Detecting invasive species with the eDNA method

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THE A. G. LEVENTIS FOUNDATION

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First application of eDNA to map alien, invasive species in Greek freshwaters (project RESILIENT)

Target species: *Gambusia holbrooki*

OBJECTIVE

Mapping the alien invasive Eastern mosquitofish *G. holbrooki* in Valencia habitats, *using BOTH* conventional fish sampling methods and eDNA sampling

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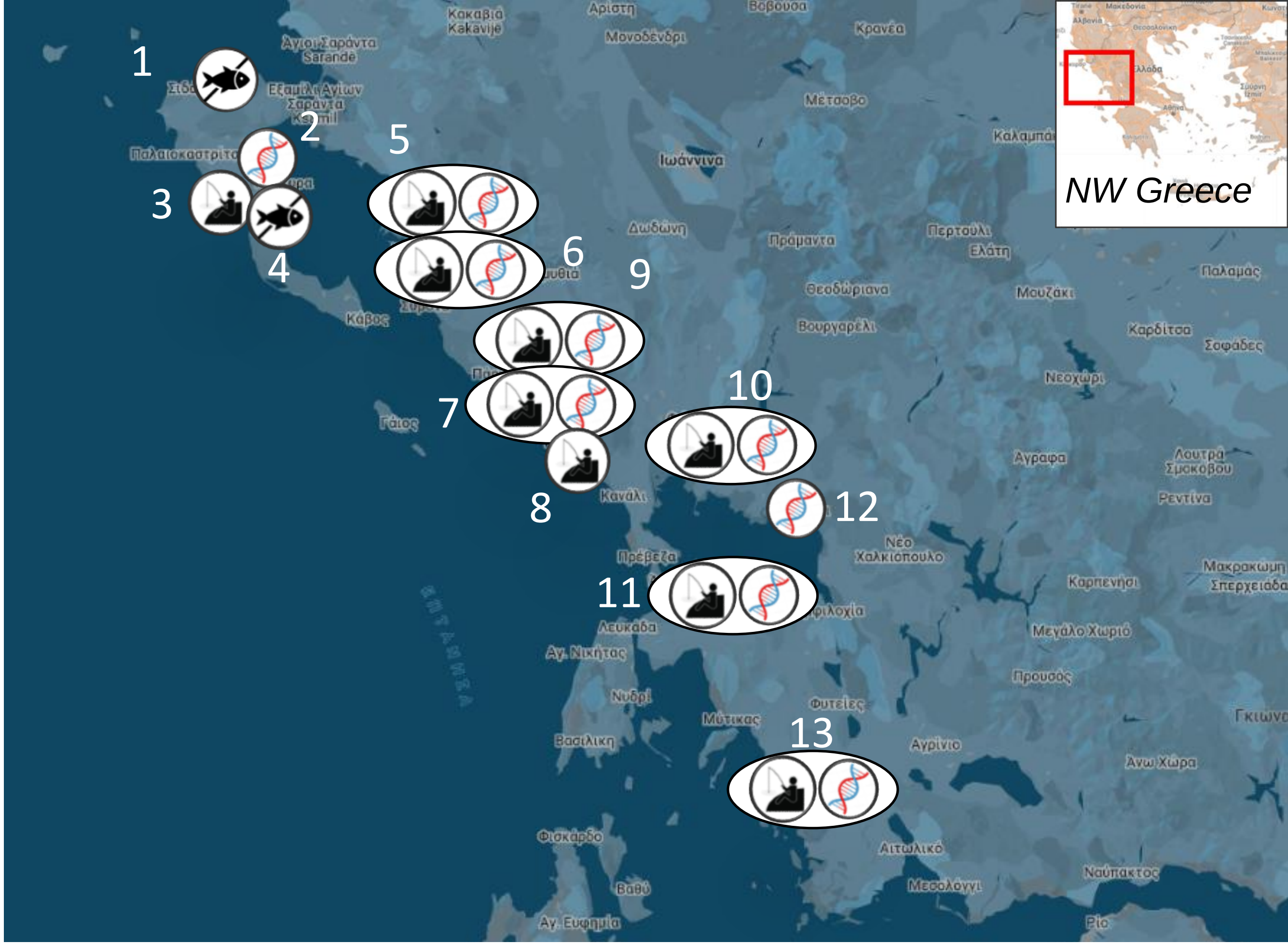
G. holbrooki

