Comisión Interamericana del Atún Tropical
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UPDATED STOCK STATUS INDICATORS FOR SILKY SHARKS (SAC-10-17)

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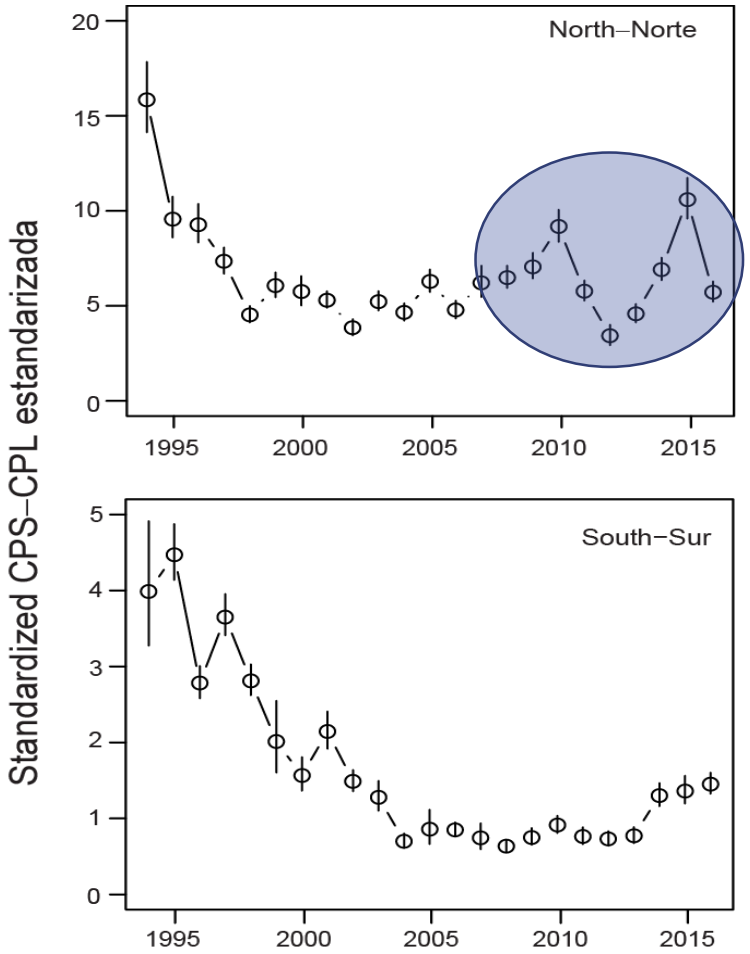
Outline

