10.0 SCARLET MACAW REINTRODUCTION, RELEASE AND POPULATION MANAGEMENT

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10.1 Introduction

Due to the busy workshop schedule and the enthusiastic discussions during each session, the important topics of scarlet macaw reintroduction, release, population augmentation, and the general topic of macaw population management could only be addressed for a few hours during the afternoon of the last day, Saturday March 14th. This chapter summarizes the information discussed that afternoon as well as information presented on Monday evening March 10th by Darrel Styles on the "Physical, Social, and Psychological Preparation of Scarlet Macaws for Reintroduction" and by Donald Brightsmith in his "Review of Three Scarlet Macaw Reintroduction Programs." Both of these presentations are based upon published works that are referenced at the end in the Literature Cited section.

A note on terminology: We use the term "reintroduction" for releasing macaws or other species into an environment were they are not found. We use the term "release" to mean releasing them into an environment where members of that species exist. We also use "release" as a generic term for freeing captive birds into the environment. Population augmentation refers to releasing members of a species into the wild specifically to increase, or augment, the existing population.

10.2 Natural Psittacine Behaviors and Implications for Captive Breeding and Release Projects

Breeding Strategies and Behavioral Implications: In his Monday evening presentation, Darrel Styles discussed the two general breeding strategies of animals and how these strategies impact their natural behavior. This discussion was important for explaining some of the inherent characteristics of psittacines that strongly impact successful captive breeding and release techniques. Much of this section is taken from his presentation and published proceedings article.

The two extremes of these breeding strategies are the K-strategists and the R-strategists. K-strategists are those animals that have low reproductive rates, long parental contact periods, and many of the survival behaviors are learned from the parents or group. Macaws are an example of K-strategists. The K-strategists rely on intelligence and learning to ensure survival of their offspring (genes). K-strategists usually demonstrate strong pair-bonding; there is little promiscuous behavior and long-term bonds are common. This means in captivity that K-strategists should be allowed to self-select mates and cannot easily be force-paired. R-strategists have high reproductive rates, short or no parental contact periods, and survival skills are predominately instinctive or innate. The R-strategists are highly promiscuous and rely on sheer numbers of offspring produced to ensure survival of their genes. Selection of mating partners is more capricious and opportunistic. Budgerigars tend towards being R-strategists. An entire spectrum

exists between the K and R strategies and many species fall somewhere in-between, but macaws are definitely K-strategists.

Darrel Styles also described the resulting types of intraspecific dynamics that provide the socialization of members of most psittacine species. The majority of parrot species are highly social creatures that live in flocks or enlarged family groups outside of the breeding season. Sexually immature juveniles live entirely in a flock until they reach reproductive age and select a mate. During the breeding season, sexually mature pairs separate from the flock to reproduce and are aggressive towards other members of their species. After fledging, chicks either join the parental flock or choose a new flock, which helps to promote genetic diversity of the species. In the wild, K-strategist species require an extended learning period to learn both social and survival skills, and it is within the flock that the juveniles learn these skills. R-strategists innately possess much of the necessary knowledge required for successful reproduction and survival. While K-strategist species may have some innate social and survival skills, it seems that most of the knowledge needed for survival, proper social interaction, and reproduction is gained during the formative learning period after weaning and up to the onset of sexual maturity.

Not understanding the differences between these breeding strategies and the behavioral consequences has led to many misapprehensions regarding captive breeding macaws and other psittacines, socializing them, and successfully releasing them into the wild environment. As mentioned previously, K-strategists form strong pair bonds and breeding is typically more successful if the birds are allowed to select their own mates. It is also more natural for pairs to be alone during the breeding season but then in larger multi-age flocks during the non-breeding season. While macaw pair bonds are usually strong, “divorces” do happen and natural re-pairing usually leads to better breeding success. These tendencies suggest that in captivity, breeding pairs should be isolated in breeding cages during the breeding season during which time they would be aggressive towards other members of their species anyway. In the non-breeding season, they should live in mixed-age groups.

Chick Rearing Strategies in Captivity: Since rearing macaw chicks in captivity – either from captive breeding or from rearing confiscated wild-hatched chicks – is one of the strategies proposed in Guatemala and elsewhere for producing birds for release into the wild, Dr. Styles discussed the four types of chick rearing approaches in captivity. They include 1) complete parent rearing; 2) partial parent rearing with hand feeding to weaning; 3) co-parenting and 4) artificial or foster incubation with complete hand-feeding to weaning.