- Fishing detection
- e DNA detection
- No detection



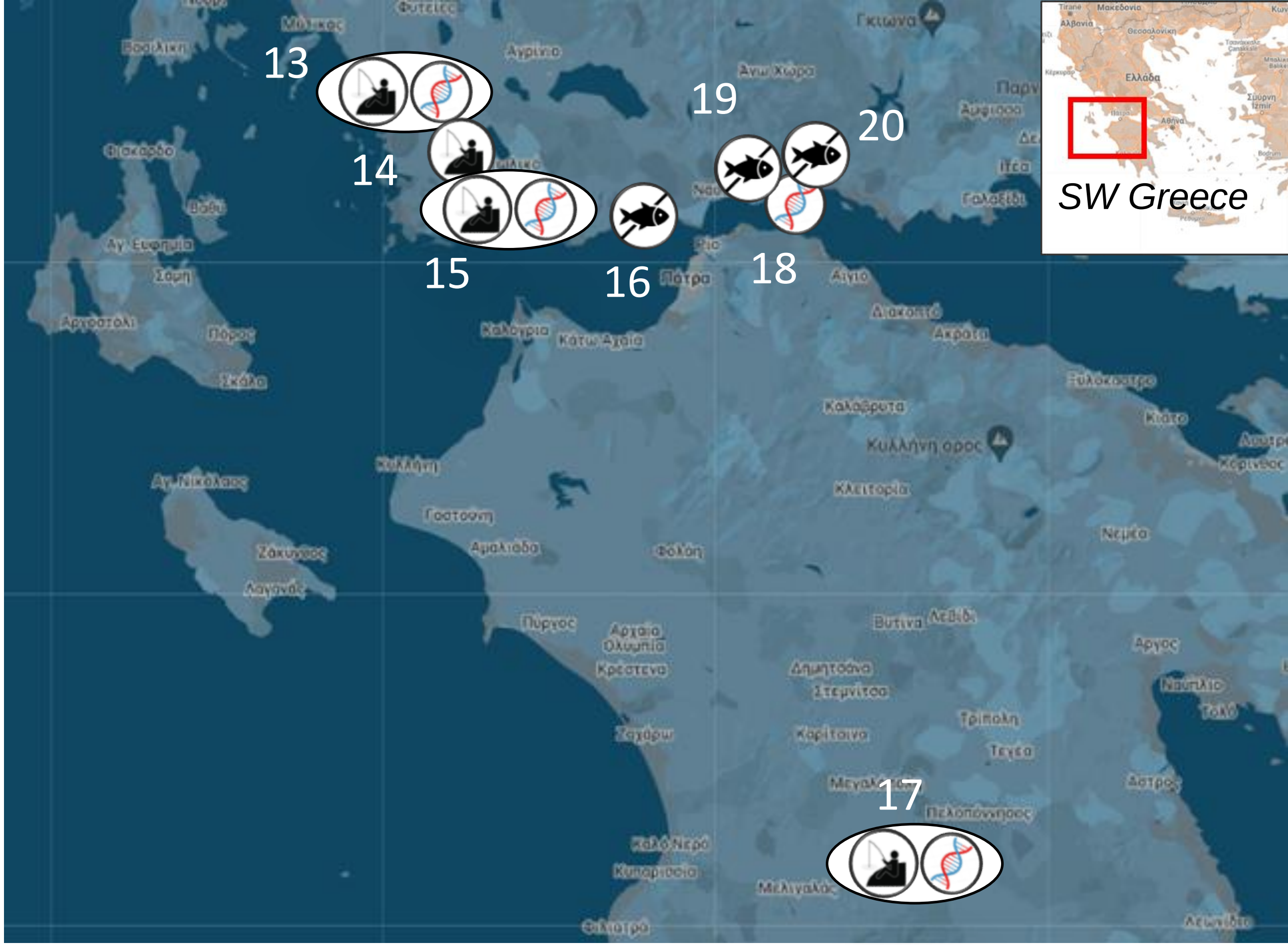
Map showing eDNA and electrofishing results of *G. holbrooki* at locations sampled in W. Greece (*V. Letourneuxi* distributional range) during the 2018 autumn survey

fresh

e-Workshop

G. holbrooki

- Fishing detection
- e DNA detection
- No detection



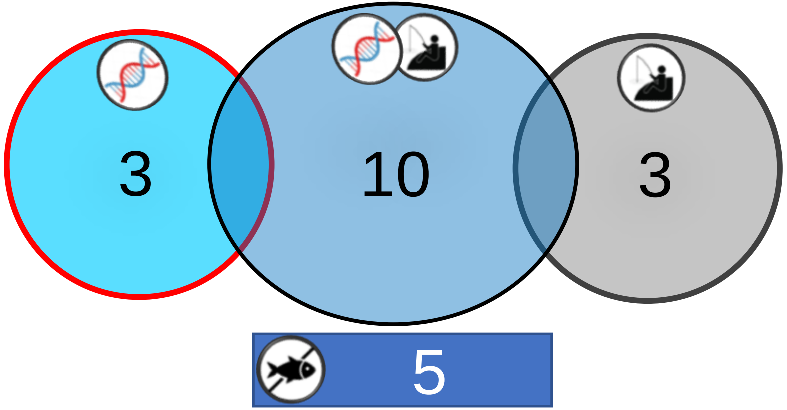
Map showing eDNA and electrofishing results of *G. holbrooki* at locations sampled in W. Greece (*V. robertae* distributional range) during the 2018 autumn survey

fresh

e-Workshop

Conclusions

- At 3 systems, *G.holbrooki* **<u>was detected through eDNA</u>** <u>but</u> **<u>NOT</u>** <u>through fish sampling</u>, → low densities, indicating the suitability of the eDNA method for species detection
- At 3 sites, *G. holbrooki* **<u>was detected through fish sampling</u>** but **NOT** through eDNA (pseudonegatives), → limitations of the method (fast flow and/or turbidity)



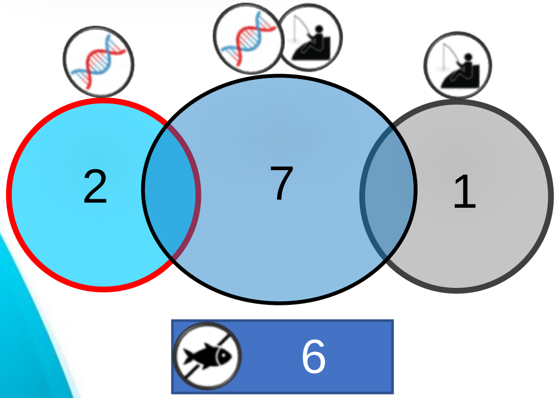
Targeting two top invaders/nation-wide survey (project PACIM)

