Echinococcus granulosus and *Echinococcus canadensis* species involved in cystic echinococcosis in Algeria

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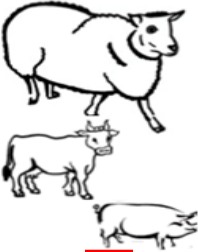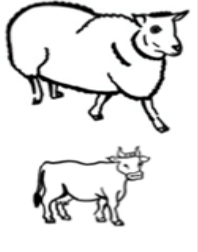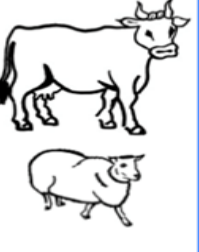
Introduction
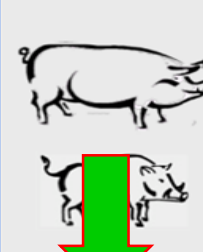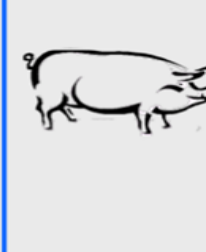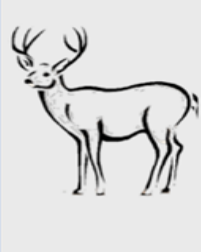
- Foodborne parasitic diseases, such as echinococcosis, represent a major public health issue. In 2010, approximately 2,479,000 people were affected, resulting in 19,300 deaths (Torgerson et al., 2015).

- **Cystic echinococcosis** (CE) manifests itself in cysts affecting humans and animals.

- The main outbreaks are located in **Africa**, Asia, and South America, primarily in rural areas.

- This zoonosis causes serious medical complications and has a significant socioeconomic impact, highlighting the urgent need to strengthen prevention and control measures.

- Cystic echinococcosis is caused by *Echinococcus granulosus sensu lato.*

Genotyping of *Echinococcus granulosus s.l.*

Predominant species
in many regions of the world

Associated with
Eastern and Northern Europe

Widely distributed in
North Africa

2 haplogroupes

Mainly found in
Corsica and Sardinia

Laurimae et *al.*, 2018

Epidemiology d'*Echinococcus granulosus s. l.* in Algeria

- According to clinicians, CE is an endemic zoonosis in Algeria.

=> It therefore constitutes a major public health and economic problem.

- It is thought to be caused mainly by *Echinococcus granulosus senso stricto.*

- However, few epidemiological studies have been conducted and the figures reported are below the actual numbers.

▮ (magenta)	*E. multilocularis* and *E. granulosus sensu lato* highly endemic
▮ (dark green)	*E. granulosus sensu lato* highly endemic
▮ (light green)	*E. granulosus sensu lato* endemic
▮ (orange)	*E. multilocularis* endemic
▯ (white)	Non-endemic or not known

(Wen et al., 2019)
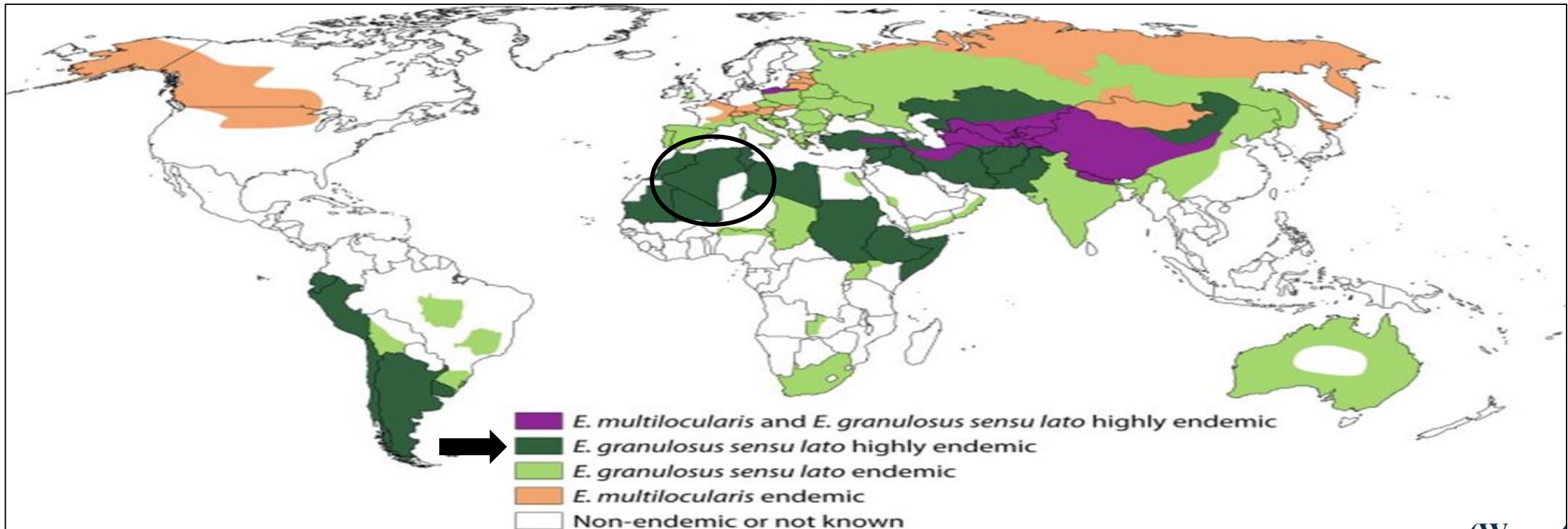
Epidemiology of E. granulosus s. l. in Algeria:
Reviews and meta-analyses

