

7_allGoM_fall

Shayna A. Sura

Tropicalization of Gulf of Mexico Fish Communities

Analysis of SEAMAP Trawl Data

Data Subset: all of GoM stations for fall trawls (October, November, December)

Number of trawl stations sampled each year

Table 1. Number of trawl stations for each year of data and the fall months during which sampling took place.

YR	num_trawls	dates
2010	375	11; 10
2011	298	11; 10
2012	276	10; 11
2013	271	11; 10; 12
2014	404	10; 11
2015	339	10; 11
2016	196	10; 11
2017	290	11; 10
2018	283	10; 11
2019	285	10; 11
2020	243	12; 10; 11
2021	264	10; 11
2022	205	10; 11

Map of trawl stations

2010 – 2022 October, November, December Data

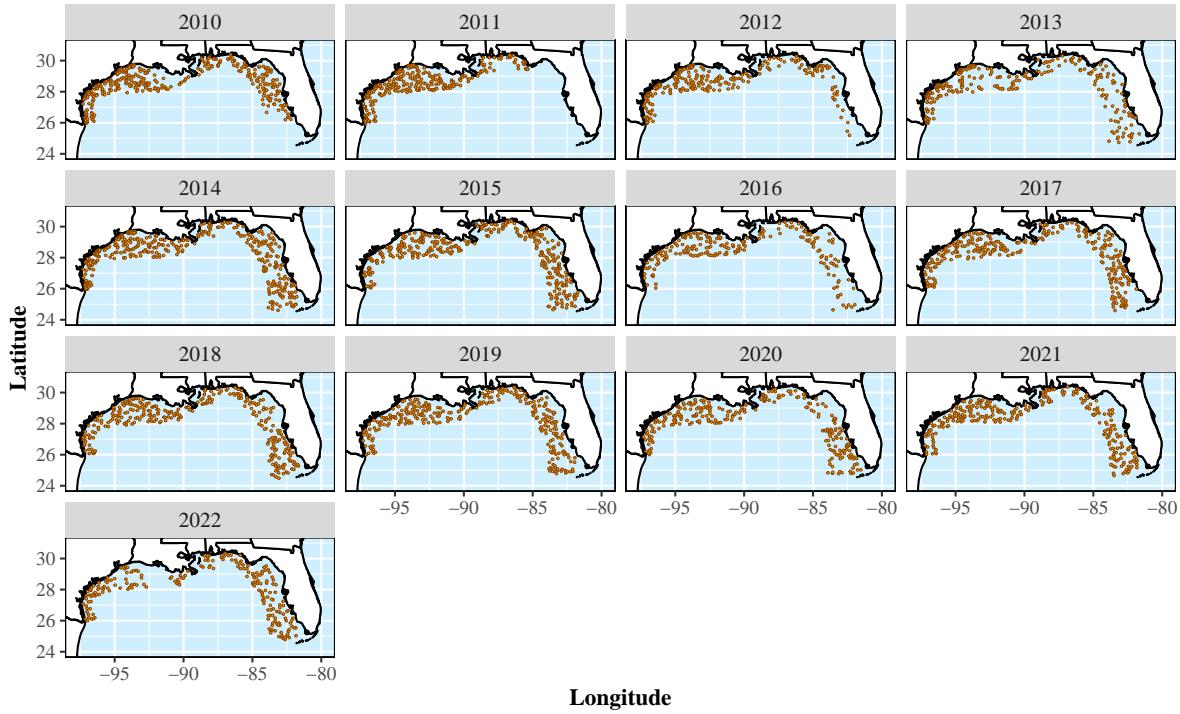


Figure 1. Trawl sampling locations for each year of data collection for this subset of data (2010-2022 fall sampling in months of October, November, and December).

There are 500 fish species that were caught in trawls in this subset of data.

Of those 500 fish species, only 288 of them had gCOB values for at least 5 years. For these fish species, linear models were constructed to test if their latitude and longitude gCOBs had shifted over time.

