Biodiversitet och predation som biologisk bekämpning av den invasiva svartmunnade smörbulten på svenska Västkusten

SDG 15.8

Leon Green, **forskare, Göteborgs Universitet**

Slutkonferens - Hantering av invasiva främmande arter

20 augusti 2025

foto: Leon Green

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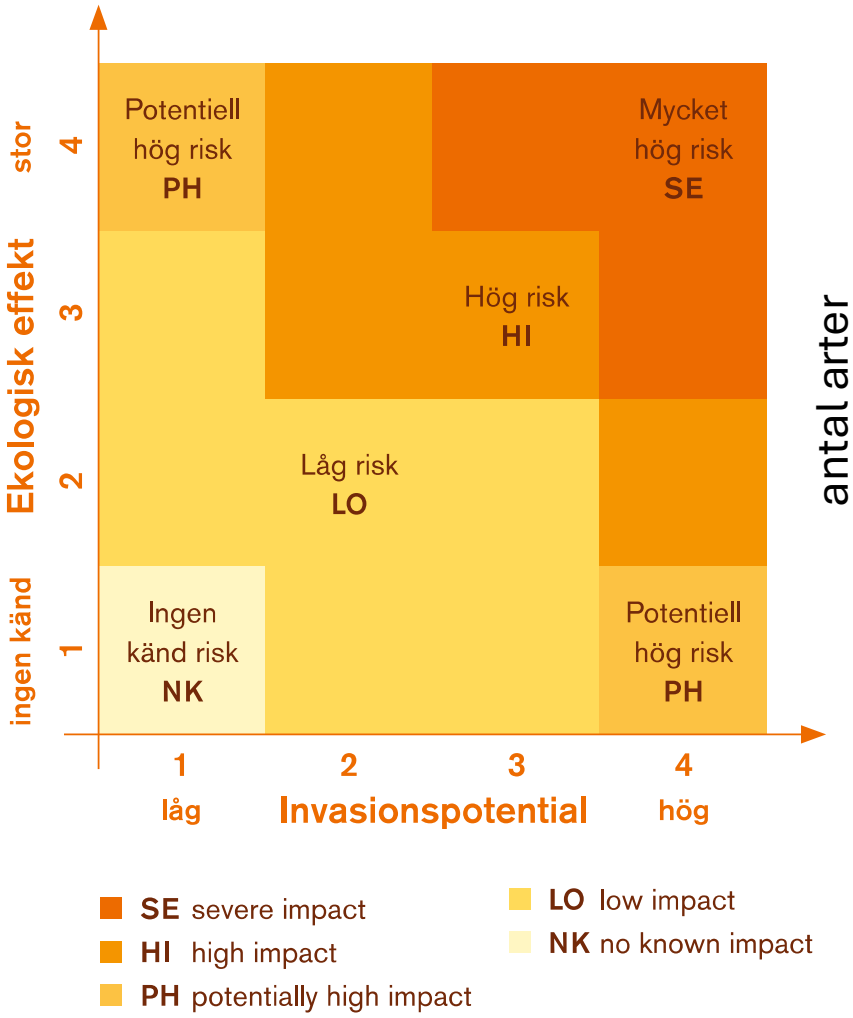
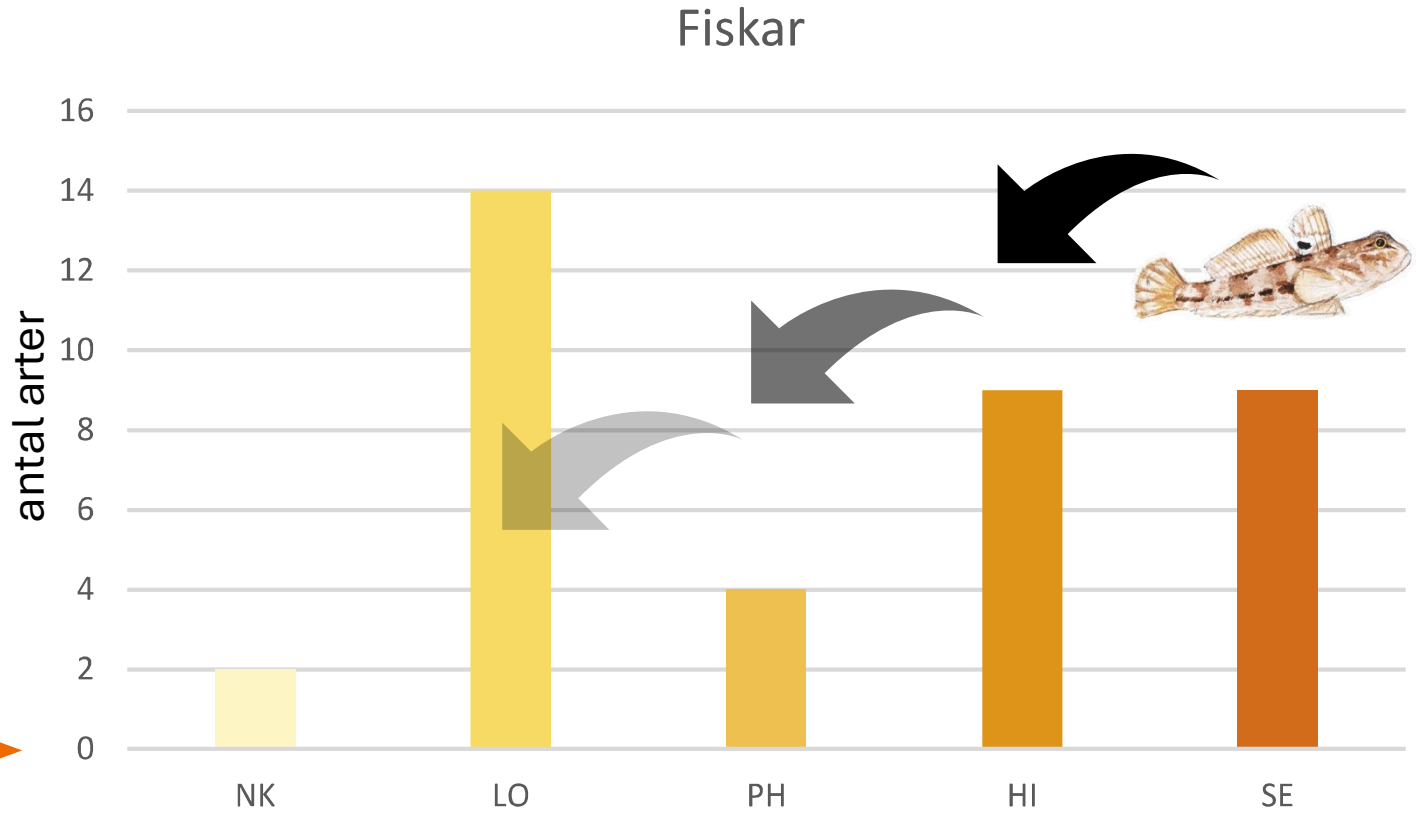
WHAT LIMITS AN INVASIVE SPECIES?





NK: No known impact – arter som inte sprider sig och som inte har någon känd ekologisk effekt.

LO: Low impact – arter utan vare sig betydande invasions-potential eller betydande ekologisk effekt.

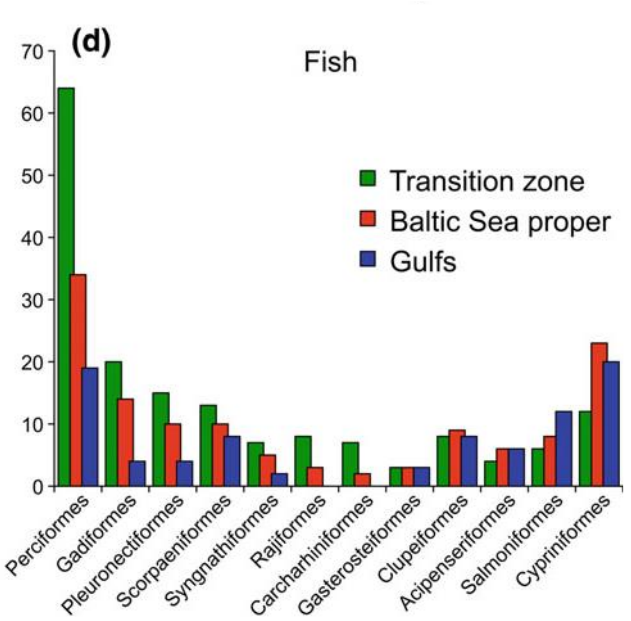
Strand et al. 2019, SLU: https://www.slu.se/ew-nyheter/2019/1/riskklassificering-av-frammande-arter/

WHAT LIMITS AN INVASIVE SPECIES?

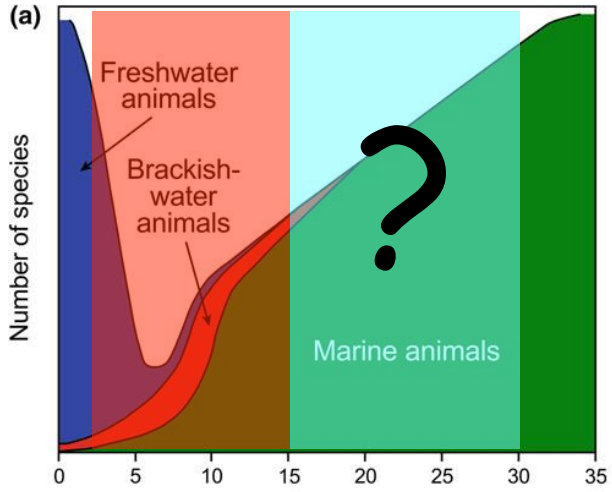
WP1: Predation – “Enemy release”

Funk et al. 2020, *J. Fish Biology*
https://onlinelibrary.wiley.com/doi/full/10.1111/jfb.14615

WP2: Competition – “Biotic resistance”



Snoeijs-Leijonmalm et al. 2016,Biological Oceanography of the Baltic Sea

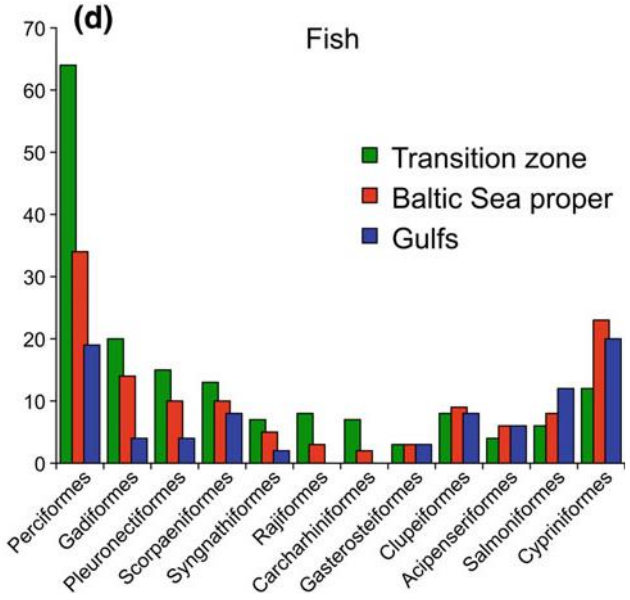


Hirsch et al. 2015, *Ambio*
https://link.springer.com/article/10.1007/s13280-015-0718-9

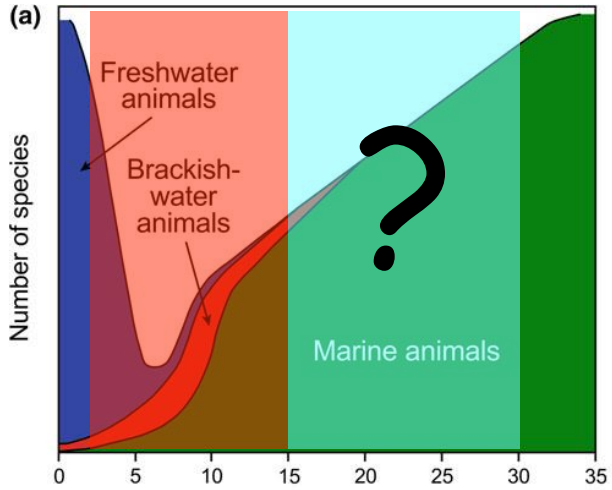
WHAT LIMITS AN INVASIVE SPECIES?