Complete parent-rearing appears to be one of the better approaches for producing reliable breeders provided that the birds reach sexual maturity in the context of an avian flock. One overlooked aspect of parent rearing is the potential importance of vocalization and recognition of vocal patterns specific for that particular species. This may be critical for flock cohesion and recognition of groups because a local “dialect” is used for identification and communication among family groups. In addition, parent-rearing may provide training in other subtle, non-vocal, species-specific behaviors (“body language”) that may have significant adaptive value for birds released where they interact with wild conspecifics. Parent-rearing may be more important for some species compared to others, but further work needs to be done to establish how important this parent-contact and communication may be in various parrot species. Optimally, chicks

should be allowed to fledge in the breeding aviary and remain with the parents for some period of time at least until they are well on their own, are physically coordinated, and can fly well. If left too long, however, the adults are likely to become aggressive towards the juveniles as the next breeding season approaches.

Partial parent-rearing with hand-feeding to weaning is a common approach in aviculture. The chicks are removed from the nest at 10-18 days of age depending on the species, just prior to the eye-slits opening and the chicks are hand reared to weaning. The chicks produced in this manner are usually healthier and more robust than parent-reared chicks due to a variety of factors. This approach may also allow the pair to produce another clutch, but again, care must be taken to avoid overproduction. Problems associated with this approach mainly deal with preventing diseases from entering the nursery.

If birds are to be hand-fed, the aviculturist needs to ensure the proper social as well as nutritional care of the chick. Chicks should be kept in groups preferably by related clutch or species of similar size and age. Housing chicks of disparate sizes or ages together does not work well.. Chicks held in clutches display more vigorous feeding responses, benefit from the thermostasis provided by other chicks' bodies, and seem socially better adjusted as they approach weaning. This "clutch mentality" seems to be one of the first social interactions learned by the neonate. Chicks reared in isolation may not perform as well or readily adapt to new social situations and environments compared to chicks reared in clutches. Good nutrition can be provided by using one of the many commercial hand rearing formulas. Since macaws need relatively high levels of dietary fat, commercial macaw hand rearing formula should be used for them. If only parrot hand rearing formula is available, some peanut butter should be added to the diet to provide fat. There is no need to conceal the fact that a human is doing the feeding, such as by using puppets or masks.

Incubator-hatching followed by hand-rearing to weaning permits the aviculturist to control the entire process and may be particularly useful for birds who have papillomas (thus infected with herpes virus) or who consistently break eggs or kill or mutilate chicks. Incubation can be accomplished by natural means, such as fostering the eggs under reliable brooding hens, or artificial means like commercial incubators. Natural incubation has a higher hatch-rate than artificial incubation. While an extremely labor-intensive process, hand-feeding from day one helps to prevent the entry of infectious disease into the nursery and permits multiple clutching from the same pair, but there is also significantly higher mortality. Partially parent-reared and incubated and hand-reared chicks should not be placed together until after weaning. Incubator hatched and hand reared chicks are immunologically naïve compared with parent reared chicks. The two populations should be housed and handled separately and never mixed until the chicks have weaned.

Co-parenting is a relatively new approach intended to develop birds that may be used successfully both for pets and for breeding. The chicks are fed in the nest by the breeding pair and the chicks are removed from the nest box and handled daily to accustom them to humans. The chicks may also be given some supplemental feeding. Rearing pet birds was not the focus of the workshop, so this approach will not be further discussed here.

Socialization of Captive Macaws: Once chicks have fledged and are well coordinated and eating well on their own, or at the end of the breeding season, the approach most likely to promote proper socialization and psychological well-being of all the birds is to put the fledglings into mixed age "neutral" flight cages to simulate the flocking that takes place in the non-breeding season. Chicks destined for release into the wild should probably be kept at all times only with members of the same species to prevent any potential species-confusion that could interfere with mate selection and breeding or that could lead to hybridization. The mixed age composition could include non-paired adults, parents and other bonded pairs, juveniles from earlier years, and recently fledged chicks, depending upon the size of the flight cage. At least a few adult breeding age birds should be included. It is important, however, that the birds be introduced together into a neutral flight cage and not one where there are already resident birds who may object to the "invasion" of strangers. In addition, birds that may exhibit unusual (to another bird) behavior such as former pets or fledglings should be observed to ensure they are not picked on or prevented from feeding by other birds. If this is a persistent problem, the subordinate birds may have to be removed and put in a flight cage with less aggressive birds.

