

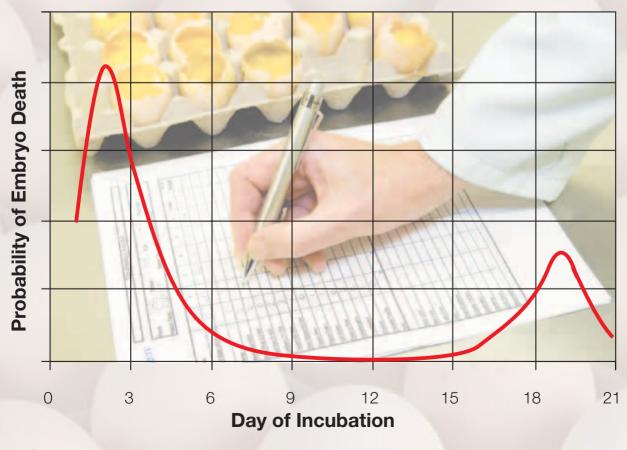
HOW TO... Break Out and Analyse Hatch Debris

05

WHY BREAK OUT AND ANALYSE HATCH DEBRIS?

- It is normal for there to be some embryo mortality during incubation.
- Embryo losses tend to follow a consistent pattern (although it will vary slightly with flock age).
- Some embryo malpositions and abnormalities have known causes and can be the result of specific problems.
- Analysing embryo mortality patterns and abnormalities can help to identify which aspects of the incubation process need closer investigation in order to improve hatchability and chick quality.

Normal Pattern of Embryo Loss During incubation showing peaks in mortality during early and late incubation







HOW TO.

Break Out and Analyse Hatch Debris

THE PROCEDURE FOR BREAKING **OUT HATCH DEBRIS**

Step 1:

Sample selection and preparation.

- Hatch debris breakouts should be integrated with other QA procedures such as measuring egg water loss and chick yield.
- Monitor three setter trays per flock per week, and label sample trays clearly at the time of set.
- The eggs used for the sample trays should be clean nest eggs of known flock source, flock age and egg age.

Note: Clear or non-viable eggs should not be removed from trays. However, it will not be possible to distinguish infertile from early embryo mortality on clear eggs left in the setter for 18 days. A separate sample of eggs should be used for fertility identification (see How To... Identify Infertile Eggs and Early Deads).

Step 2:

'Take off and count dead in shell.

- On the day of hatch, count chicks and culls out of the sample setter trays. Record their numbers per tray.
- Collect, count and separate out the unhatched (dead in shell) eggs. Record their numbers per tray.

Note: The totals for chicks plus culls and dead-in-shell should equal the number of eggs set, less any removed at candling.

Step 3:

Breaking out dead in shells.

- Identify and count any eggs where the beak has pierced the shell (pips). Record numbers, and note if any chicks are still alive.
- Open all the eggs, at the air cell. Take care not to remove any egg contents when lifting the air cell membrane.
- Identify the stage of development of the embryo and sort eggs into groups of infertile, early dead (0-7 days) mid dead (8-15 days) and late dead (15-21 days) using the pictures on page 3.
- Check very late (20-21 days) dead embryos for malpositions.
- · Check for malformations in the mid and late dead embryos.
- Also record any with cracked or poor quality shells and any eggs that are contaminated.





02

THE PROCEDURE FOR BREAKING OUT AND ANALYSING HATCH DEBRIS

05

HOW TO... Break Out and Analyse Hatch Debris

05

At the start of the recording period, the embryo will look like this: By the end, the embryo will have grown to look like this:

After death, the appearance changes and the dead in shell embryos may look like this:





The end of this stage is marked by the appearance of the egg tooth on the beak.

Mid Dead 8-14 days

Infertile

development.

No obvious signs of

Embryos have an egg tooth but no obvious feather development.

Late Dead 15-19 days

Well feathered embryo, fills the shell. Yolk may be external or retracted.

External pip 20 days

The beak has broken through the egg shell.

Contaminated

Deep discolouration of the egg contents, which smell off.

















