

Supplementary Material

Temporal functional changes in coral and fish communities on subtropical coastal coral reefs

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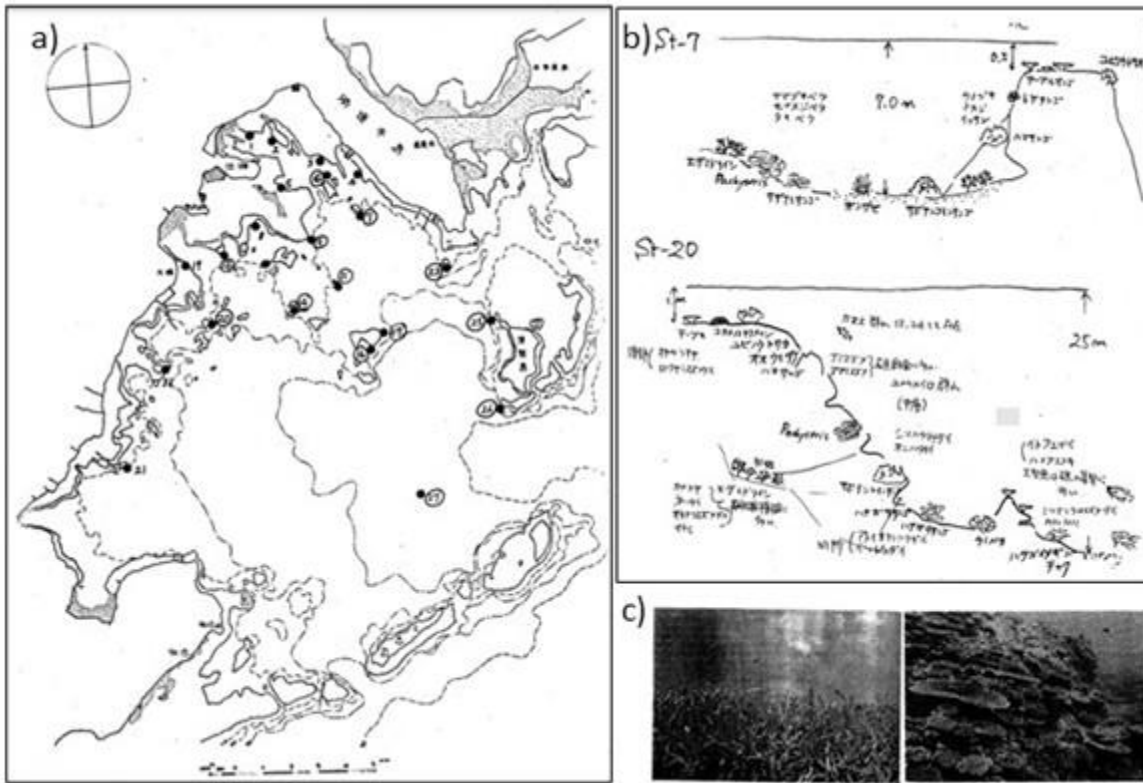


Fig. S1. (a) Yamazato and Nishihara (1977) survey map, which was georeferenced and used to calculate GPS coordinates for sites used in the 2018, 2019 and 2020 surveys. Sites were renamed for analysis. (b) Diagrams of topography, depth, and representative coral genera at site 7 (now site 1) and site 20 (now site 9). (c) Images were taken during the 1975–76 surveys showing coral assemblages (Yamazato and Nishihara 1977).

Table S1. Reef fish recorded in 1975–76 only, in all years or in modern surveys only.