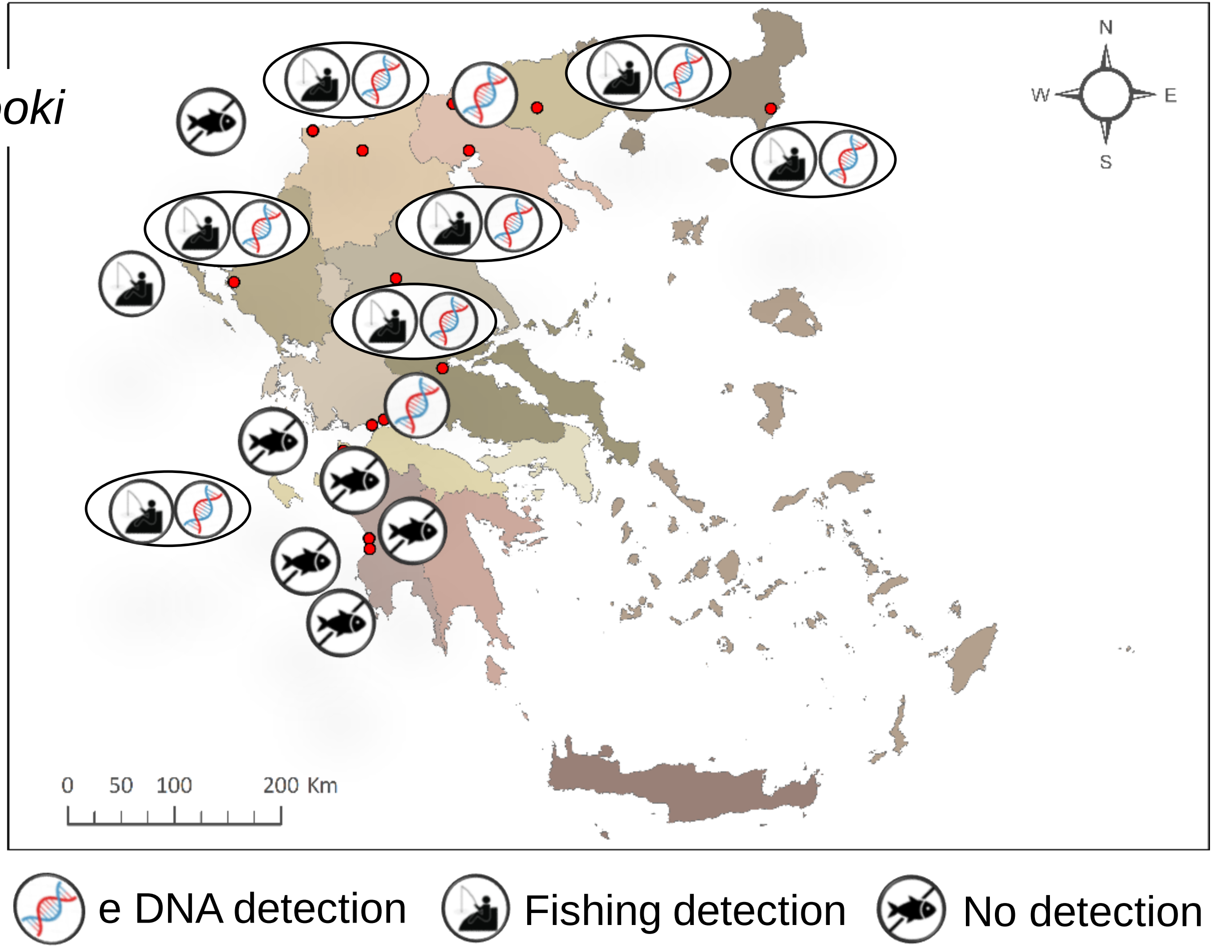
Target species: *Gambusia holbrooki* and *Pseudorasbora parva*

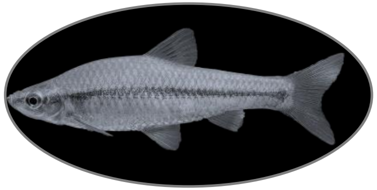
OBJECTIVE

Nation-wide survey targeting two top freshwater fish invaders, *using BOTH* conventional fish sampling methods and eDNA sampling