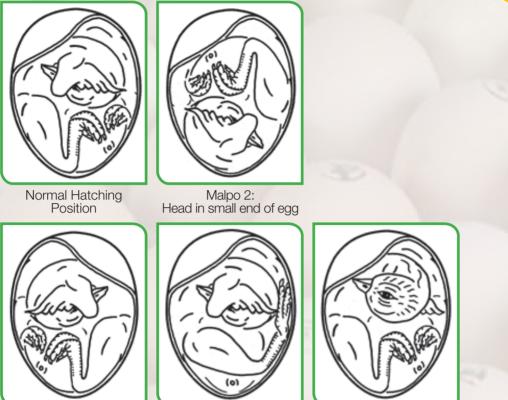




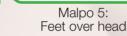
HOW TO. Break Out and Analyse Hatch Debris

COMMON MALPOSITIONS

05







Malpo 6: Beak above right wing

Note: Malpositions normally occur in 1.5% of all eggs set. The incidence of Malposition 3 (Head turned to left) and Malposition 5 (Feet over head) is normally 0.25% of eggs set (each). The incidence of Malposition 6 (Beak above right wing) is normally about 0.4% of eggs set. Head in small end of shell (Malposition 2) is the most variable malposition as it caused by setting eggs upside down. The occurrence of this malposition should not exceed 0.1% of eggs set.

COMMON MALFORMATIONS



Exposed brain



Ectopic viscera



Duplication of body parts

Note: Occasional abnormalities are not a cause for concern. Further investigation Is appropriate only if a single malformation occurs at levels over 0.5% of the eggs set.

THE PROCEDURE FOR BREAKING OUT AND ANALYSING HATCH DEBRIS



THE PROCEDURE FOR ANALYSING HATCH DEBRIS

- HOW TO... Break Out and Analyse Hatch Debris
 - 05

- Record the number of eggs falling into each category for each tray.
- Add theses numbers together to determine the total number of eggs falling within each category.
- Calculate the total as a percentage of the number of eggs set.

Example recording sheet for hatch debris break out information

				Da	te S	et					3ro	l March
Farm	B20			Date Hatched				_	14th March			
Age31	. W8	eek	<u>s</u>	Date Broken Out				24th March				
Hatch Tray Size	:	150	2	Se	tter I	No.						12
	/		Hatcher No.			_	3			3		
Tray No.				4	5	6	7	8	9	10	Total	% of Eggs Set
No. of Eggs Removed	19	18	15								52	11.6
Infertile	6	4	4								14	3.1
"Early Dead" (0-7 Days)	5	5	5								15	3.3
"Mid Dead" (8-14 Days)	2	1	1								4	0.9
"Late Dead" (15-21 Days)	5	5	4								14	3.1
External Pip	1	3	1								5	1.1
Dead and Cull Chicks	1	0	2								3	0.7
Contaminated	1	з	1								5	1.1
Poor Sheel Quality	0	0	1								1	0.2
Cracked Shell	0	0	1								1	0.2
Malpositions - Head in Small End of Egg	1	-	-								1	0.2
- Head to Left	-	-	-								-	
- Feet Over Head	-	2	1								3	0.7
- Beak Above Right Wing	-	-	-								-	-
Malformations - Exposed Brain/Eye Defect		-	-									-
- Extra Limbs		-	-									-
- Ectopic Viscera	-	-	-								-	-

Notes:

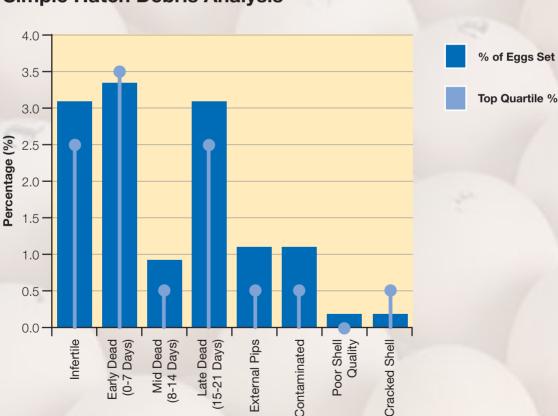


INTERPRETING RESULTS

			U		0					
	Stage of Development of Embryo									
Flock Age	Infertile Early Dead Mic		Mid Dead	Late Dead	External Pip	Cracked	Contaminated			
Young 25-30 Weeks	6	5.5	1	3.5	1	0.5	0.5			
Peak 31-45 Weeks	2.5	3.5	0.5	2.5	0.5	0.5	0.5			
Post Peak 46-50 Weeks	5	4	1	2.5	0.5	0.5	0.5			
Ageing 51-60 Weeks	8	4.5	1	3	0.5	1	1			