Recorded in 1975–76 only	Recorded in all years	Recorded in modern surveys only
<i>Acanthurus bariene</i>	<i>Abudefduf sexfasciatus</i>	<i>Abudefduf septemfasciatus</i>
<i>Acanthurus triostegus</i>	<i>Abudefduf vaigiensis</i>	<i>Acanthochromis polyacanthus</i>
<i>Amblygobius</i> sp.	<i>Acanthurus lineatus</i>	<i>Acanthurus blochii</i>
<i>Amphiprion ocellaris</i>	<i>Acanthurus olivaceus</i>	<i>Acanthurus leucopareius</i>
<i>Amphiprion perideraion</i>	<i>Amblyglyphidodon curacao</i>	<i>Acanthurus maculiceps</i>
<i>Amphiprion sandaracinos</i>	<i>Amblyglyphidodon leucogaster</i>	<i>Acanthurus mata</i>
<i>Atrosalarias holomelas</i>	<i>Amphiprion clarkii</i>	<i>Acanthurus nigricauda</i>
<i>Canthigaster janthinoptera</i>	<i>Amphiprion frenatus</i>	<i>Acanthurus nigrofuscus</i>
<i>Centropyge bicolor</i>	<i>Anampses caeruleopunctatus</i>	<i>Acanthurus nigroris</i>
<i>Cephalopholis urodeta</i>	<i>Anampses meleagrides</i>	<i>Acanthurus pyroferus</i>
<i>Chaetodon melannotus</i>	<i>Aulostomus chinensis</i>	<i>Acanthurus thompsoni</i>
<i>Chaetodon reticulatus</i>	<i>Balistoides conspicillum</i>	<i>Aethaloperca rogaa</i>
<i>Chaetodon xanthurus</i>	<i>Bodianus axillaris</i>	<i>Amblyglyphidodon aureus</i>
<i>Cheiloprion labiatus</i>	<i>Bodianus loxozonus</i>	<i>Amblyglyphidodon batunai</i>
<i>Chromis</i> sp.	<i>Bodianus perditio</i>	<i>Amblyglyphidodon ternatensis</i>
<i>Chromis vanderbilti</i>	<i>Caesio caeruleaurea</i>	<i>Anampses geographicus</i>
<i>Chromis weberi</i>	<i>Caesio cuning</i>	<i>Anampses twistii</i>
<i>Chromis xanthochira</i>	<i>Caesio teres</i>	<i>Anyperodon leucogrammicus</i>
<i>Chrysiptera biocellata</i>	<i>Canthigaster valentini</i>	<i>Arothron meleagris</i>
<i>Chrysiptera</i> sp.	<i>Centropyge ferrugata</i>	<i>Arothron nigropunctatus</i>
<i>Cirrhilabrus temminckii</i>	<i>Centropyge tibicen</i>	<i>Balistapus undulatus</i>
<i>Cirrhithichthys aprinus</i>	<i>Centropyge vrolikii</i>	<i>Balistoides viridescens</i>
<i>Cromileptes altivelis</i>	<i>Cetoscarus ocellatus</i>	<i>Bodianus anthioides</i>
<i>Ctenochaetus strigosus</i>	<i>Chaetodon argentatus</i>	<i>Bodianus bimaculatus</i>
<i>Dascyllus aruanus</i>	<i>Chaetodon auriga</i>	<i>Bodianus izuensis</i>
<i>Dascyllus reticulatus</i>	<i>Chaetodon baronessa</i>	<i>Calotomus carolinus</i>
<i>Diademichthys lineatus</i>	<i>Chaetodon bennetti</i>	<i>Calotomus japonicus</i>
<i>Elagatis bipinnulata</i>	<i>Chaetodon citrinellus</i>	<i>Cantherhines pardalis</i>
<i>Epinephelus cyanopodus</i>	<i>Chaetodon kleinii</i>	<i>Caranx melampygus</i>
<i>Epinephelus fasciatus</i>	<i>Chaetodon lunula</i>	<i>Centropyge bispinosa</i>
<i>Fistularia commersonii</i>	<i>Chaetodon lunulatus</i>	<i>Cephalopholis argus</i>
<i>Halichoeres hortulanus</i>	<i>Chaetodon ornatissimus</i>	<i>Cephalopholis boenak</i>
<i>Halichoeres leucurus</i>	<i>Chaetodon plebieus</i>	<i>Cephalopholis leopardus</i>
<i>Halichoeres trimaculatus</i>	<i>Chaetodon speculum</i>	<i>Cephalopholis polleni</i>
<i>Heniochus singularius</i>	<i>Chaetodon ulietensis</i>	<i>Chaetodon auripes</i>
<i>Iniistius dea</i>	<i>Chaetodon vagabundus</i>	<i>Chaetodon ephippium</i>
<i>Koumansetta hectori</i>	<i>Chaetodontoplus mesoleucus</i>	<i>Chaetodon guentheri</i>
<i>Labracinus</i> sp.	<i>Cheilinus trilobatus</i>	<i>Chaetodon unimaculatus</i>
<i>Meiacanthus</i> sp.	<i>Cheilodipterus macrodon</i>	<i>Cheilinus chlorourus</i>
<i>Myripristis murdjan</i>	<i>Cheilodipterus quinquelineatus</i>	<i>Cheilinus fasciatus</i>
<i>Naso brevirostris</i>	<i>Chlorurus bowersi</i>	<i>Cheilio inermis</i>
<i>Nematalosa japonica</i>	<i>Chlorurus sordidus</i>	<i>Cheilodipterus artus</i>
<i>Ostorhinchus</i> sp.	<i>Choerodon fasciatus</i>	<i>Cheilodipterus intermedius</i>
<i>Ostracion meleagris</i>	<i>Choerodon schoenleinii</i>	<i>Chlorurus bleekeri</i>
<i>Oxymonacanthus longirostris</i>	<i>Chromis atripes</i>	<i>Chlorurus japonensis</i>