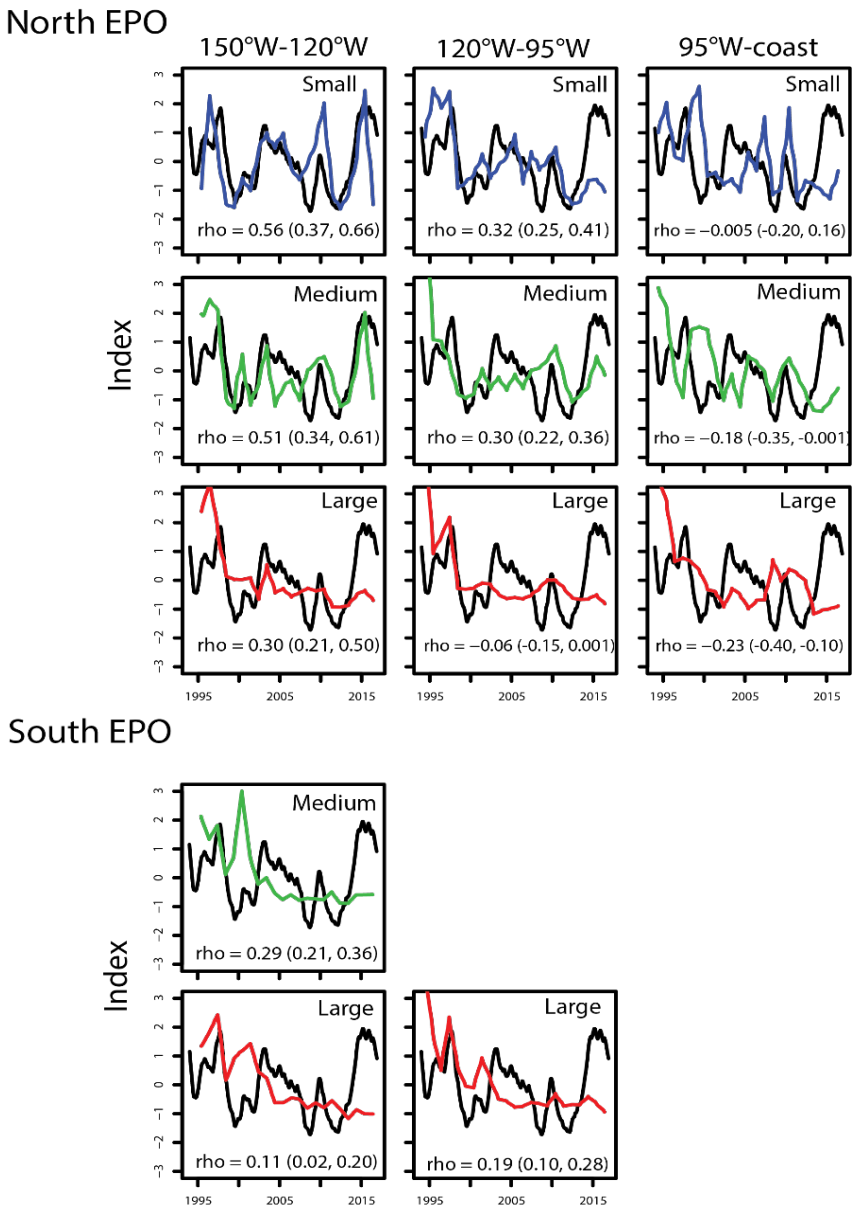
- Background
  - Environmental influences on the indices
  - Recent increase in silky sharks reported as released alive
- Updated indices for 2018
  - Data and methods
  - Results
- Future directions

Environmental influences on the indices

Indices for all silky sharks, 1994-2016, floating-object sets



Environmental influences on the indices



- Correlation between silky shark indices and the Pacific Decadal Oscillation (PDO):
  - Differs by region and shark size category;
  - Highest for small and medium silky sharks in western EPO;
  - Weaker for large silky sharks throughout EPO.
- Implications
  - ENSO events may strongly influence spatial distribution of juvenile silky sharks.

Environmental influences on the indices

Mitigating bias due to changing oceanographic conditions (Project H.5.a)

- Large silky shark index least correlated with PDO - thus potentially a better stock status indicator (SSI).
- Index still potentially influenced by inter-annual changes in oceanographic conditions.
- Specific processes that may affect index not known.
  - Environmentally-mediated movement?
  - Environmentally-mediated changes in catchability?
- Currently not possible to explicitly model processes to mitigate bias.
- Inclusion of PDO in bycatch-per-set standardization problematic; confounded with year effect.
- For now, use large silky shark index as the SSI, uncorrected for any environmental influences.

Treatment of “live-release” in bycatch-per-set standardization

- A large shark SSI requires revisiting use of data on sharks released alive (“live-release”).
- Prior to late 2004, live-release not recorded.
- In late 2004, shark form introduced; live-release data collected since then.
- Previously, counts of live-release included in “all” silky shark index.
- However, those counts not included in size-specific indices because of concern about accuracy of the length estimates of sharks released alive.

Treatment of “live-release” in bycatch-per-set standardization

- Need a consistent indicator.
- Increase in live-release means that live-release must be included in bycatch-per-set index.
- Sharks recorded as released alive in recent years would probably have been recorded as dead previously.
- Concerns about size category determination for live releases.