Spending time in socialization flight cages may in time re-educate former pets to where they could become successful breeders or potentially be released, particularly as part of a "semi-wild release" described in section 10.5 below. However, former pets may display abnormal behaviors that could adversely impact the socialization of fledglings destined for release, so socialization of former pets should probably not take place in flight cages containing fledglings (Thomas White, pers. com.). They should be socialized in flight cages containing well-adjusted older pre-adults and adults, particularly some wild caught birds..

All this information needs to be taken into account in developing a captive breeding and release program for scarlet macaws. The program should have breeding flight cages and also socialization flight cages and flocking cages for release cohorts. Fledglings are not suitable for release into the wild. Fledglings and other juveniles should be socialized in flocks containing a variety of ages, particularly well-adjusted older birds and wild-caught adults. They should be allowed to select their own mates if they are to be used as breeders. Sexually mature birds may be released in the non-breeding season, but may be less flexible than younger birds. The optimum age for releasing scarlet macaws is likely to be about 1 to 3 or 4 years of age, since they will begin evidencing serious breeding behavior shortly thereafter. Bonded pairs should be released together. Older wild caught birds and active, inquisitive older birds who are in good physical condition, are familiar with wild foods, and who are well integrated into a release flock are also likely to be suitable release candidates.

Soft Release/Reintroduction Strategies: Three release/reintroduction options are discussed in the following parts of this chapter. The first is the classic reintroduction/release approach where captive-raised young birds (including birds taken from wild nests as chicks and raised in captivity) are released as pre-adults from a pre-release cage at the desired location. Only a "soft release" approach should be used, where the released birds are acclimated to the site in a pre-release cage and are provided supplemental food after release. The second is an approach termed "precision release" where a pre-adult is released at the site of a nest where juveniles are fledging (recently introduced by Thomas White, Puerto Rican Parrot Recovery Program). The third, "semi-wild release," is where free flying, somewhat human-habituated and perhaps somewhat

human-dependant birds are released to fly free in protected human-modified and human-occupied landscapes, allowing pairs to breed and possibly raise young that develop without significant human interaction and are not so human dependant.

The last topic discussed is that of managing populations of macaws or other psittacine species in human modified environments where free flying populations would not be likely to persist if human management actions were not undertaken.

10.3 Soft-Release of Groups

Both “hard” and “soft” release protocols have been used for releasing animals into the wild. The choice of protocol may well influence whether the released animals survive, so this is a serious issue. In a hard release, the animals are transported to the release location and released directly into the wild. A soft release is a more conservative approach in which the animals are kept in an on-site acclimation cage for a period of time and provided food and water. Wild conspecifics may visit the acclimation cage and provide the beginnings of social groupings. Typically the animals are provided some period of supplemental feeding after release. For animals as dependent upon learning and flock membership for survival as psittacines, only soft release protocols should be used, even for translocations of wild caught birds.

The purpose of a soft release of a group of scarlet macaws or of other parrot species could be to establish a new population in an area or to increase the number of individuals in an already existing population. In some cases, the purpose of a release could be to liberate previously confiscated individuals into a suitable location. A release could also be done to increase the level of genetic variability in an existing population. Lack of genetic diversity does not appear to be a problem in the Petén. In the case of El Salvador, scarlet macaws have been extirpated and a release would be a true reintroduction. However, due to the widespread human population impact, it is not clear that a reintroduction into the “wild” would be successful there and other approaches may need to be considered (e.g., see section 10.5). The discussion regarding the WCS-Guatemala monitoring sites (Chapter 6) resulted in participants concluding that, if a release of macaws were to be conducted in the Petén, the El Perú site is the first choice, at least initially, because of the presence of the WCS monitors and security personnel to help protect the birds from hostile human interference. However, it was noted by Brightsmith that the disease risks of releasing birds in areas with relatively large populations are greater than when conducting releases in areas partially or wholly depopulated.