Recorded in 1975–76 only	Recorded in all years	Recorded in modern surveys only
<i>Paracirrhites arcatus</i>	<i>Chromis chrysur</i>	<i>Chlorurus microrhinos</i>
<i>Paracirrhites forsteri</i>	<i>Chromis flavomaculata</i>	<i>Choerodon jordani</i>
<i>Parapercis cylindrica</i>	<i>Chromis lepidolepis</i>	<i>Chromis albicauda</i>
<i>Parupeneus crassilabris</i>	<i>Chromis margaritifer</i>	<i>Chromis albomaculata</i>
<i>Parupeneus cyclostomus</i>	<i>Chromis ovatiformis</i>	<i>Chromis alleni</i>
<i>Parupeneus indicus</i>	<i>Chromis ternatensis</i>	<i>Chromis analis</i>
<i>Pervagor melanocephalus</i>	<i>Chromis viridis</i>	<i>Chromis delta</i>
<i>Platax pinnatus</i>	<i>Chrysiptera cyanea</i>	<i>Chromis notata</i>
<i>Plectroglyphidodon dickii</i>	<i>Chrysiptera glauca</i>	<i>Chromis opercularis</i>
<i>Pomacanthus imperator</i>	<i>Chrysiptera rex</i>	<i>Chromis xanthura</i>
<i>Pomachromis</i> sp.	<i>Cirrhilabrus cyanopleura</i>	<i>Chromis yamakawai</i>
<i>Pseudocaranx dentex</i>	<i>Diploprion bifasciatum</i>	<i>Chrysiptera caeruleolineata</i>
<i>Pseudocheilinus hexataenia</i>	<i>Ecsenius bicolor</i>	<i>Chrysiptera parasema</i>
<i>Pterois lunulata</i>	<i>Epinephelus merra</i>	<i>Chrysiptera starcki</i>
<i>Rhinecanthus verrucosus</i>	<i>Epinephelus quoyanus</i>	<i>Chrysiptera unimaculata</i>
<i>Sargocentron spiniferum</i>	<i>Forcipiger longirostris</i>	<i>Cirrhilabrus katherinae</i>
<i>Scarus prasiognathos</i>	<i>Gomphosus varius</i>	<i>Coris batuensis</i>
<i>Scarus scaber</i>	<i>Halichoeres melanochir</i>	<i>Coris dorsomacula</i>
<i>Siganus puellus</i>	<i>Halichoeres prosopeion</i>	<i>Coris gaimard</i>
<i>Stethojulis interrupta</i>	<i>Hemigymnus fasciatus</i>	<i>Ctenochaetus binotatus</i>
<i>Synodus variegatus</i>	<i>Hemigymnus melapterus</i>	<i>Ctenochaetus striatus</i>
<i>Syphraena</i> sp.	<i>Heniochus chrysostomus</i>	<i>Dascyllus trimaculatus</i>
<i>Thalassoma trilobatum</i>	<i>Heniochus monoceros</i>	<i>Diagramma pictum</i>
<i>Trimma</i> sp.	<i>Labroides bicolor</i>	<i>Dischistodus prosopotaenia</i>
<i>Zebrasoma flavescens</i>	<i>Labroides dimidiatus</i>	<i>Epibulus insidiator</i>
	<i>Labropsis manabei</i>	<i>Epinephelus malabaricus</i>
	<i>Lethrinus nebulosus</i>	<i>Epinephelus polyphekadion</i>
	<i>Lutjanus kasmira</i>	<i>Forcipiger flavissimus</i>
	<i>Lutjanus vitta</i>	<i>Genicanthus lamarck</i>
	<i>Meiacanthus kamoharai</i>	<i>Gnathodentex aureolineatus</i>
	<i>Naso lituratus</i>	<i>Halichoeres bleekeri</i>
	<i>Nemateleotris magnifica</i>	<i>Halichoeres chrysus</i>
	<i>Neoglyphidodon melas</i>	<i>Halichoeres marginatus</i>
	<i>Neoglyphidodon nigroris</i>	<i>Halichoeres nebulosus</i>
	<i>Ostorhinchus properuptus</i>	<i>Halichoeres scapularis</i>
	<i>Ostracion cubicus</i>	<i>Heniochus varius</i>
	<i>Paraluteres prionurus</i>	<i>Hipposcarus longiceps</i>
	<i>Parapercis pacifica</i>	<i>Hyporthodus septemfasciatus</i>
	<i>Parupeneus barberinoides</i>	<i>Kyphosus bigibbus</i>
	<i>Plagiotremus laudandus</i>	<i>Kyphosus pacificus</i>
	<i>Plagiotremus tapeinosoma</i>	<i>Labrichthys unilineatus</i>
	<i>Plectorhinchus chaetodonoides</i>	<i>Lethrinus lentjan</i>
	<i>Plectroglyphidodon lacrymatus</i>	<i>Lutjanus bohar</i>
	<i>Plectropomus leopardus</i>	<i>Lutjanus ehrenbergii</i>
	<i>Pomacanthus semicirculatus</i>	<i>Lutjanus fulviflamma</i>
	<i>Pomacentrus bankanensis</i>	<i>Lutjanus gibbus</i>
	<i>Pomacentrus brachialis</i>	<i>Lutjanus lutjanus</i>

