



**Indian Island
2023**

Indian Island 2023

Species diversity has declined over the last 10 years in terrestrial as well as marine habitats. Nonetheless, some native species are thriving in the warmer, shallower bay, as are invasive kelps, and potentially harmful algal blooms.

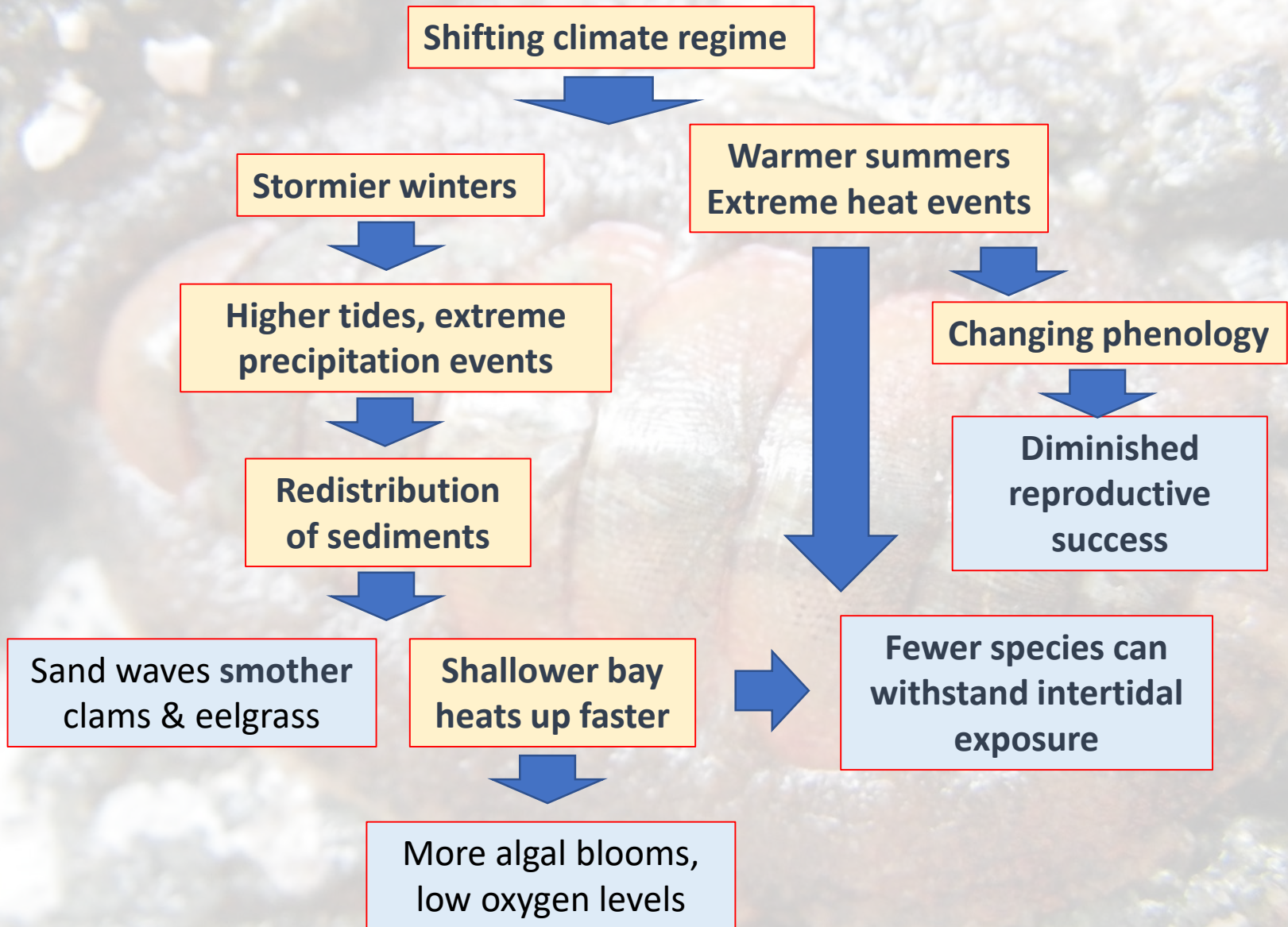
Most of these changes are a result of warming, stormier seas. However, growing numbers of summer visitors have exacerbated the impacts of warming on the intertidal zone and uplands.

