Animal Disease Spread Model (ADSM) Text Support Document for Training

The slide-based training was designed to optimize visual interest. This format does not always create a slide bank that is printer friendly. In some sections, there are many images and little text. This text support document is intended to be a printer-friendly version of the slides that can be used as a reference. This document is not intended to take the place of main training slides.

Training 5 Control Measures

Slide	Image	Text
1	Laying Hens	Animal Disease Spread Model Control Measures
2	ADSM Application Sample Scenario with Outputs	Table of Contents Overview Control Protocol Vaccination Global Parameters Zones and Zone Effects
3	No Image	Document Conventions The following conventions are used throughout the training modules: **_TRAINING MODULES_** other than the one you are currently in will use all capital letters, bold face, italics and underline. *Rhetorical questions* and *extra notes* will be in orange italics. Conventions applying to the ADSM application are: Navigation tabs on right and Admin panels on left are designated with an underline. Examples are Project Panel or Population tab. Items with an action on click, such as [Apply] Button or [Save As] icon are enclosed in square brackets. *Parameter fields* (inputs) are in blue italics and *Variables (*outputs) are in green italics. Navigation Tabs > *Parameter field* indicates to go to the given navigation tab to find the given field. Hyperlinks appear in bright green type with underline http://navadmc.github.io/ADSM/
4	Gear Section Break	Overview
5	Cow in chute, hand on muzzle for visual check	Control Measures ADSM allows great flexibility in how it can apply control measures. These measures can be described as integrated controls, as you can use a combination of controls in the same scenario. A possible goal might be to compare different control combinations for effectiveness and cost. For example: *What happens if we increase the destruction ring size?* *What happens if we destroy detected units and vaccinate in a ring around those detections?*

		What are the government costs of depopulation, including indemnity, appraisal, and disposal? Many questions can be explored by modifying parameters.
6	ADSM Application Control Form	The <u>Controls tab</u> gives brief descriptions of how control measures can be applied. It is necessary to give your Control Master Plan a descriptive *Name*. All Controls can be turned off completely using the [on/off toggle] on the <u>Controls tab</u>. This parameter allows a baseline to be run with no controls. *What does that mean when the simulation runs uncontrolled spread?* In reality, if disease was spreading in an area, people would change their behavior. For example, producers would not take animals to their regular market if they believed the market to be infected. The simulation cannot account for this change in human behavior.
7	Sheep gazing down on reader	ADSM controls have several vaccination features that were modified or were not available in NAADSM.
8	Bellowing bull	Functionality in ADSM that was not in NAADSM Additional Triggers Start, Stop and Restart Retrospective Vaccination Vaccination Rings Vaccination Priorities **VACCINATION STRATEGY** will be covered in a separate training.
9	Cattle, swine and small ruminant images	Control parameters are applied at 3 levels: Some parameters interact with a specific production type. Some parameters are applied when an event in one production type triggers an event in another production type. Some parameters happen across all production types. As a result, control parameters are not in a single navigation tab in ADSM.
10	Decision flow chart from ADSM Model Specifications	Behind the Scenes The decision process and the methods for each control measure are detailed in the Model Specifications in the wiki. https://github.com/NAVADMC/ADSM/wiki/Model-Specification
11	Gear Section Break	Control Protocol
12	Beef cattle, mountains in background	The Sample Scenario uses all controls except *Cost Accounting*. Note that the parameters in the Sample Scenario are for demonstration purposes only and do not represent a specific disease or a recommended control strategy.
13	Cattle, swine and small ruminant images	Control Protocol is applied at a production type level. The Control Protocol allows you to make as many unique sets of parameters as needed based on the production types you are using.
14	Control Protocol menu	Control Protocol in Sample Scenario The Sample Scenario is using all controls except *Cost Accounting*. Check the box to use a specific control measure.