Table 2. The number of fish species that have significantly shifted latitudinally or longitudinally based upon their gCOBs.

climate_zone	significant latitude shift	North shifted	South shifted	significant longitude shift	West shifted	East shifted
deep-water	5	0	0	0	0	0
subtropical	205	35	0	35	27	8
temperate	4	1	0	1	0	0
tropical	74	19	0	19	12	1
						11

Warning: There were 2 warnings in `mutate()`.

The first warning was:

i In argument: `across(all_of(tropical_directions), str_to_sentence)`.
Caused by warning in `stri_trans_totitle()`:
! argument is not an atomic vector; coercing
i Run `dplyr::last_dplyr_warnings()` to see the 1 remaining warning.

Warning: There were 2 warnings in `mutate()`.

The first warning was:

i In argument: `across(all_of(subtropical_directions), str_to_sentence)`.
Caused by warning in `stri_trans_totitle()`:
! argument is not an atomic vector; coercing
i Run `dplyr::last_dplyr_warnings()` to see the 1 remaining warning.

Warning: There were 2 warnings in `mutate()`.

The first warning was:

i In argument: `across(all_of(temperate_directions), str_to_sentence)`.
Caused by warning in `stri_trans_totitle()`:
! argument is not an atomic vector; coercing
i Run `dplyr::last_dplyr_warnings()` to see the 1 remaining warning.

Table XX. The tropical fish species that have significantly shifted their geographical center of biomass (gCOB) over time.

south	west	east
Apogon affinis	Hemanthias vivanus	Chilomycterus schoepfii
Bothus robinsi	Null	Diplectrum bivittatum
Calamus arctifrons	Null	Echiophis intertinctus
Chilomycterus schoepfii	Null	Gobiesox strumosus

south	west	east
<i>Cryptotomus roseus</i>	Null	<i>Ophichthus puncticeps</i>
<i>Diplectrum bivittatum</i>	Null	<i>Ophidion holbrookii</i>
<i>Echiophis intortinctus</i>	Null	<i>Porichthys pectorodon</i>
<i>Equetus lanceolatus</i>	Null	<i>Rhynchoconger flavus</i>
<i>Gobiesox strumosus</i>	Null	<i>Syacium papillosum</i>
<i>Hemanthias vivanus</i>	Null	<i>Synodus foetens</i>
<i>Lepophidium jeannae</i>	Null	<i>Trachinocephalus myops</i>
<i>Nicholsina usta</i>	Null	Null
<i>Ophidion holbrookii</i>	Null	Null
<i>Porichthys pectorodon</i>	Null	Null
<i>Prionotus roseus</i>	Null	Null
<i>Scorpaena brasiliensis</i>	Null	Null
<i>Syacium papillosum</i>	Null	Null
<i>Synodus foetens</i>	Null	Null
<i>Trachinocephalus myops</i>	Null	Null

Table XX. The subtropical fish species that have significantly shifted their geographical center of biomass (gCOB) over time.

south	west	east
<i>Acanthostracion quadricornis</i>	<i>Centropristes philadelphica</i>	<i>Acanthostracion quadricornis</i>
<i>Aluterus schoepfii</i>	<i>Cyclopsetta chittendeni</i>	<i>Alectis ciliaris</i>
<i>Antennarius striatus</i>	<i>Dorosoma petenense</i>	<i>Ariosoma balearicum</i>
<i>Ariosoma balearicum</i>	<i>Elacatinus xanthiprora</i>	<i>Bellator militaris</i>
<i>Bagre marinus</i>	<i>Hypanus say</i>	<i>Chaetodipterus faber</i>
<i>Bellator militaris</i>	<i>Lonchopisthus micrognathus</i>	<i>Diplectrum formosum</i>
<i>Calamus bajonado</i>	<i>Selene setapinnis</i>	<i>Gymnothorax saxicola</i>
<i>Centropristes philadelphica</i>	<i>Trachinotus carolinus</i>	<i>Hyporthodus niveatus</i>
<i>Chaetodipterus faber</i>	Null	<i>Kathetostoma alboguttata</i>
<i>Chaetodon sedentarius</i>	Null	<i>Lutjanus synagris</i>
<i>Cyclopsetta chittendeni</i>	Null	<i>Monacanthus ciliatus</i>
<i>Cyclopsetta fimbriata</i>	Null	<i>Mullus auratus</i>
<i>Diplectrum formosum</i>	Null	<i>Prionotus ophryas</i>
<i>Dorosoma petenense</i>	Null	<i>Prionotus rubio</i>
<i>Gastropsetta frontalis</i>	Null	<i>Prionotus tribulus</i>
<i>Gymnothorax saxicola</i>	Null	<i>Sardinella aurita</i>
<i>Haemulon plumieri</i>	Null	<i>Syphurus diomedeanus</i>
<i>Hyporthodus flavolimbatus</i>	Null	<i>Syphurus plagiura</i>
<i>Monacanthus ciliatus</i>	Null	<i>Synodus poeyi</i>
<i>Mullus auratus</i>	Null	Null