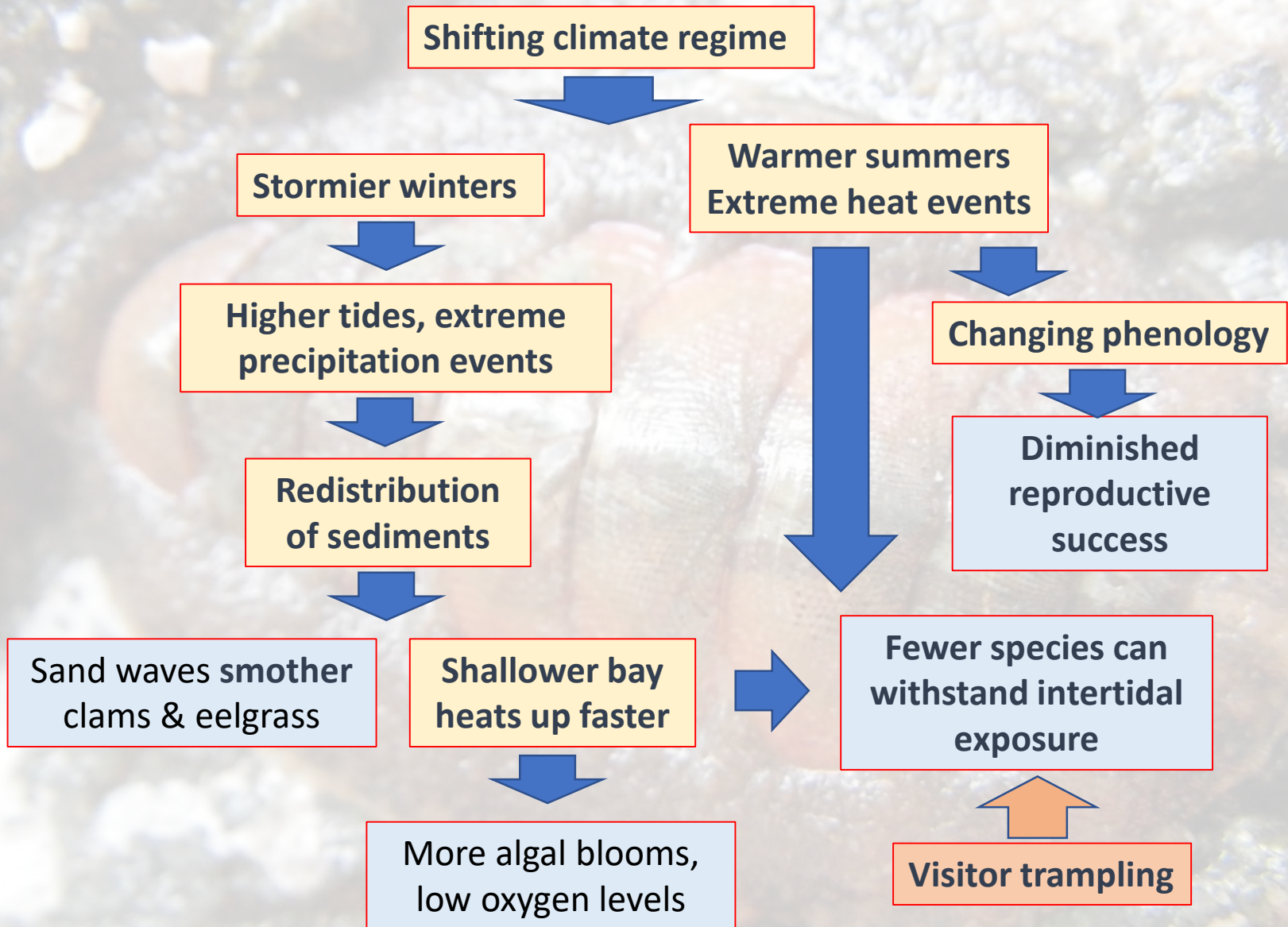


Monitoring since 2009 has focused on three kinds of intertidal habitats

Winter storms, summer heat stress and visitor impacts have all **increased**







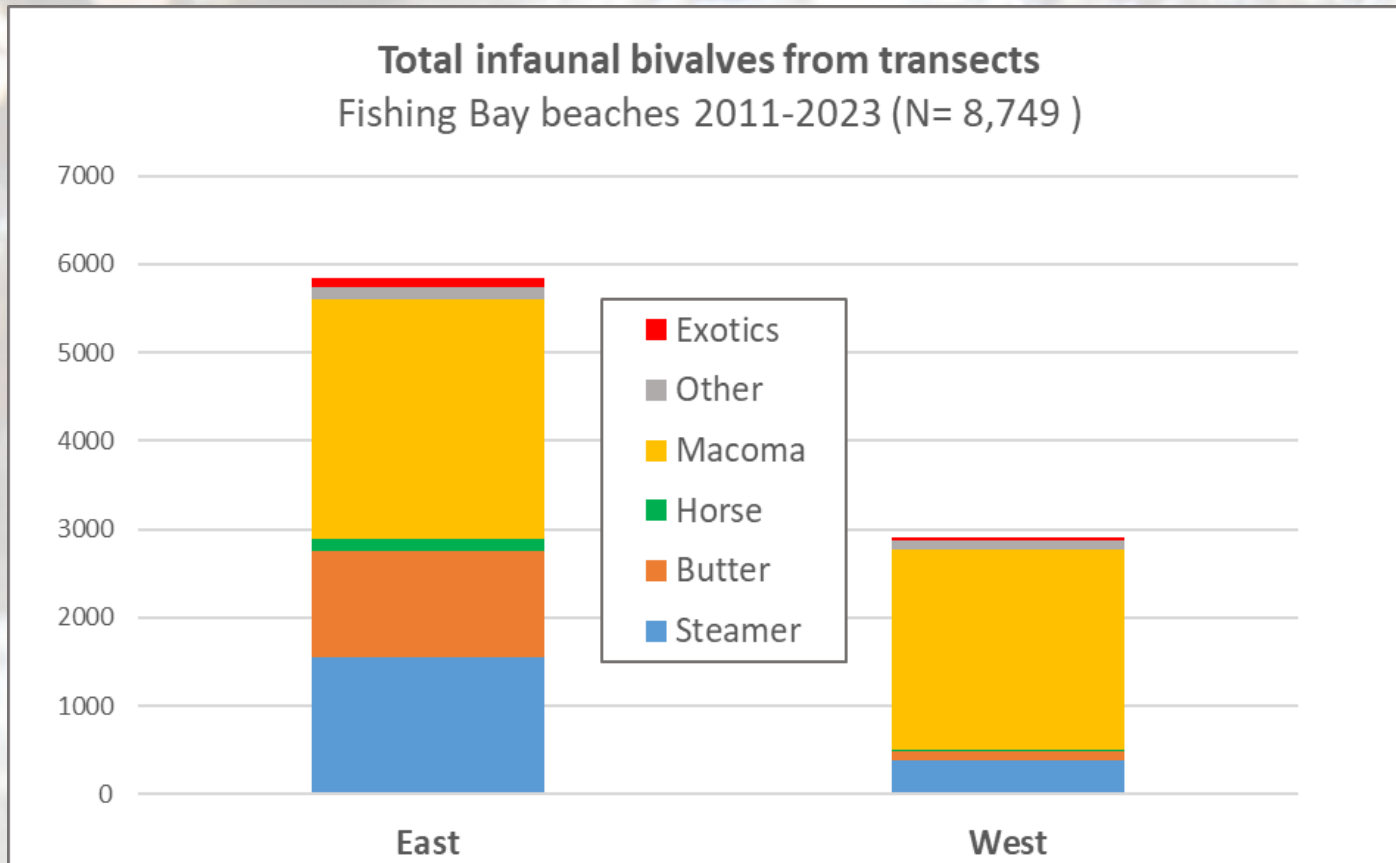