According to a meta-analysis conducted in 2022 by Karshima et al. and published in Parasites & Vectors, there are no data on human CE in Algeria.
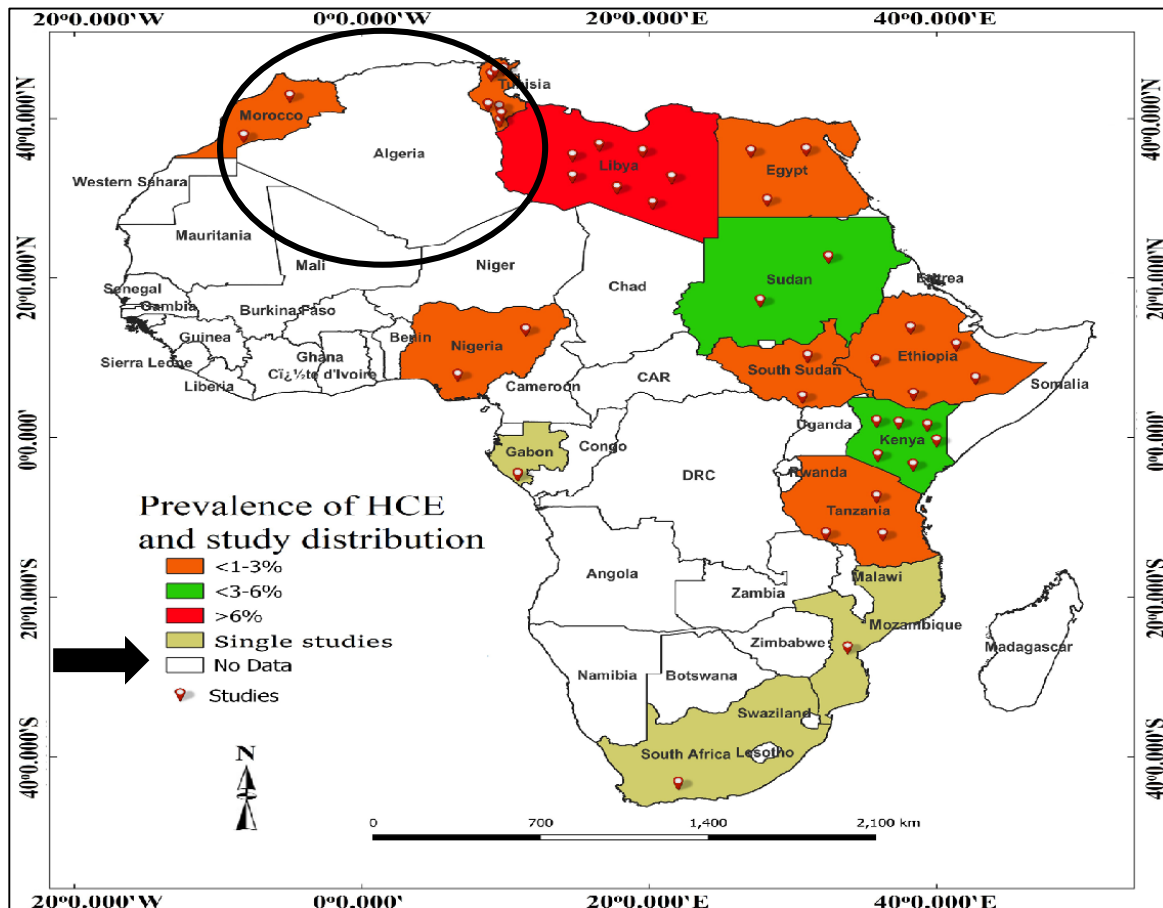
Another study from 2024, by Nocerino et al. (Acta tropica), revealed a high prevalence of animal CE in Ouargla and a moderate prevalence in Adrar and central and eastern northern Algeria.
=> According to this study, a large part of the territory remains unexplored.
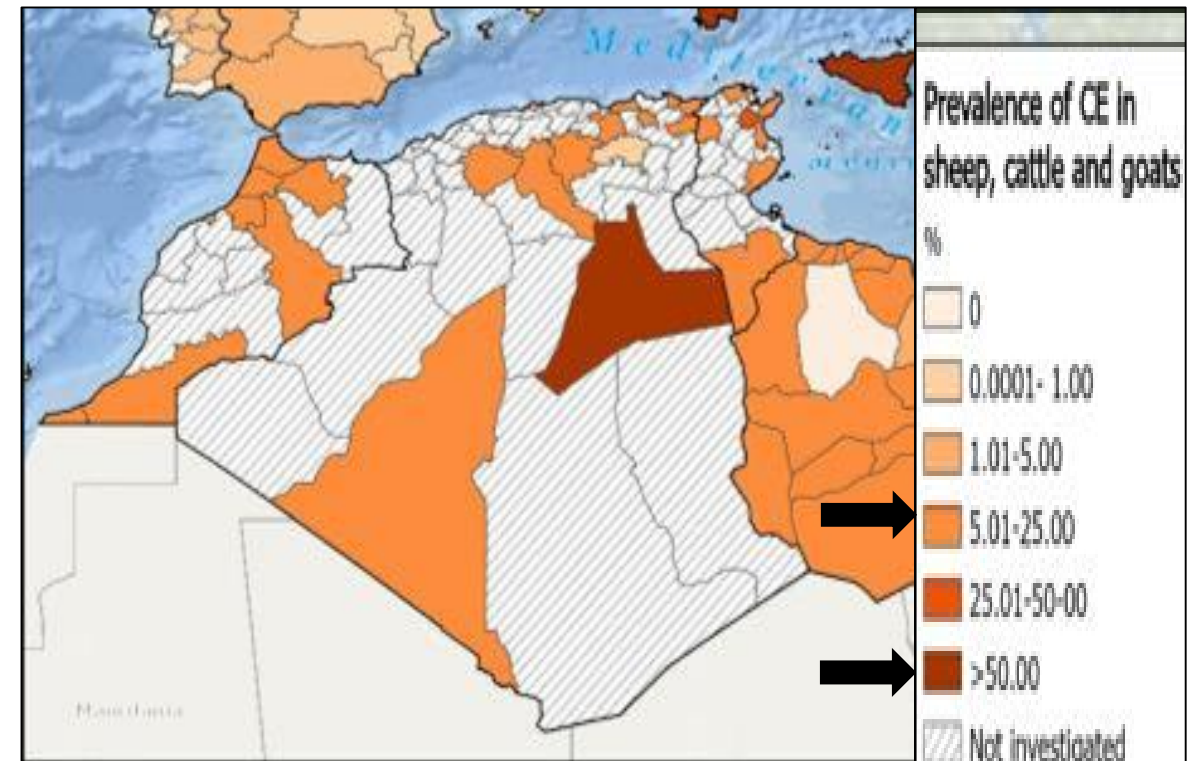
PROBLEM

