Red Wolf Recovery Program Adaptive Work Plan FY00-FY02

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PREFACE

This plan specifies the framework and general goals of an adaptive management plan by which the feasibility of controlling red wolf/coyote hybridization will be assessed. This plan specifies annual goals. However, the plan retains the flexibility to adapt to new findings, either from the analysis of the data collected during the implementation of the plan or from the findings of modeling efforts of research partners (see below I, 2 and 3), or both. The intent of this version of the plan is to specify the core components and basic goals of a plan by which the hybridization threat can be assessed and managed in a logical, adaptive (scientific–see I below) framework. From this core framework, the data it is designed to collect, and the modeling efforts and sensitivity analysis currently underway, the Red Wolf Advisory Team will be able to assess the program's progress and make recommendations regarding adaptions (changes) to the plan. The red wolf recovery program is currently working under a 3-5 year time-line to determine whether wild red wolves and sympatric eastern coyotes can coexist and still maintain the genetic identity of red wolves. This plan covers a 3 year time-line. If results at the end of this period (or before) indicate clearly that the red wolf either is or is not recoverable in the wild, the appropriate actions should be undertaken.

PURPOSE AND BACKGROUND

The purpose of this plan is to specify the goals and implementation strategy of an adaptive management plan that was designed to assess, control and manage hybridization occurring between red wolves and coyotes in the only extant population of red wolves in the United States. The U.S. Fish and Wildlife Service began restoring red wolves to the wild in 1987. Red wolves had been declared extinct in the wild in 1980. The history of the red wolf reintroduction program prior to the temporal scope of this plan is well documented (Kelly and Phillips, in press, Phillips et al in press, Gilbreath 1998, Phillips et al. 1995).

During the week of April 12, 1999, at the request of the U.S. Fish and Wildlife Service, a 3.5 day facilitated workshop was conducted by the Conservation Breeding Specialist Group (CBSG) of the IUCN's Species Survival Commission. The purpose of this workshop was to gather together experts who had studied wolves, coyotes, genetics, modeling and canid population biology to discuss the biological and ecological issues facing red wolf recovery. Four subject areas were identified to be the focus of the workshop: (1) red wolf population monitoring, (2) red wolf hybridization with coyotes, (3) selection of additional release sites, and (4) the role of the captive breeding program.

After reviewing data on the reproduction of red wolves in the wild, the attendees of this workshop concluded that the proportion of hybrid litters from red wolf/coyote interbreeding was alarmingly high, and recommended that the workshop focus solely on issues surrounding red-wolf/coyote hybridization, including: how much hybridization could occur in the population in northeastern North Carolina (NENC) while still maintaining its genetic integrity, how to assess the degree of hybridization in the population, and how to limit hybridization to acceptable levels on a landscape scale. This workplan details an adaptive management approach (Holling 1978, Walters 1986) to these issues that is based on the recommendations from the CBSG workshop (Kelly et al. 1999).

ORGANIZATION OF THIS DOCUMENT

This plan is organized into 3 sections: (I) an overview of the adaptive management paradigm and a discussion of how the red wolf adaptive management plan (RWAMP) is consistent with this paradigm, (II) a description of the experimental approach of the adaptive plan, and (III) goals of the plan and measures by which adaptions to this plan should be based.

(I) Adaptive Resource Management and the Red Wolf Recovery Program

Adaptive resource management (ARM) is an approach derived from the need to blend research and management. To be effective resource stewards, wildlife managers should refrain from conducting research and management independently. Instead, sound scientific principles should be applied to solve problems. Adaptive management provides the paradigm by which this can be accomplished (Lancia et al. 1996).

Adaptive management is characterized by a 4 step process (Walters 1986): (1) reach a consensus among stakeholders, (2) analyze existing data and model preliminary predictions regarding various management schemes, (3) assess how sensitive predictions are to changes in various assumptions and variables, and (4) implement management in an experimental context. Adaptation of a plan is effected via feedback from experimental results generated in step. Because the red wolf recovery program (RWRP) was seen to be in a crisis stage by the participants of the CBSG workshop, the RWRP did not adhere to the sequential implementation of this process. Instead, based on the results of the CBSG workshop (Kelly et al. 1999), several of the 4 steps outlined above were engaged simultaneously. Nonetheless, the Service's mission of working with others and basing decisions on sound science is consistent with the adaptive management paradigm and provided somewhat of a head-start on the 4 steps mentioned above. The current state of each step is detailed below.