Sandy beach

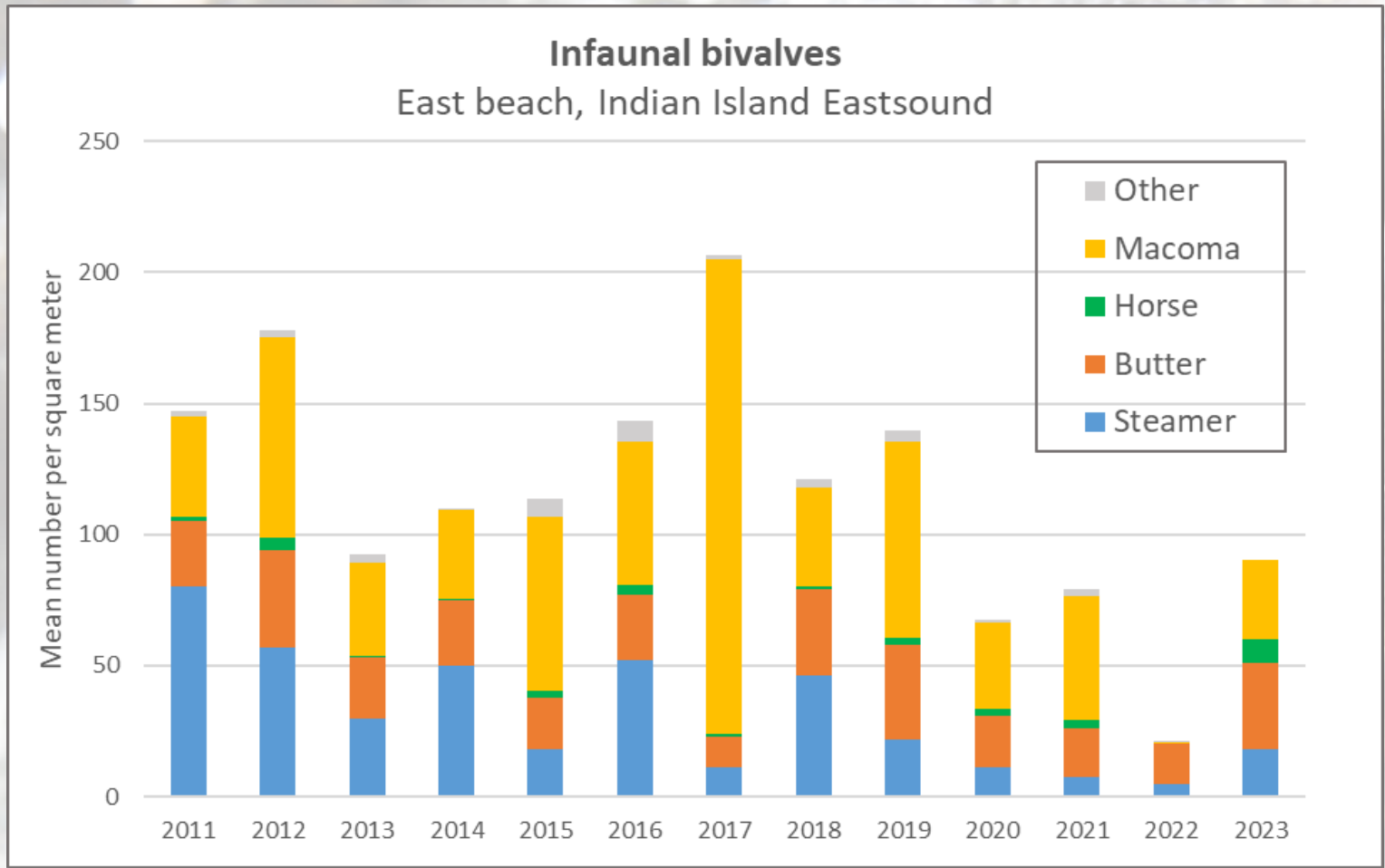
Cobble beach

Eelgrass meadow

Above the tides

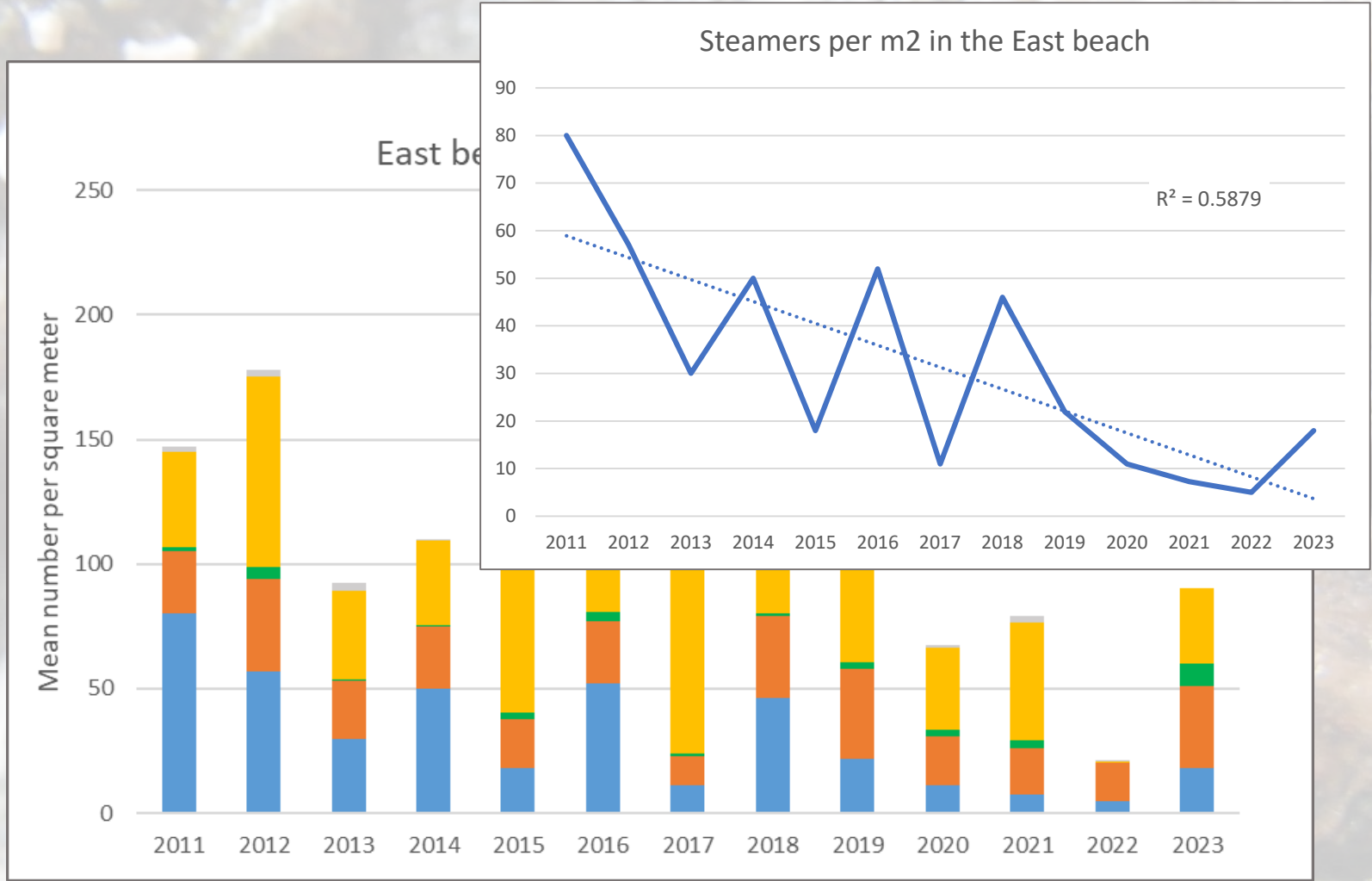


The west end of the beach has grown siltier, and lost most of its “hard-shelled” clams as a result