Percentage silky sharks reported as released alive, floating-object sets

	Small	Medium	Large	All
	Pequeños	Medianos	Grandes	Todos
2004	2.9	0.9	0.1	1.4
2005	2.8	3.3	4.4	3.3
2006	5.4	4.9	8.1	5.6
2007	6.2	5.4	7.4	6
2008	3.9	6.2	12.4	6.2
2009	4.9	9.7	15.5	10.5
2010	13.4	17.3	17.5	15.7
2011	16.7	14.6	31.3	18.6
2012	10.3	17.2	28.6	20.1
2013	28.2	22.3	34.3	26
2014	29.4	34.5	45.9	36.5
2015	27.9	34.7	46.2	38.5
2016	32.2	38.9	44	38.6
2017	45.8	52.6	61.7	54.3
2018	43.4	64.8	85	65.5

Updated indices for 2018

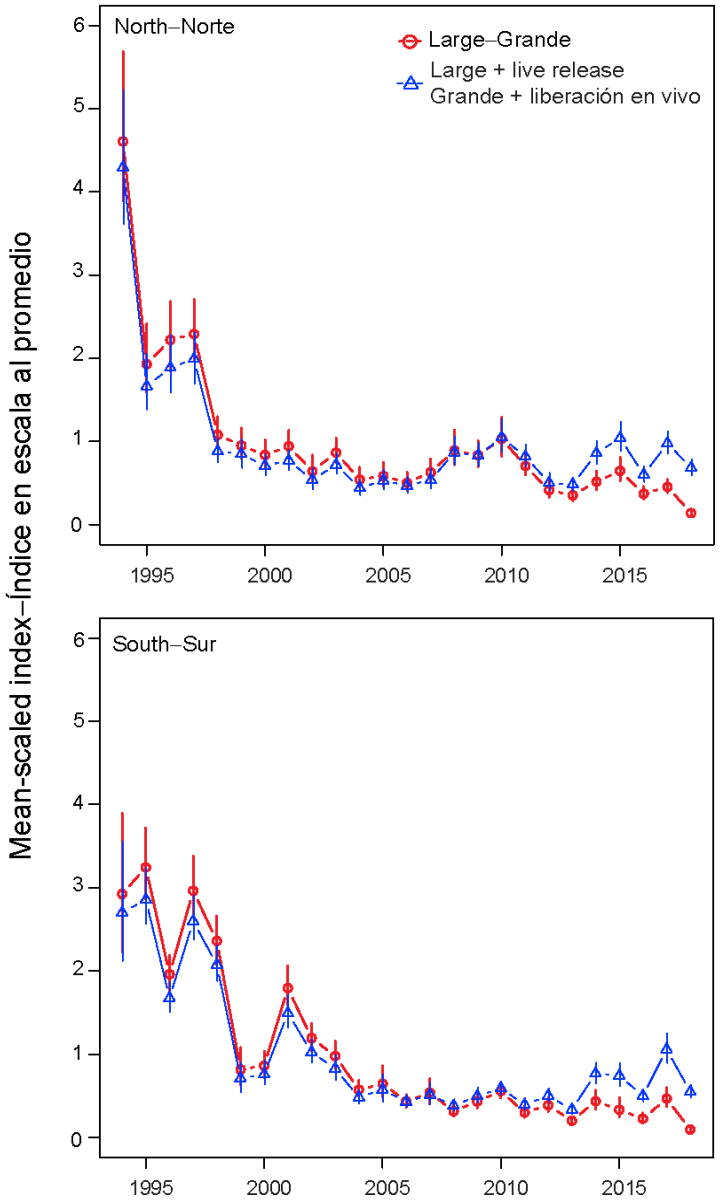
- Floating-object set indices
  - Observer data: 1994-2018.
  - Zero-inflated negative binomial generalized additive model fitted to bycatch-per-set.
  - Covariates: year, latitude, longitude, calendar day, set time, net depth, object depth, SST, proxies for local object density, log tuna catch, log non-silky bycatch.
  - Index for large (> 150 cm total length) silky sharks.
  - With and without live-release data; north and south EPO.
  - Index is sum of predictions on a 1° grid for each year.