Recorded in 1975–76 only	Recorded in all years	Recorded in modern surveys only
	<i>Pomacentrus chrysurus</i>	<i>Lutjanus monostigma</i>
	<i>Pomacentrus coelestis</i>	<i>Lutjanus quinquelineatus</i>
	<i>Pomacentrus lepidogenys</i>	<i>Luzonichthys waitei</i>
	<i>Pomacentrus moluccensis</i>	<i>Macolor niger</i>
	<i>Pomacentrus nagasakiensis</i>	<i>Macropharyngodon negrosensis</i>
	<i>Pomacentrus philippinus</i>	<i>Malacanthus latovittatus</i>
	<i>Pomacentrus</i> sp.	<i>Monotaxis grandoculis</i>
	<i>Pomachromis richardsoni</i>	<i>Mulloidichthys flavolineatus</i>
	<i>Ptereleotris evides</i>	<i>Mulloidichthys vanicolensis</i>
	<i>Pterocaesio tile</i>	<i>Myripristis hexagona</i>
	<i>Pygoplites diacanthus</i>	<i>Naso hexacanthus</i>
	<i>Rhinecanthus aculeatus</i>	<i>Naso unicornis</i>
	<i>Sargocentron rubrum</i>	<i>Naso valmingii</i>
	<i>Scarus ghobban</i>	<i>Neoglyphidodon thoracotaeniatus</i>
	<i>Scarus</i> sp.	<i>Neoniphon sammara</i>
	<i>Scolopsis bilineata</i>	<i>Neopomacentrus cyanomos</i>
	<i>Siganus argenteus</i>	<i>Neopomacentrus nemurus</i>
	<i>Siganus unimaculatus</i>	<i>Neopomacentrus violascens</i>
	<i>Siganus virgatus</i>	<i>Oplegnathus punctatus</i>
	<i>Sufflamen chrysopterum</i>	<i>Ostorhinchus angustatus</i>
	<i>Symphorus nematophorus</i>	<i>Ostorhinchus apogonoides</i>
	<i>Thalassoma amblycephalum</i>	<i>Ostorhinchus endekataenia</i>
	<i>Thalassoma hardwicke</i>	<i>Ostorhinchus nigrofasciatus</i>
	<i>Thalassoma janseni</i>	<i>Ostorhinchus notatus</i>
	<i>Thalassoma lunare</i>	<i>Ostorhinchus novemfasciatus</i>
	<i>Thalassoma lutescens</i>	<i>Oxycheilinus digramma</i>
	<i>Zanclus cornutus</i>	<i>Paracaesio xanthura</i>
	<i>Zebrasoma scopas</i>	<i>Paracanthurus hepatus</i>
	<i>Zebrasoma velifer</i>	<i>Parapercis clathrata</i>
		<i>Parapercis hexophtalma</i>
		<i>Parapercis snyderi</i>
		<i>Parupeneus barberinus</i>
		<i>Parupeneus ciliatus</i>
		<i>Parupeneus multifasciatus</i>
		<i>Parupeneus spilurus</i>
		<i>Pentapodus caninus</i>
		<i>Plagiotremus rhinorhynchus</i>
		<i>Plectorhinchus lessonii</i>
		<i>Plectroglyphidodon leucozonus</i>
		<i>Plectropomus areolatus</i>
		<i>Pomacanthus sexstriatus</i>
		<i>Pomacentrus alexanderae</i>
		<i>Pomacentrus amboinensis</i>
		<i>Pomacentrus nigromarginatus</i>
		<i>Pomacentrus vaiuli</i>
		<i>Prionurus scalprum</i>
		<i>Pristotis obtusirostris</i>