Compare the results with the targets for the age of the flock concerned

• Plot results against target. If any figure is above target an investigation into the reason for this should be set up



Simple Hatch Debris Analysis

Notes: Any assessment of infertility made at the end of incubation during a breakout is likely to be inaccurate as it is not possible to distinguish true infertile from early deads. If the early dead plus fertility numbers exceeds the target then follow the procedures in the **How To... Identify Infertile Eggs and Early Deads** before taking further action.



06

05

Break Out and Analyse

Hatch Debris

HOW TO... Break Out and Analyse Hatch Debris

POSSIBLE CAUSES OF EMBRYO MORTALITY

05

InterestFormatine exponent 2-96 hours. Slow to reach incubation temperatures Condensation on egg surface Turning argie/frequency not correct Long egg storage Fluctuating egg storage temperatureInadequate egg collection Nutrition Egg contamination Floor/soiled eggsMid Doad (B-14 Days)Embryo temperature too highNutritional deficiencies ContaminationLate Dead (B-14 Days)Setter/hatcher temperatures/humidities incor- rect - check egg shell temps and water loss. Transfer damage Eggs set upside down Insufficient water LossNutritional deficiencies ContaminationAt pipingInadequate turning/oggs set upside down transfer damage Egg shell disinfection inappropriate Condensation on egg surface during storage or rransportNutritional deficiencies ContaminationContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or transportNutritional deficiencies Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow urning angleBeak above right wing - Nutritional deficiencies (Incolic acid)MalpositionsExposed brain - high early incubation temperature mid-term Erros pip seg surjection temperatures mid-term ind-term Erros pip incubation temperatures of the majpositions - causes unknownBeak above right wing - Nutritional deficiencies (Incolic acid)MaltormationsExposed brain - high early incubation temperatures mid-term eggs during collection/transportBeak above right wing - Nutritional deficiencies (Incolic acid)		Hatchery	Farm				
Early Dead (1-7 Days)Slow to reach incubation temperatures Condensation on egg surface Turning angle/frequency not correct Long egg storage Fluctuating egg storage temperatureInadequate egg collection Nutrition Egg contamination Floor/solied eggsMid Dead (8-14 Days)Embryo temperature too highNutritional deficiencies ContaminationLate Dead (15-19 Days)Setter/hatcher temperatures/humidities incor- rect - check egg shell temps and water loss. Transfer damage Eggs set upside down insufficient water LossNutritional deficiencies ContaminationAt pipingEdg shell disinfection in hatcher Long egg storageNutritional deficiencies ContaminationContaminationEgg shell disinfection in hatcher Long egg storageNutritional deficiencies ContaminationContaminationEgg shell disinfection in hatcher Long egg storageHigh levels of floor eggs Poor nest hygieneMalpositionsdown, high incubation temperature or shallow uming angle Boak above right wing - heat stress Other malposition - causes unknownBeak above right wing - Nutritional deficiencies (incleic acid)MaltormationExcosed brain - high early incubation temperature ures Etra limbs - rough handling or jarring of theBeak above right wing - Nutritional deficiencies (incleic acid)							
Early Dead (1-7 Days)Condensation on egg surface Turning angle/frequency not correct Long egg storage Fluctuating egg storage temperatureNutrition Egg contamination Floor/solled eggsMid Dead (8-14 Days)Embryo temperature too highNutritional deficiencies contaminationLate Dead (15-19 Days)Setter/hatcher temperatures/humidities incor- rect - check egg shell temps and water loss. Transfer damage Eggs set upside down Insufcient water LossNutritional deficiencies contaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive funigation in hatcher Long egg storage surface during storage or transport Thin or cracked shells High level of contamination in the hatchery (if taite deads only)Nutritional deficiencies Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shalow turning angleBeak above right wing - Nutritional deficienciesMalpositionsExposed brain - high early incubation tempera- turesBeak above right wing - Nutritional deficienciesMalformationExposed brain - high early incubation temperature turesBeak above right wing - Nutritional deficienciesMalformationsExposed brain - high early incubation temperature turesBeak above right wing - Nutritional deficienciesMalformationsExposed brain - high early incubation temperature turesBeak above right wing - Nutritional deficienciesMalformationsExposed brain - high early incubation temperature turesBeak above right wing - Nutritional deficiencies							