MISSING

Robust epidemiological data on this parasite
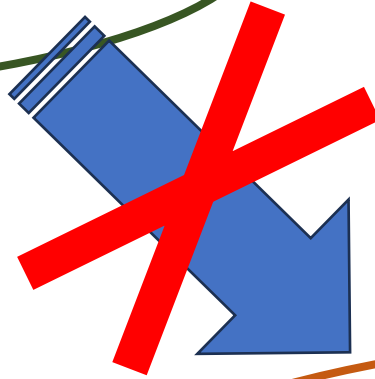
The development of appropriate strategies for the prevention and control of this disease

SOLUTION

Genotyping
of several specimens of E. granulosus
taken from Algerian patients

Using different parts of the cyst

Components of a hydatid cyst
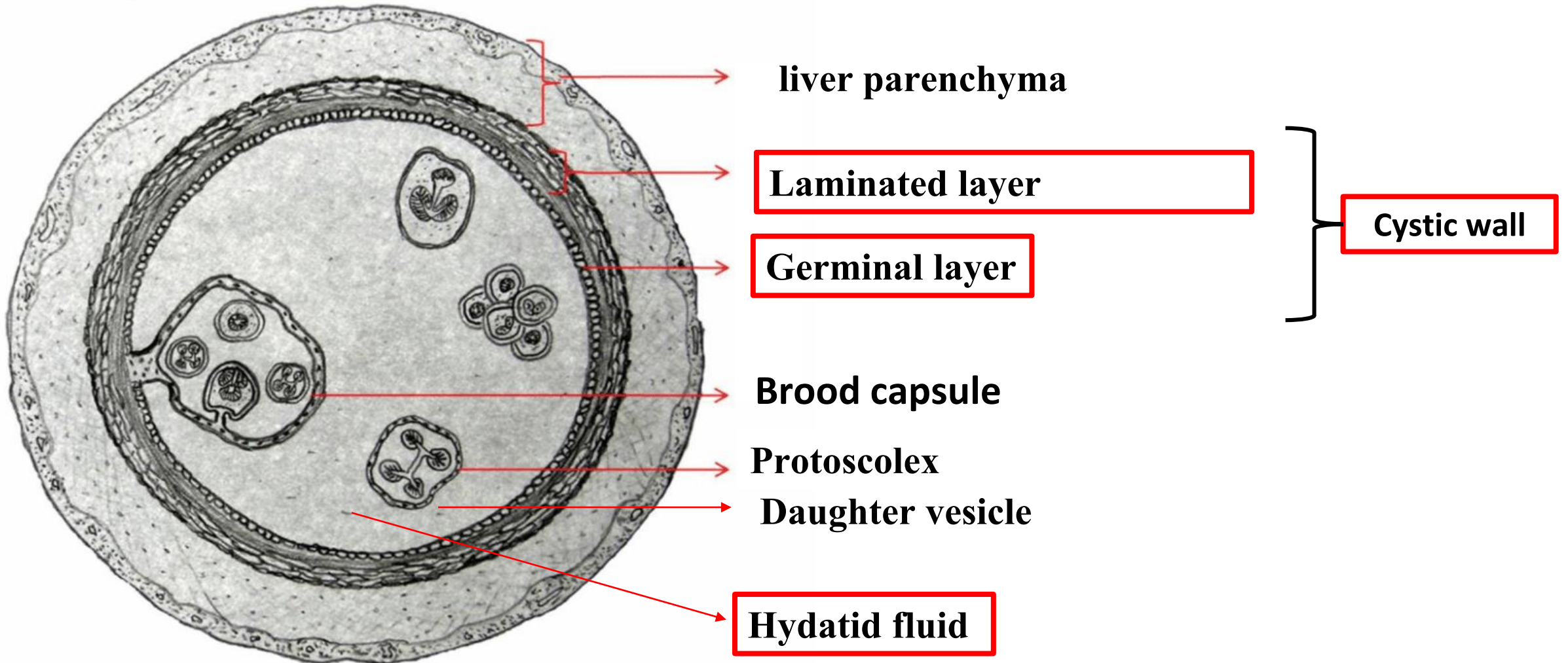
liver parenchyma