But even on the east beach, clam populations have declined

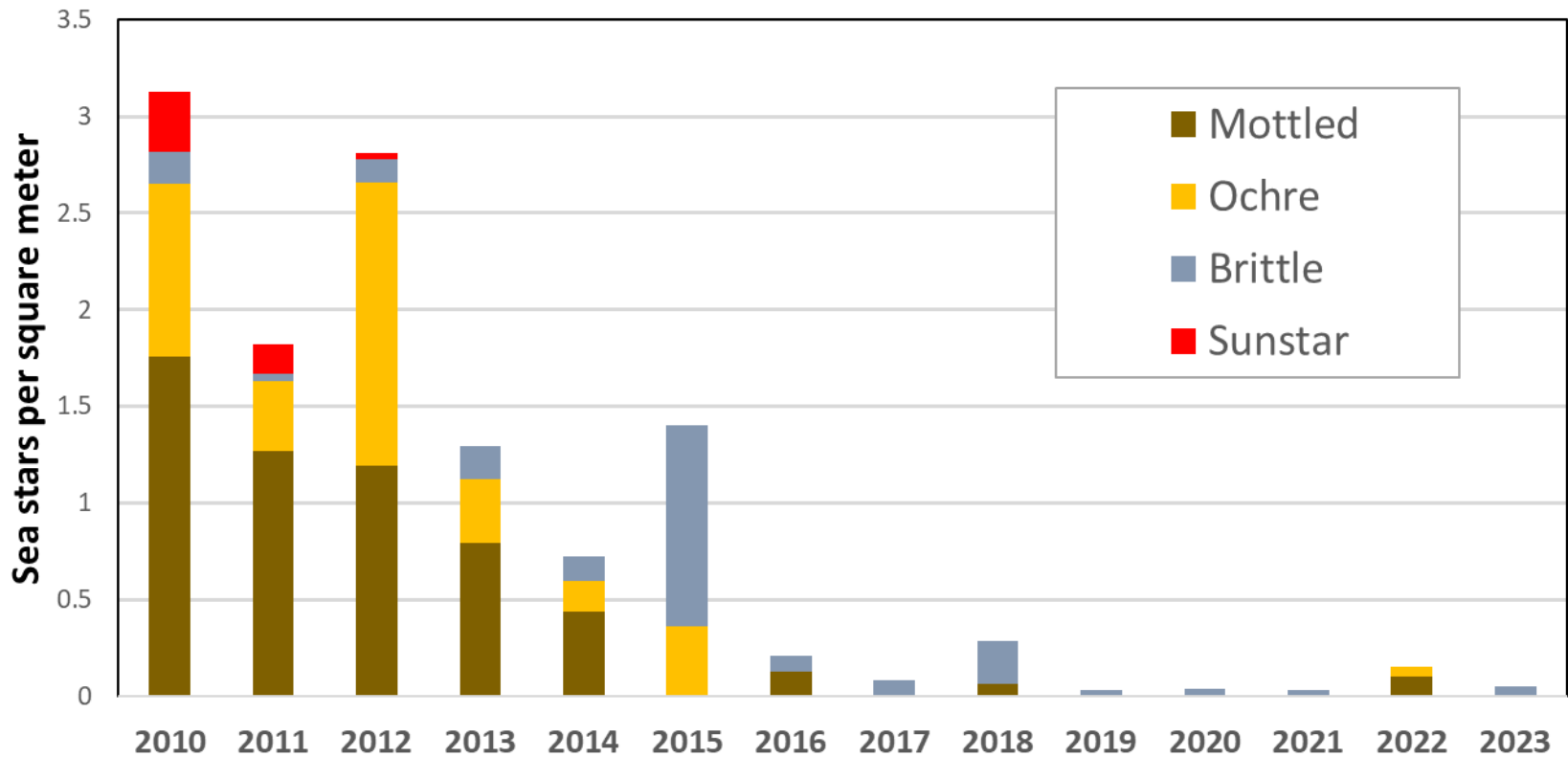
Sandy beach



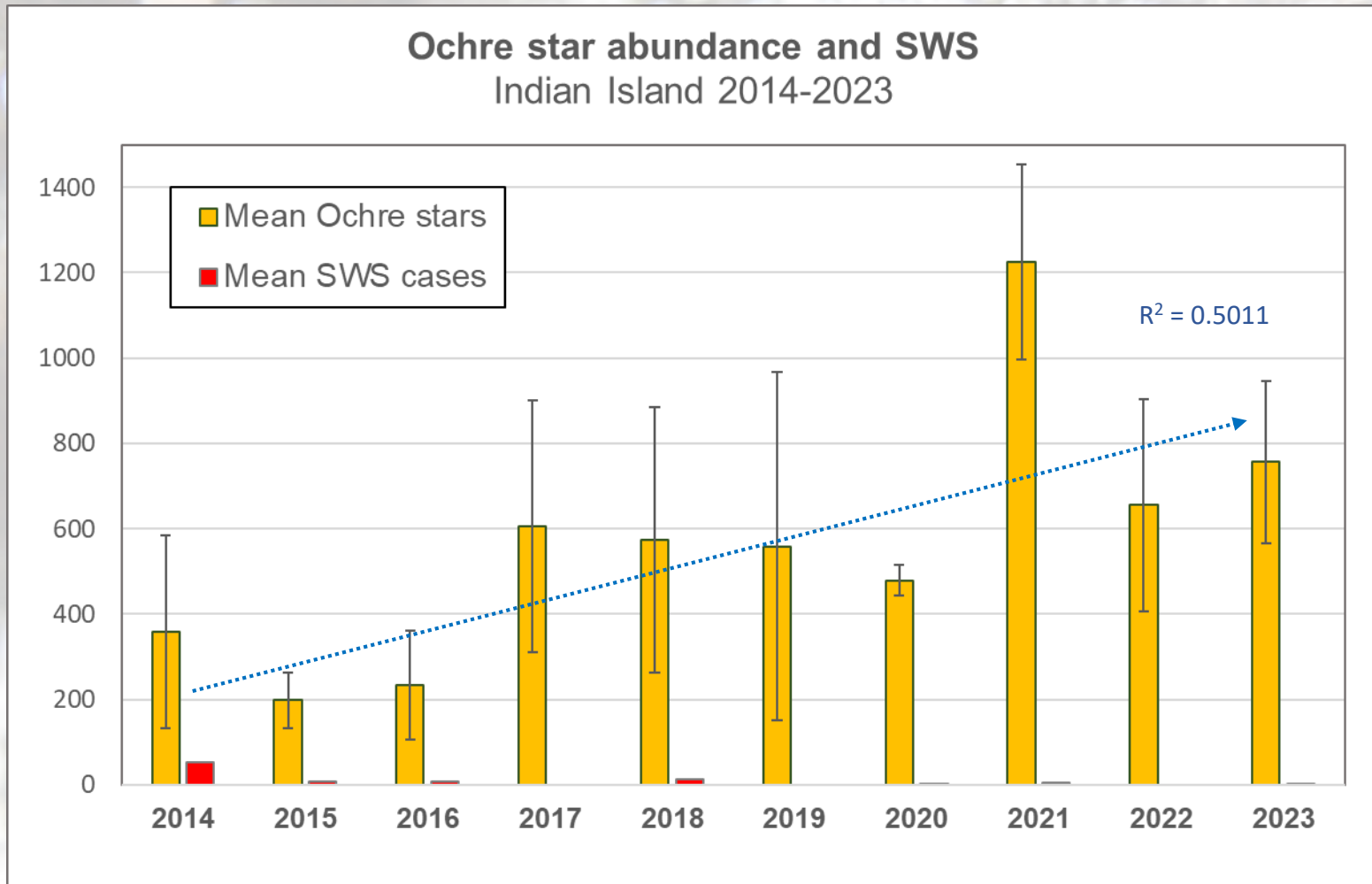
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Seastars beneath beach cobbles