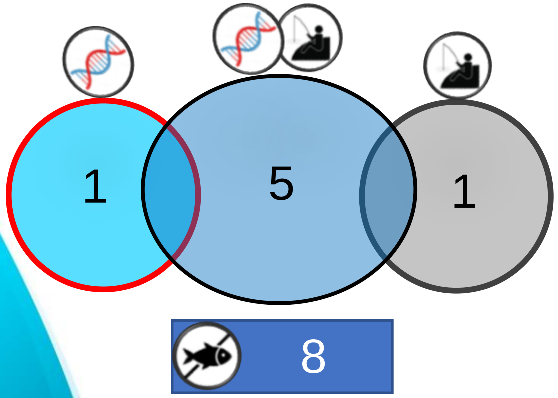
G. holbrooki

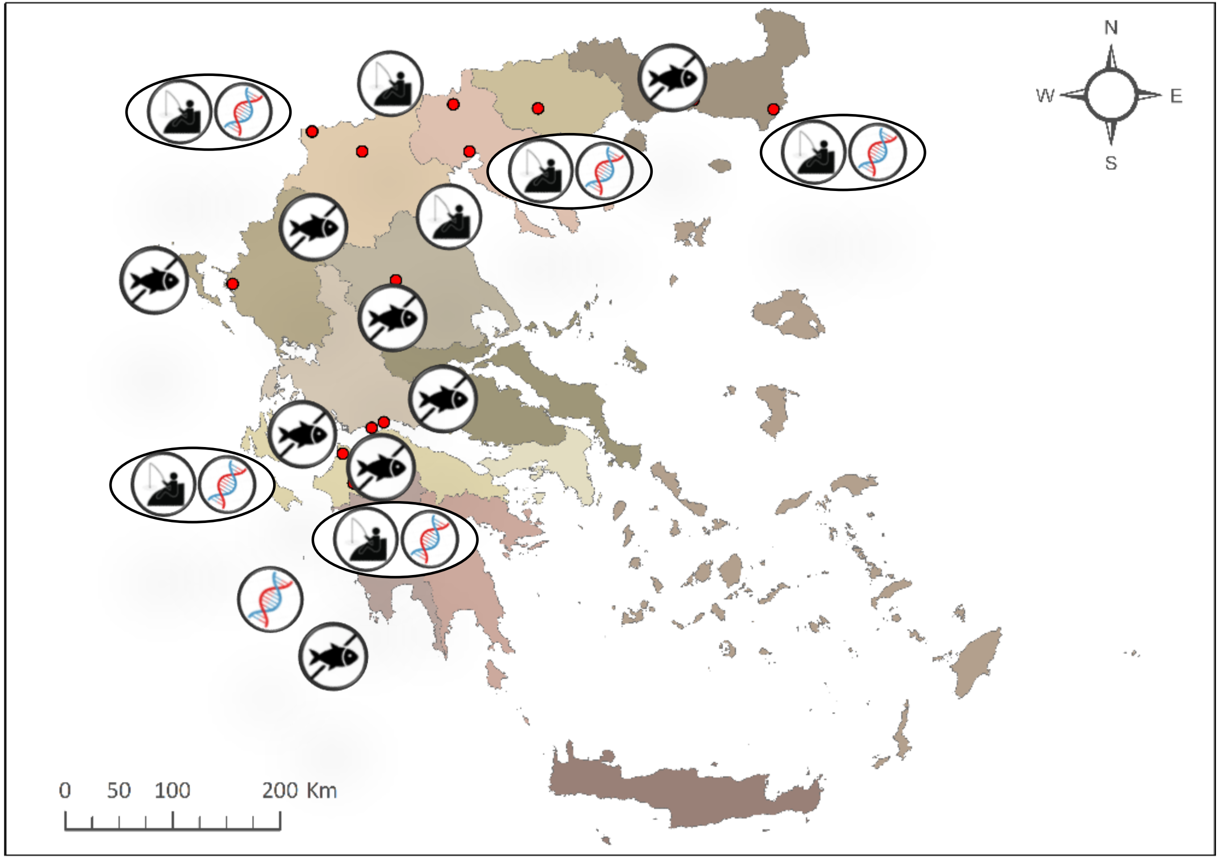

2
7
1
6


N
W
E
S
0 50 100 200 Km
e DNA detection
Fishing detection
No detection



P. parva





e DNA detection Fishing detection No detection

Conclusions

- At two systems (within known range), ***G.holbrooki* was detected through eDNA** but **NOT** through fish sampling, i.e. low densities, indicating the suitability of the eDNA method for species detection
- No eDNA pseudo-negatives for *G. holbrooki*

- At one system, ***P. parva* was detected through eDNA** but **NOT** through fish sampling (early detection of recent expansion?)
- Two eDNA pseudo-negatives for *P. parva*

Occupancy Modelling

True Positive
True Negative

False Positive
False Negative

TRUE **FALSE**

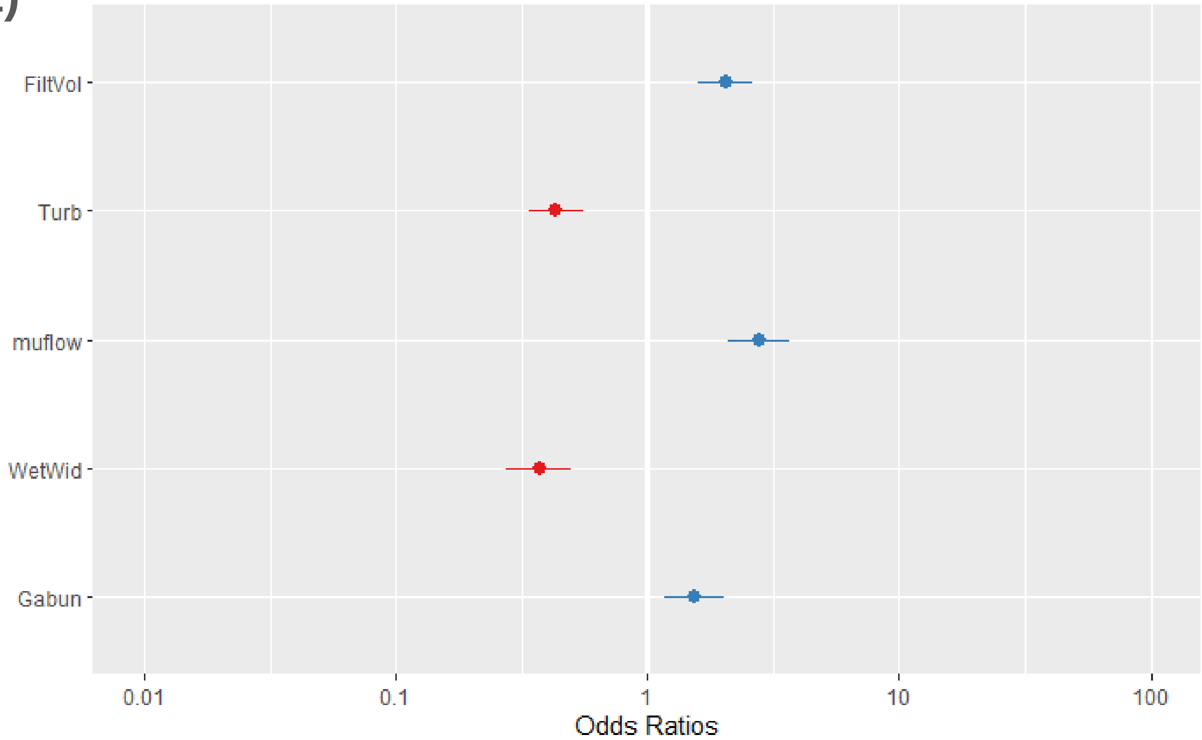
Generalized Linear Modelling

23 environmental, habitat and biological variables from 16 sampling locations were regressed against the outcome of the eDNA analysis in order to identify the most significant predictors