Laminated layer

Germinal layer

Cystic wall

Brood capsule

Protoscolex

Daughter vesicle

Hydatid fluid

Methodology

22 samples (liquid and membrane) from hydatid cysts

DNA extraction

1

PCR amplification with primers:
-12S-*Echinococcus* (Roelfsema et *al* 2016)
 -EgG1 (Stefanic et *al* 2004)

Frost revelation

PCR product purification

2

Sanger sequencing

3

qPCR amplification on mitochondrial target(Knapp et *al* 2023)
- *E. granulosus* : cox3
-*E. canadensis* :nad5
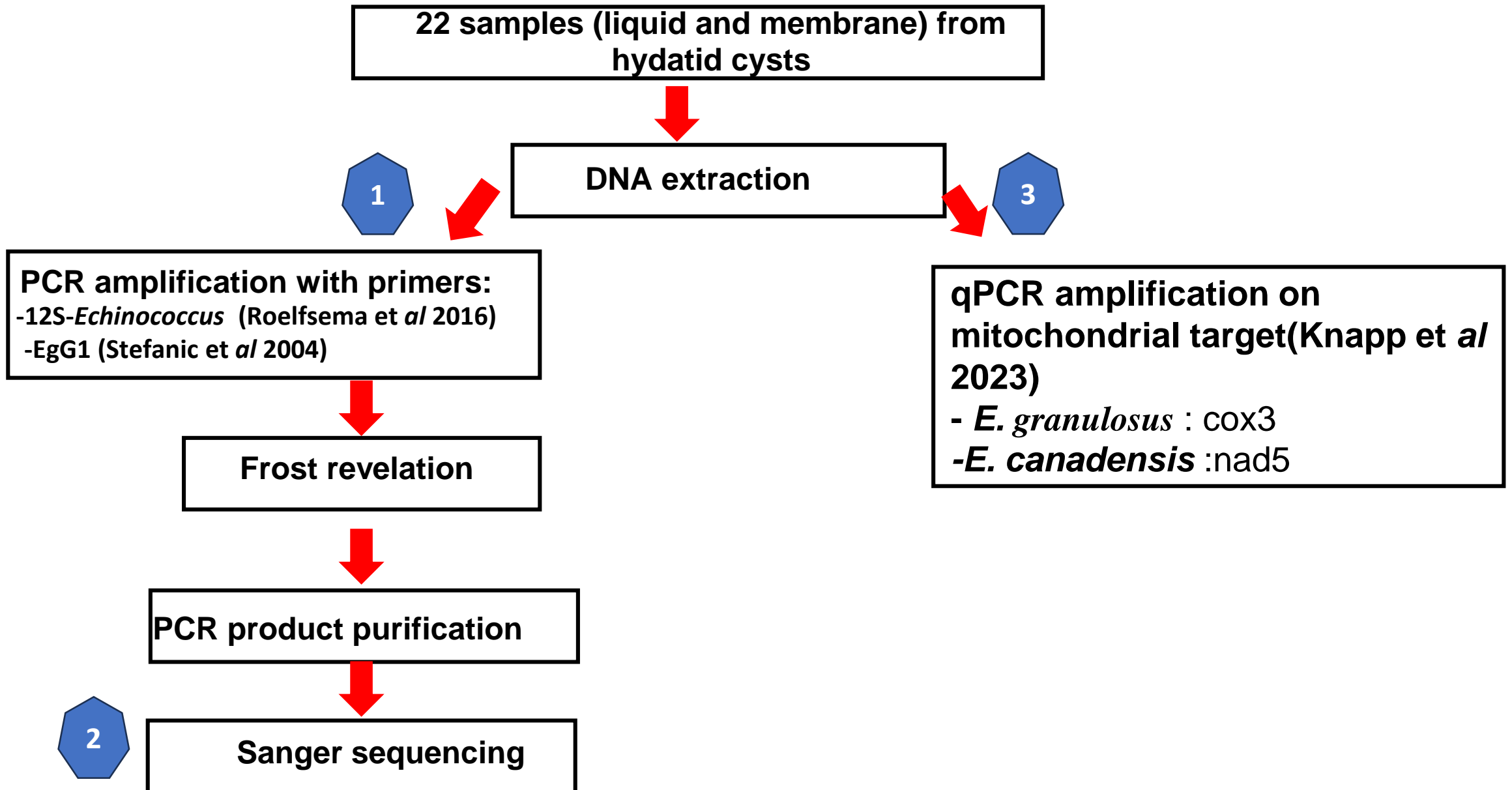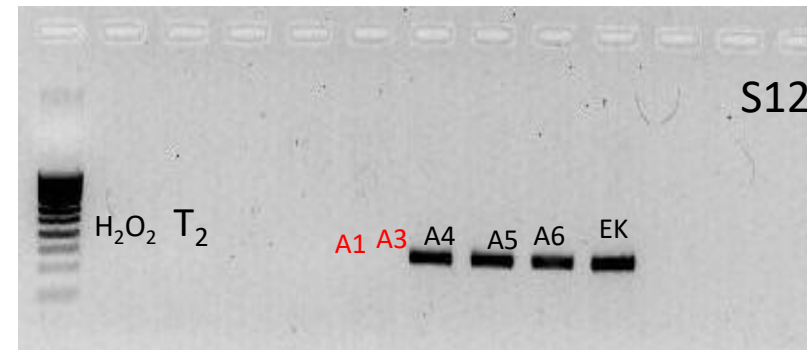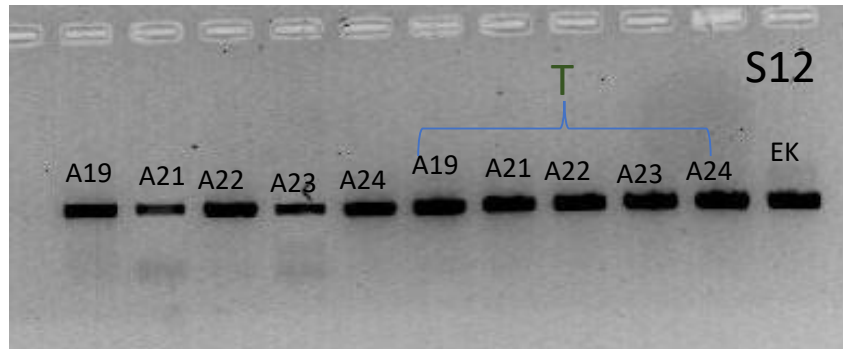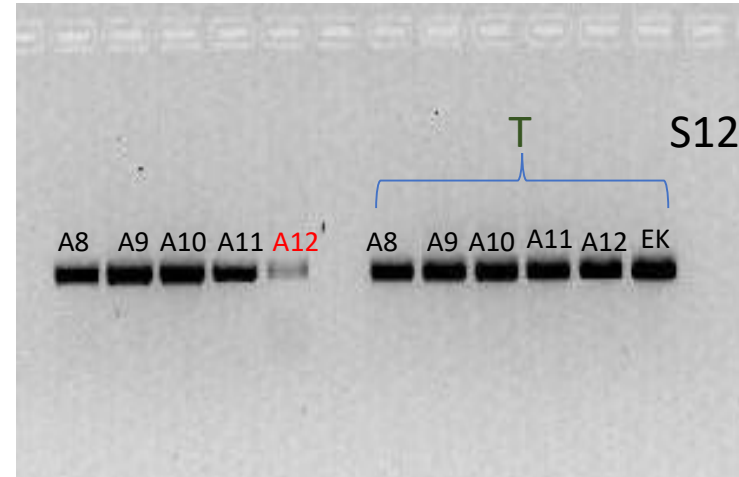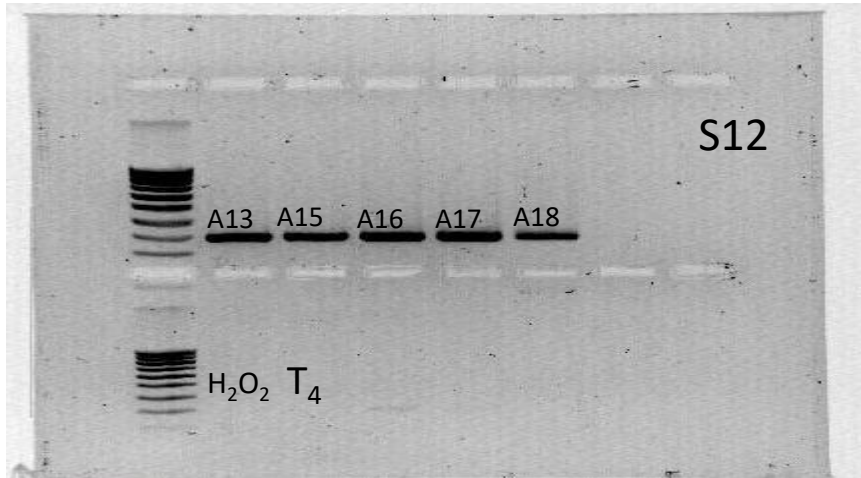
RESULT A1 and A2 are negative in S12
:

14/22: *Echinococcus granulosus*, **genotype:G1,** GenBank Acc No :MG672205.1

1/22: *Echinococcus granulosus*, **genotype:G6/G7,** GenBank Acc No :MF162290.1

1/22: *Echinococcus granulosus*, **genotype:G3,** GenBank Acc No :KY052050.1

Result of qPCR on mitochondrial target

Patients	EGG1(Cq)	EGG5/EGG6(Cq)
A1	ND	ND
A3 *	40,01	
A4	27,5	
A5	27,8	
A6	30,15	
A7 (LH)	34,9	
A8		29,21
A9	23,4	
A10	22,2	
A11	23	
A12*	39,76	
A13	29,7	
A14(MBR)	28,4	
A15	33,8	
A16	30,2	
A17	26,8	

Patients	EGG1(Cq)	EGG5/EGG6(Cq)
A18	32,7	
A19	31,2	
A20(MBB)	28,4	
A22	28,8	
A23	ND	ND
A24	24,4	

* : Négative en PCR 12S et EgG1

CONCLUSION

20/22:
***Echinococcus granulosus*, genotype: G1 (*E. granulosus sensu stricto*)** ,
GenBank Acc No :MG672205.1

1/22:
***Echinococcus granulosus*, genotype:G6/G7 (*E. canadensis*),** GenBank Acc No
:[MF162290.1](MF162290.1)

1/22:
***Echinococcus granulosus*, genotype: G3 (*E. granulosus sensu stricto*),**
GenBank Acc No :KY052050.1

✓ Our results are consistent with the work of (Zait et al., 2016; Moussa et al., 2021), which highlighted the

dominance of the G1 genotype in Algeria.