Mean annual per square meter, Indian Island

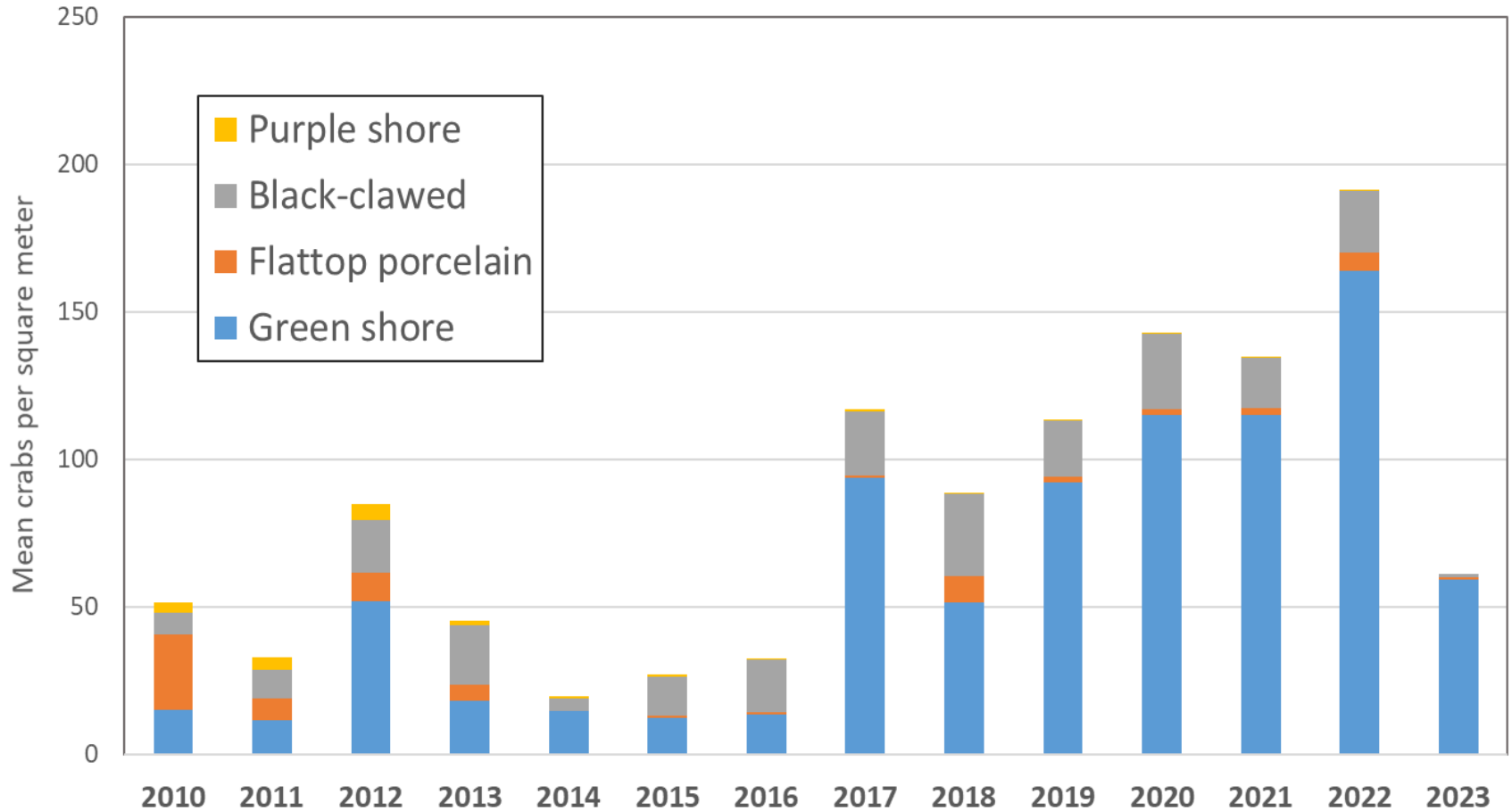


Diverse sea stars were routinely found in the cobble beach until 2015



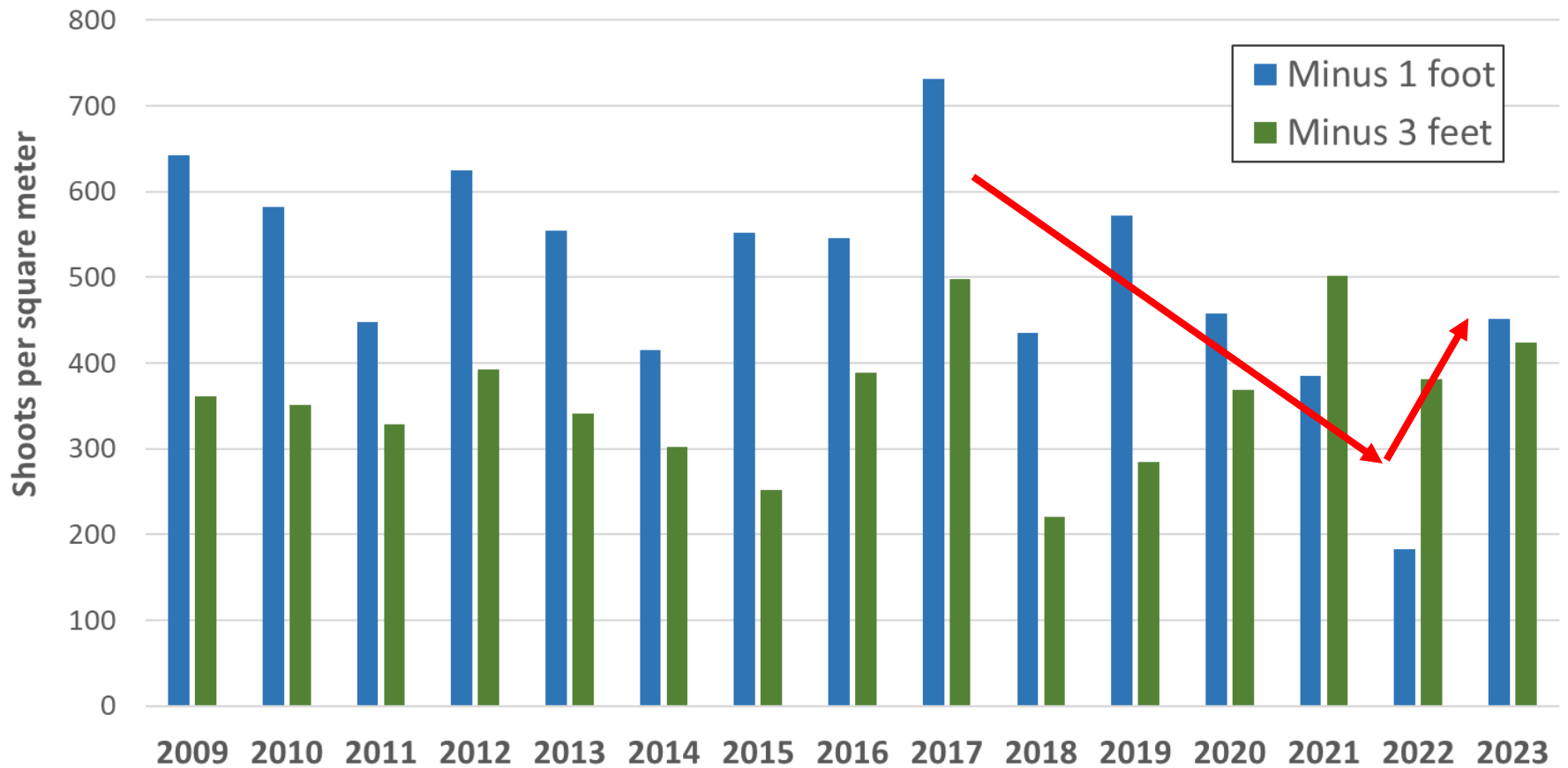
Ochre Stars **rebounded** following the 2014-2015 Wasting epidemic

Juvenile crabs beneath beach cobbles Indian Island, 2010-2023

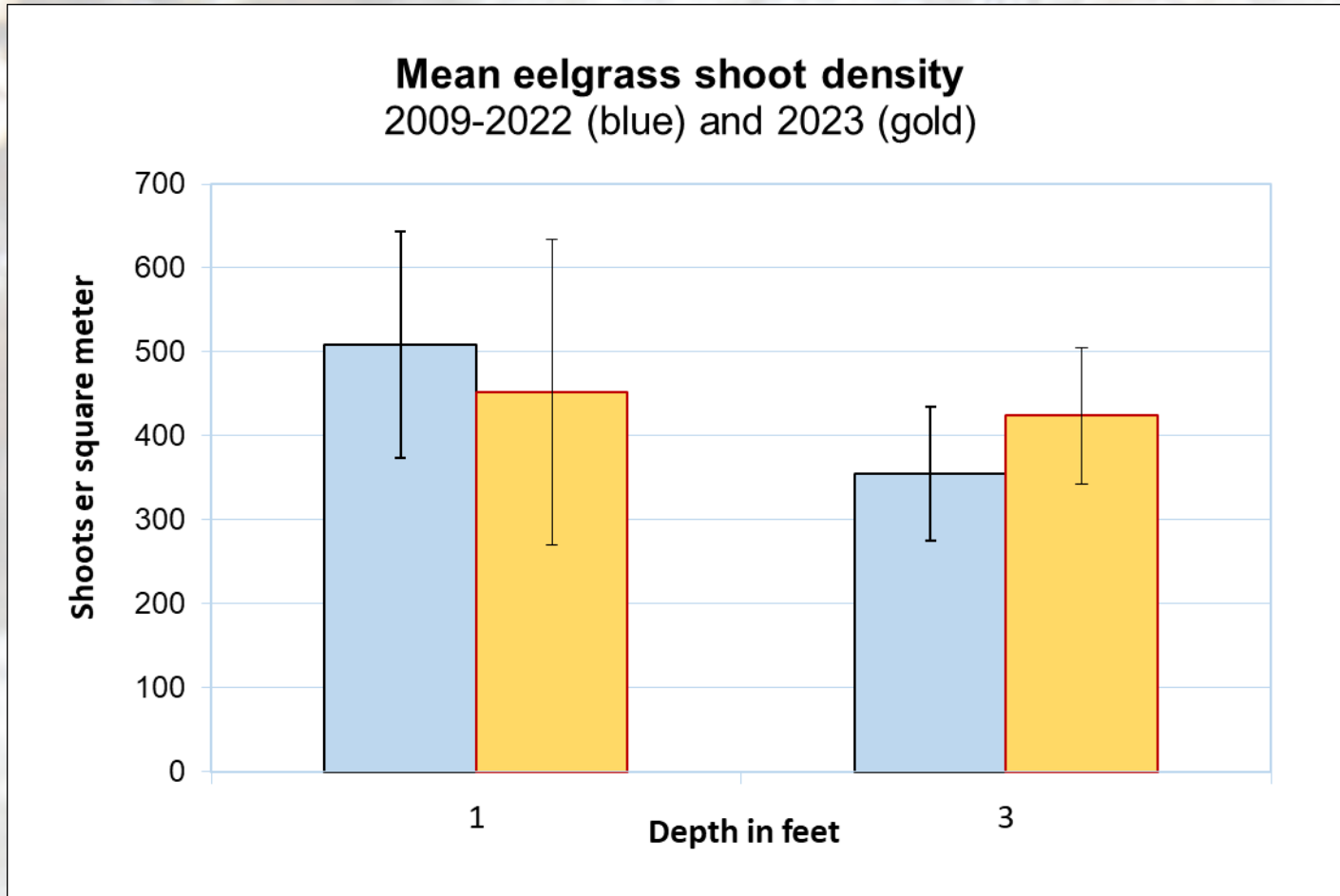


Green Shore Crabs recovered and thrived after the 2014-2015 “Blob” but other intertidal crab species declined; and now Green Shores crashed

Indian Island, annual eelgrass shoot density Depths of -1 foot and -3 feet, 2009-2023



Shallow (blue bars) eelgrass, thinning since 2017, has rebounded



Eelgrass density in **deep water** is limited by turbidity (reduced light penetration) while in **shallow water**, exposure to heat plays a larger role