south	west	east
<i>Opsanus pardus</i>	Null	Null
<i>Peprilus burti</i>	Null	Null
<i>Priacanthus arenatus</i>	Null	Null
<i>Prionotus ophryas</i>	Null	Null
<i>Prionotus rubio</i>	Null	Null
<i>Rostroraja texana</i>	Null	Null
<i>Selene setapinnis</i>	Null	Null
<i>Serranus phoebe</i>	Null	Null
<i>Sphoeroides dorsalis</i>	Null	Null
<i>Sphoeroides spengleri</i>	Null	Null
<i>Sphyrana tiburo</i>	Null	Null
<i>Sympodus diomedeanus</i>	Null	Null
<i>Sympodus plagiusa</i>	Null	Null
<i>Synodus poeyi</i>	Null	Null
<i>Xyrichtys novacula</i>	Null	Null

Table XX. The temperate fish species that have significantly shifted their geographical center of biomass (gCOB) over time.

south	west	east
<i>Centropristes striata</i>	Null	Null

2010–2022 October, November, & December
all latitudinal trends in gCOBs

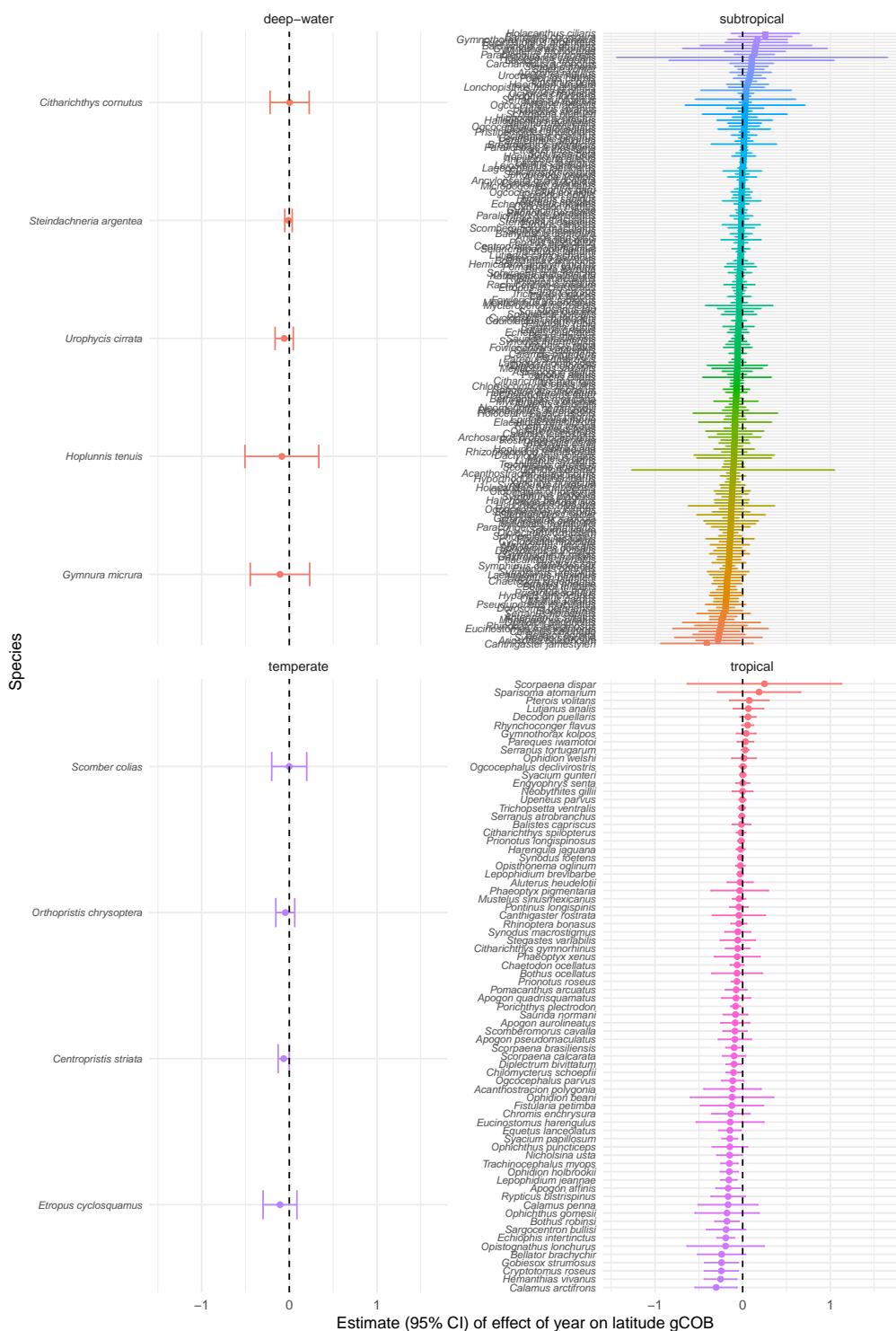


Figure 2. Latitudinal trends in gCOBs for fish species (deep-water, subtropical, temperate, tropical).