Later Deeds (1-7 Days)Turning angle/trequency not correct Long egg storage Fluctuating egg storage temperatureEgg contamination Floor/solied eggsMd Dead (8-14 Days)Embryo temperature too highNutritional deficiencies contaminationLate Dead (15-19 Days)Setter/hatcher temperatures/humidities incor- rect – check egg shell temps and water loss. Transfer damage Eggs set upside down Insuffeient water LossNutritional deficiencies contaminationAt pipingInadequate turning/eggs set upside down Insuffeient water LossNutritional deficiencies contaminationContaminationInadequate turning/eggs set upside down Insuffeient water LossNutritional deficiencies contaminationAt pipingInadequate turning/eggs set upside down Insuffeient water LossNutritional deficienciesContaminationInadequate turning/eggs set upside down Insuffeient water LossPointional deficienciesContaminationInadequate turning/eggs set upside down Insuffeient water LossPointional deficienciesContaminationInadequate turning/eggs set upside down Insuffeient water LossPointional deficienciesContaminationInadequate turning/eggs set upside down Insuffeient in hatcher Long egg storagePointional deficienciesContaminationInadequate turning/eggs set upside down Insuffeient in apport Thin or cracked shells High lavel of contamination in the hatchery (If ad edadis only)High levels of floor eggs Poor neet hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shalow turning angle Beak above right wing - h							
Late Dead (5-14 Days)Embryo temperature too highNutritional deficiencies ContaminationLate Dead (15-19 Days)Embryo temperature too highNutritional deficiencies ContaminationLate Dead (15-19 Days)Setter/hatcher temperatures/humidities incor- rect - check egg shell temps and water loss. Transfer damage Eggs set upside down Insufficient water LossNutritional deficiencies ContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Eggs set upside down Insufficient water LossNutritional deficiencies ContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationCondensation on egg surface during storage or transport Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies (inoleic acid)MalformationsExposed brain - high early incubation temperatures tures Ectopic visera - high incubation temperatures tures Ectopic visera - high incubation temperatures tures Ectopic visera - high incubation temperatures turesExposed brain - high early incubation temperatures tures							
Idd Dead (6-14 Days)Fluctuating egg storage temperatureMid Dead (6-14 Days)Embryo temperature too highNutritional deficiencies ContaminationLate Dead (15-19 Days)Setter/hatcher temperatures/humidities incor- rect - check egg shell temps and water loss. Transfer damage Eggs set upside down Insuficient water LossNutritional deficiencies ContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationTransfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or transport Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shalow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies flinoleic acid)MalformationsExposed brain - high early incubation tempera- tures Extra limbs - rough handling or jaring of theExposed brain - high incubation temperatures huring of the							
Mid Dead (8-14 Days)Embryo temperature too highNutritional deficiencies ContaminationLate Dead (15-19 Days)Setter/hatcher temperatures/humidities incor- rect - check egg shell temps and water loss. Transfer damage Eggs set upside down insuficient water LossNutritional deficiencies ContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationTransfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationTransfer damage Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationHigh level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow urining angle Baak above right wing - Nutritional deficiencies Gother malpositions - causes unknownBeak above right wing - Nutritional deficiencies end -lermMalformationsExposed brain - high incubation temperatures ind-lerm Extra limbs - rough handling or jarring of theFransfer damage erring of the			Floor/soiled eggs				
InternationEmbryo temperature too highContamination(g-14 Days)Setter/hatcher temperatures/humidities incor- nect - check egg shell temps and water loss. Transfer damage Eggs set upside down Insuffcient water LossNutritional deficiencies ContaminationAt plpingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationTransfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationTransfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationTransfer damage Excessive fumigation in hatcher Long egg storageHigh levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficienciesMalformationsExposed brain - high incubation temperatures ind erem Ectopic visera - high incubation temperatures ind erem Extra limbs - rough handling or jarring of theSetter/hatcher Long ending of the		Fluctuating egg storage temperature					