Recorded in 1975–76 only	Recorded in all years	Recorded in modern surveys only
		<i>Pseudodax moluccanus</i>
		<i>Pseudojuloides elongatus</i>
		<i>Ptereleotris microlepis</i>
		<i>Pterocaesio marri</i>
		<i>Rhinecanthus rectangulus</i>
		<i>Sargocentron ittodai</i>
		<i>Sargocentron spinosissimum</i>
		<i>Scarus chameleon</i>
		<i>Scarus dimidiatus</i>
		<i>Scarus festivus</i>
		<i>Scarus forsteni</i>
		<i>Scarus frenatus</i>
		<i>Scarus fuscocaudalis</i>
		<i>Scarus globiceps</i>
		<i>Scarus hypselopterus</i>
		<i>Scarus niger</i>
		<i>Scarus ovifrons</i>
		<i>Scarus psittacus</i>
		<i>Scarus rivulatus</i>
		<i>Scarus rubriviolescens</i>
		<i>Scarus schlegeli</i>
		<i>Scolopsis affinis</i>
		<i>Scolopsis ciliata</i>
		<i>Scolopsis lineata</i>
		<i>Scolopsis monogramma</i>
		<i>Siganus corallinus</i>
		<i>Siganus spinus</i>
		<i>Stegastes altus</i>
		<i>Stegastes fasciolatus</i>
		<i>Stegastes lividus</i>
		<i>Stegastes nigricans</i>
		<i>Stegastes obreptus</i>
		<i>Stegastes punctatus</i>
		<i>Stethojulis bandanensis</i>
		<i>Stethojulis trilineata</i>
		<i>Suezichthys gracilis</i>
		<i>Thalassoma cupido</i>
		<i>Thalassoma quinquevittatum</i>
		<i>Upeneus tragula</i>
		<i>Variola albimarginata</i>
		<i>Variola louti</i>