Reach a Consensus among Stakeholders (1)

In the ideal ARM paradigm, all stakeholders concede something to implement a plan. In the context of the red wolf recovery program, red wolves are reintroduced under the experimental non-essential (ENE) designation available in section 10(j) of the Endangered Species Act. This designation allows for a weakening of the provisions of the act that prohibit the take of an endangered species. So in a broad sense, advocates of wolf introduction and restoration conceded some protection of wolves to accomplish restoration; and, by having greater flexibility to take wolves, opponents to wolf restoration were more amenable to wolves on their land. The rule-making process associated with an ENE designation provides the forum for reaching consensus. This process typically involves public meetings and written comment periods that result in the revision of a proposed rule to reflect consensus. The red wolf program followed such a process to derive its current management rule. However, the advent of a serious threat to recovery from hybridization precipitated the need to change the current red wolf rule. Prior to initiating the rule changing process, the RWRP pro-actively conducted open houses in the local communities to inform stakeholders of the need to change the rule and described conceptually the Adaptive Plan being proposed. Although the rule package has not yet been published for public comment, the open houses have functioned to inform and begin the process of generating consensus.

Analyze Existing Data and Generate Models (2)

In an effort to better understand how red wolves live in the wild, data collected during the reintroduction program is beginning to be analyzed (Phillips et al. in press, VanManen et al. 1999, Kelly 1994). However, prior to the CBSG workshop no analysis had examined hybridization. Participants of the CBSG workshop crafted a deterministic model of coyote genetic introgression into the NENC red wolf population. This model revealed the current red wolf population could sustain very little hybridization if it was to maintain its genetic identity. As a result of the predictions of this model, the participants of the CBSG workshop made recommendations from which the current adaptive management plan was conceived (see II below). However, these recommendations and the adaptive plan are based on a theoretical model of the space use and behavior of sympatric red wolves and coyotes. Little empirical data exist on this topic. Since the CBSG workshop, the Service, via partners at Universities, have initiated research projects to address this dearth of data. In the interim, models of redwolf/coyote/hybrid interactions are being developed from theoretical information, published data on other populations and similar species (e.g., gray wolves).

<u>Assess How Sensitive Predictions Are To Changes In Assumptions and Variables (3)</u>

After the CBSG workshop, the Service contracted with research partners to assess the sensitivity of the models on which the adaptive plan is based. A sensitivity analysis of the introgression model is currently underway. Likewise, a red wolf/coyote/hybrid spatial use model is currently being developed. Results from these analyses may identify variables or assumptions which significantly effect the predictions of the models. Field efforts can then be directed to collect data on these key variables or to test key assumptions so that the models can be refined with empirical data from red wolves, coyotes and or hybrids in NENC. Eventually, ideally after empirical data from NENC are incorporated, the introgression and spatial models will be integrated to assess the overall impact of hybridization on a landscape scale and help determine whether the adaptive plan is working.

<u>Implement Management in an Experimental Context (4)</u>

See III below (Implementation Of The Plan And Measures By Which Adaptions Should Be Based) for information on how the red wolf program is implementing this component of the adaptive management paradigm.