Sargassum muticum

First detection in the San Juan Islands 2003

First established at Indian Island 2012, west side

First established on east side of Indian Island 2023

97 patches in eelgrass meadow 2022

23 patches in eelgrass 2023



Sargassum muticum

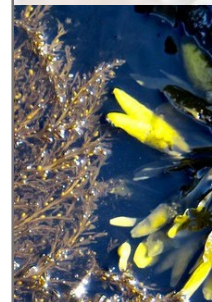
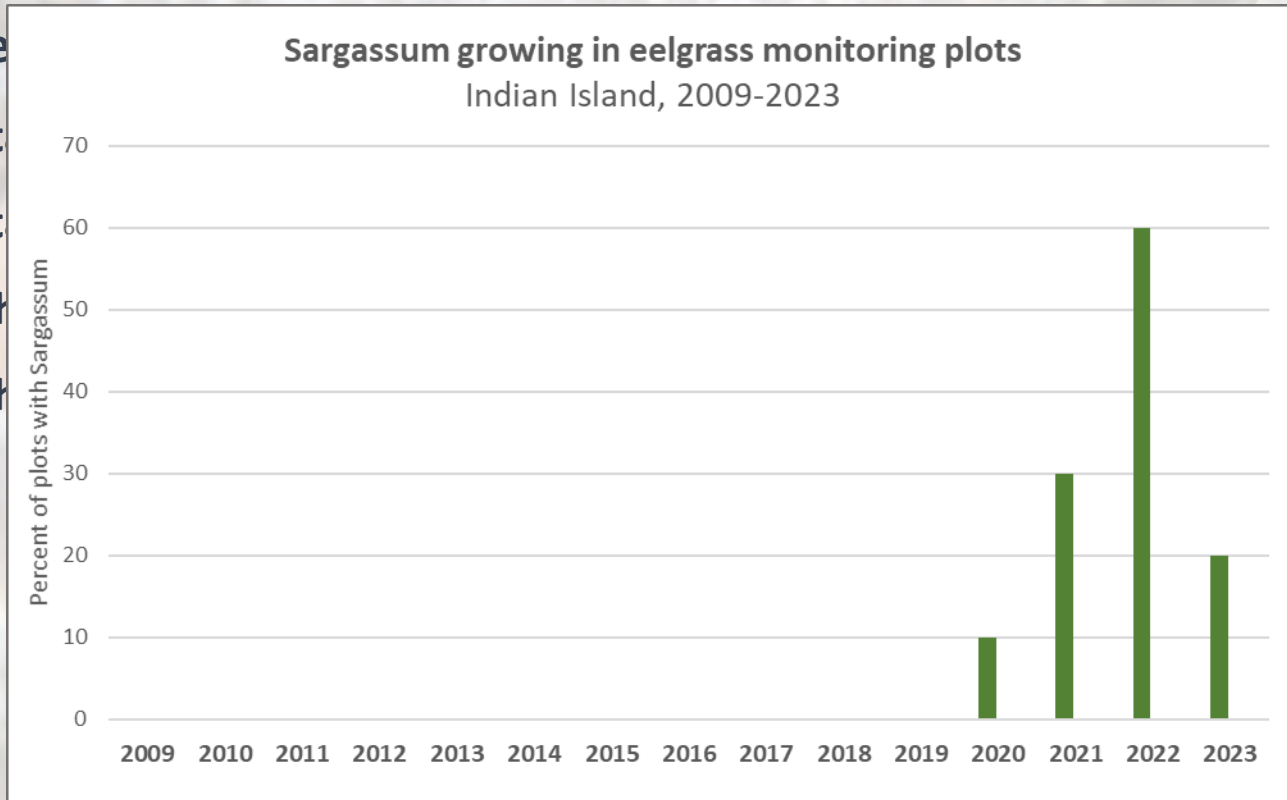
First de

First est

First est

97 patch

23 patch



Algal blooms

Noctiluca “tomato soup” (non-toxic) earlier and more frequent

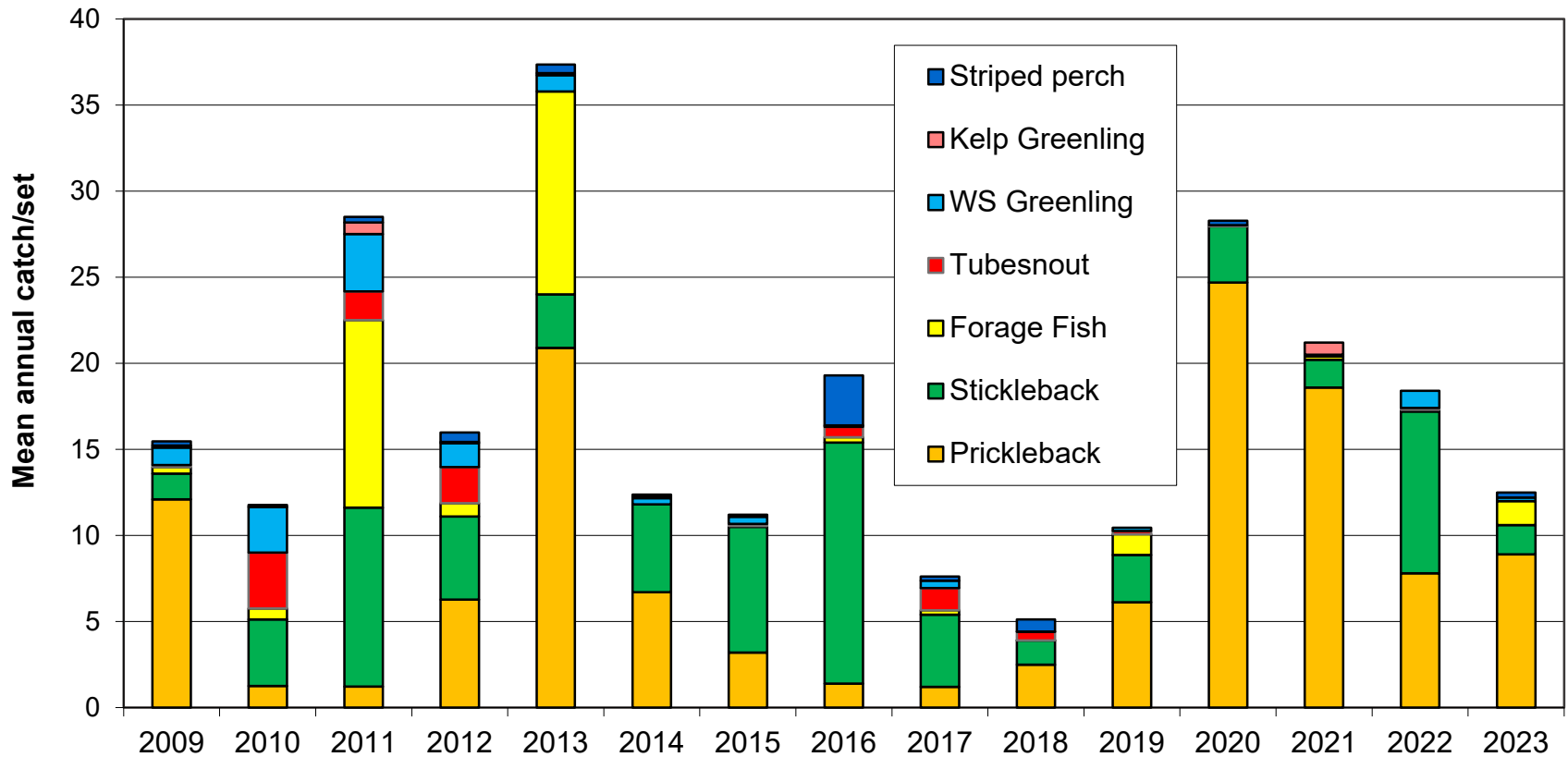
Heterosigma (can suffocate fish) more frequent and more extensive