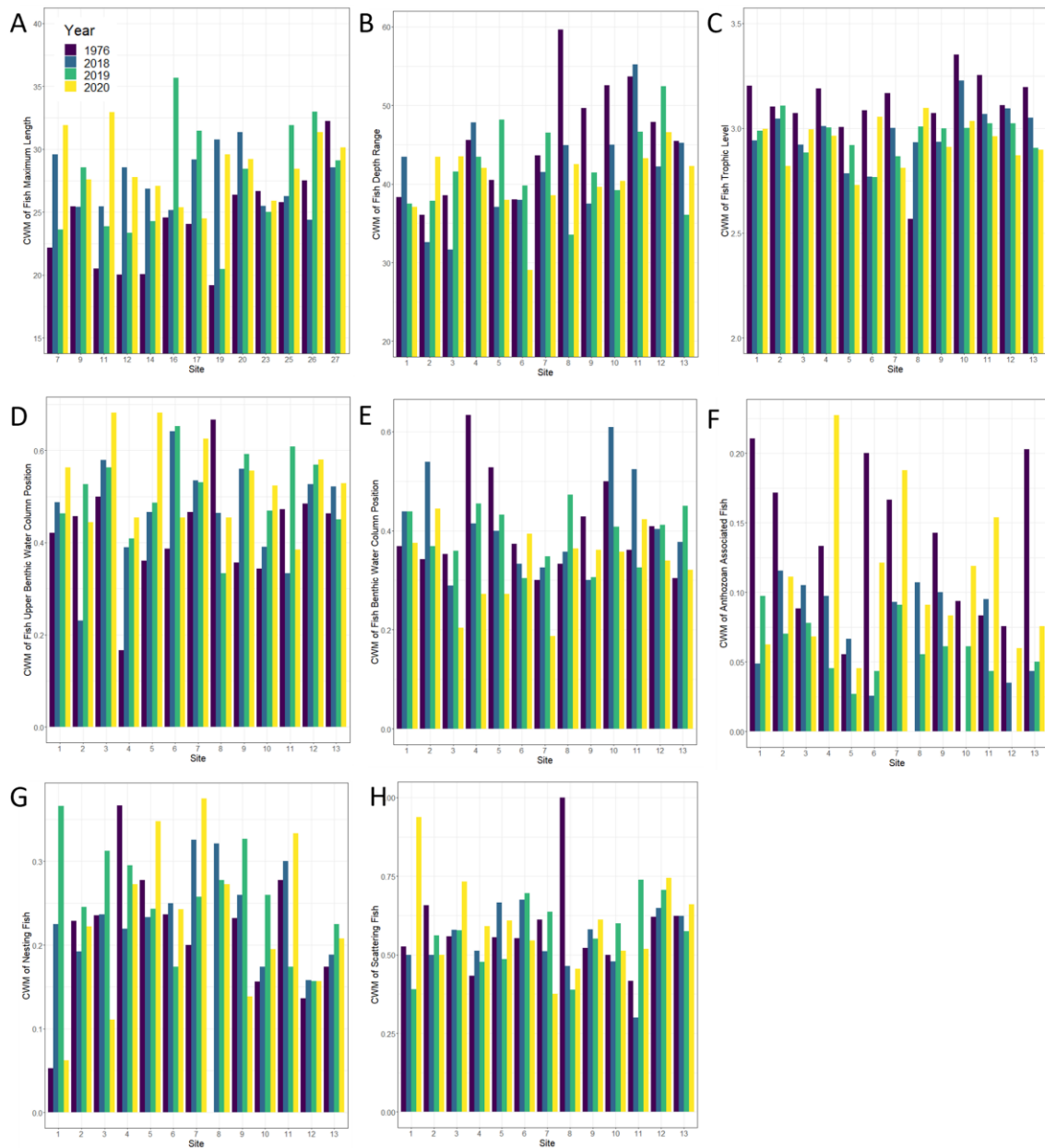


Fig. S2. Community weighted means (CWM) of each influential fish trait at each of the sites (1–13) around Nakagusuku Bay, across the 4 years (purple, 1975–76; blue, 2018; green, 2019; yellow, 2020). (a) CWM value for fish maximum length at each site across the four years. (b) CWM value for the depth range of fish at each site across the four years. (c) CWM value of fish trophic level at each site across the four years. (d) CWM value for the fish water column position trait upper benthic at each of the sites across the four years. (e) CWM value for the fish water column position trait benthic at each of the sites across the four years. (f) CWM value for the fish water column position anthozoan associated at each of the sites across the four years. (g) CWM value for the fish parental trait of nesting at each site across the four years. (h) CWM value for the fish parental trait of scattering at each site across the four years.

References

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