		Notice that *vaccination* is both checked and is set as inactive (greyed out). Control Protocol is not the place to flip the switch to turn the vaccination strategy on. The vaccination switch is turned on because of a vaccination ring on <u>Vaccination Rings tab</u>. *Use the [+ New Control Protocol] to add an additional control protocol.*
15	Control Protocol Detection with function	Control Protocol in Sample Scenario - Detection Detection will be used by the simulation. This stage of detection could be considered Passive Surveillance. There are 3 parameters within detection. *Name* parameter describes the integrated control measures in one Control Protocol. *Probability of observing clinical signs* – This parameter sets the days that pass before clinical signs become visible and can be observed. This clock starts counting from the time of infection. *Probability of reporting disease after first detection* – This is based on producer behavior in reporting disease to the authorities. This clock starts counting at first detection. *Detection is a zone trigger* – This parameter will create control zones. Details of <u>Zone</u> and <u>Zone Effects</u> will be covered later in this training. *Clicking [Apply] is necessary to save changes.*
16	Windmill landscape with zone signage	Detection and Quarantine A diseased unit is quarantined on the day immediately following its detection. Units are also quarantined when they are placed on the prioritized waiting list for destruction. Quarantined units cannot be involved in direct contact, but indirect contact and airborne spread may occur to or from a quarantine unit.

17	Veterinarian taking notes and ADSM Control Protocol Tracing Form	Control Protocol in Sample Scenario – Tracing
		Tracing will be used in the simulation. Tracing is also called contact tracing or dangerous contact tracing. It is a task used during disease outbreaks to determine where disease may have spread. When an undetected unit is identified by a trace investigation, it will be quarantined.
		This process traces one step in the spread network. It identifies units that were recipients of contact from infected, detected units (referred to as "trace out" or "trace forward") or units that were sources of contact to infected, detected units ("trace in" or "trace back").
		There are 11 parameters within tracing. The concepts are similar and will be described in groups.
		Using a check box, users can turn on:
		    Direct spread forward tracing
		    Direct spread back tracing
		    Indirect spread forward tracing
		    Indirect spread back tracing

18	ADSM Model Specification diagrams of tracing	Model Specifications in the Wiki has examples of how tracing could work. https://github.com/NAVADMC/ADSM/wiki/Model-Specification
19	ADSM Control	Control Protocol in Sample Scenario - Tracing Both types of spread have a *trace success rate*. This parameter describes how often the simulation successfully traces a contact.

	Protocol Tracing Form	*Does the simulation find 100% of traces or 1% of traces?* You will have to decide for your situation. Tracing makes you ponder the theoretical question *"How many staff do we have to dedicate to tracing activities in the case of an outbreak?"* The Sample Scenario has the direct trace set to 0.9 successful traces. Therefore, out of 100 possible traces, 90 were successful. The Sample Scenario has the indirect trace set to 0.1 successful traces. Therefore, out of 100 possible traces, 10 were successful. There is no tracing for airborne spread. The output data provides the total number of possible contacts. This allows you to verify how the trace success rate was implemented.
20	ADSM Control Protocol Tracing Form	Control Protocol in Sample Scenario - Tracing Both types of spread have a *trace period*. This parameter describes the number of days before detection that should be considered for contact tracing. *Would you ask the detected farms to recall all direct movement for the last 7 days? For the last 14 days, or more?* The time window to perform tracing will depend on the characteristics of the disease you are modeling. The Sample Scenario has the direct trace set to 14 days and indirect trace set to 14 days. Tracing is an event that requires administrative time. A *trace result delay* can be set with a relational function to mimic a time delay before the administrative resources are in place. Traces, both direct and indirect, can *trigger a zone focus*. Details of <u>Zone</u> and <u>Zone Effects</u> will be covered later in this training.

21	Cow in chute nasal swab and Control Protocol menu	Control Protocol in Sample Scenario
		If tracing is used to identify connected units, there are two other steps that we can use as control measures:
		  Laboratory testing
		  Clinical examinations

22	ADSM Control Protocol Testing Form	Sample Scenario - Testing
		Based on *Tracing*, you can decide to test any of the four possible trace methods.
		You can turn on testing for:
		  Direct spread forward tracing
		  Direct spread back tracing
		  Indirect spread forward tracing
		  Indirect spread back tracing

23	Veterinarian performing blood draw and ADSM Control Protocol Testing Form	Control Protocol in Sample Scenario - Testing *Test specificity* and *Test sensitivity* parameters can be set to mimic the type of test you want to simulate. A *tracing delay* can be set using a probability density function.
24	Veterinarian performing hoof exam and ADSM Control	Control Protocol in Sample Scenario - Exam Exam is the default method of detection, based on the *detection parameter of observing clinical signs*. This is passive surveillance. In the *Exam* section, you can increase the *probability of successfully detecting disease* for each of the four trace methods. This is active surveillance.

