Anacropora				VIP15-GP-0073	UF	Cnidaria	11406			4/8/2015
3049	dPHIL_07326	Ophiothrix __dPHIL_07326_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothrix				VIP15-GP-0077	UF	Echinod	17384			4/8/2015
3050	dPHIL_07327	Ophiothela __dPHIL_07327_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0075	UF	Echinod	17382			4/8/2015
3051	dPHIL_07328	Ophiothela __dPHIL_07328_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0075	UF	Echinod	17382			4/8/2015
3052	dPHIL_07329	Ophiothela __dPHIL_07329_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0075	UF	Echinod	17382			4/8/2015
3053	dPHIL_07330	Ophiothela __dPHIL_07330_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0075	UF	Echinod	17382			4/8/2015
3054	dPHIL_07331	Ophiothela __dPHIL_07331_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0075	UF	Echinod	17382			4/8/2015
3055	dPHIL_07332	Ophiothela __dPHIL_07332_VIP15-GP-00	Mindoro	GAL-51		Field	Ophiothela				VIP15-GP-0075	UF	Echinod	17382			4/8/2015
3056	dPHIL_07333	Leptoseris yabei __dPHIL_07333_VIP15-GI	Mindoro	GAL-51		Field	Leptoseris	yabei			VIP15-GP-0044	UF	Cnidaria	11403			4/8/2015

Photo relabeling field guide production

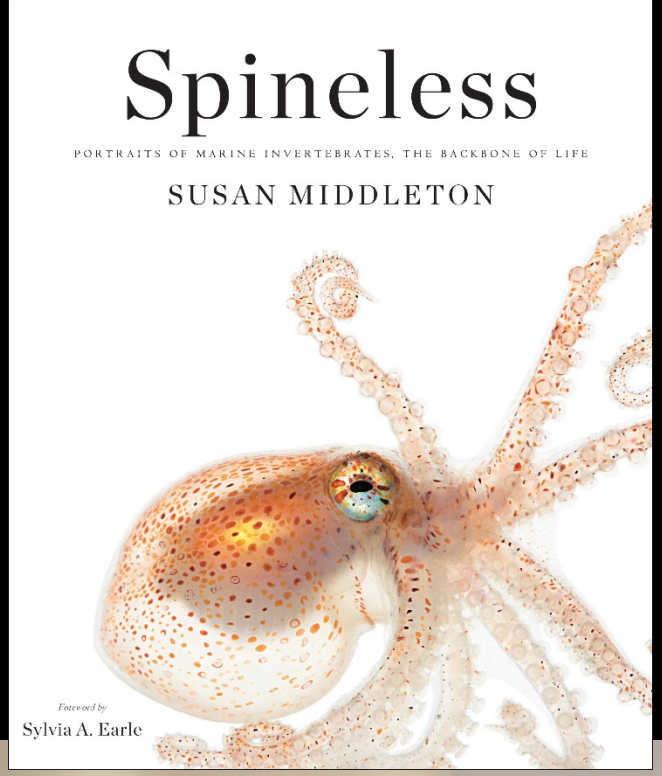
- Concatenate command to design new name
  - e.g. name-catalog number-photo number
- R script to rename selected photos
- Arrange in folders
- Create Contact Sheet in Photoshop
  - File → Automate → Contact Sheet



Contact sheet

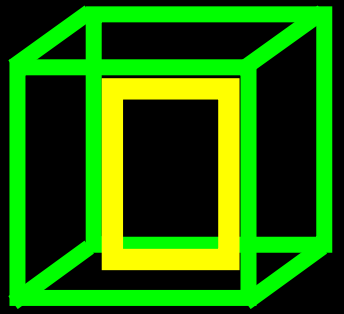
Serve online

- Specify
- iDigBio
- CalPhotos
- FLMNH-IZ website through html
- No good general overall solution for databasing or serving photos
  - need database when no specimen
  - tracking quality, orientation, processing



Photography - great way to engage and inspire about biodiversity

Marine
ONE CUBIC FOOT



350 individuals in this collage

photos courtesy of David Liittschwager

Acknowledgements

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