(e) 14 Days)ContaminationContaminationLate Dead (15-19 Days)Setter/hatcher temperatures/humidities incor- rect - check egg shell temps and water loss. Transfer damage Eggs set upside down Insuffcient water LossNutritional deficiencies ContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or ransport Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficienciesMalformationsExposed brain - high early incubation temperatures mid-term Extra limbs - rough handling or jarring of theBeak above right wing - Nutritional deficiencies	Mid Dead	Embryo tomporaturo too bigh	Nutritional deficiencies				
Late Dead (15-19 Days)rect - check egg shell temps and water loss. Transfer damage Eggs set upside down Insuffcient water LossNutritional deficiencies ContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or Thin or cracked shells High level of contamination in the hatchery (if tate deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow Urning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies enditiencies acid)MalformationExposed brain - high early incubation temperatures ind-termExposed brain - high incubation temperatures ind-termMalformationsExposed brain - high incubation temperatures ind-termExposed brain - high incubation temperatures incubation temperatures incubation temperatures	(8-14 Days)		Contamination				
Late Dead (15-19 Days)Transfer damage Eggs set upside down Insuffcient water LossNutritional deficiencies ContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside cown, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficienciesMalformationsExposed brain - high early incubation temperatures mid-termExposed brain - high early incubation temperatures mid-term							
Late Deau (15-19 Days)Iransfer damage Eggs set upside down Insuffcient water LossContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate ContaminationNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress of there malpositions - causes unknownBeak above right wing - Nutritional deficiencies linoleic acid)MalformationExposed brain - high early incubation temperatures mid-term Ectopic visera - high incubation temperatures mid-termExposed brain - high early incubation temperatures mid-term		rect – check egg shell temps and water loss.	Nutritional deficiencies				
At pipingEggs set upside down Insuffcient water LossContaminationAt pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or transport Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies Beak above right wing - heat stress other malpositions - causes unknownMalformationsExposed brain - high early incubation temperatures mid-term Extra limbs - rough handling or jarring of the		Transfer damage					
At pipingInadequate turning/eggs set upside down Transfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or transportHigh levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficienciesMalformationsExposed brain - high early incubation tempera- turesExposed brain - high incubation temperatures mid-term Extop to visera - high incubation temperatures mid-termExposed brain - high early incubation temperatures mid-term	(Eggs set upside down	Contamination				
At pipingTransfer damage Excessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or transport Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies (inoleic acid)MalformationsExposed brain - high early incubation temperatures mid-term Extra limbs - rough handling or jarring of theImage the stress to the stress		Insuffcient water Loss					
At pipingExcessive fumigation in hatcher Long egg storageNutritional deficienciesExcessive fumigation in hatcher Long egg storageNutritional deficienciesContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or transport Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies (linoleic acid)MalformationsExposed brain - high early incubation tempera- tures Ectopic visera - high incubation temperatures mid-term Extra limbs - rough handling or jarring of theNutritional deficiencies		Inadequate turning/eggs set upside down					
Excessive fumigation in hatcher Long egg storageEgg shell disinfection inappropriate Condensation on egg surface during storage or transport Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies (linoleic acid)MalformationsExposed brain - high early incubation temperatures mid-term Extra limbs - rough handling or jarring of theHigh levels of floor eggs Poor nest hygiene		Transfer damage	Nutritional deficiencies				
ContaminationEgg shell disinfection inappropriate Condensation on egg surface during storage or transport Thin or cracked shells High level of contamination in the hatchery (if late deads only)High levels of floor eggs Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies [inoleic acid]MalformationsExposed brain - high early incubation temperatures mid-term Extra limbs - rough handling or jarring of theFigh levels of floor eggs Poor nest hygiene	At piping	Excessive fumigation in hatcher					