Updated indices for 2018

Floating-object sets	Sets with no large silky sharks (including live-release)	Sets with large silky sharks (including live-release)	Total sets
North EPO	28,883	10, 063	38,946
South EPO	36,163	11,827	47,990

Model fit	% deviance explained Logistic	% deviance explained Count model
North EPO, large	16.9%	26.7%
North EPO, large + live-release	14.8%	24.2%
South EPO, large	30.2%	23.6%
South EPO, large + live-release	23.8%	23.3%

Updated indices for 2018



- The indices with and without live releases likely bracket the bycatch-per-set trend.
- Index based only on counts of dead sharks is too pessimistic.
- Index that includes live-release data likely too optimistic because any live-release that occurred prior to 2005 was not recorded.
- The real trend is considered closer to index that includes live-release.
- Indices suggests relatively stability for over a decade.
- The indices decreased in 2018 to about the 2016 level, following an increase in 2017.

Future directions

- Conduct observer survey to identify any difficulties encountered in estimating species and lengths of sharks released alive.

- Identify options for improving observer sampling protocol for collecting shark species and size composition data.

- Investigate methods, e.g. tagging studies, to evaluate the relationship between abundance, spatial distribution, and cross-IATTC convention area movement, and inter-annual variability in oceanographic conditions.

- Expand Project H.5.a to include additional research to better understand the correlation between silky shark and environmental indices.