WP2: Competition – “Biotic resistance”

WP1: Predation – “Enemy release”



Snoeijs-Leijonmalm et al. 2016,Biological Oceanography of the Baltic Sea



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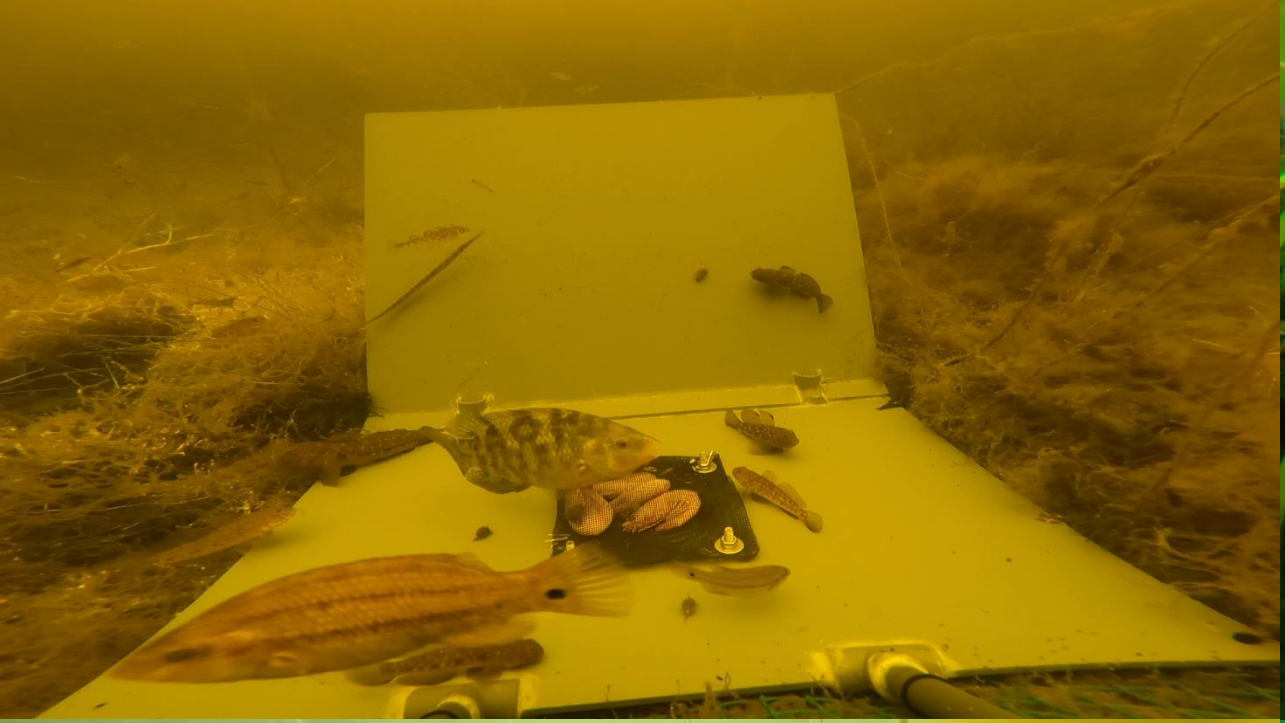
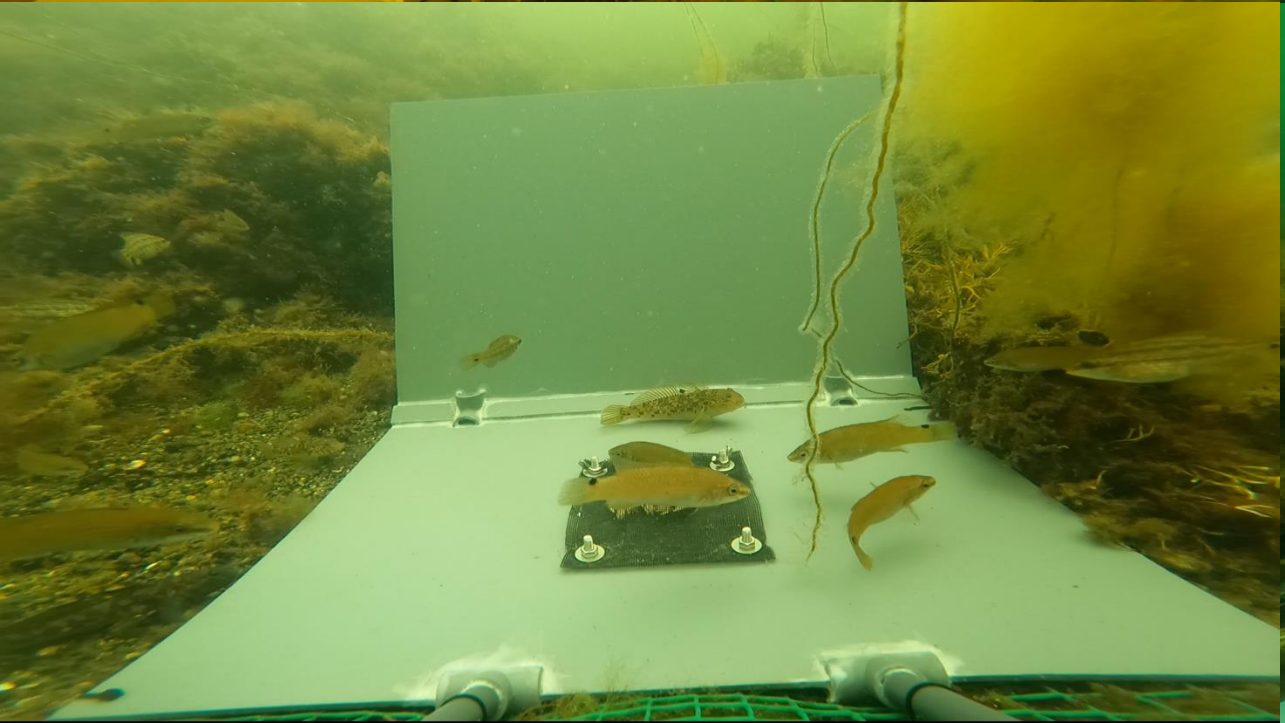
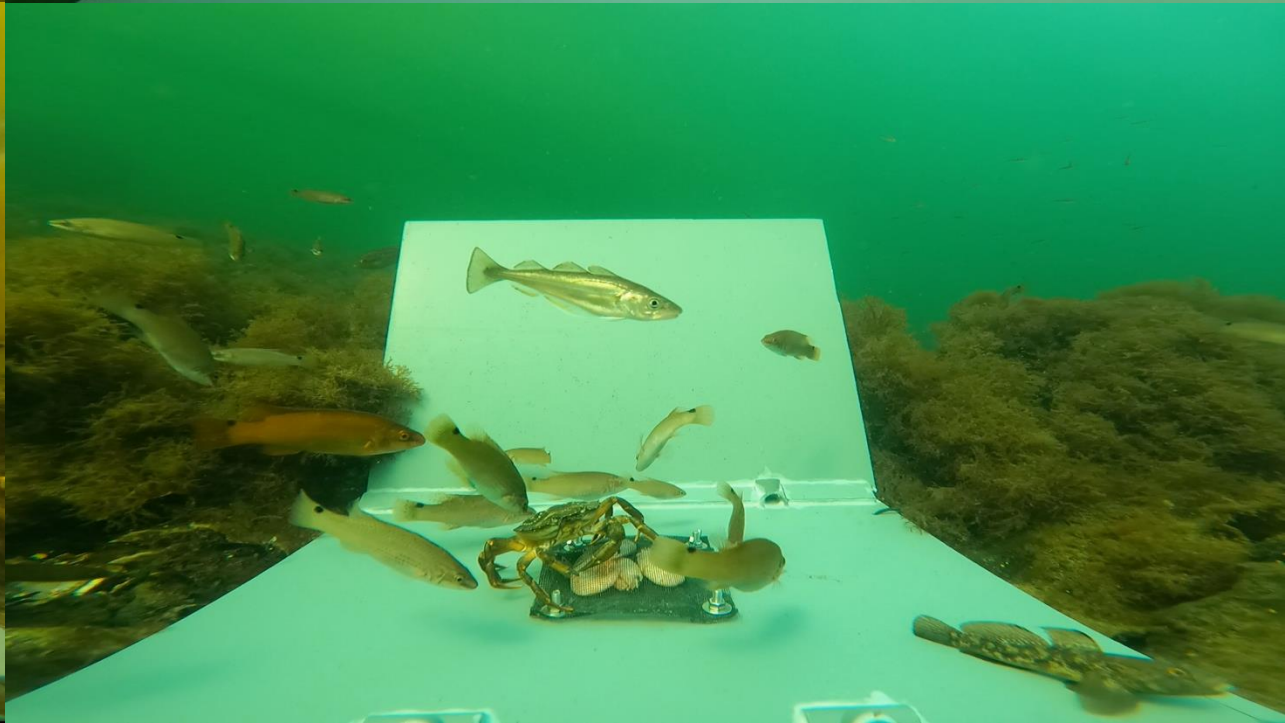
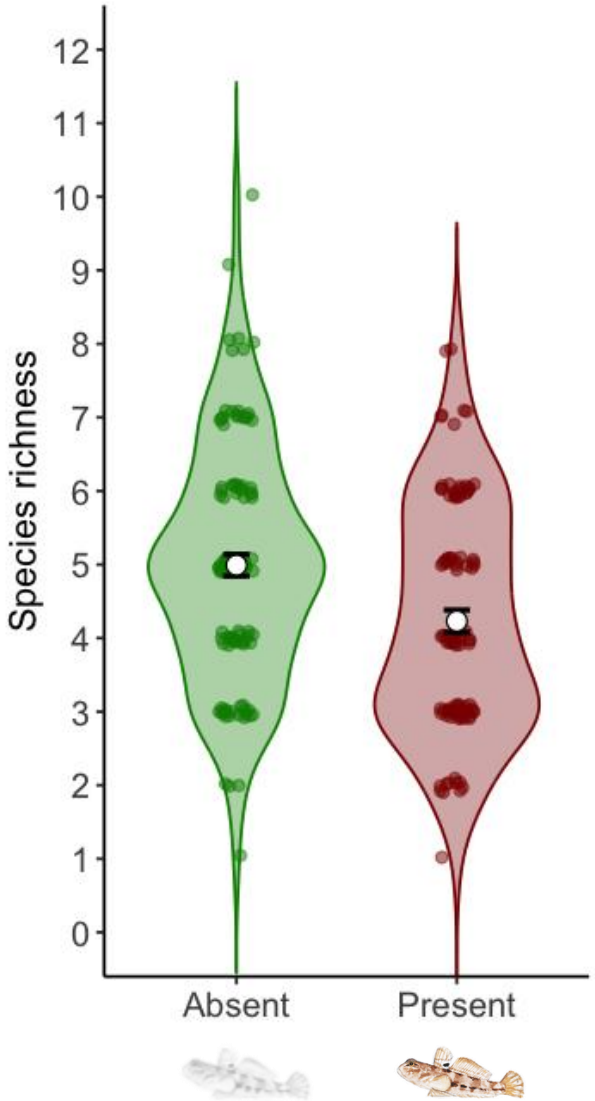
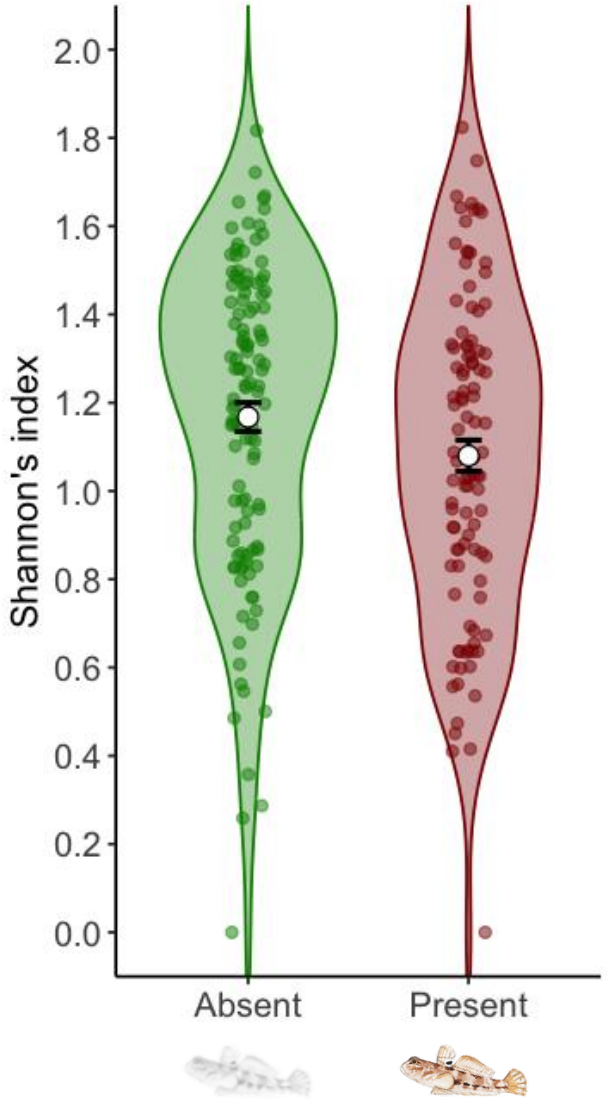
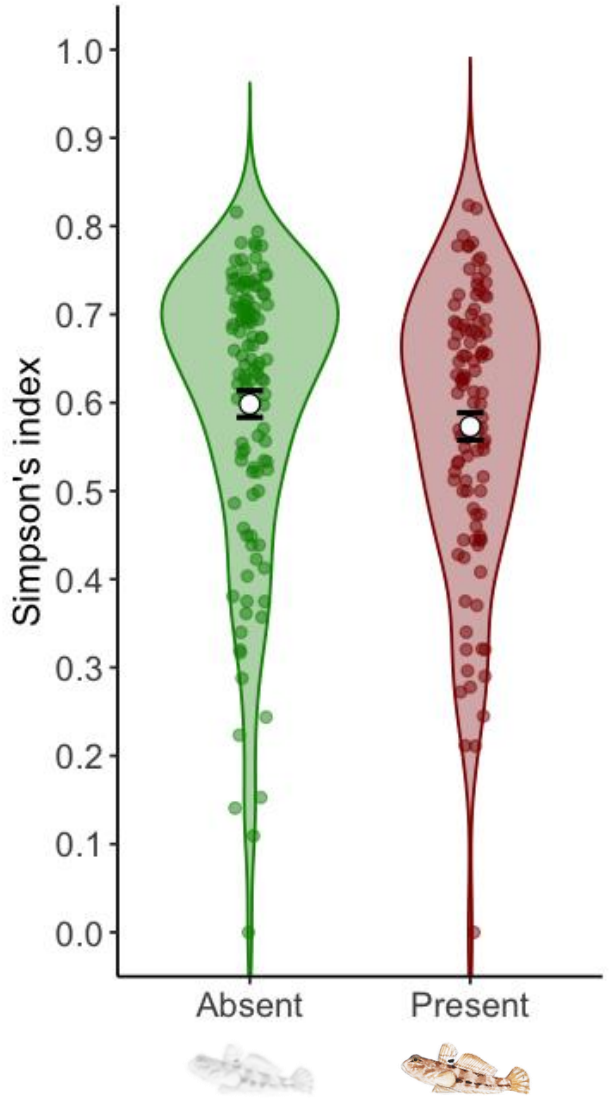