(II) Goals Of The Adaptive Plan And A Description Of The Experimental Approach

The goal of the red wolf adaptive plan is to reduce hybridization between red wolves and coyotes to a level that does not threaten the long term genetic integrity of the red wolf in the wild. There are 2 fundamental approaches to achieving this goal: (1) is to attempt to control coyotes (i.e., to pro-actively and opportunistically remove them from the population), and (2) is to capture, sterilize, radio-collar and release coyotes until wolves can take their place. With respect to 1, man's inability to control coyotes is noteworthy. Recall that wolves were rather easily exterminated from the U.S. during the predator control efforts of the early 20th century, while at the same time the range of the coyote increased. Efforts to reduce domestic lamb losses to coyote predation by killing coyotes further illustrates the futility of trying to control coyotes. Decades of effort have been spent trying to remove coyotes to protect domestic lambs from predation. However, because coyotes are territorial and typically kill lambs to provision their pups, research is currently underway by the U.S. Department of Agriculture to test whether sterilized coyotes will function to protect lambs by defending their space against coyotes that need to provision pups. It is this concept of holding space that is being applied to manage hybridization and help save the red wolf.

There are 2 primary components of the red wolf adaptive plan, one is to eliminate "zones of ignorance", and the other is to insure that all known breeding units are red wolf. Areas where we are unaware of what type of canid, if any, is present, or when we know a red wolf is present but are unaware of whether it is part of a breeding group or is nomadic (Crabtree 1988) or transient (Windberg and Knowlton 1988) are referred to as "zones of ignorance". To illustrate, if a giant slice of swiss cheese were overlaid on the landscape, the cheese would represent the area occupied by known red wolf breeding groups and the holes would be the "zones of ignorance". Sterilization not only achieves the primary goal of the adaptive management plan (limit coyote introgression) but also provides a biological means by which "zones of ignorance" can be systematically eliminated. Eliminating zones of ignorance represents a critical intermediate step in transitioning to a landscape that is occupied predominantly by red wolf breeding groups (transition from swiss cheese to provolone).

However, the underlying tenet of this approach is that space (territories) is limited and that non-breeding pairs of coyotes, non-hybridizing mixed pairs, and breeding wolf pairs are best to occupy that space because the introgression of non-red wolf genes will be controlled and space will be limited or unavailable for other pairs to establish themselves. This underlying tenet however, assumes that coyotes and red wolves do not share space, are antagonist towards each other when not paired, and exclude one another from their respective territories. As mentioned earlier, data to test these assumptions currently do not exist but will be collected as the hybridization adaptive management progresses.

(III) Implementation Of The Plan And Measures By Which Adaptions Should Be Based

The red wolf adaptive plan is framed around the following biological seasons:

October - January:	Pre-breeding/Pair Bonding
February-March:	Breeding
April-May:	Whelping
June-September:	Pup-rearing.

Goals, by season, and general methods of the RWAMP are presented below. These goals will be implemented in a priority order according to 3 zones identified during the CBSG workshop (Figures 1 and 2). For example, if the goals withing Zone 1 have not been achieved, pursuit of those goals in Zone 2 should not be undertaken. An outline of foals and tasks follow:

1. October - January (Pre-breeding/Pair Bonding):
    a. Insure known breeding wolf groups are wolves
        i. Capture and assess ID and disposition[1] of the members of each group.

[1] See appendix A for a key by which untagged animals are identified and their disposition determined.

b. Relocate ***each member*** of ***each group*** a minimum of ***30 <u>usable</u>*** locations sampled appropriately throughout this season. Log, enter and plot locations within a week of when they are collected.

c. Summarize data for Advisory Team Meeting.

d. Convene Advisory Team after the holidays but before March.

2. February-March (Breeding):
   a. Continue with objective 1 if not yet completed.
   b. Identify with whom suspected lone wolves are associating (address partial zones of ignorance):
      i. Capture, and assess ID and disposition[1] of every animal caught while trapping for suspected associates
      ii. Use remote cameras, observation and scat surveying to focus capture efforts.
   c. When "b" is completed focus can shift to addressing complete zones of ignorance (areas where we have no canids collared):
      i. Capture, assess ID and disposition[1] of every animal caught
      ii. Use remote cameras, observation and scat surveying to focus capture efforts

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[1] See appendix A for a key by which untagged animals are identified and their disposition determined.

d. Relocate ***each collared animal*** a minimum of ***30 <u>usable</u>*** locations sampled appropriately throughout this season. Log, enter and plot locations within a week of when they are collected.

e. Survey ARNWR for presence of coyotes or hybrids (e.g., scat surveys for genetic ID).