1. Fish species
2. Filtered Volume
3. Ecoregion
4. Latitude
5. Longitude
6. Temperature
7. pH
8. Turbidity
9. D.O. Saturation
10. Flow
11. Fast habitat %
12. Wetted Width
13. Depth
14. Coarse Substrate %
15. Shadedness
16. Helophytes
17. Bottom Vegetation
18. G. hol. abundance
19. G.hol. density
20. G. hol. abundance/Min
21. P. par. abundance
22. P. par. density
23. P. par abundance/Min

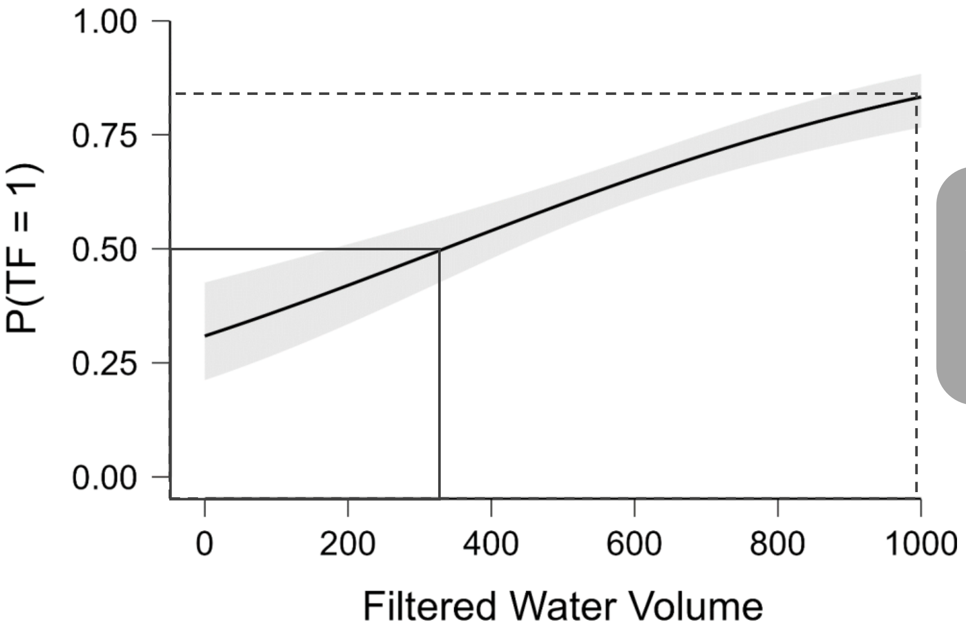
RESULTS
Effect of Standardized Coefficients

(P<0.01)



Conditional Plot of Filtered Water Volume

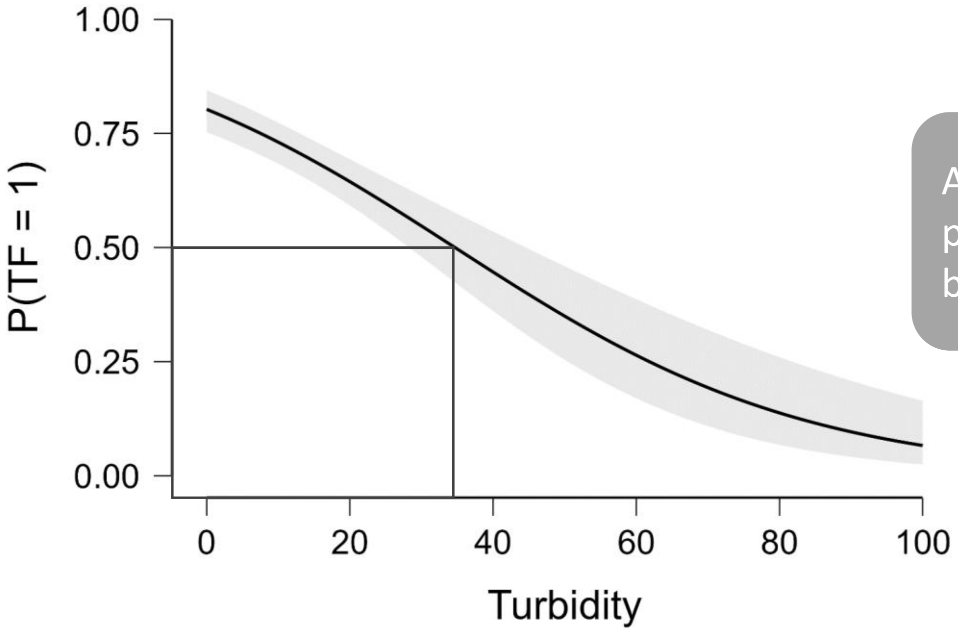
The odds of a TRUE replicate outcome occurring increased by 0.24% for every unit of increase in the Volume of Filtered Water per replicate sample.