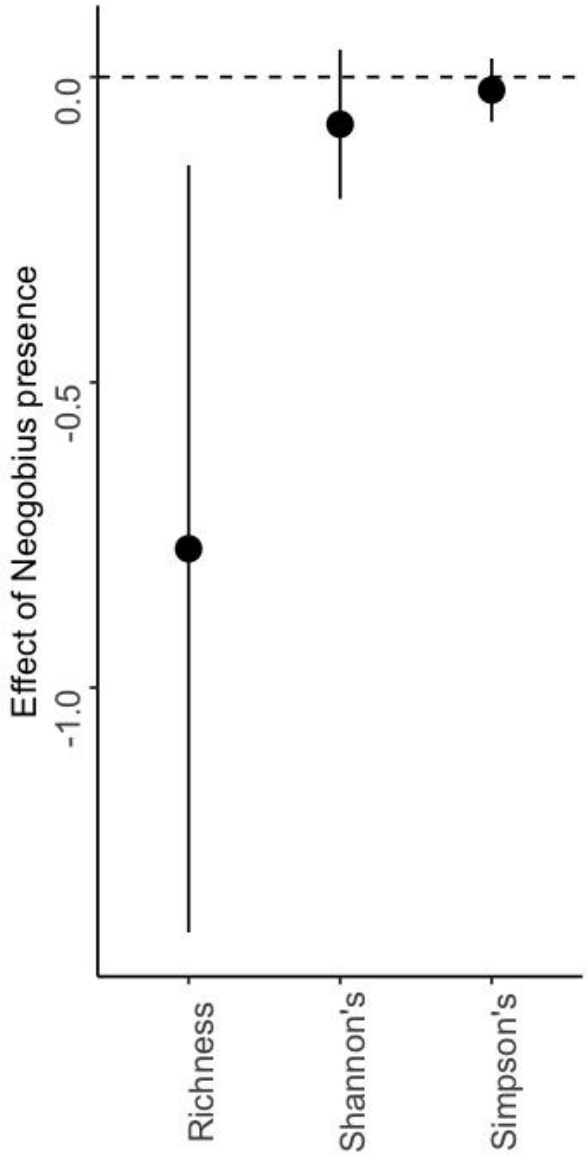



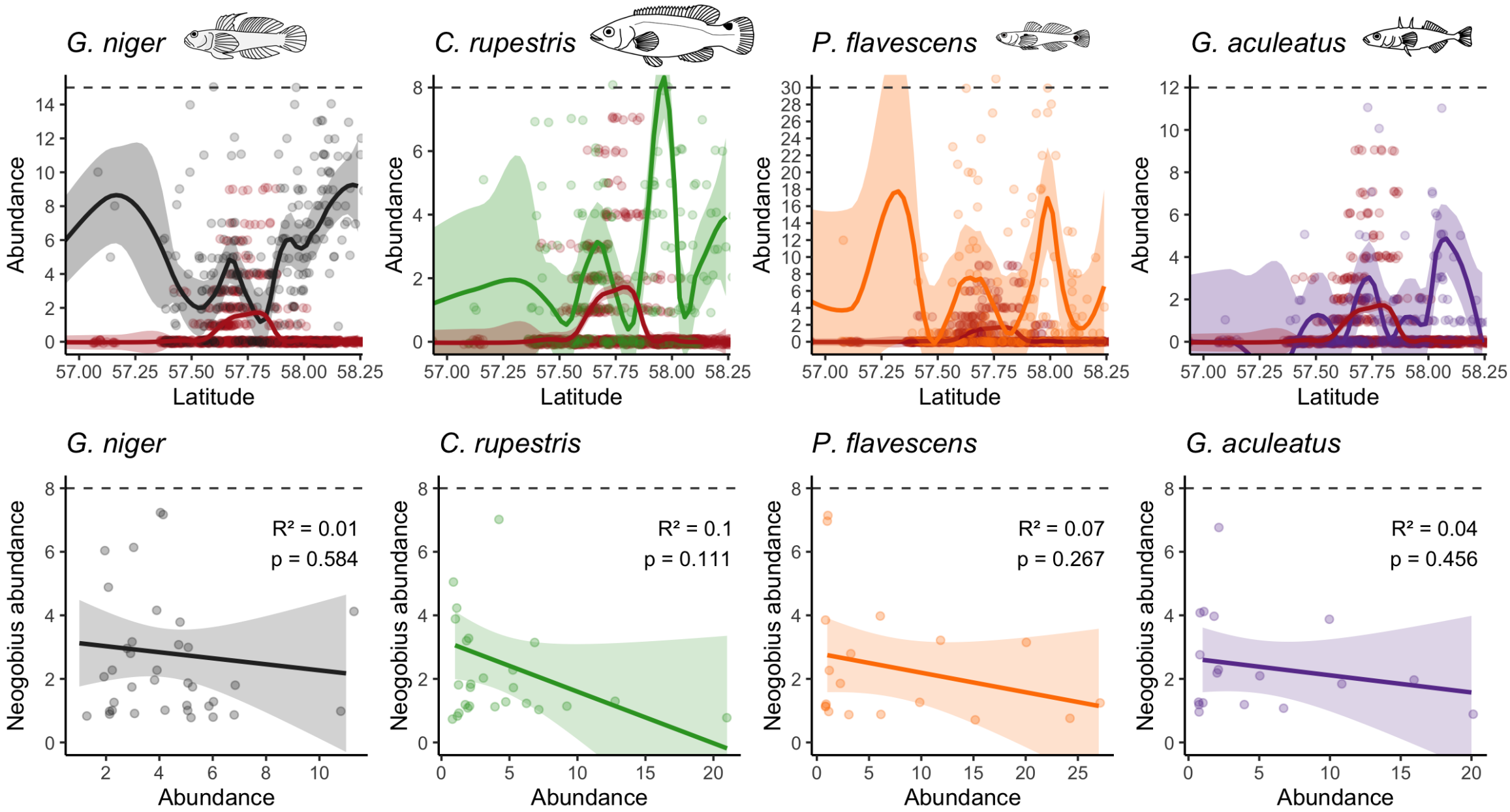
ALPHA DIVERSITY

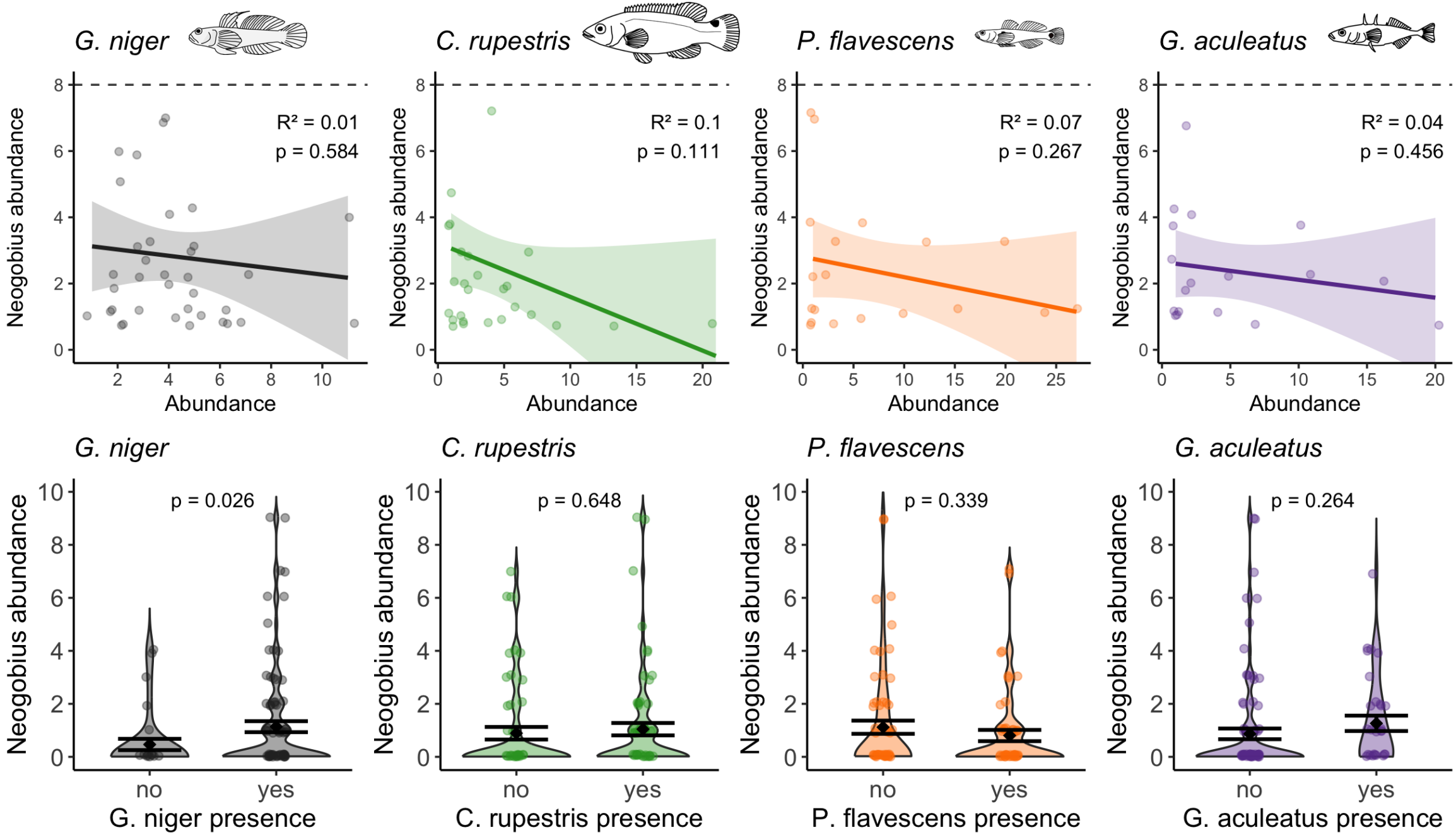


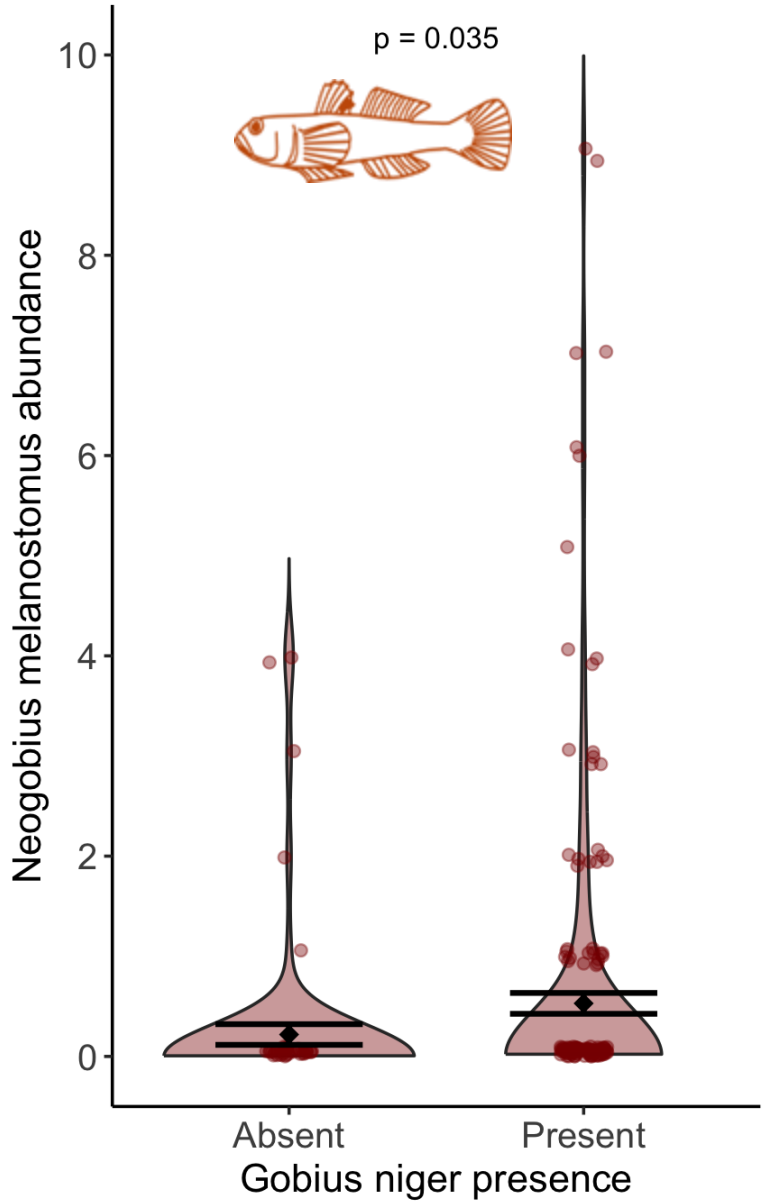


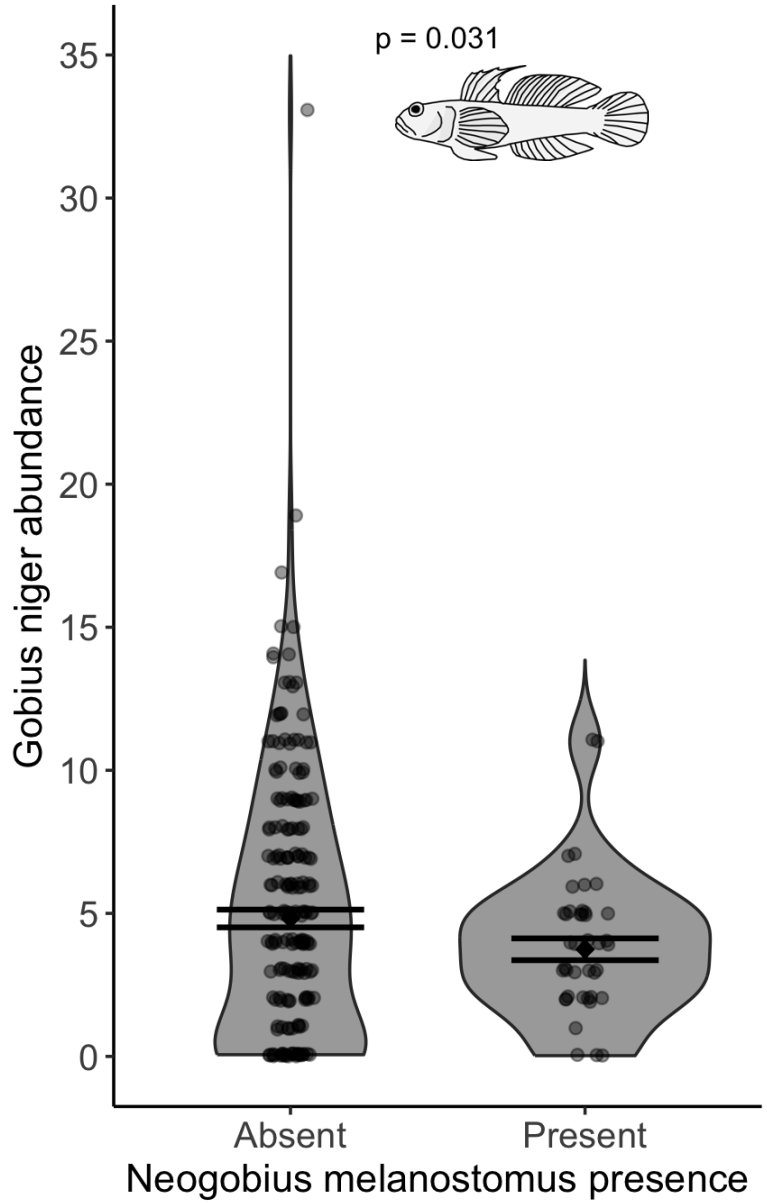


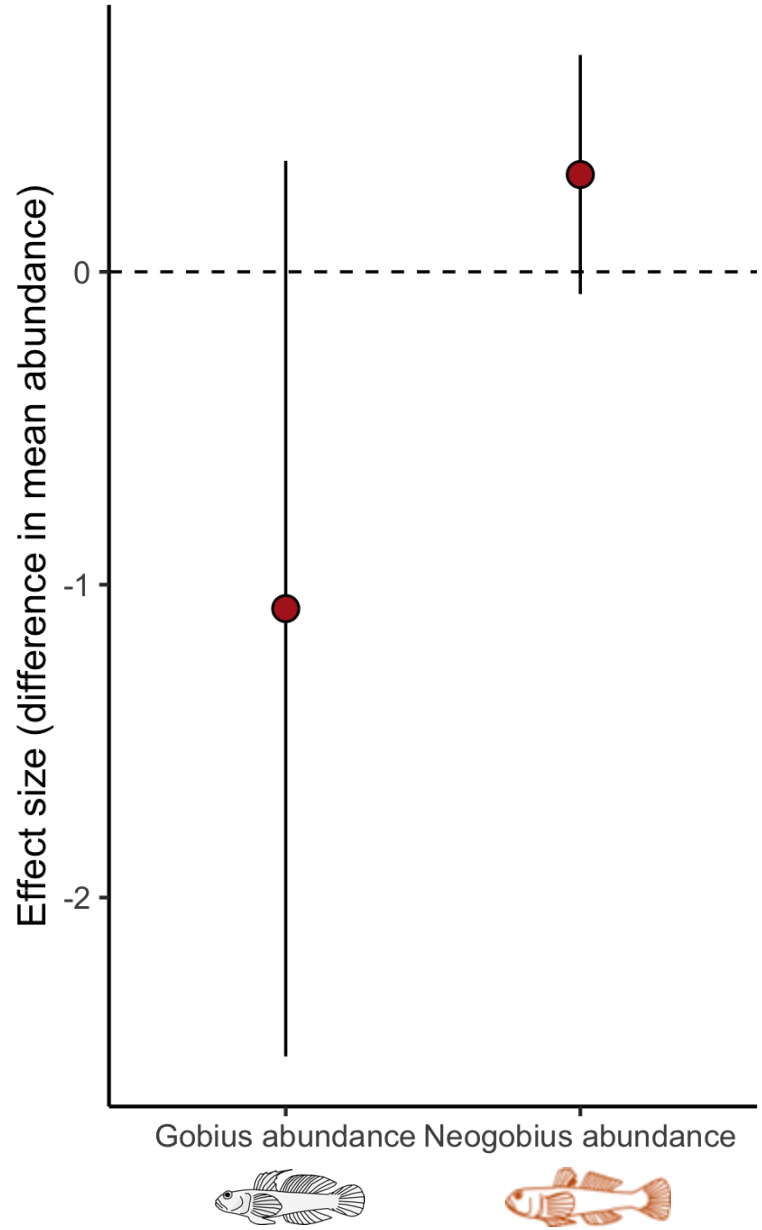