Scarlet macaw biology is very seasonal in the El Perú area (and the other monitored areas). The macaws are not year-round residents. Their presence in the monitored areas is presumably due to the food resources that become available in those locations during the macaw breeding season and because of the availability of nest sites. The birds return to the areas for nest site selection and defense in December. Eggs are laid February through April and fledging occurs May through July, with most clutches being laid in February and most fledging taking place in May. Later clutches represent replacement clutches for eggs or chicks that die or are predated. The fledglings and parents leave the area in September, presumably because food resources in the area decline. A release of scarlet macaws in one of the monitored areas will have to take into account that food resources decline as the rainy season arrives and progresses, and from about

September through November there may be insufficient food for scarlet macaws. Either the released birds need to have been assimilated into the wild population sufficiently that they migrate out of the area with the wild birds or else supplemental food may need to be supplied not only when they are first released but also for the months until food resources are again available and the wild birds return. Alternatively, the released birds that do not migrate could be recaptured and considered for release again in a later year.

The seasonality of the scarlet macaw biology in the Petén suggests a timetable for the process of captive breeding and then juvenile bird preparation, acclimatization, and release that is described below.

Preparation and Selection of Release Candidates: Chicks that fledge from captive parents should remain with their parents for one to several months. Then they should be moved to a large mentoring and socialization flight cage that includes fledglings, release candidates, older birds, and possibly even the parents and non-breeding pairs. Fledglings should be observed to make sure they are not picked on by other birds. If they are, they should be moved to a "halfway house" flight cage to mature with a few selected non-aggressive older birds for a few months. (Any birds that are persistently picked on should be permanently removed from consideration for release). Parents and other breeding birds may instead be flocked separately in the non-breeding season, possibly along with a few other breeding age birds.

In about December, captive breeding pairs in the Petén area should be returned to their breeding cages, and any release candidates for the coming year should be selected and placed together in a flocking cage. The size of the flock will depend upon the size of the *in situ* pre-release cage at the release location, but Don Brightsmith's study indicated larger flocks are better, particularly for a reintroduction into an area without resident members of the same species. Realistic and acceptable flock size ranges are likely to be about 6 to 16 macaws. A larger number of birds would require a very expensive pre-release cage, taking up funds that might be better used elsewhere. Releases of smaller numbers of birds should only take place if wild macaws frequently visit the cage during acclimization so that immediate assimilation into the wild flock is assured. Equal numbers of males and females are probably advisable but may not be required for release into an already existing population. It may be advisable to have a few extra "alternates" in the cage in case one or two individuals need to be removed.

Once release candidates are selected and put into the flocking cage, they should not have contact with other birds (especially poultry). As long as adequate disease testing is performed, the juveniles for release could come from multiple suitable scarlet macaw sources; for example, from both Aviarios Mariana and from ARCAS. No contact with any other birds is essential once the first round of disease testing is performed (see below). Diet should be an adequate and well-balanced diet that can be replicated initially at the release site, plus as many wild foods as possible. The birds should be observed in the flight cage to insure the flock members show ability to manipulate wild foods, physical agility, and a sense of flock membership. Any birds not adapting well or that appear ill should be removed and evaluated. The flock should remain together for at least several months, say until April for release into a site in the Petén in mid-May or June.

Prevention of Disease Introduction: See Chapter 8 on disease issues for testing recommendations. Because domestic poultry can carry disease, untested poultry should be kept away from birds to be released. Two rounds of disease testing separated by at least one month are recommended, plus a general hands-on examination by a veterinarian, preferably an avian veterinarian. Negative PCR test results for polyoma, Pacheco's (psittacine herpes), and Chlamydophila psittaci should be required. If the source facility has any non-Neotropical birds (e.g., cockatoos), then tests for psittacine beak and feather disease (PBFD) should also be done. Other tests may be required by local authorities or felt advisable by members or advisors of a project.

Move to Release Site: The birds need to be visually healthy, eating well, flying well, socializing well with other group members, with no behavioral or physical abnormalities. A checkup by an avian vet is recommended. Transport the birds in carrying cages to the pre-release flight about 6 weeks to two months before date of intended release. In the Petén that would mean transport in April for a release in mid-May or June.

Pre-release Flight Cage: The cage should be constructed at the location of the release on flat ground in an open area that preferably has no overhanging vegetation nearby that predators could use to get on top of cage. The flight size and design will depend upon finances available. A size approximately 12 m long, 5 m wide, 3 m high is a suggestion for about 10 – 12 birds. A release door should be constructed either on the roof or in the upper part of one of the sides. Meter-high metal sheeting with an overhang could be installed along the bottom of the cage to dissuade ground predators. Some sort of roofing material should cover part of the cage to afford protection from sun and rain. A natural dirt floor is adequate.