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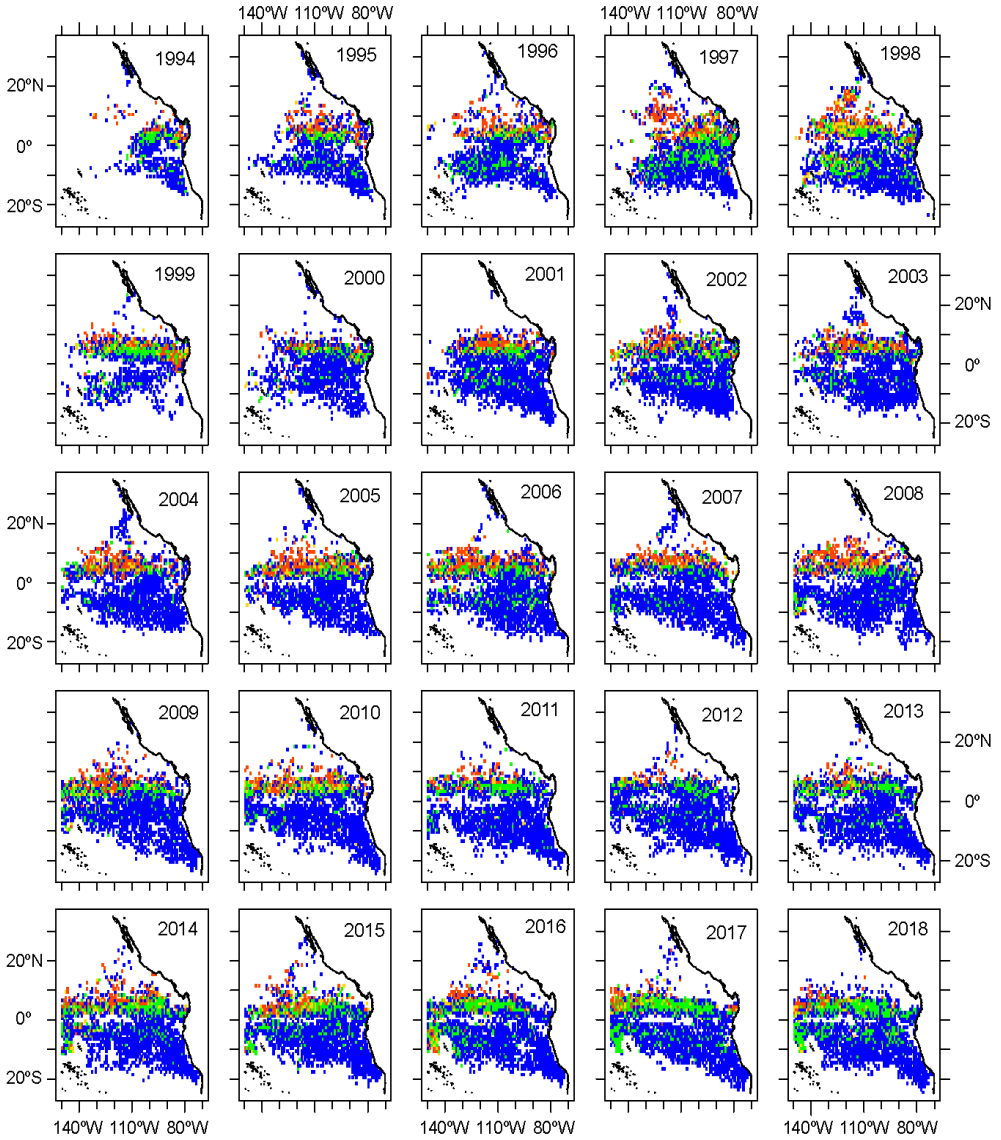