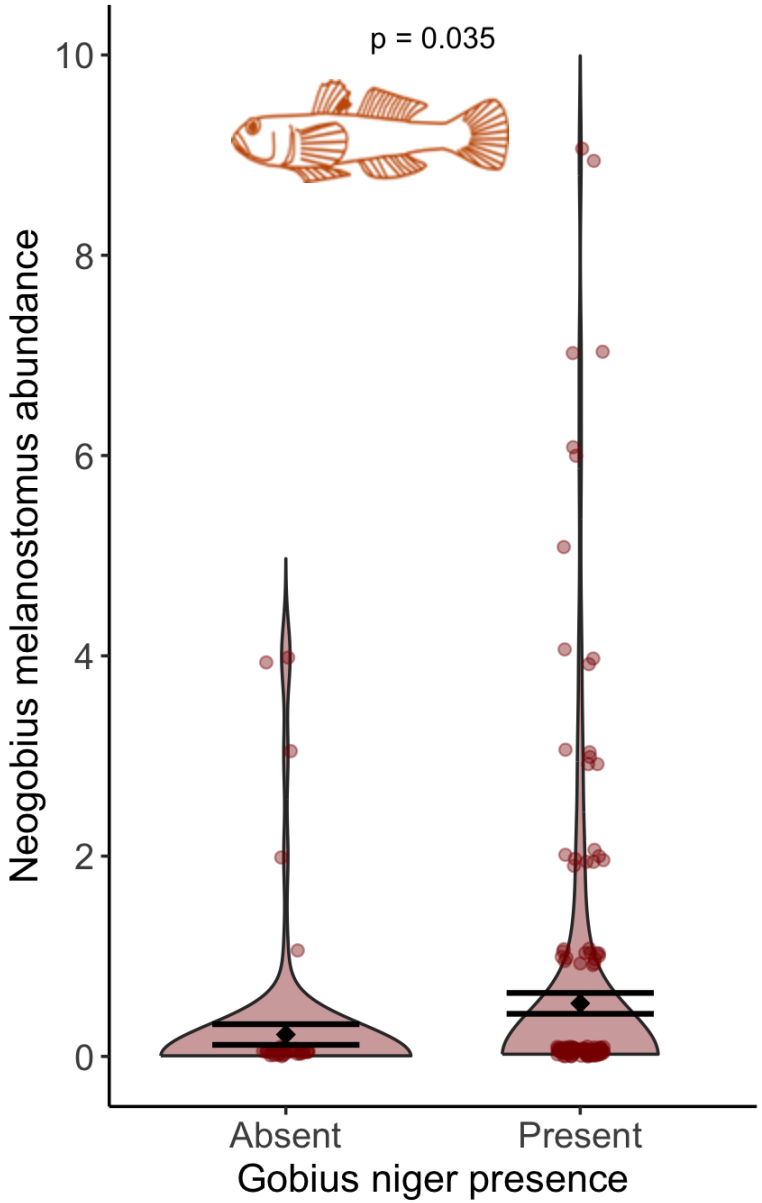

G. niger
C. rupestris
P. flavescens
G. aculeatus
Abundance
Latitude
57.00 57.25 57.50 57.75 58.00 58.25
Neogobius abundance
R² = 0.01
p = 0.584
R² = 0.1
p = 0.111
R² = 0.07
p = 0.267
R² = 0.04
p = 0.456