2010–2022 October, November, & December
all longitudinal trends in gCOBs

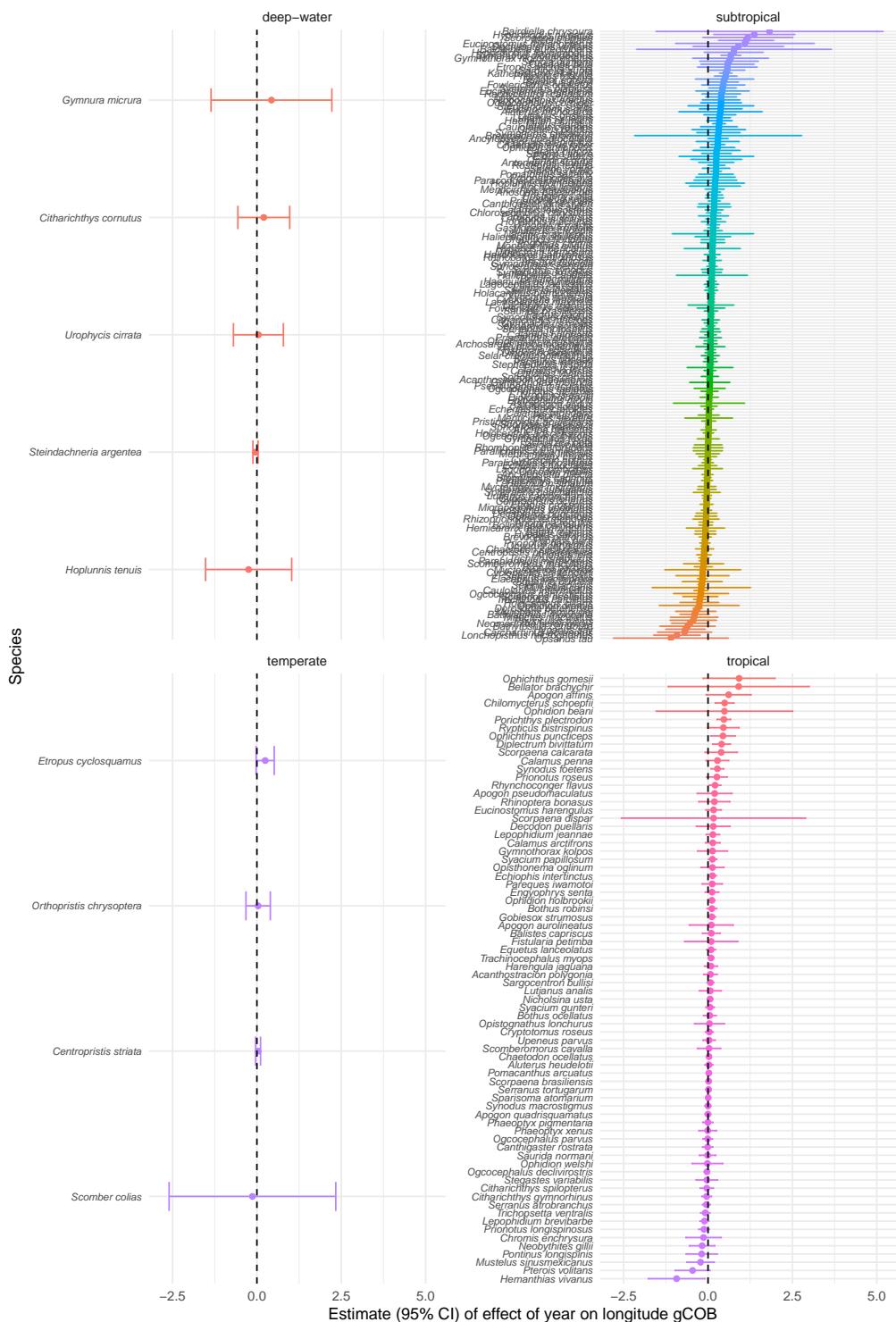


Figure 3. Longitudinal trends in gCOBs for fish species (deep-water, subtropical, temperate, tropical).