	Protocol Exam Form	
25	Carcass disposal image	Destruction Destruction may also be known as depopulation, or euthanasia, and is a possible control measure that can be used in ADSM.
26	Control Protocol menu	Sample Scenario - Destruction *Destruction* is used in the Sample Scenario. Recall that control protocols are assigned at a production type level. When destruction is checked in the control protocol list, then destruction will happen to assigned production type units that are detected.
27	Carcass disposal image and ADSM Control Protocol Destruction Form	Control Protocol in Sample Scenario - Destruction The parameters provided for destruction are used when units beyond the detected units should be destroyed. These parameters support ring destruction and pre-emptive destruction based on tracing of a dangerous contact.
28	ADSM Control Protocol Destruction Form	Control Protocol in Sample Scenario – Destruction Rings There are two options for ring destruction. The first option, *ring trigger*, applies destruction in a ring around the detected unit; it is also known as pre-emptive destruction. It allows you to set the *radius* of the ring. The second option for *ring destruction targets* units that have had traces (dangerous contacts). This ring uses the same radius as the pre-emptive destruction.

29	ADSM Control Protocol Destruction Form	Sample Scenario – Destruction Traces
		There are four options for destruction based on a trace, which is the concept of destroying a dangerous contact.
		Using a check box, you can turn on destruction for:
		       Direct spread forward tracing
		       Direct spread back tracing
		       Indirect spread forward tracing
		       Indirect spread back tracing

30	ADSM Control Protocol Destruction Priority	Control Protocol in Sample Scenario – Priority Destruction also sets the *priority* of a given production type. This number is used as the secondary sort for the drag-and-drop priority widget on the <u>Destruction Global tab</u>. Primary sort and secondary sort
31	Animal Vaccination in chute	Vaccination Vaccination has many parameters. Some are applied across all production types. Some are applied between production types. Some are applied at the production type level. In this training module, we will cover vaccination at a high level. There is an additional training to address ***<u>Vaccination Strategy</u>*** in more detail.
32	Control Protocol menu	Control Protocol in Sample Scenario - Vaccination In this case, we are looking specifically at the vaccination parameters that are applied based on the production type.

		Notice the check box is inactive (greyed out) but still checked. Vaccination is not initiated from this parameter. Vaccination starts when a trigger and a ring have been set. These items will be covered at a high level in this Vaccination section and in more detail in the ***Vaccination Strategy*** training module.
33	ADSM Control Protocol Vaccination	Sample Scenario's Control Protocol: **Cattle Control** These parameters assume that vaccination has been triggered, is applied in a ring, and has a priority set. *Name* describes the integrated control measures in one Control Protocol. *Vaccinate Detected units* is a yes/no option. *Minimum time between vaccinations* allows for a secondary (booster) vaccination to happen at an appropriate interval after the initial vaccination. The default value is set to 99,999 days, which results in only one vaccination per unit during the iteration. If needed, the parameter is changed to a more reasonable value, down to 1 day between vaccinations. The parameter cannot be empty. *Days to Immunity* describes the number of days (whole number) needed for the vaccine to generate an immune response and is required. *Vaccine Immune period* is a probability density function that allows a range to be set for the window of vaccine-induced immunity.
34	Calculator	Cost Accounting Cost Accounting allows you to calculate the costs of a scenario. Be aware that the costs ADSM estimates are the cost the responding government agency would incur in an outbreak. In reality, there are many other costs involved in an outbreak, such as: Personnel costs for deployment, lodging, overtime pay, and others Producer costs from business disruption Trade costs for losing trade partners that are unwilling to allow imports
35	Control Protocol menu	Control Protocol in Sample Scenario – Cost Accounting *Cost Accounting* is not activated in the Sample Scenario. However, there are values saved if you want to toggle the functionality on. *Cost Accounting* does not change the progression of a simulation. Rather, it uses counts of units/animals affected in an iteration and multiplies that count to provide an estimate of costs. *Cost of carcass disposal per animal * count of animals = total disposal cost*
36	Farm with quarantine signage	Control Protocol in Sample Scenario – Cost Accounting *Cost Accounting* has two groups in the Control Protocol that are summarized in the data outputs: Destruction costs Vaccination costs We might also expect additional costs due to increased surveillance. Those costs vary by both the surveillance zone and the production type. The <u>Zone Effects tab</u> will cover that parameter.
37	Control activities and	Control Protocol in Sample Scenario – Cost Accounting