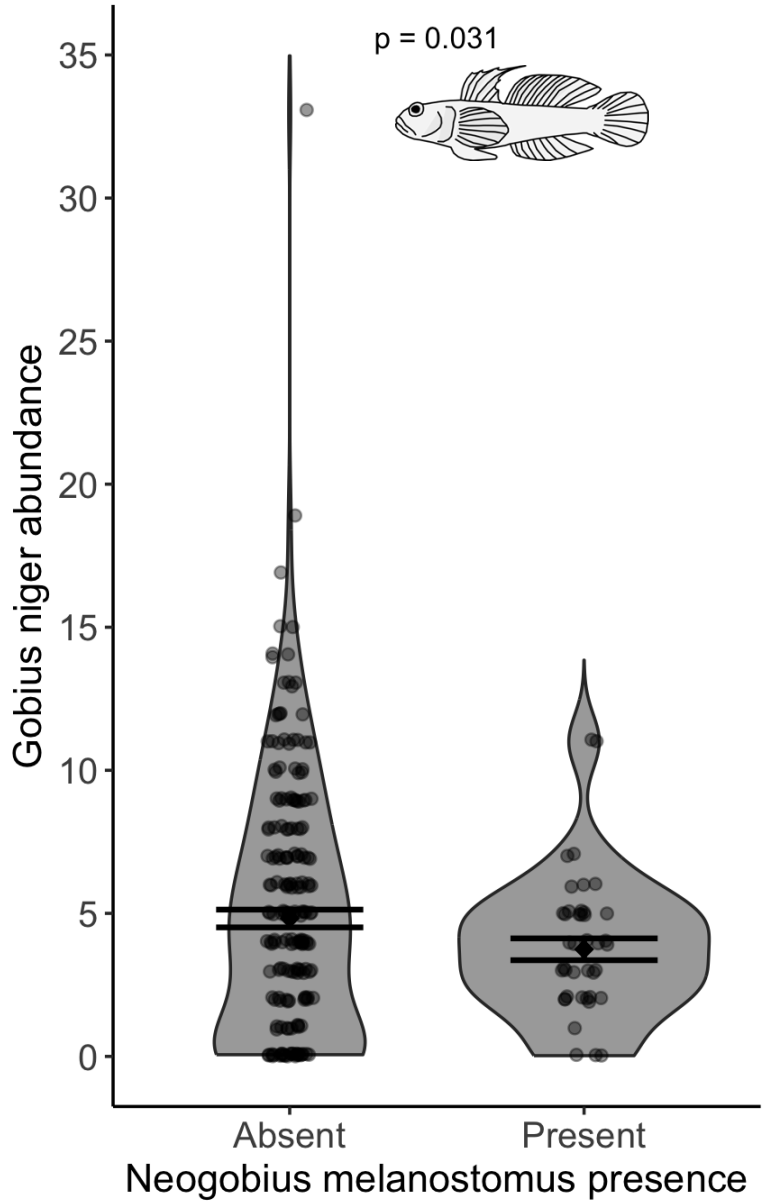

G. niger
C. rupestris
P. flavescens
G. aculeatus
Neogobius abundance
Abundance
R² = 0.01
p = 0.584
R² = 0.1
p = 0.111
R² = 0.07
p = 0.267
R² = 0.04
p = 0.456
p = 0.026
p = 0.648
p = 0.339
p = 0.264
no
yes
G. niger presence
C. rupestris presence
P. flavescens presence
G. aculeatus presence

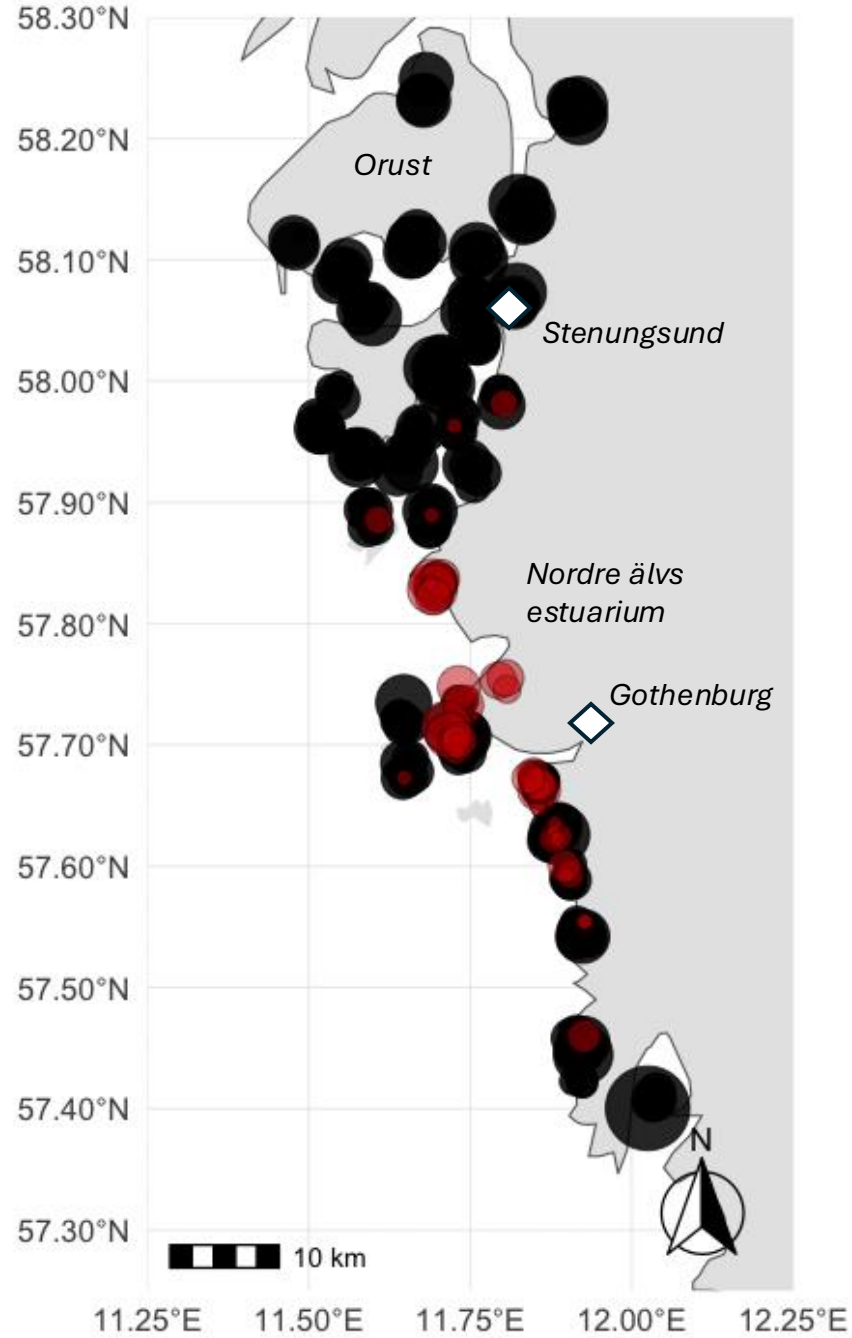

p = 0.035
Neogobius melanostomus abundance
10
8
6
4
2
0
Absent
Present
Gobius niger presence

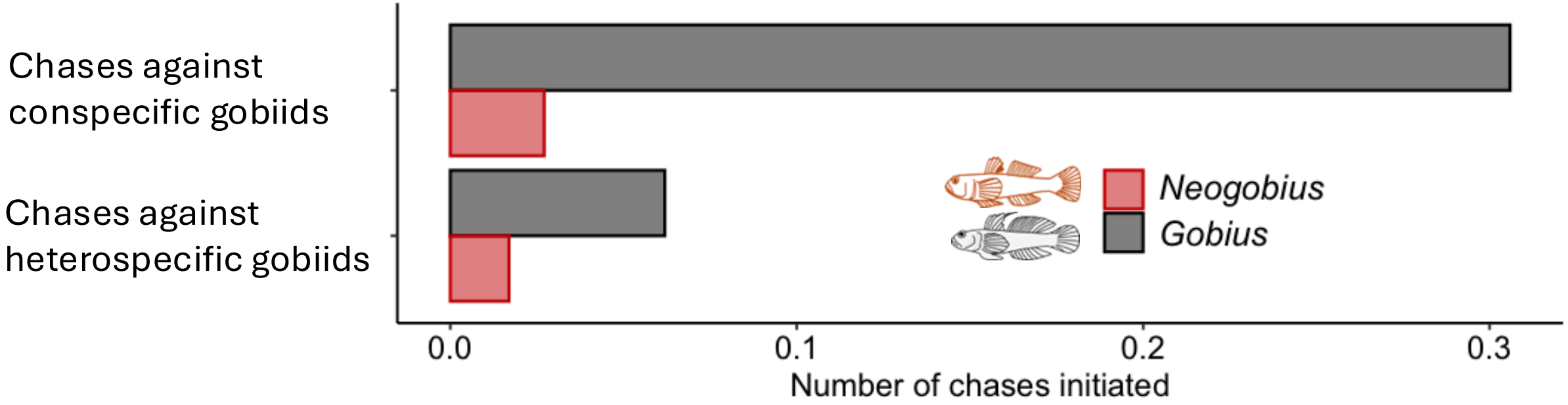

p = 0.031
Gobius niger abundance
35
30
25
20
15
10
5
0
Absent
Present
Neogobius melanostomus presence

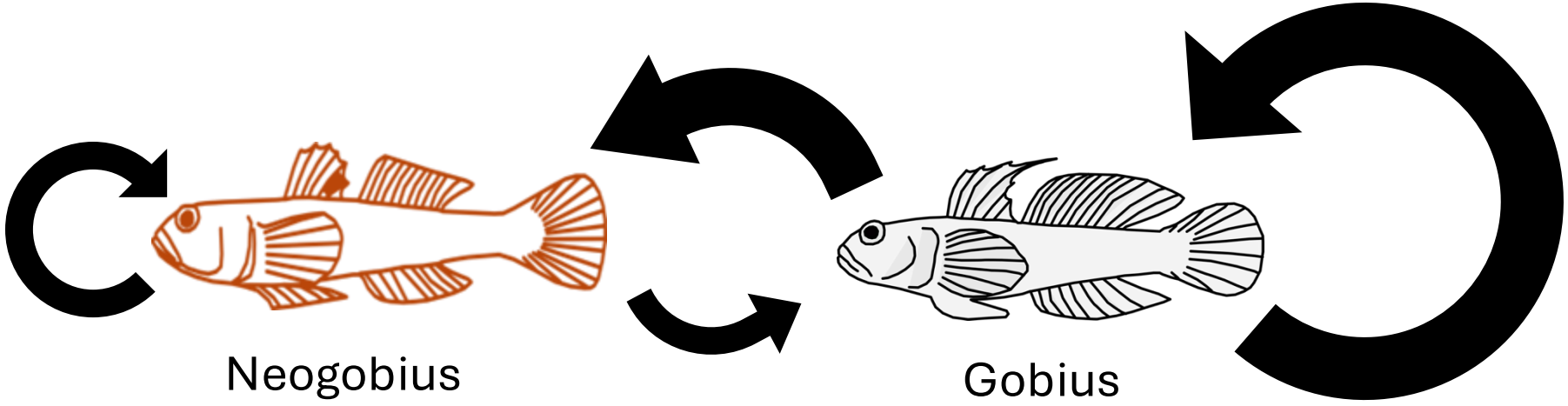

Effect size (difference in mean abundance)
0
-1
-2
Gobius abundance
Neogobius abundance


p = 0.035
Neogobius melanostomus abundance
10
8
6
4
2
0
Absent
Present
Gobius niger presence


p = 0.031
Gobius niger abundance
35
30
25
20
15
10
5
0
Absent
Present
Neogobius melanostomus presence