At approximately 350 ml, the probability of a true outcome rises over 50%

Conditional Plot of Turbidity

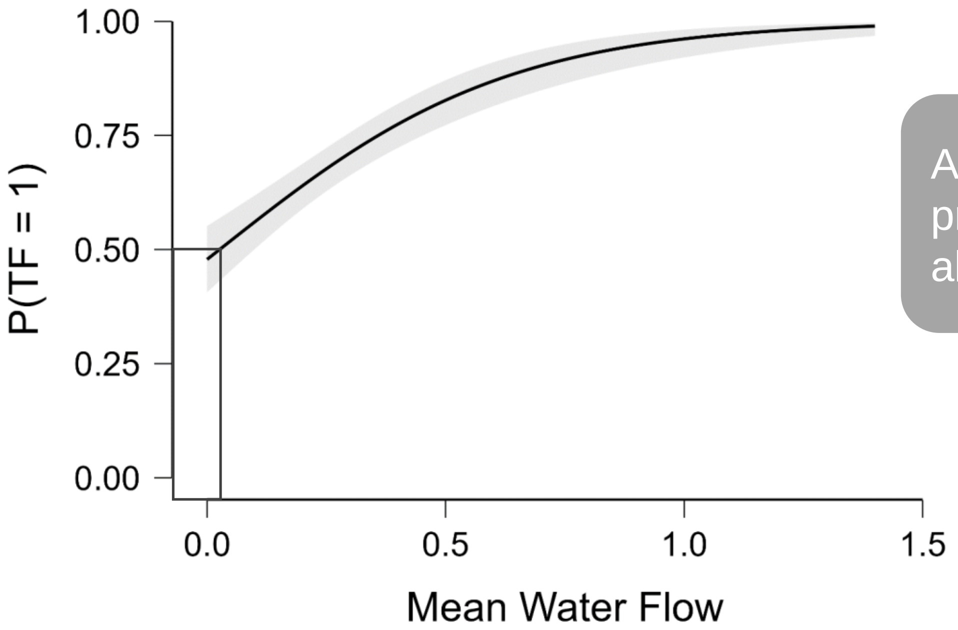
The odds of a TRUE replicate outcome occurring decreased by 3.97% for every unit of increase in water turbidity.



At approximately 35 NTU, the probability of a true outcome fell below 50%

Conditional Plot of Mean Water Flow

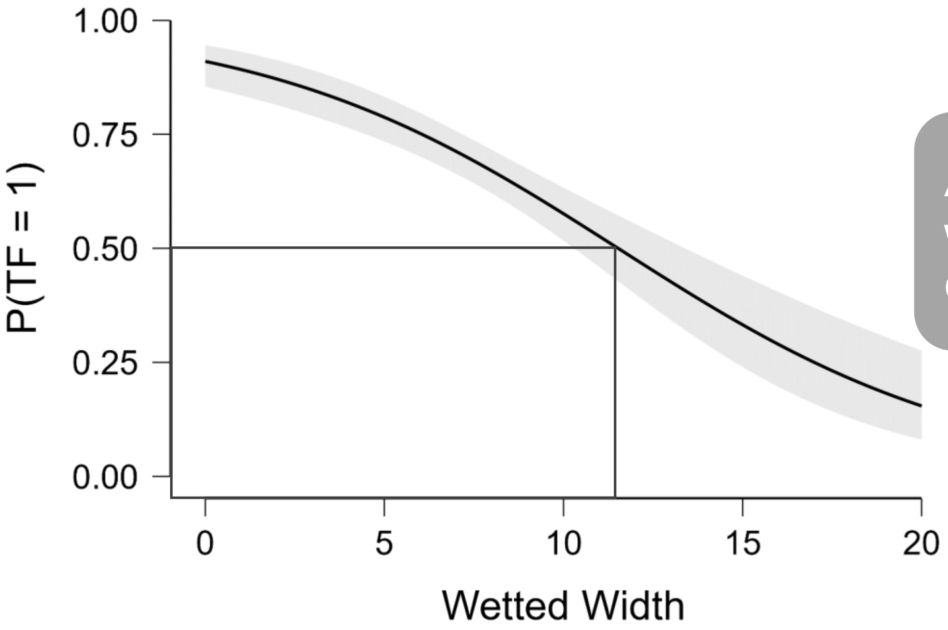
The odds of a TRUE replicate outcome occurring increased by 2618.91% for every unit of increase in water flow.



Already at zero flow, the probability of a true outcome was almost 50%

Conditional Plot of Wetted Width

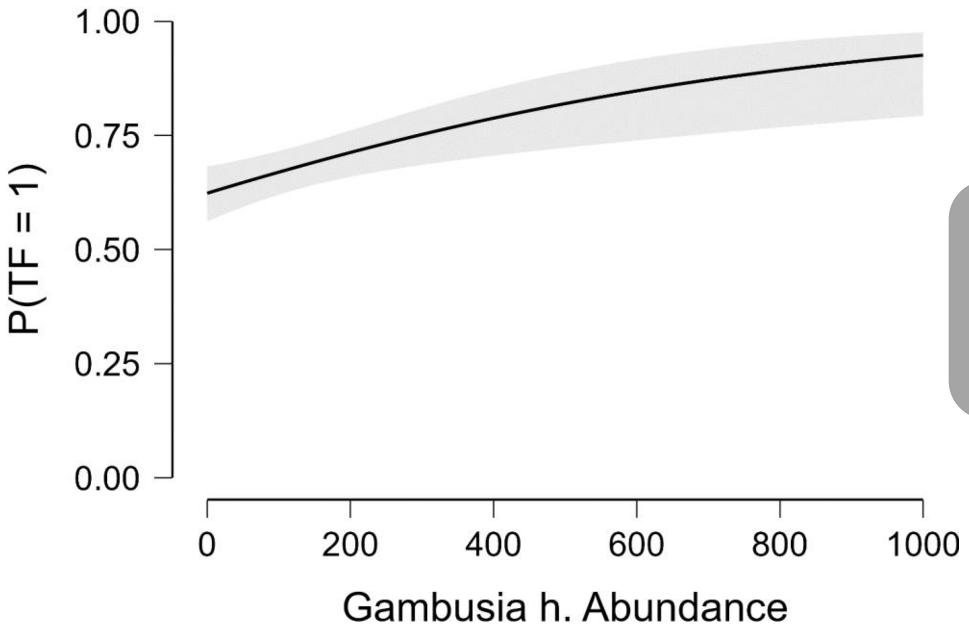
The odds of a TRUE replicate outcome occurring decreased by 18.18% for every unit of increase at wetted width.