2010–2022 October, November, & December
significant latitudinal shifts in gCOBs

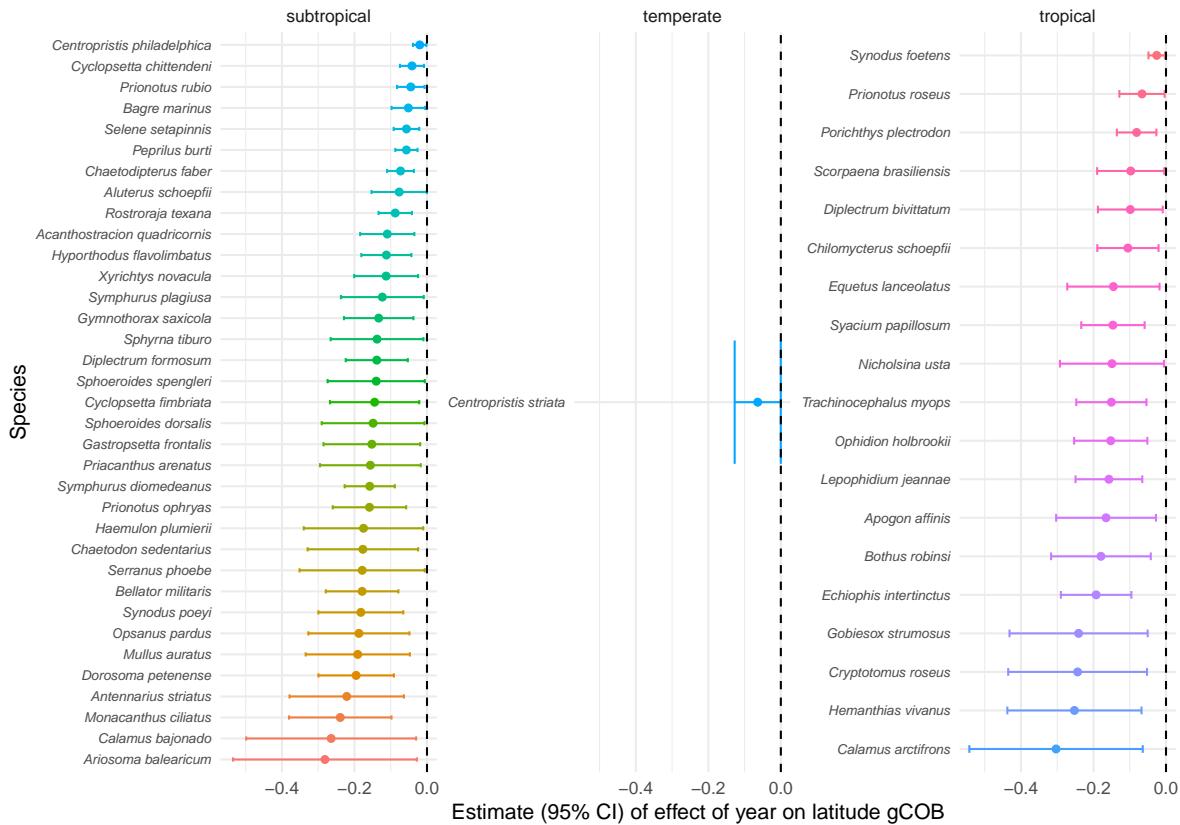


Figure 4. Latitudinal trends in gCOBs for fish species (deep-water, subtropical, temperate, tropical) with a significant shift over time.