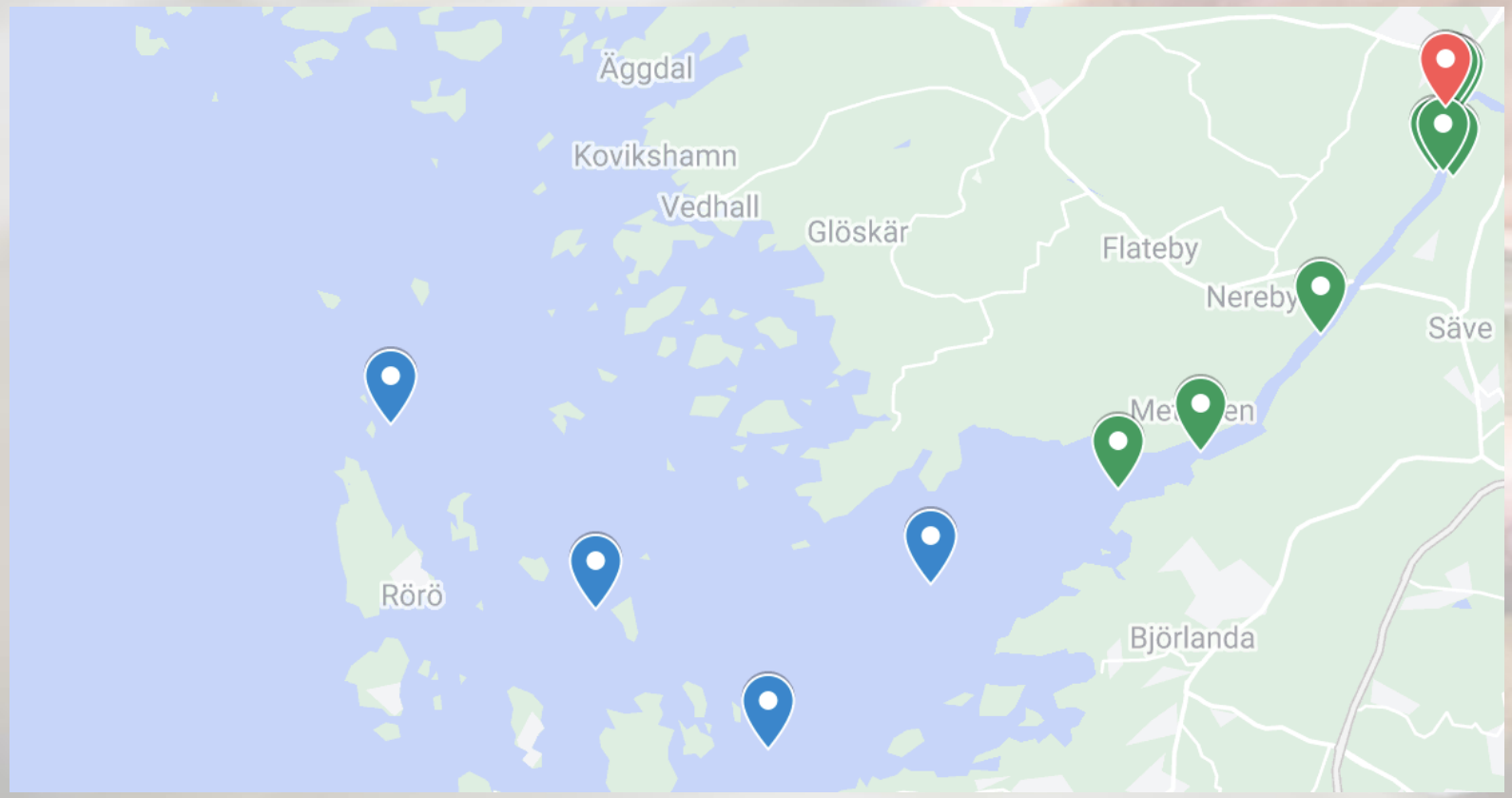

58.30°N
58.20°N
58.10°N
58.00°N
57.90°N
57.80°N
57.70°N
57.60°N
57.50°N
57.40°N
57.30°N
Orust
Stenungsund
Nordre älvs estuarium
Gothenburg
N
10 km
11.25°E
11.50°E
11.75°E
12.00°E
12.25°E


Chases against conspecific gobiids
Chases against heterospecific gobiids
Neogobius
Gobius
0.0
0.1
0.2
0.3
Number of chases initiated


Neogobius
Gobius

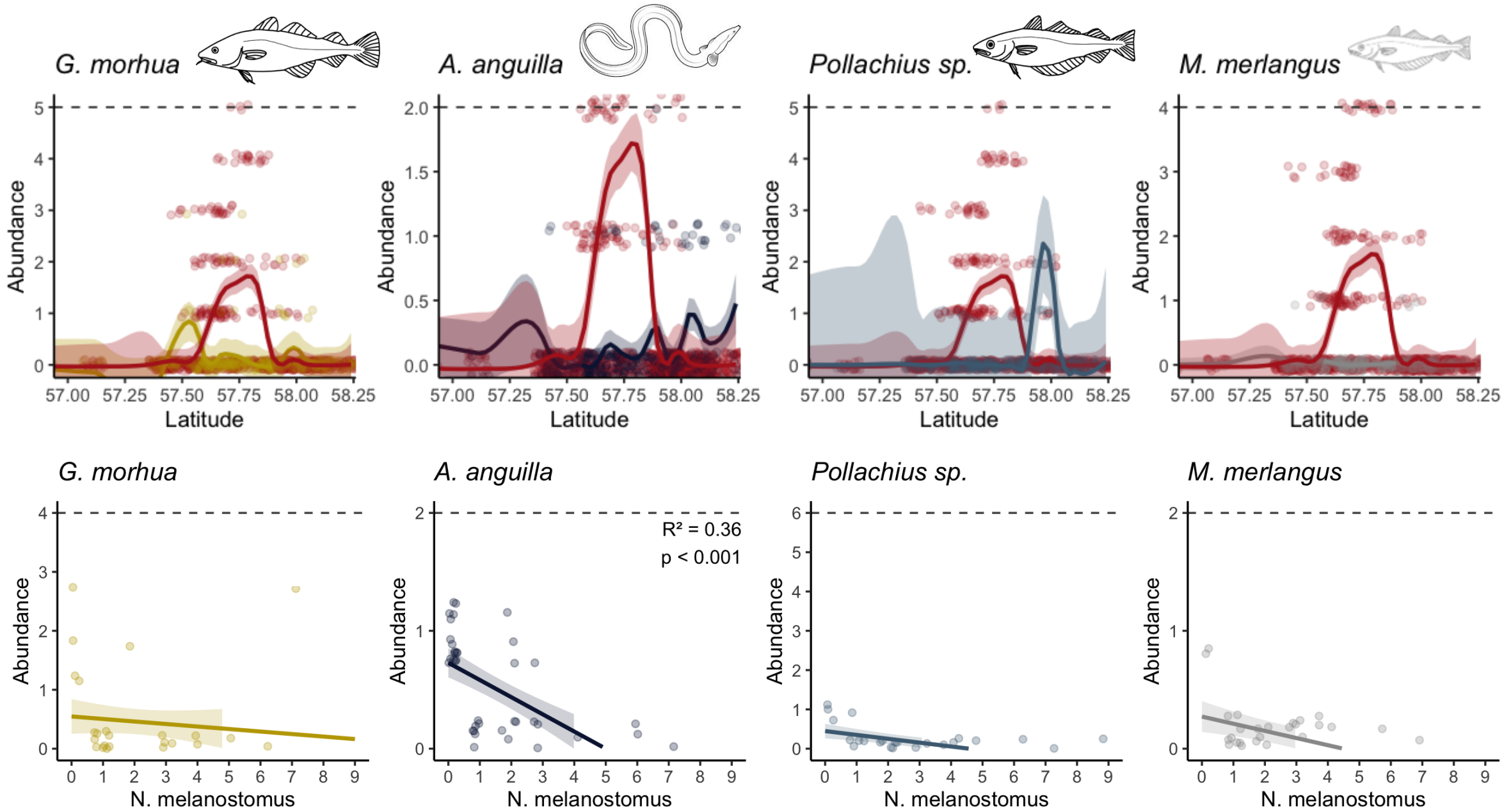
PREDATION

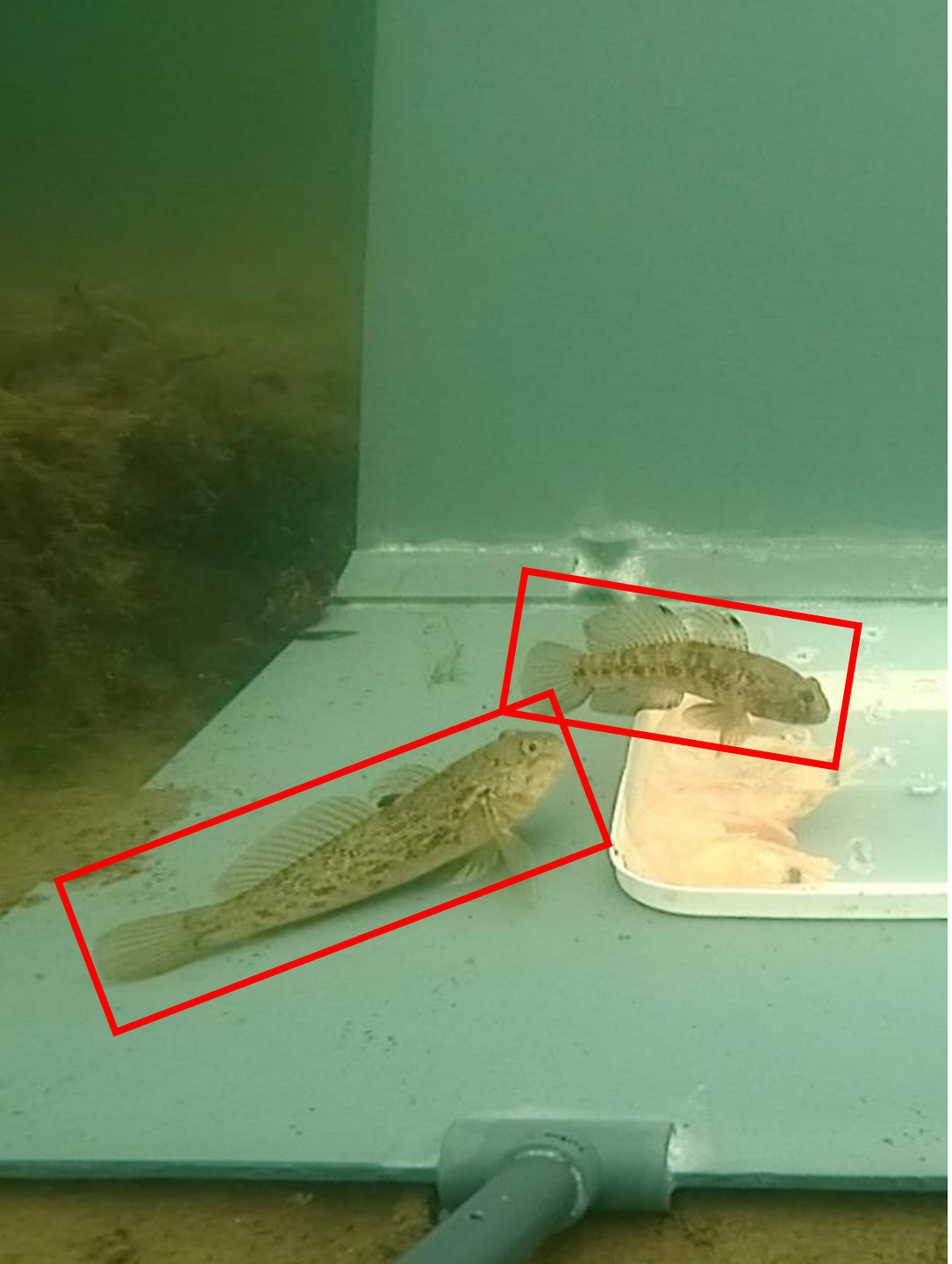
80 fykes deployed in November and December along a salinity gradient in the Nordre Älv estuary for 2x5 sampling occasions at 8 sites.