	ADSM Control Protocol Cost Accounting Form	*Destruction costs* cover the variety of activities that would support a control strategy including destruction.
38	Control activities and ADSM Control Protocol Cost Accounting Form	Control Protocol in Sample Scenario – Cost Accounting *Vaccination costs* cover the variety of activities that would support a control strategy including vaccination.
39	ADSM Output settings Form	Control Protocol in Sample Scenario – Cost Accounting To include calculations of costs in your output data, be sure to check the appropriate *Cost Tracking* options on the <u>Output Settings tab</u>.
40	Cattle near windmill	Control Protocol Summary We have covered all the sections within Control Protocol. The next step is to assign the Control Protocol to the production type that matches your parameters.
41	ADSM Assign Control Protocols Form and Production Type Panel	Assign Control Protocol: **Cattle Control** The <u>Assign Protocol tab</u> is used to associate a Control Protocol to a specific production type. The list of available production types is presented by the application. A pull-down list is displayed, showing all the Control Protocols that have been created. The dashed line (-------) indicates that no assignment has been made. Assign Control protocols as needed to a given production type. In the Sample Scenario, the Swine Production type is set to null, or no assignment. Notice the lack of assignment can also be seen in the <u>Production Type panel</u>, indicated by an uncolored circle.
42	Gear Section Break	Vaccination
43	ADSM Navigation tabs and vague map	The two parameter blocks that are implemented between production types support vaccination and are: <u>Vaccination Rings tab</u> - the switch that indicates a vaccination strategy will begin if certain detection conditions have been met. <u>Vaccination Triggers tab</u> - details the conditions needed to start vaccination.
44	ADSM Vaccination Ring Rules Form over vague map	Vaccination Rings The <u>Vaccination Ring tab</u> holds the ring parameters. The ring radius is the area to be covered by a vaccination strategy. Sample Scenario has a ring rule implemented. Hover over the name to see the full text name of the Ring Rule. *Use the [+ New Vaccination Ring Rule] to add an additional ring.*
45	ADSM Vaccination Ring Rules Form	Sample Scenario's ring rule - The *ring rule* ***Cattle*** detection triggers ***Cattle*** vaccination within *5.0 km* *Hint: Select the yellow box first; the box will have a highlighted outline when selected. Click on production type from the*

		production type list to add to box. Click again on production type within the yellow box to remove. Hover text appears on both Add and Remove.

46	ADSM Vaccination Ring Rules Form	***Cattle** detection triggers **Cattle** vaccination within 5.0 km*
		Let's break this down
		    1) After trigger conditions are fulfilled (set on <u>Vaccination Triggers tab</u>), then…
		    2) Detection of disease in **Cattle** production types…
		    3) Results in vaccination in **Cattle** production types, and…
		    4) A vaccination ring around each detected unit will include all units of **Cattle** within a radius of **5 km** from the detected production type.
		Note that the vaccination pattern can omit the inner section if needed by including an inner radius value.

47	ADSM Vaccination Ring Rules Form with ring showing inner radius	*In what situation would an inner radius make sense?* There may be many reasons to use an inner radius. One example is when a destruction ring has been set to pre-emptively depopulate units that are within 1 km of a detected production type. There is no reason for the simulation to apply both a destruction event and attempt to apply a vaccination event.
48	ADSM Vaccination Ring Rules Form	Production types in rings *Which production types can be used?* The combinations are only constrained by the number of production types you have used in your scenario. One or more production types can be added in the *detection* box, and one or more production types can be added in the *resulting vaccination* box. The Sample Scenario is a very simple example and shows only Cattle as the trigger and Cattle as the recipient.
49	ADSM Vaccination Triggers Form	Sample Scenario Vaccination Trigger *What are the conditions that trigger vaccination to begin?* The Sample Scenario has a *trigger* implemented as the condition to start vaccination, named *3 infected units detected in Swine, Cattle*. There are six conditions that can be set by one or more production types. In addition, there is also a trigger than can be set to *stop vaccination*. If vaccination has been stopped, it is possible to *restart vaccination* with the same six triggers that are used to start the vaccination strategy initially. Capacity for vaccination will be covered later and note that start capacity and restart capacity can be different.
50	ADSM Vaccination Triggers Form showing trigger and production types	Trigger - 3 infected units detected in Swine, Cattle Note that the *trigger group* contains both Swine and Cattle. The Sample scenario example is triggered by a *number of units detected*. Therefore, the trigger name reflects the details of the trigger. To make the trigger a *restart trigger*, use the yes/no checkbox at the bottom of the parameter. *Hint: Select the yellow box first; the box will have a highlighted outline when selected. Click on a production type from the list to add to the box. Click again on production type within the yellow box to remove. Hover text appears on both Add and Remove.*