Pseudo-Nitzschia (Domoic acid, toxic) more frequent



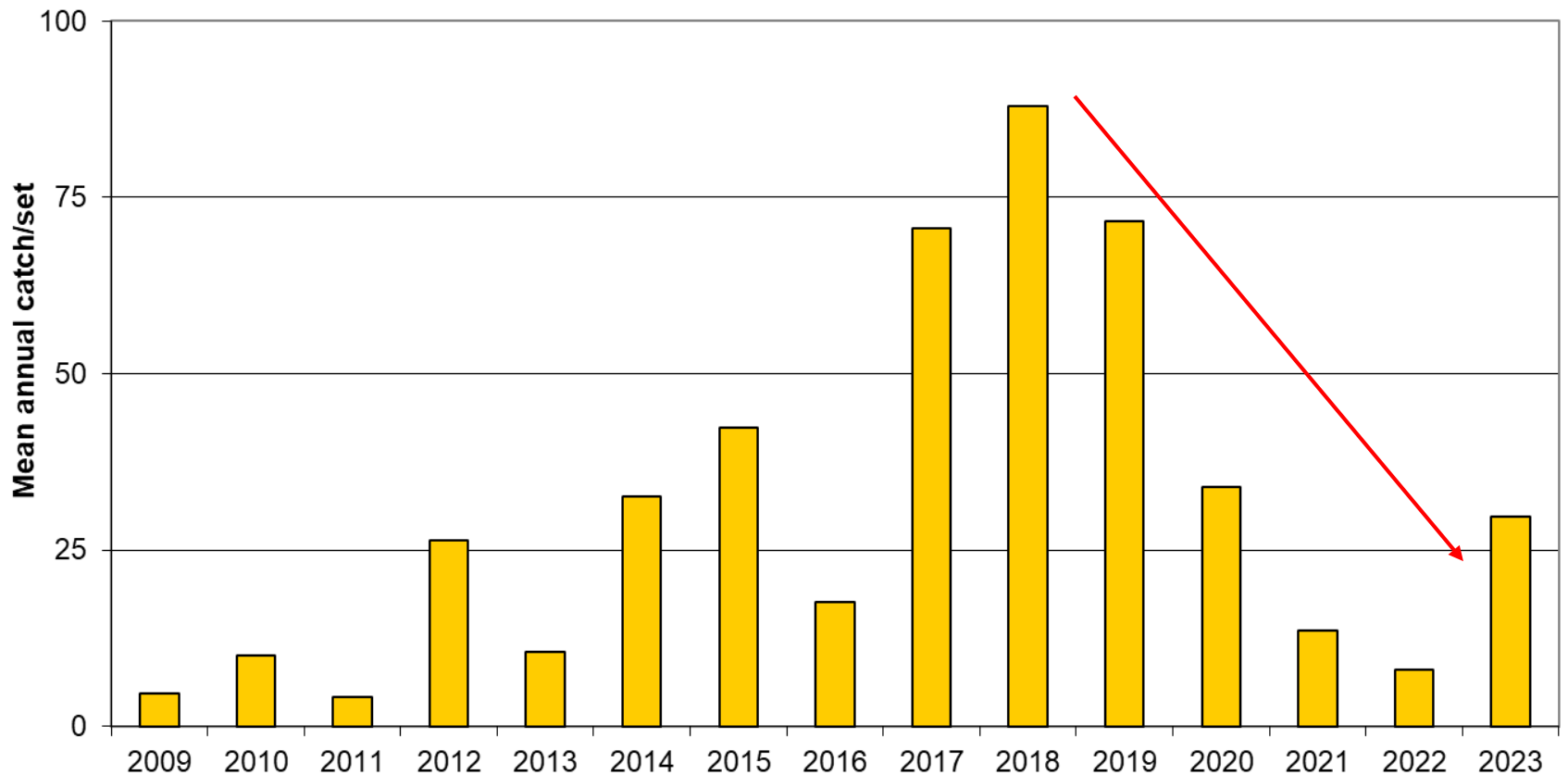
Noctiluca scintillans

Fish community diversity and abundance Indian Island, 2009-2023



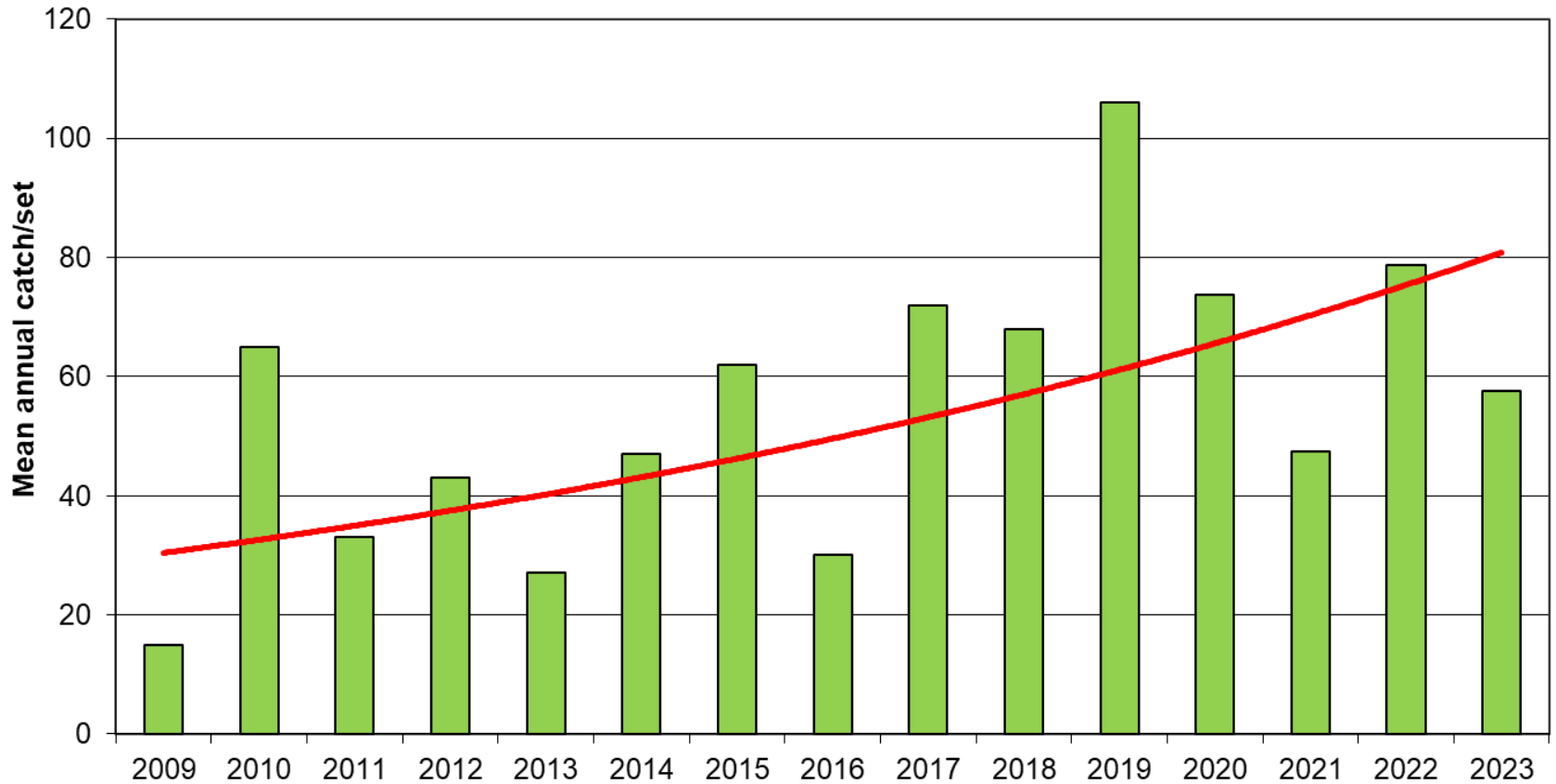
Fish diversity in the eelgrass plummeted in 2014. Forage fishes and greenlings were most affected. Pricklebacks and sticklebacks, least.