Geographical distribution of the different genotypes
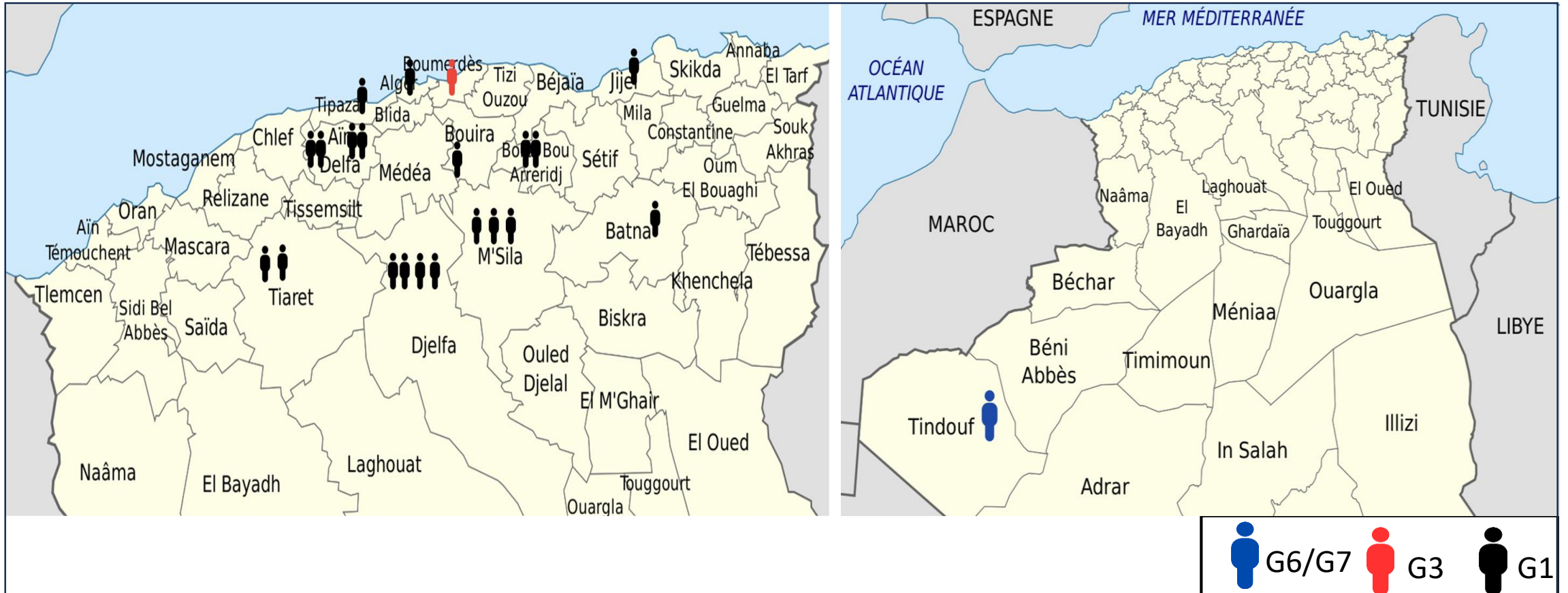
Genotype G1 (in black) is found in many regions, mainly in the North
=> indicating a more widespread distribution in areas where small ruminant farming practices are common.

Geographical distribution of the different genotypes
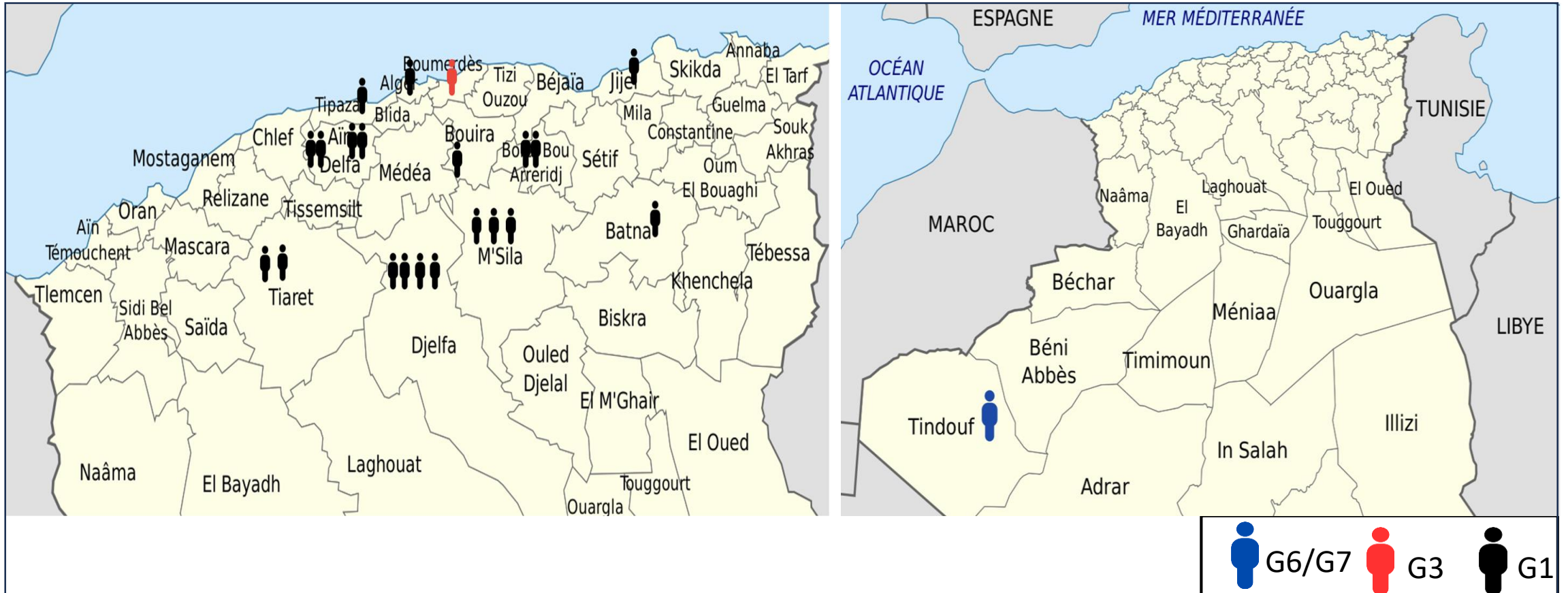
The **G3 genotype** (in red) is concentrated in the Boumerdès region,
=> which may indicate a distribution specific to certain local practices or environmental conditions.