At approximately 10 m. of wetted width, the probability of a true outcome fell below 50%

Conditional Plot of *G. holbrooki* Abundance

The odds of a TRUE replicate outcome occurring increased by 0.2% for every unit of increase in the abundance of *G. holbrooki*



On non-occupied sites (zero abundance), the probability of a true outcome was already over 50%

Widening the scope, two more top invaders/nation-wide survey in Greek freshwaters (project AFRESH)

Target species: *Carassius gibelio* and *Lepomis gibbosus*

OBJECTIVE

Nation-wide survey targeting two more top freshwater fish invaders,
Using BOTH conventional fish sampling methods and eDNA sampling

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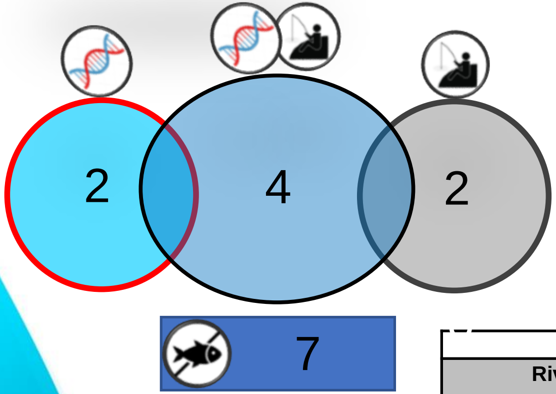
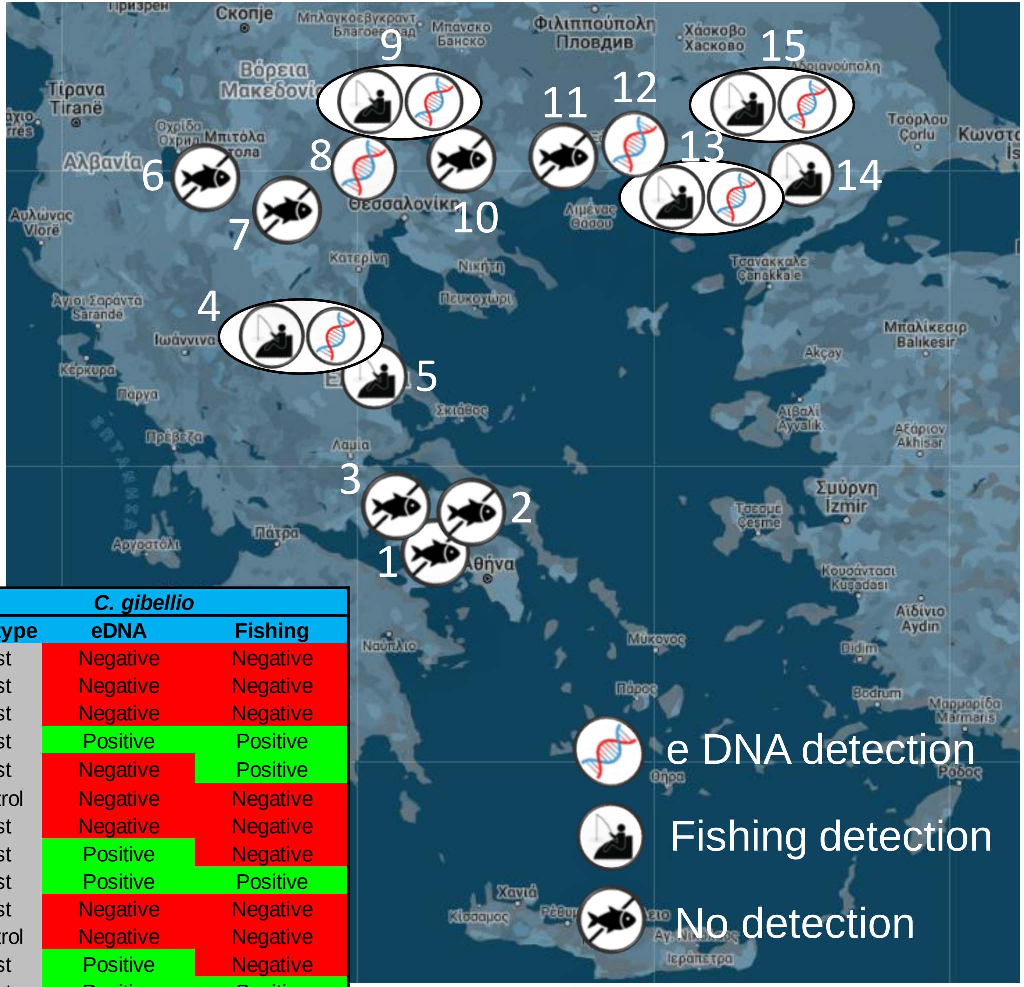
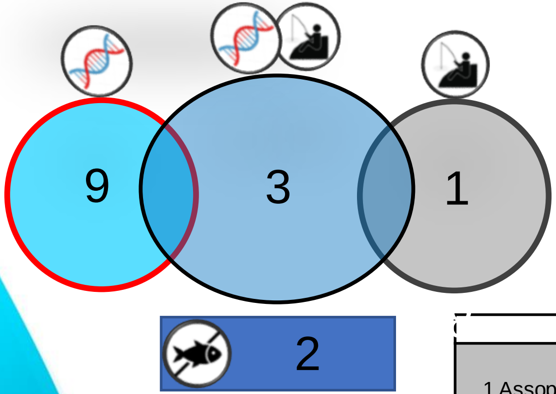
C. gibelio