51	ADSM Vaccination Triggers Form showing trigger and production types and vaccination	Sample Scenario Trigger order *What if I have multiple triggers? Which one starts vaccination?* You may use multiple triggers. When any one of the triggers meets the requirements, vaccination will start.
52	Calves in a field	Summary - Vaccination This section has looked at parameters for vaccination at a very high level. A separate training module covers more vaccination concepts and details on how to build a vaccination strategy. Next, we will review the parameters applied across all production types. They are called Global parameters.
53	Gear Section Break	Global Parameters
54	Cattle, swine and small ruminant images	What does Global mean? There are certain parameters that apply across all production types. We describe these parameters as being "Global."
55	ADSM Vaccination Global Form	Terminology - Global There are two blocks of parameters that apply across all production types. The word "Global" is used to describe these parameters. <u>Vaccination Global</u> <u>Destruction Global</u> <u>Vaccination Global </u>adds functionality to a vaccination strategy. <u>Destruction Global </u>adds functionality to destruction.
56	ADSM Vaccination Global Form	Vaccination Global <u>Vaccination Global </u>allows vaccination to be *prioritized* at a primary and secondary level. The number of vaccinations that can be accomplished in a day are driven by the capacity. The restart capacity is used with the *Stop vaccination trigger.* The concept is that vaccination would be easier to resume if resources were already in place. *Vaccinate retrospective days* allows the inclusion of detections that happened before the trigger. Additional details are provided in ***VACCINATION STRATEGY*** module.
57	Disposal foam in chicken barn and ADSM Destruction Global Form	Destruction also has several parameters that are applied globally.
58	ADSM Destruction Global Form	The *priority order* interacts with other parameters to implement a primary and secondary sort. The priority order *Reason* refers to the *Destruction Reason order* widget at the bottom of the form.

		All the reason options are shown, regardless if used in your scenario. Recall that all the trace options are activated back in the <u>Control Protocols tab</u>. On each widget, drag items to rearrange the order for your scenario.
59	ADSM Destruction Global Form	The *priority order **Production Type*** refers to the *Destruction priority* setting from <u>Control Protocol</u> > *Destruction*. Primary Sort Secondary Sort of the production types
60	Calendar	The priority order ***Time Waiting*** refers to the number of days a unit has been in the destruction queue. The simulation will destroy those units that have been waiting the longest. *See* https://github.com/NAVADMC/ADSM/wiki/Model-Specification#destruction-capacity *for additional details.*
61	ADSM Destruction Global Form feedlot in background	You can delay the start of the destruction program. *Capacity* is represented as a probability density function and describes the number of units per day that can be destroyed. The simulation doesn't consider the size of the unit (number of animals housed on the unit) nor does it consider the physical size of the production type species*. [Apply] is necessary to save changes.*
62	Cattle	Summary – Global Parameters This section has looked at parameters that apply across all production types. This process supports destruction and the vaccination strategy after it has been started. <u>Zones</u> and <u>Zone Effects</u> will be the next topic.
63	Gear Section Break	Zones and Zone Effects
64	Vague map	Zones are areas of differing surveillance and control policies. There can be an arbitrary number of zones, each with a unique name. The basic form of a zone is a circle around a unit. Typically, higher levels of surveillance correspond to smaller circles. Areas outside the circle also constitute a zone, with the lowest surveillance level. The outside zone uses the parameters established to describe the background zone. For example, the probability of detection in the background zone uses the probability value that was set in the Control Protocol.
65	ADSM Zone Form over stylized map	A zone requires a descriptive ***name*** and a ***radius***. *[Apply] is necessary to save changes.*
66	ADSM Zone Effects Form over farm with quarantine signage	<u>Zone Effects</u> provide parameters to change *direct* and *indirect movements*, such as a movement standstill or a quarantine control zone. Within the zone, the *probability of detection* can also be increased. Zones have a specific *cost* that combines both the production type and the specific zone.
67	ADSM Assign Zone Effects Form	Assign Zone Effects The <u>Assign Effects</u> tab is used to associate the effects in the zone with both the zone and the specific production type. The list of available Zones and production types is presented by the application. A pull-down list is provided of all Zone Effects that have