Geographical distribution of the different genotypes
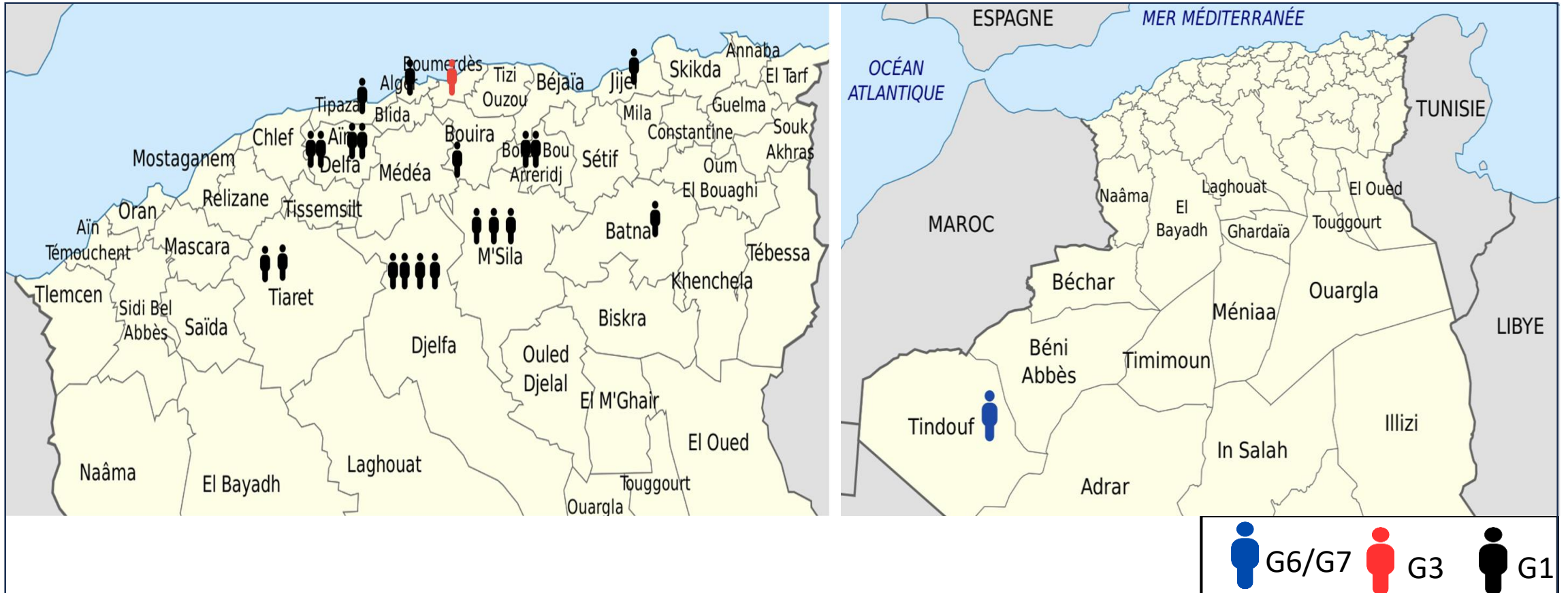
-The **G6/G7 genotype** (in blue) is mainly present in the southwest (Tindouf)
=> which may suggest an association with arid or semi-arid environments and camel breeding

Geographical distribution of the different genotypes

- **Factors influencing this distribution:**

High-case density areas typically coincide with agricultural or pastoral regions where livestock—especially sheep and goats—are extensively raised. Such environments create optimal conditions for sustaining the transmission cycle of *Echinococcus granulosus*.

- **Epidemiological implications:**

This distribution highlights endemic areas (north and pastoral regions) where control and prevention measures could be intensified.

The diversity of genotypes (G1, G3, G6/G7) indicates active circulation and the possible introduction of external strains, requiring ongoing genetic surveillance.