Outside Feeding Station: A feeding station should be constructed outside the cage within sight of the macaws in the cage. One design is to have the feeding station built into a side of the pre-release cage so that the same feeding station could be used before and after release and possibly even be used as a trap if a bird needs to be recaptured. Alternatively, the feeding station could be located not far from the door from which the macaws will be released Beginning a few days before the release is to take place, food should begin to be placed on the feeding station in sight of the macaws. However it is constructed, the outside feeding station should resemble the feeding station used inside the cage for the weeks before release.

Security: Security will need to be provided for the 6 – 8 weeks during which the birds are in the pre-release cage. One option is to have the cage located near the camp where macaw monitors sleep and to have one or two guard dogs around the cage at night. Another option is to build a small sleeping area for a night monitor. Use of one or two guard dogs still should be considered to alert the monitor to possible predators.

Care and Feeding: The birds should first be given the basic well-balanced diet they were used to in the flocking cage, but they should also immediately be presented with wild foods in as natural a state as possible (e.g., on branches hanging from some sort of stand). Careful consideration should be given to the design of the feeding station inside the cage. It should be similar to the feeding station outside of the cage. One option is to have the feeding station built into a side of the pre-release cage so that the same station can be used before and after release and possibly

even be used as a trap if a bird needs to be recaptured. Over about a month the birds should be shifted to a diet consisting of significant quantities of natural foods but with sufficient amounts of the basic balanced diet to ensure good nutritional status. A macaw monitor should observe the macaws to make sure all are adapting to the wild foods and to the new environment. Any bird that doesn't adapt well or that behaves oddly or is injured should be evaluated to decide if it is suitable for release or not.

Anti-predator Training: There are three species of hawk eagles in the Petén that may be macaw predators, but there are no known reports of actual predation. In the case of smaller birds such as *Amazona* species, the possibility of anti-predator training should be considered. As an example, the Puerto Rican Parrot Recovery Program has developed fairly successful predator avoidance training for their *Amazona* species, *A. vittata*, against red-tailed hawks, *Buteo jamaicensis*. This program should be consulted if there is a desire to institute anti-predator training.

Evaluation and Preparation for Release: After 6 – 8 weeks the birds should be evaluated and prepared for release. Criteria for suitability for release include: (1) all birds socializing well with each other; (2) all birds manipulating and feeding well on wild foods; (3) a sustained flight capability, especially along the length of the cage; (4) no obvious health problems, and optimally (5) visits by resident wild macaws (if not a reintroduction) and vocalizations back and forth between wild and caged macaws. While not mandatory, if wild macaws are in the area this should occur because of the social nature of the birds. If interaction does not occur, the situation is odd, and the release situation should be re-evaluated. Is it still too early in the breeding season for chicks to have fledged? Have the wild macaws already migrated out of the area? Is a release still advisable? A final deworming is recommended. For temporary marking, plastic leg bands may be put on the birds or marks made on tail feathers with magic markers, etc. If any radio or satellite transmitters are to be used, they should be put on the birds several weeks to a month before release and the collared birds observed for adequate adaptation. It may be preferable to use dummy units rather than live transmitters to preserve battery power, and the mockups could be slightly heavier than the actual units. Replacement with actual telemetry units could take place during the final health check and deworming. A few days before release, a regular schedule of placing food on the outside feeding station(s) in sight of the caged macaws should bgin. The regular schedule of placing fresh food out should continue until the released birds have left the area with the wild birds or until they no longer return to the feeding station. This may require providing food for the released macaws for a time period of several months up to a year.

Release: Before or at dawn[*] and as unobtrusively as possible, the door to the outside should be opened and then left open, allowing the birds to go in and out as they wish for 3-4 weeks. By that time the macaws should have joined the wild flock and no longer use the pre-release cage or feeding station for any significant period of time. Any bird that spends a large amount of time in or on the cage or at the feeding station should be re-evaluated for suitability for release. Fresh food should be provided on a regular schedule in the outside feeding station(s) until the birds no longer depend upon the supplemental food for significant nutrition. Attempts should be made to recapture any bird that does not migrate with the wild birds in September or that does not seem

[*] Opening of release door at dawn suggested by Thomas White of Puerto Rican Parrot Recovery Project based upon their successful experience. As the birds become active as daylight increases, they begin to exit the cage as they notice the door is open.

to be adapting well. If it is hanging around the feeding station, attempts can be made to lure it back into the pre-release cage with food, or trap it at the feeding station if it has been so designed.