3. April-May (Whelping):

   a. Continue with objective 2 if not yet complete.

Figure 1. Location of red wolf recovery area.

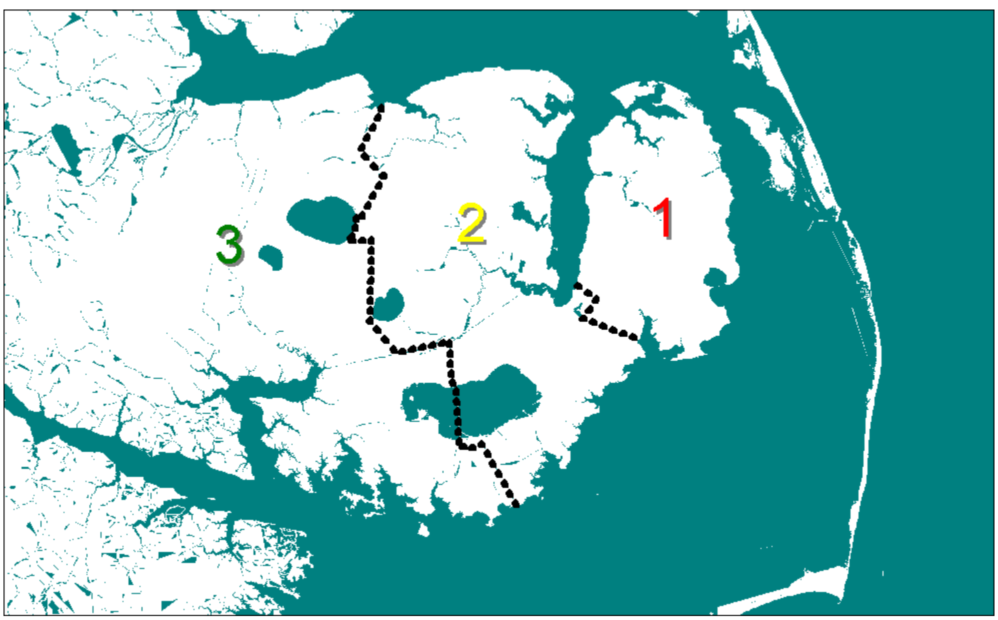

Figure 2. Close-up of designated red wolf recovery area and the management zones specified in the red wolf adaptive management plan: (1) is priority or "coyote free" zone, (2) is secondary or "experimental zone", and (3) is tertiary or "hybrid zone".

b. Monitor **all** ***breeding age*** canids (including those sterilized) during these months to ascertain whether they exhibit localized movements.

c. If non-wolf females localize movement, effort should be made to determine if she has whelped (find the den).

d. If wolf females localize movements, location and date should be recorded.

e. Relocate ***each collared animal*** a minimum of ***30 usable*** locations sampled appropriately throughout this season. Log, enter and plot locations within a week of when they are collected.

f. Consider releases.

4. June-September (Pup-rearing):

a. Relocate ***each collared animal*** a minimum of ***30 usable*** locations sampled appropriately throughout this season. Log, enter and plot locations within a week of when they are collected.

b. Summarize data for Advisory Team Meeting.

c. Convene Advisory Team in late summer (before Oct. Field Season)

d. Conduct insertions.

These seasonal goals are biologically justified. Focusing on known breeding groups of wolves during pre-breeding insures the ability to capture and begin tracking wolves that will serve as dispersers into the population. That is, they represent a large, annually available source of wild wolves. Known wolf groups can easily contribute (by several orders of magnitude) more wolves to the population than both island projects. Since known wolf groups represent the cheese, they should not be exposed to activities during the breeding and whelping seasons that may compromise their ability to raise offspring for recruitment into the population (e.g., disturbing, tagging, or sampling, neonates--less than 12 weeks old--in or at den sites). Focusing on the known wolves during pre-breeding avoids or minimizes disturbance to them during gestation and lactation and helps insure pup survival. In contrast, the focus on partial and complete zones of ignorance during the breeding and into the whelping season (if necessary) minimizes the production of hybrids (maximizes our control of hybrid production). See Knowlton (1972) for a discussion of the temporal effectiveness of coyote control and why control during the breeding season is so effective.