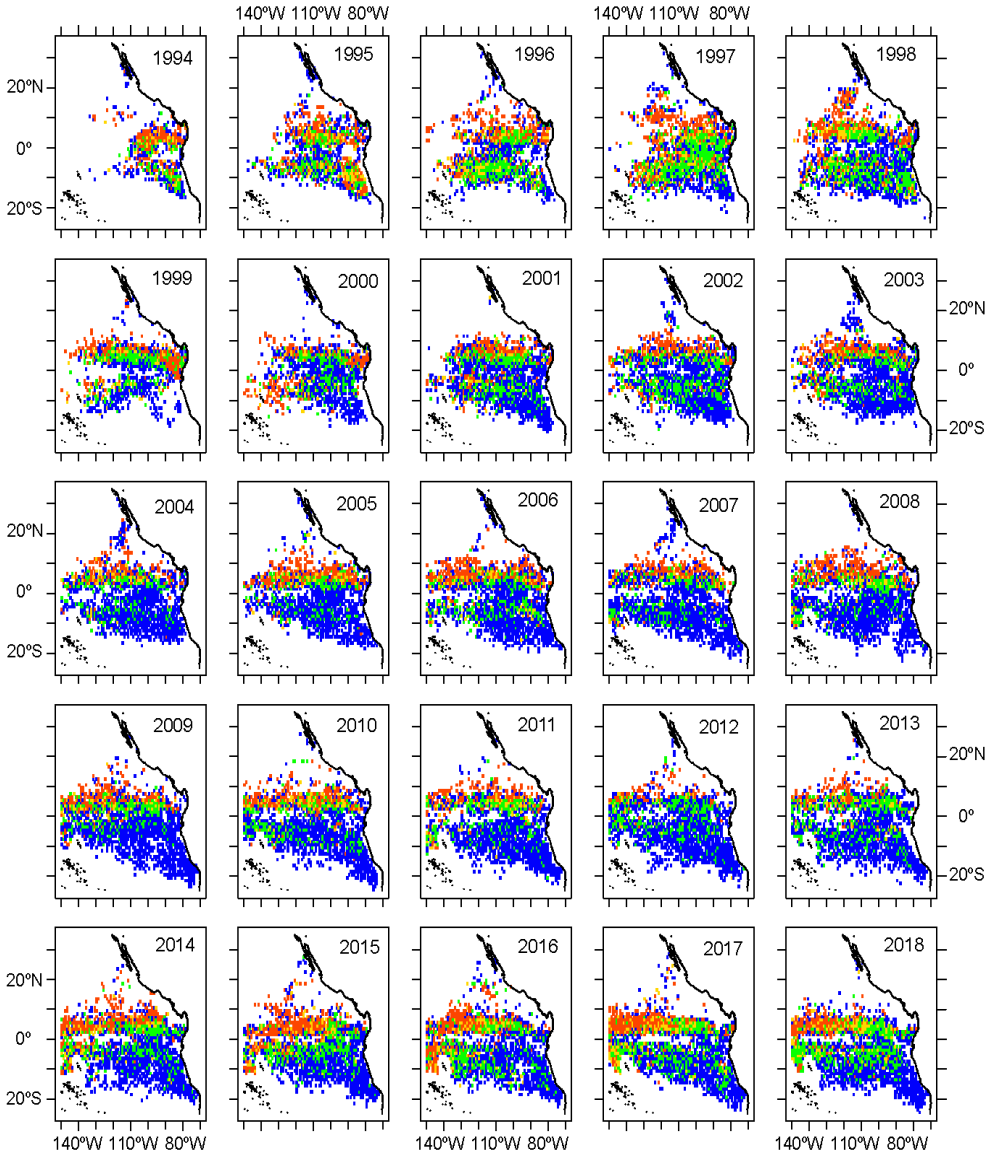
Thank you! Questions?