Distribution of genotypes by occupation

Unemployed
(n=10)

Housewives
(n=9)

G1 (n=10)

G1 (n=8)
G6/G7 (n=1)
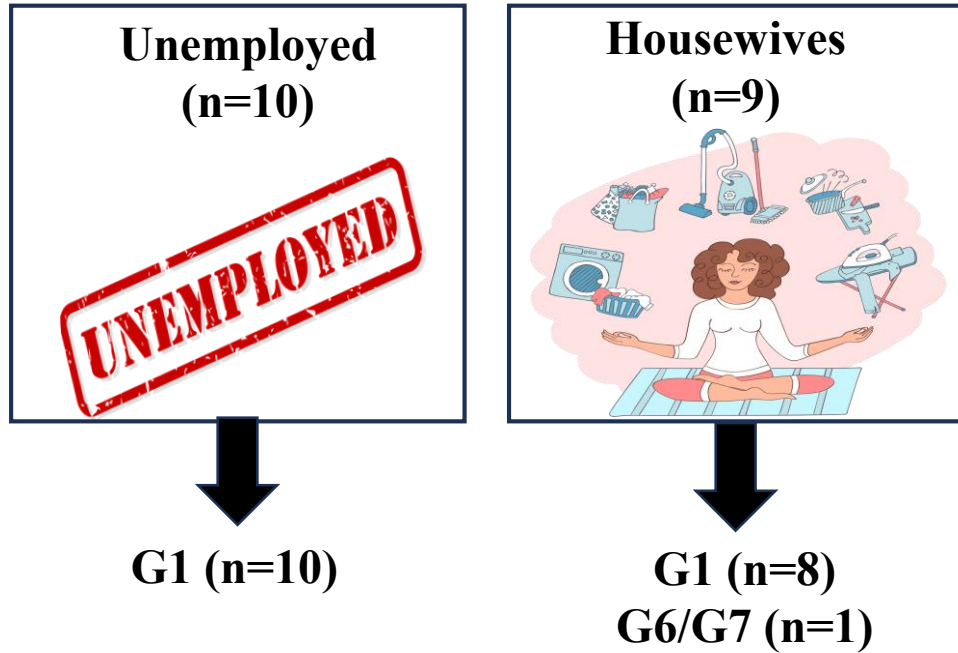
1/ Unemployed: This category is the most represented and is exclusively associated with the genotype G1.
=> This could be linked to social sensitivity or a lifestyle that promotes exposure to the parasite.

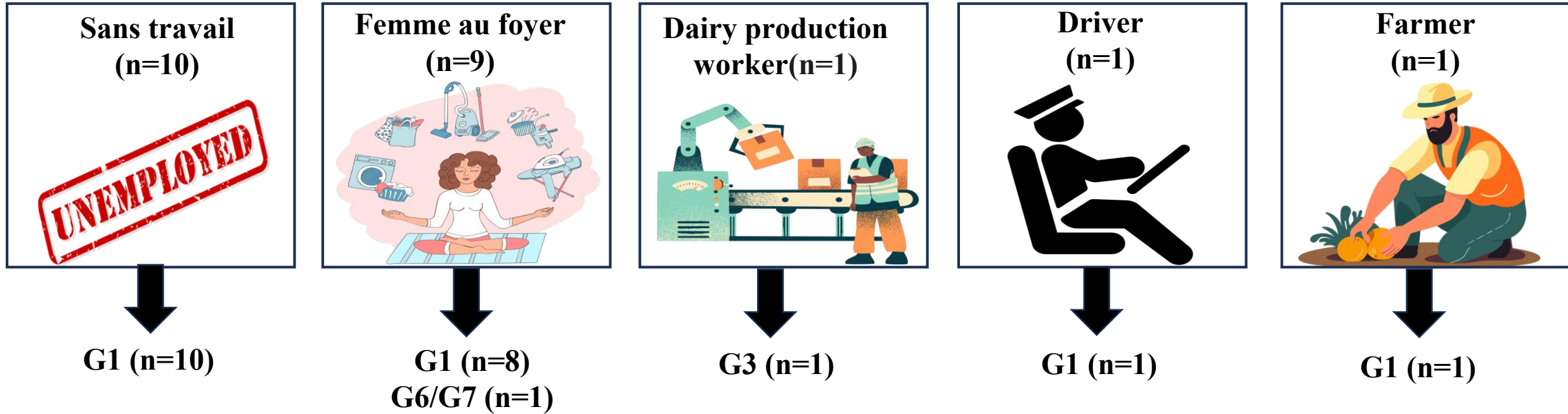**2/ Housewives**: Mostly linked to genotype G1 (n=8) and one case of G6/G7.
=> This prevalence could be linked to frequent contact with domestic animals or contaminated food.

Distribution of genotypes by occupation

Sans travail (n=10)	Femme au foyer (n=9)	Dairy production worker(n=1)	Driver (n=1)	Farmer (n=1)

G1 (n=10)

G1 (n=8)
G6/G7 (n=1)

G3 (n=1)

G1 (n=1)

G1 (n=1)

3/ **Dairy production** worker: Only case associated with genotype G3
=> probably due to occupational exposure to infected animals or their products

4/ **Driver and Farmer**: These two occupations are associated with genotype G1.
=> Exposure for drivers may be indirect, while farmers are potentially exposed through direct contact with contaminated soil, plants, water, or animals.

CONCLUSION

KEY FINDINGS:

✔ Predominance of genotype G1 in the cases studied (20/22).

✔ Rare presence of genotypes G6/G7 and G3.

✔ Housewives and rural populations constitute the groups at highest risk.

Diagnostic advances:

✔ qPCR and sequencing show high sensitivity for genotype identification.

✔ Biological samples such as the cyst wall (including germinal layer; in addition to the hydatid fluid usually used) can be used effectively.

Prospects

➢ Increase sampling (more patients, other locations, etc.)

➢ Extend studies to other regions to better map the genotypes present.

➢ Correlate epidemiological data with clinical data.

COLLABORATION

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