The approach outlined above will simultaneously stop known introgression, reduce zones of ignorance, provide data to test key hypotheses and allow for the determination of whether the RWAMP is working (i.e., is the red wolf recoverable in the wild). Specific measures used to evaluate the plan follow.

The hypotheses listed below (P1-P3) were stated as null hypotheses in a proposal from the RWRP to the NC Wildlife Resource Commission (Kelly 1999), they are restated here as predictions:

P1: Red wolves are territorial to the exclusion of pairs or groups of coyotes.

P2: Coyote territories are smaller than red wolf territories.

P3: Red wolves directly (inter-specific aggression) cause coyote mortality.

Additionally, the following predictions need to be tested to determine the overall efficacy of the RWAMP:

P4: The number of known red wolf breeding units increases over time.

P5: The percent of land occupied by red wolves is greater over time.

P6: Total number of known “breeding” pairs or groups (sterilized pairs, and red wolf pairs) increases with time.

P7: The number of sterilized animals decreases over time.

P8: The number of mixed pairs that change to wolf pairs is greater than the number of wolf pairs that change to mixed pairs.

P9: The percent of the known reproduction (red wolf and hybrid) that is hybrid decreases overtime.

P10: The number of hybrids captured decreases over time.

P11: The percent hybrid litters is on a trajectory to a value that is consistent with maintaining 90% of the founding genetic diversity for 100 years (1-2% of the red wolf reproduction is hybrid).

Statistically, testing some of these predictions may be problematic. Many are cast as time series data and a lack of independence of observations may be an issue, especially for analysis of variance and linear regression techniques. However, many can be cast as null models which should enhance their test-ability. Nonetheless, the most appropriate means by which these predictions are tested is dependant on the review of the Advisory Team.

Table 1. Red wolf adaptive management plan predictions and data needs.

Prediction	Data Currently being collected?	If No, Does Plan Address?
P1*	No	Yes, n>30 locations/animal/season
P2	No	Yes, n>30 locations/animal/season
P3	Yes	
P4	Yes, baseline established	
P5*	No	Yes, n>30 locations/animal/season
P6	Yes, baseline established	
P7	Yes, baseline established	
P8	Yes	
P9	Yes	
P10	Yes, baseline established	
P11	Yes	

* P1 and P5 are ***KEY*** to determining the underlying tenet of this plan that space is limiting and red wolves will exclude coyotes. Data with regard to these predictions is critical to assess the feasability of managing hybridization, and thus whether red wolves can coexist with eastern coyotes.

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Appendix A. Key to determine ID and disposition of wolf-like canids in NENC.

	Question or Action	If, Yes...	If, No...
1	Is canid previously marked but not genetically identified?	2	4
2	Is both a sire and dam associated with the canid?	3	4
3	Are suspected (listed in database) sire and dam from captive stock or have both been genetically identified?	6	5
4	Was canid captured as a result of targeting a known group?	5	14
5	Morphologically, does canid appear wolf-like (does it meet standards)?	6	8
6	Are there extenuating circumstances to suggest the animal may not be a wolf?	8	7
7	***Process as a wolf and release***		
8	Is canid believed to be a puppy (<1yr old)?	9	17
9	Is pen space available to hold puppy?	10	11
10	***Hold pup pending genetic identification***		
11	Is there a need for the sex of the canid as a release candidate?	12	19
12	Could pen space be made available by euthanizing an unknown canid of the opposite sex?	13	17
13	***Euthanize an animal being held for genetic id of an opposite sex–place canid in pen***		
14	Does the canid have any suspected siblings that have been tested genetically?	15	16
15	Did the canid's suspected siblings test as a wolf?	5	16
16	Does morphology appear wolf-like (does it meet the standards)?	6	17
17	Is animal from land where sterilization of non-red wolves (coyotes and or hybrids) is ok?	18	19
18	***Sterilize, process and release***		
19	***Euthanize***		