Photo: Jeff Muir

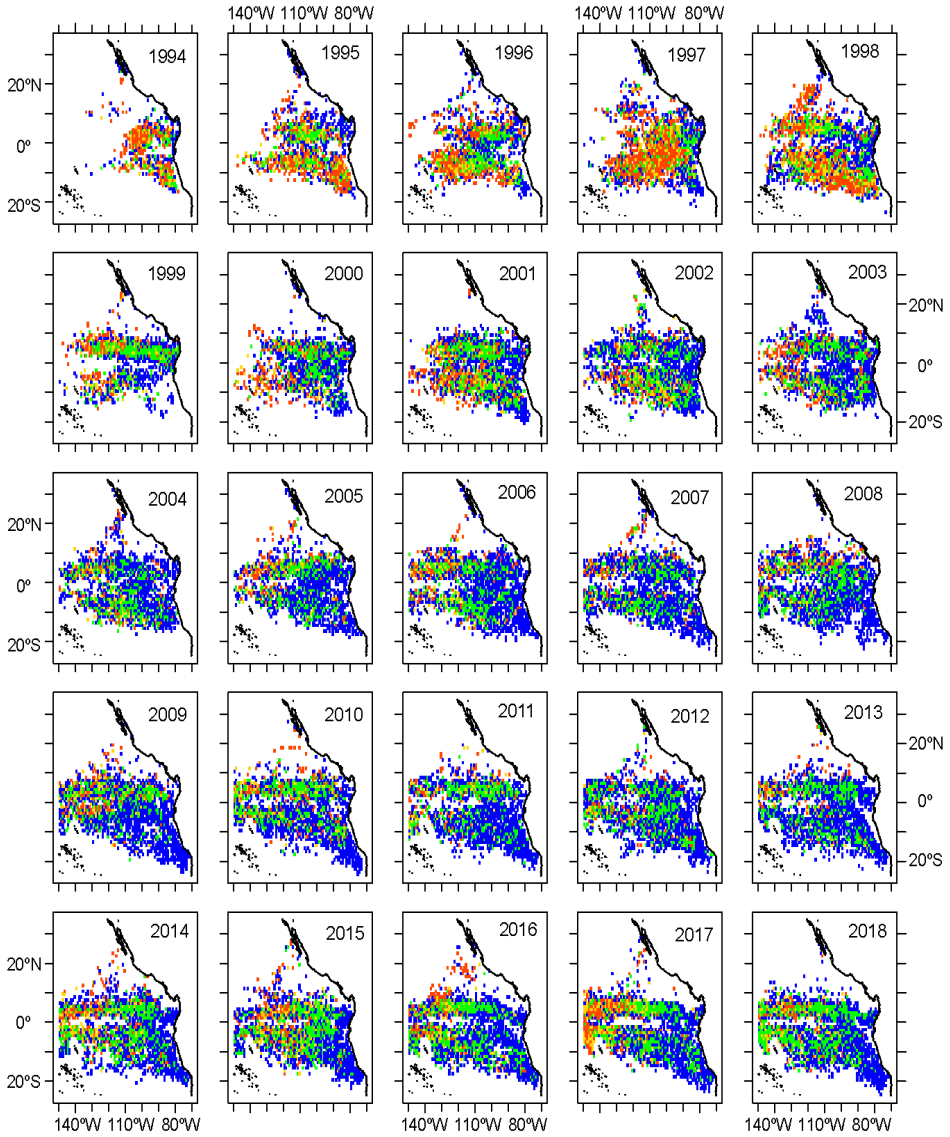
Average BPS: small silky sharks



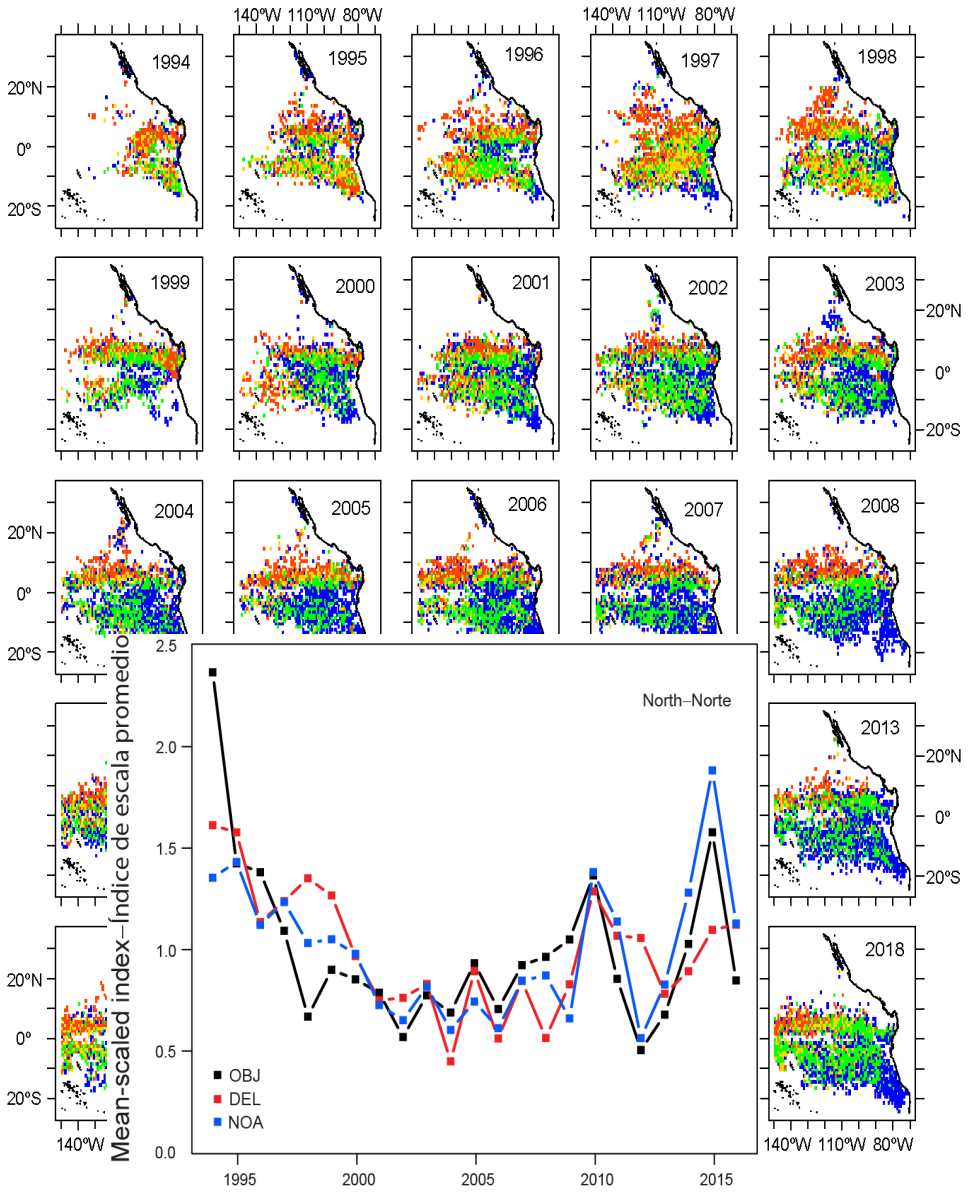
Average BPS: medium silky sharks



Average BPS: large silky sharks



Average BPS: all silky sharks



North EPO indices, by set type