

Field data combined with a modelling approach as tools to evaluate the protection of the duck population following vaccination against highly pathogenic avian influenza

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In response to increasingly severe avian influenza outbreaks from 2020 and an increasing zoonotic risk, France has been implementing a vaccination campaign against highly pathogenic avian influenza in meat and fattening duck farms with more than 250 animals since October 2023. This campaign is supported by a traceability and monitoring system of vaccinated animals. As part of this shift in strategy to fight HPAI, our study aims to (i) review the deployment of the vaccination campaign over its first six months (Oct 2023 – March 2024) and (ii) assess the level of assumed vaccine protection at the population level through a modelling approach and real-world data analysis.

Vaccination protocol at the time of the study (Volvac® B.E.S.T. AI+ND vaccine*, Boehringer Ingelheim)



Field data sources

Population data

Identification of all batches raised (farm ID, batch ID, location, hatching and slaughter dates,...)

Vaccination data

Identification of all vaccination operations (farm ID, batch ID, vaccination date, injection ranking, no. of animals vaccinated,...)

Data analysis

Descriptive indicators

Weekly number of batches injected

Vaccination coverage in the meat duck and fattening duck populations, calculated as percentages of batches with at least one injection

Ages at first, second, third injections

Time period between two injections

Assumed vaccine protection

→ Takes into account compliance with the vaccine protocol and biological elements assessed through experimental data
→ Assumes a herd-immunity effect within a batch after vaccination

The level of assumed vaccine protection should be interpreted with caution: it is mainly linked to the level of vaccination-induced seroconversion assessed through experimental data.

Each day, attribution of a protection status to each batch:

Unprotected

■ No/incomplete/delayed vaccination
■ Animals too young to be vaccinated (<21 d.o)

Partially protected

■ 1st dose received, waiting for 2nd
■ 2nd dose received <7 days ago

Fully protected

■ 2nd dose received 7–42 days ago
■ 3rd dose received

End of protection

■ 2nd dose received >42 days ago (no 3rd dose)

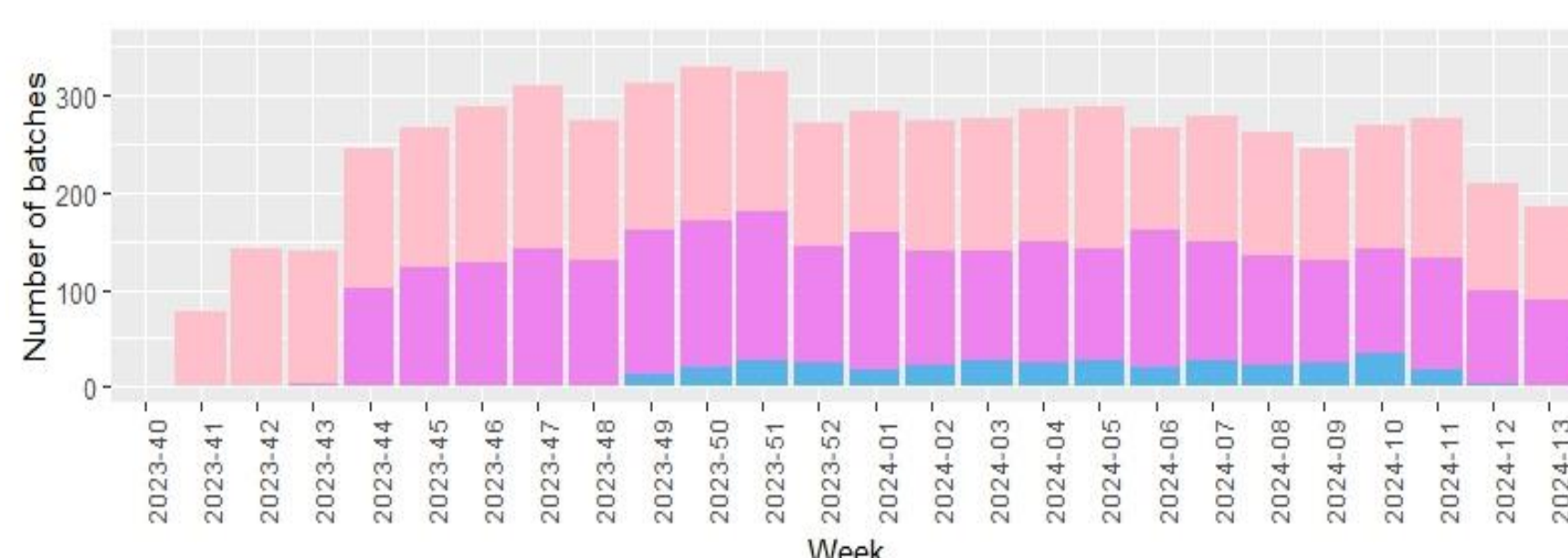
Modelling approach (individual-based model at the batch level) considering only the vaccination protocol and biological factors related to immune response