- 211 individual fish caught and measured (incl round goby, Cod, Burbot, Perch, Eel)
- Roughly half of the Cod (*Gadus morhua*) had visible fish prey in their guts
- All Burbot (*Lota lota*) had visible fish prey in their guts
- Samples from 34 Cod and Burbot sent to dPCR analysis:

Individual	Species	Body mass (g)	Fork length (mm)	Gape (mm)	N
1	*Gadus morhua*	26.9	129.0	21.4	-
2	*Gadus morhua*	29.5	135.0	19.3	-
3	*Gadus morhua*	30.9	142.0	20.0	-
4	*Gadus morhua*	43.7	154.0	20.2	-
5	*Gadus morhua*	71.7	183.0	32.5	-
6	*Gadus morhua*	141.3	231.0	35.8	-
	Mean of blanks *G. morhua*	94.7	186.1	30.9	
-	[min–max]	[26.0–282.8]	[129.0–286.0]	[17.9–52.2]	21
7	*Lota lota*	292.2	312.0	45.5	-
	Mean of blanks *L. lota*	425.6	346.5	48.2	
-	[min–max]	[136.0–921.3]	[262.0–447.0]	[36.5–71.6]	6


G. morhua
A. anguilla
Pollachius sp.
M. merlangus
Abundance
Latitude
57.00 57.25 57.50 57.75 58.00 58.25
N. melanostomus
R² = 0.36
p < 0.001



SCIENTISTS ANNOTATE

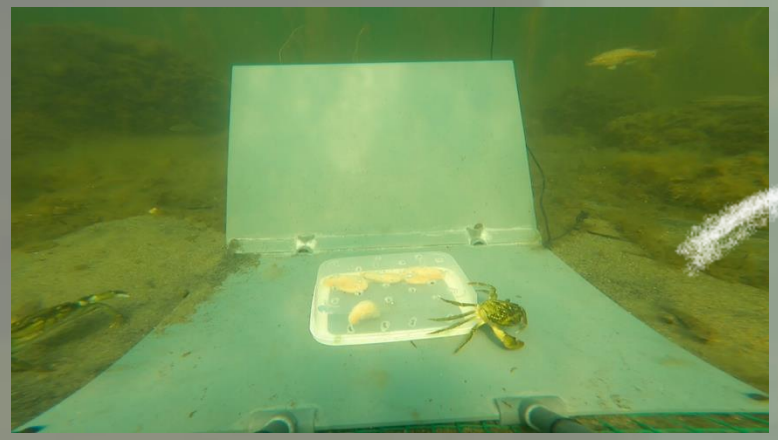
YOLOv8 ALGORITHM TRAINED ON ID RECORDS

ALGORITHM ANNOTATES

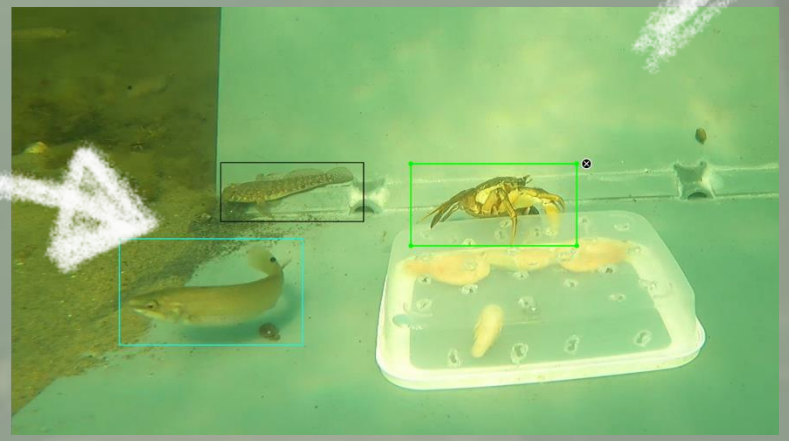
DATA GENERATED


Gobius
Neogobius

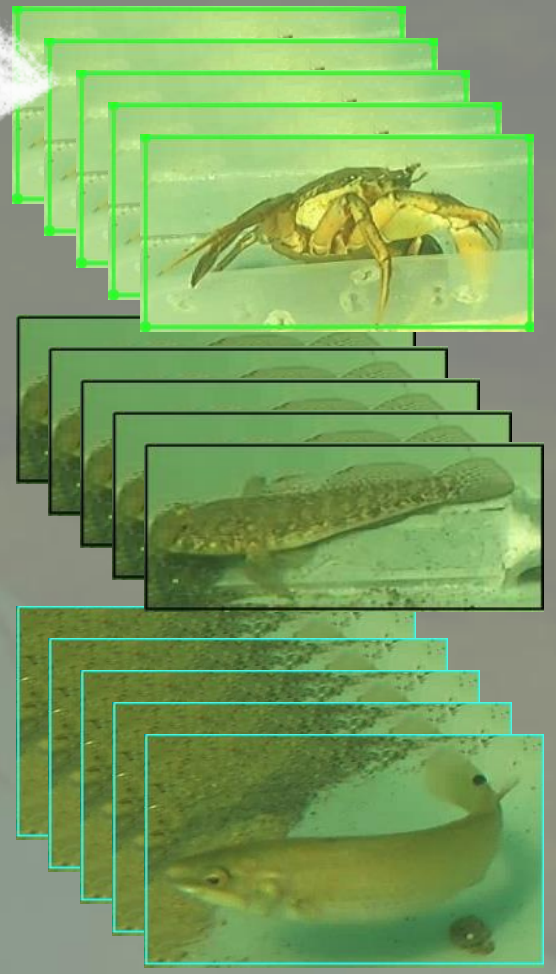
IDENTIFIED OBJECTS ARE COLLECTED



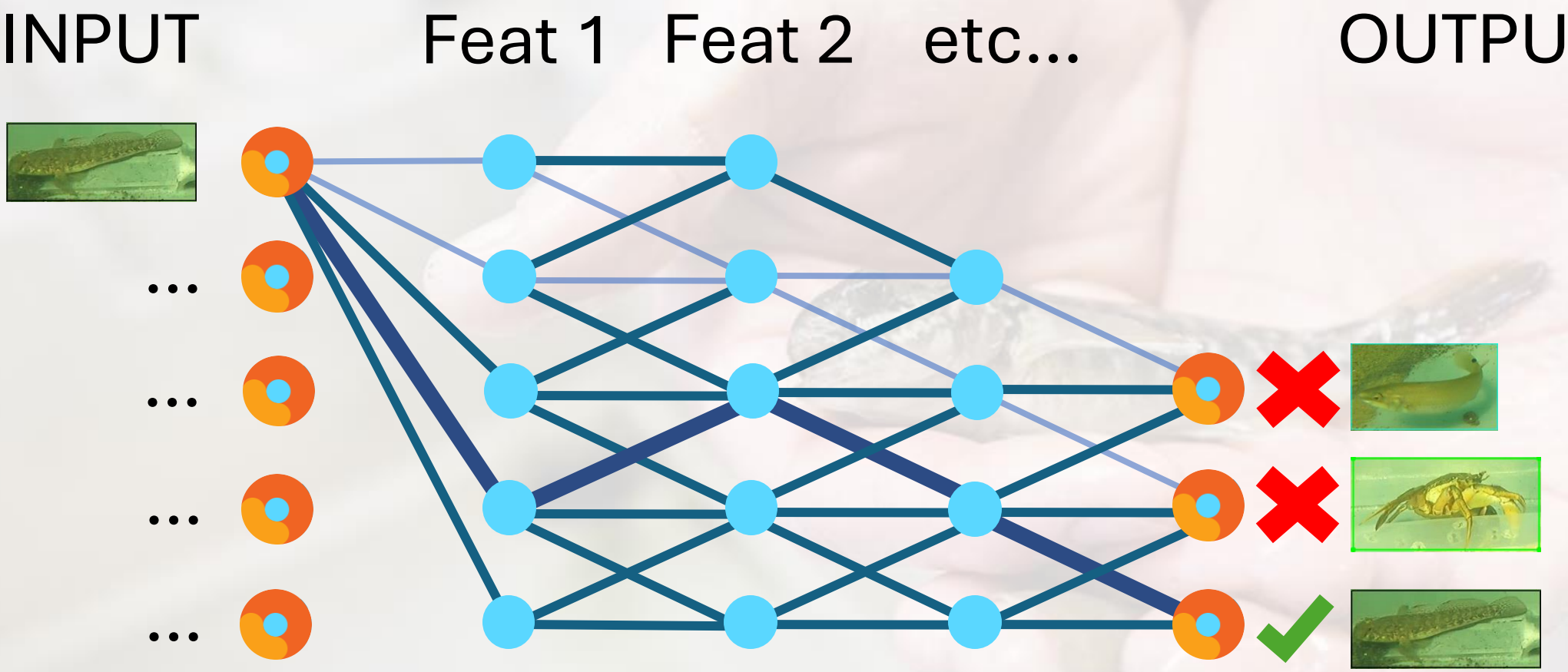
VIDEO SECTION IS ANNOTATED (Zooniverse)



STILL IMAGE IS ANNOTATED (Zooniverse)