ContaminationCondensation on egg surface during storage or transportHigh levels of floor eggs Poor nest hygieneThin or cracked shellsHigh level of contamination in the hatchery (if late deads only)Head in small end – egg incubated upside down, high incubation temperature or shallow turning angleBeak above right wing - Nutritional deficiencies (inoleic acid)MalpositionsExposed brain - high early incubation temperatures mid-termExposed brain - high incubation temperatures mid-term		Long egg storage					
ContaminationCondensation on egg surface during storage or transportHigh levels of floor eggs Poor nest hygieneThin or cracked shellsHigh level of contamination in the hatchery (if late deads only)Head in small end – egg incubated upside down, high incubation temperature or shallow turning angleBeak above right wing - Nutritional deficiencies (inoleic acid)MalpositionsExposed brain - high early incubation temperatures mid-termExposed brain - high incubation temperatures mid-term		Foo shell disinfection inappropriate					
ContaminationtransportHigh levels of floor eggsThin or cracked shellsPoor nest hygieneHigh level of contamination in the hatchery (if late deads only)Head in small end – egg incubated upside down, high incubation temperature or shallow turning angleBeak above right wing - Nutritional deficiencies (linoleic acid)MalpositionsExposed brain - high early incubation tempera- turesExposed brain - high early incubation tempera- turesMalformationsExposed brain - high early incubation tempera- turesEctopic visera - high incubation temperatures mid-term Extra limbs - rough handling or jarring of the							
Thin or cracked shellsPoor nest hygieneHigh level of contamination in the hatchery (if late deads only)Poor nest hygieneMalpositionsHead in small end – egg incubated upside down, high incubation temperature or shallow turning angleBeak above right wing - Nutritional deficiencies (linoleic acid)MalpositionsExposed brain - high early incubation temperatures mid-termExposed brain - high incubation temperatures mid-term	Oratoriation		High levels of floor eggs				
Iate deads only)MalpositionsMalpositionsMalpositionsExposed brain - high early incubation temperatures other malpositions - causes unknownMalformationsExposed brain - high early incubation temperatures mid-term Extra limbs - rough handling or jarring of the	Contamination	Thin or cracked shells	Poor nest hygiene				
Malpositions Head in small end – egg incubated upside down, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknown Beak above right wing - Nutritional deficiencies (linoleic acid) Malformations Exposed brain - high early incubation temperatures mid-term Ectopic visera - high incubation temperatures mid-term Extra limbs - rough handling or jarring of the Extra limbs - rough handling or jarring of the Evaluation temperatures							
Malpositionsdown, high incubation temperature or shallow turning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies (inoleic acid)MalformationsExposed brain - high early incubation tempera- turesEctopic visera - high incubation temperatures mid-termMalformationsEctopic visera - high incubation temperatures mid-termHigh incubation temperatures mid-term		late deads only)					
Malpositionsturning angle Beak above right wing - heat stress Other malpositions - causes unknownBeak above right wing - Nutritional deficiencies (linoleic acid)MalformationsExposed brain - high early incubation tempera- turesEctopic visera - high incubation temperatures mid-termBeak above right wing - Nutritional deficienciesMalformationsExtra limbs - rough handling or jarring of theBeak above right wing - Nutritional deficiencies	Malpositions						
Malpositions Beak above right wing - heat stress (linoleic acid) Other malpositions - causes unknown Exposed brain - high early incubation temperatures Malformations Ectopic visera - high incubation temperatures Malformations Ectopic visera - high incubation temperatures Extra limbs - rough handling or jarring of the			Dooly obovo right wing . Nutritional deficiencies				
Malformations Other malpositions - causes unknown Malformations Exposed brain - high early incubation temperatures Ectopic visera - high incubation temperatures mid-term Extra limbs - rough handling or jarring of the							
Malformations Exposed brain - high early incubation temperatures Malformations Ectopic visera - high incubation temperatures mid-term Extra limbs - rough handling or jarring of the							
Malformations Ectopic visera - high incubation temperatures mid-term Extra limbs - rough handling or jarring of the		Other maipositions - causes unknown					
Malformations Ectopic visera - high incubation temperatures mid-term Extra limbs - rough handling or jarring of the	Malformations	Exposed brain - high early incubation tempera-					
Extra limbs - rough handling or jarring of the							
eggs during collection/transport							
		eggs during collection/transport					