Field data: actual vaccination operations, incl. delayed vaccinations, incomplete protocols, absence of vaccination

Deployment of the vaccination campaign

More than 51 million of doses recorded as administered to production ducks, among them 51% to meat ducks and 49% to fattening ducks raised for foie-gras production.

Weekly distribution of the number of batches having received a first dose (pink), a second dose (purple) or a third dose (blue): example of fattening duck batches



95.2%

of meat duck batches

95.6%

of fattening duck batches

vaccinated at least once.

Ages at and time between vaccinations mostly **in line with the recommended protocol.**

Very high vaccination coverage
Satisfactory compliance with the requirements

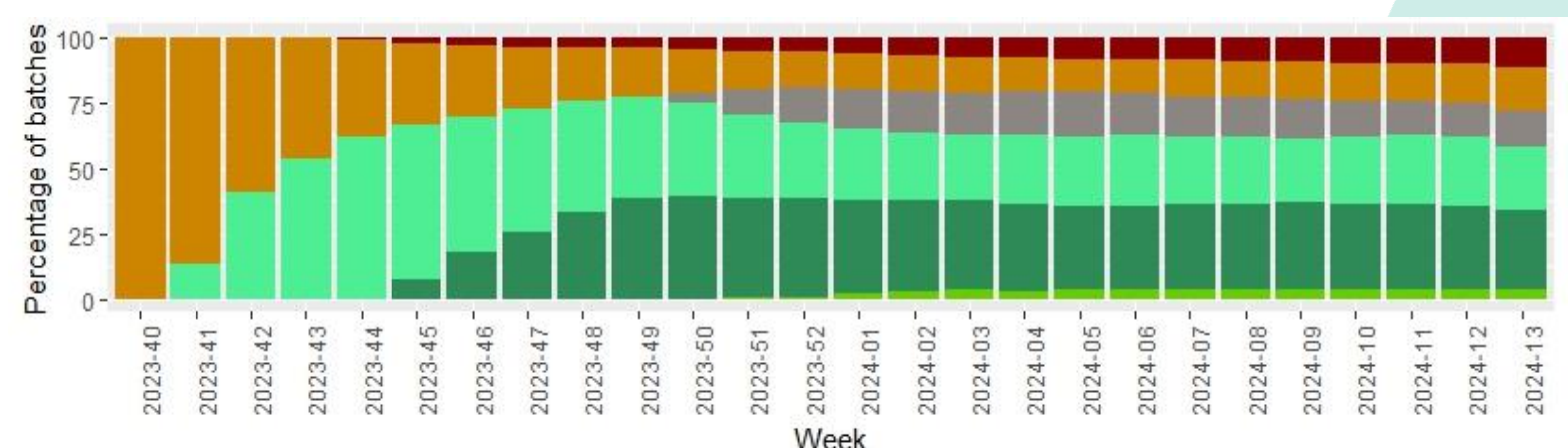
Level of assumed vaccine protection

Main model outputs:

maximum **45%** of meat duck batches with **full protection** after the 2nd dose.

In fattening ducks, lower percentage (around **40%**) but around **5%** more of batches protected with the **third dose**

Consistent with field data: example for fattening duck population



Evolution of the level of assumed vaccine protection in fattening duck population as assessed on the basis of actual vaccination data (Legend above)

Taking into account production cycles and despite satisfactory compliance with vaccination, **moderate percentage of batches with assumed complete protection at any given time**, linked to the vaccination schedule itself, the onset and duration of immunity in vaccinated animals.

But drastic reduction in the number of HPAI outbreaks in French duck farms since vaccination was implemented (only 2 outbreaks over the study period) → Further work needed to:

- Evaluate the post-vaccination immune response in field conditions and the actual protection of ducks
- Optimise vaccination protocols
- Assess the optimal population immunity level