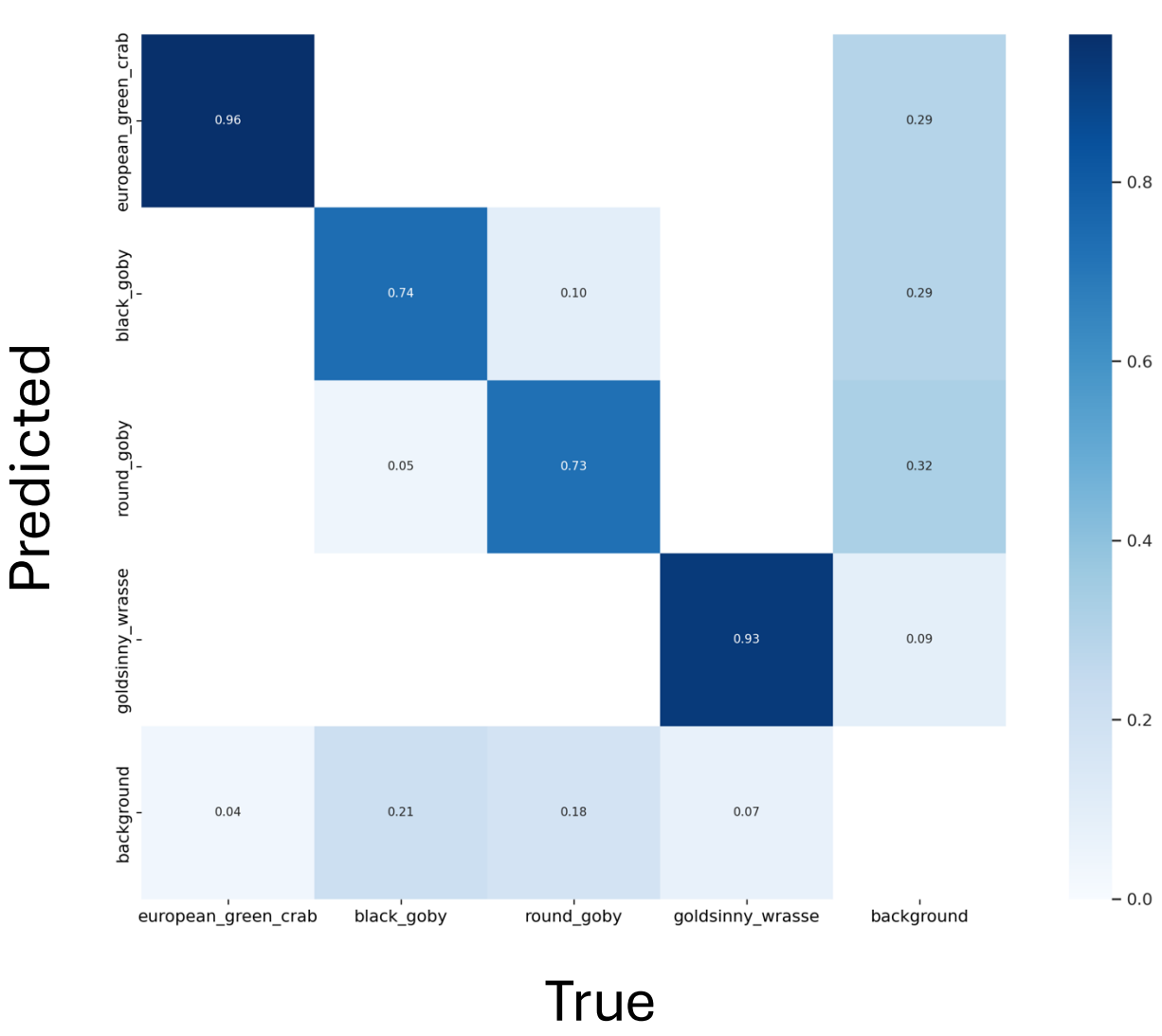


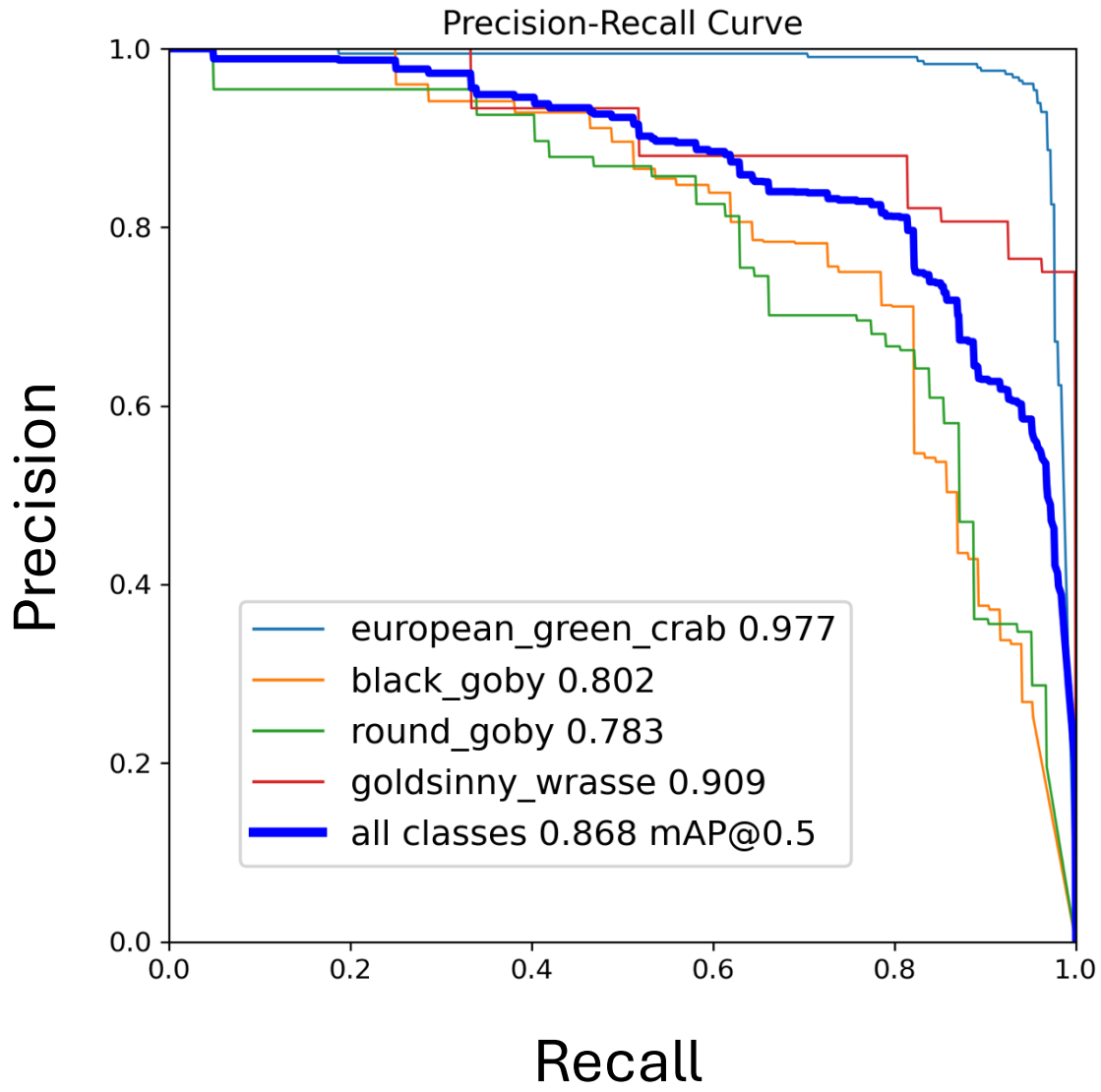
TRAINING THE AI YOLO MODEL



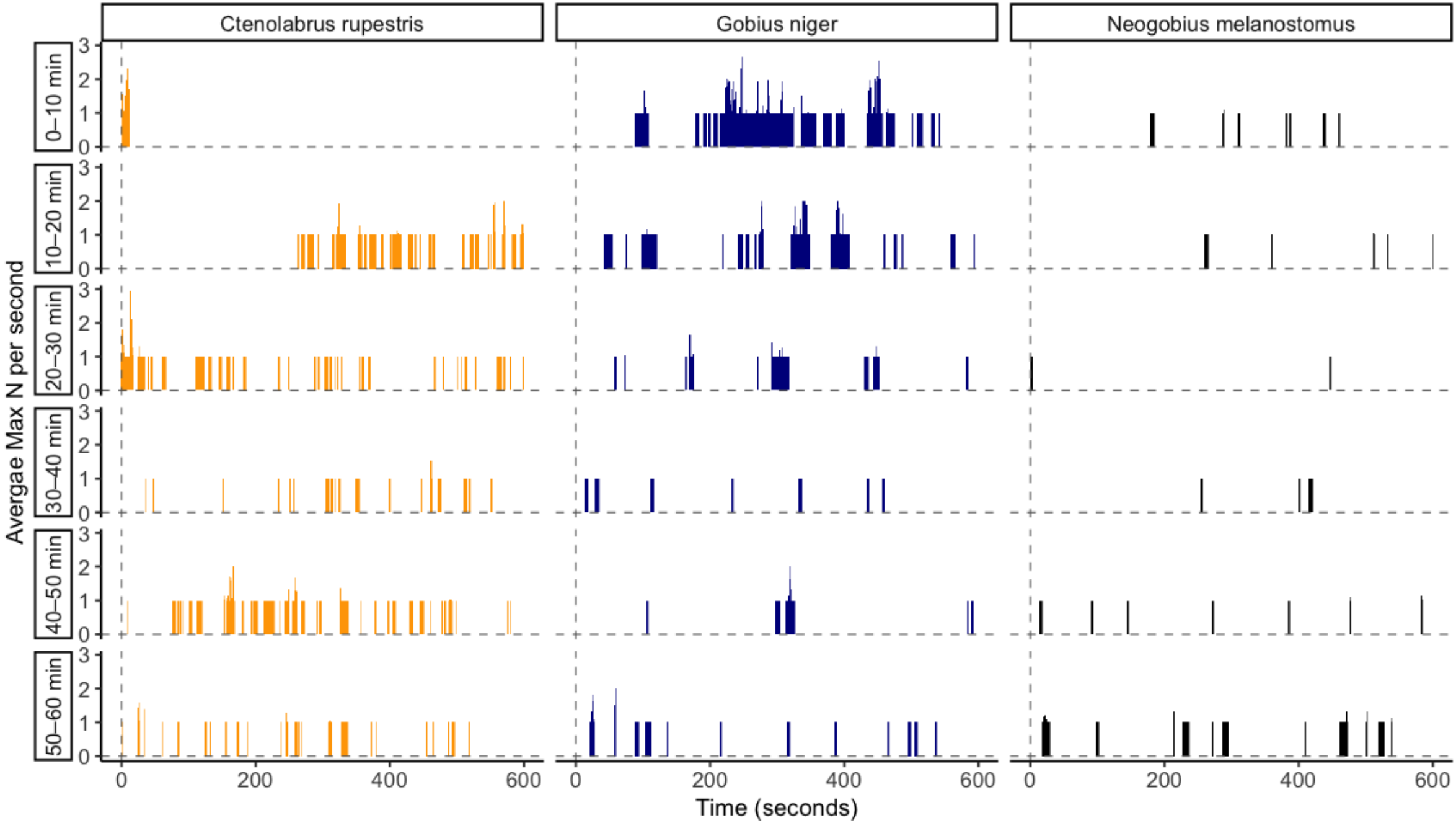
AI image detection model (Yolo_v8) capable of counting (selected) fish species and differentiating between native black goby and invasive round goby. (Green, Obst et al., 2024)

MODEL SPECIFICS





Green, Svensson et al. (*in prepp*)


Ctenolabrus rupestris
Gobius niger
Neogobius melanostomus
0–10 min
10–20 min
20–30 min
30–40 min
40–50 min
50–60 min
Avergae Max N per second
0
1
2
3
0
200
400
600
Time (seconds)

TAKE HOME MESSAGES:

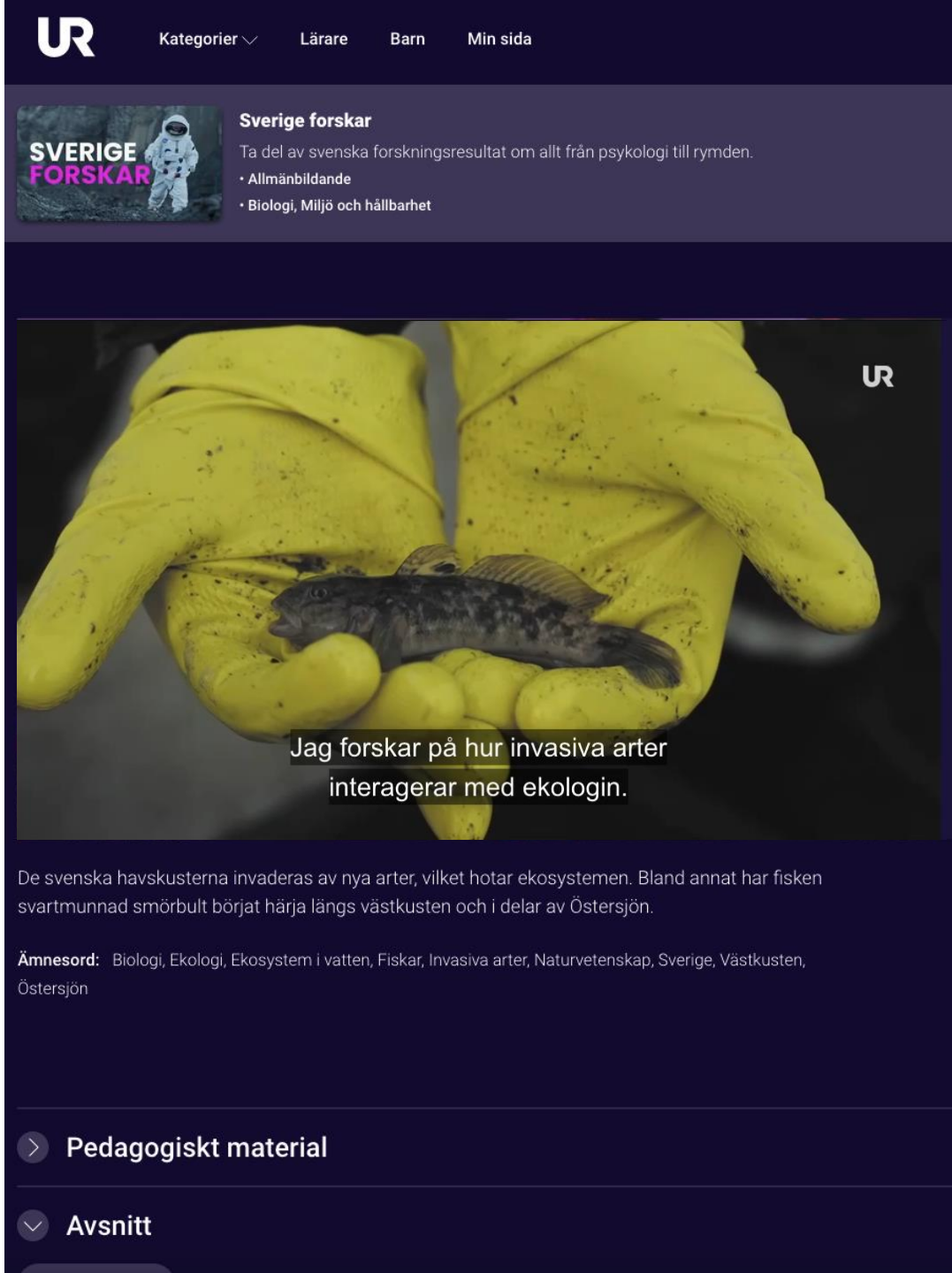
- *Neogobius* presence is limited - small zone of abundance.
- *Neogobius* presence is linked to lower fish diversity - cause / effect still to be determined.
- *Neogobius* presence or abundance does not impact the most abundant fishes of similar size.
- *Gobius* abundance decrease slightly in areas with *Neogobius* – signs of competition.
- *Neogobius* abundance is slightly positively impacted by *Gobius* – if habitat is good for *Gobius*, it is also good for *Neogobius*.
- *Gobius* is an abundant and active competitor – *Neogobius* numbers could be higher if not due to competition.
- *Neogobius* is a prey for several species – but predatory fish are low in abundance.
- Ecology is (still) more complex than we think!

COMMUNICATION

- Workshop with COASTVISION (SLU, Uni Agder, IMR) on AI in fish identification
- Dialogworkshop Aquatic Invasive Species (Denmark, Norway, Sweden)
- CeMEB spring symposia (international)
- Society for Experiemental Biology annual conference (international)

Outreach:

- ODF student fair - Tech Challenge at Chalmers
- Inauguration of Västerhavsveckan (also on Swedish national Television, SVT)
- Västerhavsveckan at Kristineberg
- Västerhavsveckan in Gothenburg & Lysekil
- The podcast "Under Havsytan”
- ”Sverige Forskar” URplay








THANK YOU!

NATUR VÅRDS VERKET

Havs och Vatten myndigheten

FORMAS

@Leon_at_Sea

leon.green@bioenv.gu.se

https://www.gu.se/forskning/invasiva-fiskarter