		been created. The dashed line (-------) indicates that no assignment has been made.
		Assign Zone Effects as needed to a given production type and zone. In the Sample Scenario, all combinations are assigned to the one Zone Effect strategy. The assignment can also be seen in the Production Type panel, indicated by the colored circles.
68	Vague map	Zones or Rings?
		ADSM uses both rings and zones. They appear similar, as they are both circles with a user-defined radius. However, the action within the circle varies between the two concepts.
		Zones in ADSM are circular areas created around detected, infected premises. Inside zones, more stringent controls on movements may be applied and more intensive surveillance activities may be carried out. Zones have a user-defined name that appears in outputs.
		A ring is an area of action specifically for the control activities depopulation and vaccination. The ring is radial, and the user defines the radius. A ring does not get named and cannot be distinctly identified in the results outputs. Within the simulation, a ring does not act in the same way as a zone.
69	Swine	Summary – Zones and Zone Effects
		This section has looked at parameters for zones and zone effects that apply to both a production type and a zone. The parameters allow us to change the actions of control measures within a given area around a detected unit.
70	Gear Section Break	What's Next?
71	Longhorn	In this training, we covered:
		Overview – A conceptual look at control measures
		Control Protocol – Parameters that are assigned by production type Detection, Tracing, Testing, Exams, Destruction, Vaccination, Cost Accounting
		Vaccination – Parameters allowing an event in one production type to apply measures in other production types relating to vaccination
		Global Parameters – Parameters that act on all production types
		Zones and Zone Effects – Parameters acting on zone control areas around detected units
72	Flock of Sheep	**Join the flock!**
		Learn more about ADSM or try an example
		ADSM is currently available at
		https://github.com/NAVADMC/ADSM/releases/latest
		Try the sample scenario
		https://github.com/NAVADMC/ADSM/wiki/A-Quick-Start-Guide:-Running-the-sample-scenario
		Read the wiki pages link https://github.com/NAVADMC/ADSM/wiki
73	Goat on with green foliage	What's Next?
		Training materials are posted at http://navadmc.github.io/ADSM/
		Training includes:
		Overview
		Populations and Production Types

		Getting Started Disease Parameters Control Parameters Output Settings and Run Results Detailed Evaluation of Results - Verification and Validation Vaccination Strategy Administration
74	Cows grazing with blue sky and green grass	The outcome of an ADSM simulation (as with any computer simulation model) depends heavily on the quality of the scenario input parameters; the assumptions of the modeler who created the scenario; and the capabilities and limitations of the model framework itself. The utility of disease models like those created with ADSM critically depends on input and interpretation of experts familiar with the behavior of disease within populations, and with the limitations, assumptions, and output of the model. While ADSM is available as a service to animal health communities, the ADSM team does not necessarily endorse results obtained with the ADSM application or any conclusions drawn from such results. Note that the parameters provided in the Sample Scenario are simple examples to clarify concepts in the application. These parameters do not represent any real population or disease event.
75	Cattle image	This work was funded in whole through Cooperative Agreement AP18VSCEAH00C005 with the University of Tennessee Department of Animal Science by the Animal and Plant Health Inspection Service, an agency of the United States Department of Agriculture. University of Tennessee Animal Science logo Photo credits Canva.com Rutledge Farm, Big Sky MT, Darci Darlington Pinecroft Farms, Woodstock CT, Mariah Chapman Jennie Steiner Jason Leung, unsplash University of Arkansas
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