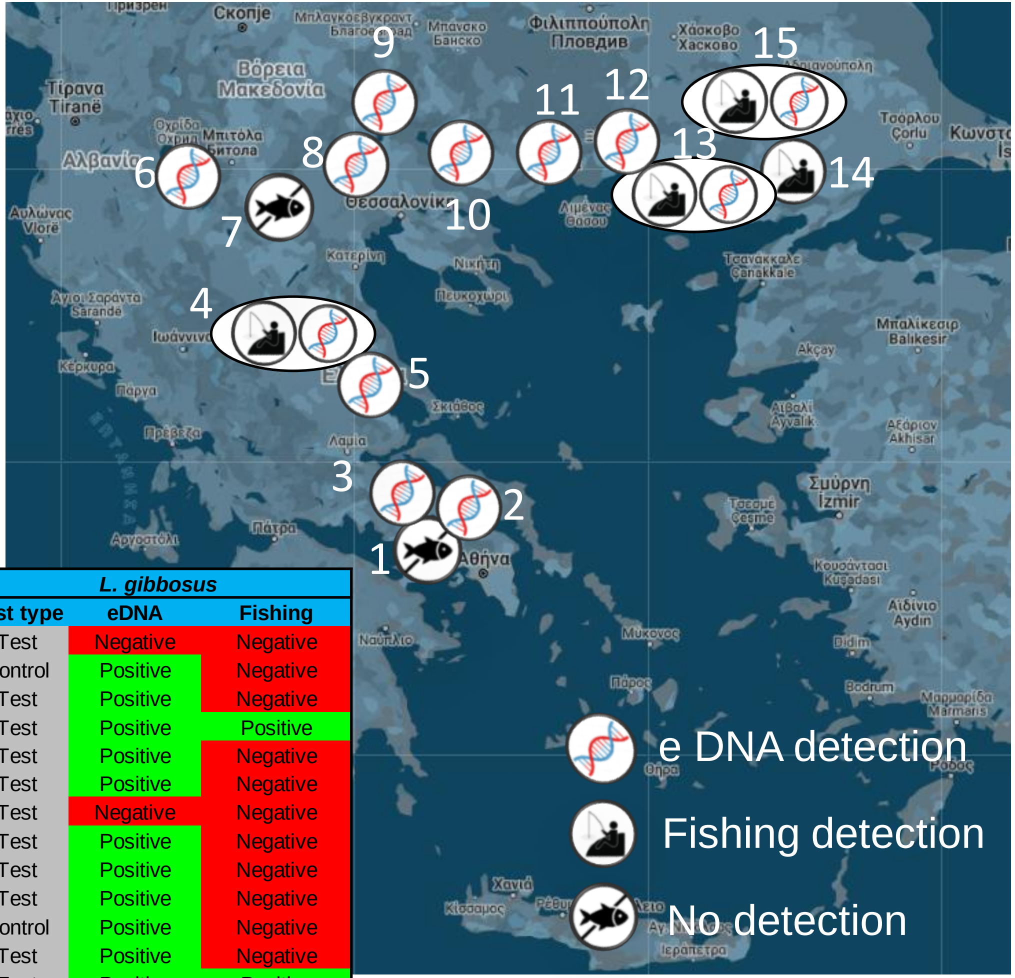


		C. gibellio	
River Basins	**Test type**	**eDNA**	**Fishing**
1 Assopos Beot.	Test	Negative	Negative
2 Assopos Beot.	Test	Negative	Negative
3 Kifissos Beot.	Test	Negative	Negative
4 Pinios Thes.	Test	Positive	Positive
5 Pinios Thes.	Test	Negative	Positive
6 Prespa (Ag. Germanos)	Control	Negative	Negative
7 Aliakmon	Test	Negative	Negative
8 Axios	Test	Positive	Negative
9 Doiran	Test	Positive	Positive
10 Strymon	Test	Negative	Negative
11 Nestos	Control	Negative	Negative
12 Kossynthos	Test	Positive	Negative
13 Filiouris	Test	Positive	Positive
14 Evros	Test	Negative	Positive
15 Evros	Test	Positive	Positive



L. gibbosus





		L. gibbosus	
River Basins	**Test type**	**eDNA**	**Fishing**
1 Assopos Beot.	Test	Negative	Negative
2 Assopos Beot.	Control	Positive	Negative
3 Kifissos Beot.	Test	Positive	Negative
4 Pinios Thes.	Test	Positive	Positive
5 Pinios Thes.	Test	Positive	Negative
6 Prespa (Ag. Germanos)	Test	Positive	Negative
7 Aliakmon	Test	Negative	Negative
8 Axios	Test	Positive	Negative
9 Doiran	Test	Positive	Negative
10 Strymon	Test	Positive	Negative
11 Nestos	Control	Positive	Negative
12 Kossynthos	Test	Positive	Negative
13 Filiouris	Test	Positive	Positive
14 Evros	Test	Negative	Positive
15 Evros	Test	Positive	Positive

Conclusions

- At 2 systems (within known range), ***C. gibelio* was detected through eDNA** but **NOT** through fish sampling, i.e. low densities, indicating the suitability of the eDNA method for species detection
- One eDNA pseudo-negative for *C. gibelio*

- At 5/9 systems, ***L. gibbosus* was detected through eDNA** but **NOT** through fish sampling (early detection of recent expansion?)
- One eDNA pseudo-negatives for *L. gibbosus!*


Ευχαριστώ πολύ για την προσοχή σας!