2010–2022 October, November, & December
significant longitudinal shifts in gCOBs

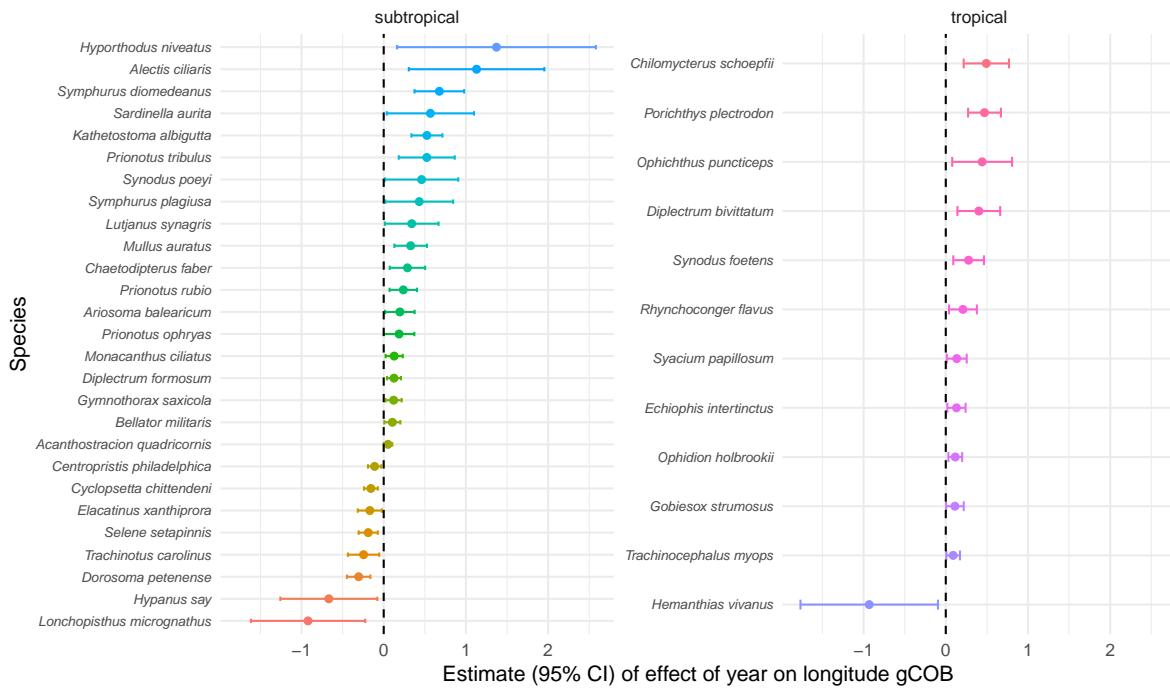


Figure 5. Longitudinal trends in gCOBs for fish species (deep-water, subtropical, temperate, tropical) with a significant shift over time.