Plainfin Midshipmen abundance Indian Island, 2009-2023

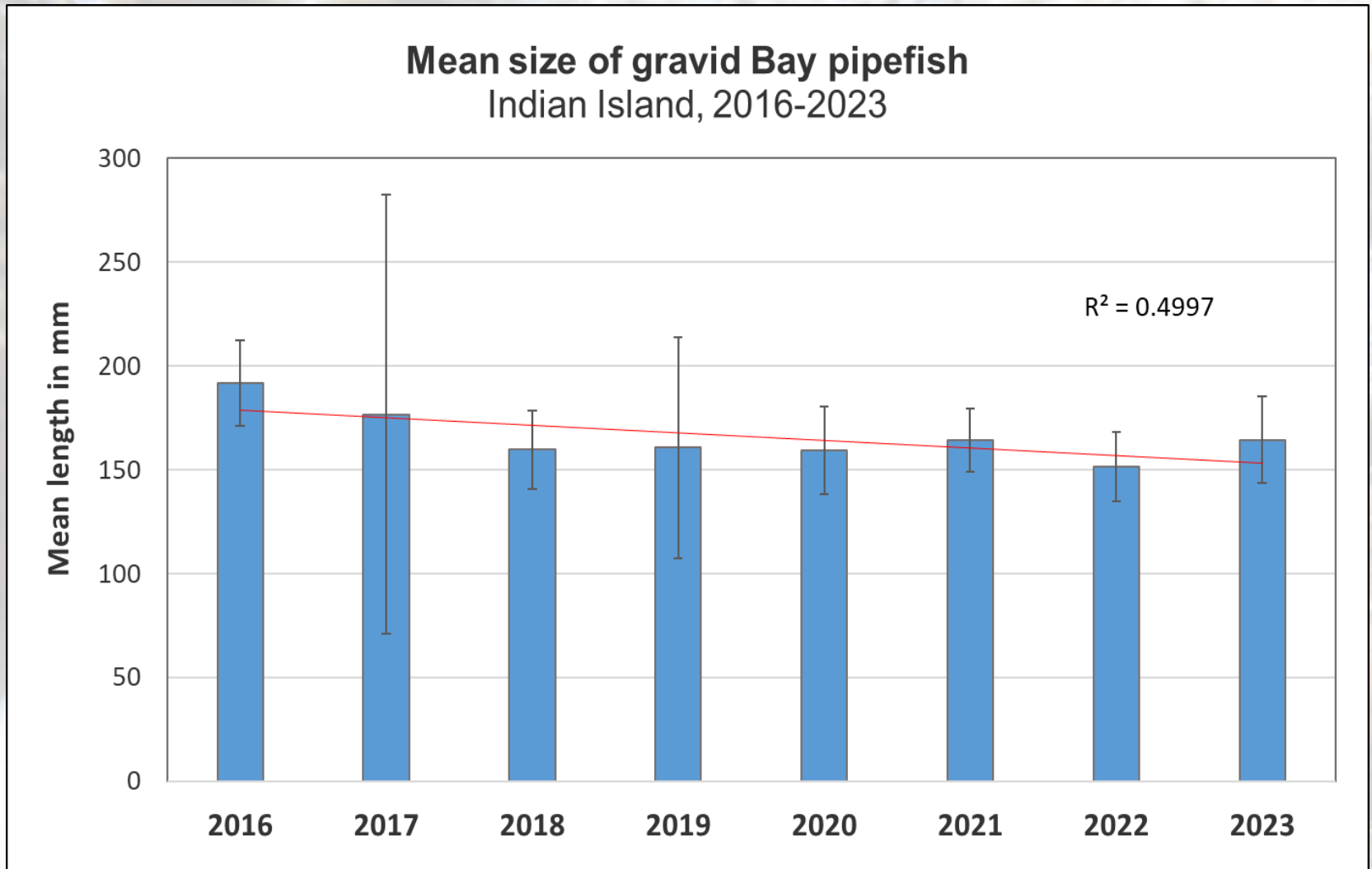


Midshipmen nest in the rocky intertidal zone. They initially responded positively to warming but went into decline in 2019 – from trampling?

Bay pipefish abundance
Indian Island, 2009-2023



Bay Pipefish mate and brood their eggs in the eelgrass. They seem to be doing well – perhaps even increasing, on average



However, the average size of gravid male Pipefish (carrying eggs) has decreased slightly over the last six years: they are mating younger

Eelgrass meadow



Herring spawn

March 24, 2022

Herring still spawn occasionally around Indian Island, which used to be a significant spawning and rearing bay for these keystone forage fish

Above the tides

Seasonal trail closures
have restored the native
wildflower meadow,
but Black Oystercatchers
failed to nest again



Above the tides

- 2010 Pair nested May-June, **one chick fledged**
- 2011 Pair nested May-June, **two chicks fledged**
- 2012 Pair nested May-June, **2/3 eggs hatched** but chicks predated
- 2013 Pair nested in May, eggs predated but pair remained to mid-July
- 2014 Pair arrived May, on nest until early July, no chicks seen
- 2015 Pair arrived May, on nest until early July, no chicks seen
- 2016 Pair arrived late May, **one chick hatched** June 15, last seen July 15
- 2017 Pair arrived early June but no nest or eggs observed
- 2018 Three arrived late April, foraged, left June 1st, no nest observed
- 2019 Two pairs arrived May 7, departed June 15; no nest observed
- 2020 Pair arrived April 20, seen sporadically but not nesting
- 2021 Pair arrived late May, lingered at nest site but did not lay
- 2022 Oystercatchers seen foraging in June; no nesting
- 2023 Oystercatchers seen foraging in June; no nesting



Above the tides

Human noise, off-trail use
Dogs (often unleashed)
Nest predators



Average number of visitors per minus-tide day:

2018 72 people and 2.2 dogs

2019 65.7 people and 1.9 dogs

2023 69 people and 2.3 dogs

Record: 233 visitors on one 3-hour tide

By this measure, we estimate average 60 days/summer = 4,200 visitors

Meadow recovery



Meadow recovery

May 2014



Above the tides

Meadow recovery



May 2018

Above the tides



White-crowned sparrows
Rough-winged swallows
Anna's hummingbirds
Killdeer

Key findings

Sandy beach

Cobble beach

Eelgrass meadow

Above the tides

Shifting sand and silts are gradually diminishing “hard-shell clam” habitat and reducing infaunal diversity. More of the beach is anaerobic.

Key findings

Sandy beach

Cobble beach

Eelgrass meadow

Above the tides

Sea star diversity remains low, but Ochre Stars rebounded fully from the 2014 Seastar Wasting Syndrome (SWS) outbreak.

Juvenile crab diversity also remains low. Green Shore Crabs, which initially thrived, decreased as well in 2023.

Key findings

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Cobble beach

Eelgrass meadow

Above the tides

Eelgrass has thinned in shallow waters, where it is exposed more often between tides.

Fish diversity remains low compared to 10 years ago. Plainfin Midshipmen continued to decline. Bay Pipefish are increasing but maturing earlier, which may eventually impact their reproductive success.

Key findings

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Cobble beach

Eelgrass meadow

Above the tides

Invasive *Sargassum* has colonized the intertidal rocky reef and eelgrass aggressively since 2020. Its impacts on fauna diversity remain uncertain.

Algal blooms have grown more frequent and in 2022-2023 arrived as early as February. Impacts remain uncertain but additional monitoring and research may be needed.

Key findings

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Cobble beach

Eelgrass meadow

Above the tides

Seasonal trail closures since 2012 have led to recovery of native wildflowers by reducing the trampling of spring shoots and flowers.

Seasonal trail closures have not been sufficient to protect shorebird nesting.

Celebrating 10 years!

Robyn Lowe

Youth Stewards

Roan Ontjes DeGroot 2023

Anika Blackman 2022

Justin Krisch-Derr 2020-21

Emma Thoron 2019-20

Alyssa Johns 2018

Raeann Boero 2016-17





Russel Barsh, *Director*
Christian Oldham, *Indian Island Coordinator*
Anita Holliday, *community scientist*
Leah Johnson, *science educator*
Alex Assaf, *Kwiah Trustee for Orcas Island*

*Many, many
community volunteers since 2009!*