Modifications and customization of these guidelines will be needed for specific projects and as experience is gained. Consideration should also be given to using a similar protocol for the release of other psittacine species, particularly ones that have been confiscated as chicks and raised by humans.

Thomas White, Jr., of the Puerto Rican Parrot Recovery Program made a valuable comment that should be kept in mind: “The process of converting captive-reared birds to truly wild birds can be a multigenerational process. Don’t expect the first ‘pioneers’ of a reintroduced population to simply “go wild” just because they’re free. If you have to keep giving them supplemental food and cozy nest boxes for the first few years, then so be it. It may actually be the second, even third, generation of fledglings that really become the truly wild birds. Above all…BE PATIENT!”

10.4 Precision Release of Small Numbers

This technique involves releasing one or more young birds (1 to 3 years old) adjacent to a nest that has fledged at least one youngster within a day or two beforehand. The newly fledged juveniles cannot fly very well, so they remain in a localized area for several days and are attended by their parents. This means there are "mentor birds" of the same species for the newly released birds to associate with and learn behaviors from. Because their chicks have fledged, the adult parents are no longer defensive of the nest cavity nor aggressive towards new birds. This technique has recently (2008) been used successfully for Puerto Rican parrots (Thomas White pers. com.).

The released bird or birds need to be fully prepared for release, meaning they need to have been in a large flight with other birds so that they are socially competent and have good flying skills. They need to have been presented with the same type of wild food as they will find at the release site. They need to have been fully checked out for disease issues. And they need to be juveniles no older than one or two or perhaps three years of age so they do not cause the wild parents to have aggression issues towards strange adult macaws. The hard release version may be done by just bringing the new birds in carriers from where they had been living and opening the carrier doors and allowing them to fly out when the adults and fledglings are in the immediate vicinity. A softer version of this would involve having the birds to be released reside for a few days in a small portable flight so that the wild and captive macaws can become familiar with each others’ presence through vocalizations and sight. Again, the door to the small flight would be opened unobtrusively when wild macaws are in the immediate vicinity.

There are advantages to considering use of this technique when adding new individuals into an already existing breeding population, but there are also caveats. A major advantage is that it is cheaper than the soft release approach described in section 10.3. There is no need for a large pre-release flight and several months of care. It can be done with smaller number of birds because the new birds are being introduced into a pre-existing group of wild birds (the parents and chicks), so there is no longer the need to release a flock of a dozen or more. On the other hand,

only one or several birds could be released at any one time and it may be difficult to know if the wild fledglings are actually nearby. Myers and Vaughn (2004) found in their study of newly fledged scarlet macaws in Costa Rica that for the first 1 – 12 days the fledglings remained within about 1 km of their nest sites, although the exact distances were quite variable. Several fledglings spent seven days within 250 m of their nest tree, while another fledgling flew 3 km away on day four with its parents but then returned the next day with its parents to its sibling that had remained closer to the nest.. This technique has never been tried with scarlet macaws so there is no guarantee it would work as well as it seems to for Puerto Rican parrots, a completely different genus.

An experimental protocol for attempting a precision release with scarlet macaws is outlined below. At least the first few times such a release is attempted, consideration should be given to tagging wild chicks before fledging and the juvenile release birds with radio telemetry collars such as the Holohil AI-2C and tracking them to see if the release birds integrate with the wild family. Argos satellite collars probably would not give frequent enough positions nor would the positions be of sufficient accuracy.

Identify and Prepare Release Candidates: Use similar techniques and criteria as for the soft release protocol described in section 10.3.

Locate Wild Nests and Prepare for Release: Identify and observe one or more successful wild nests in the release area. As soon as the last wild chick seems likely to fledge in a few days, transport one or several of the release birds to the release site. Place in a small portable flight cage unless the chick has fledged. If it has, either release the new macaw from the carrying cage or, alternatively, place in the portable flight cage for one or several days, observing if the wild and captive birds vocalize to one another.

Release: As soon as the last wild chick fledges and assuming parents and chick(s) are in the vicinity, unobtrusively open the cage door and allow the release bird(s) to leave on their own.

Monitoring: Observe the wild and released birds for a few days or more to see how well the released birds adapt to the area, how well they forage, and how well they interact with the wild birds. In case of poor adaptation, attempt to recapture the captive-raised birds, perhaps by using a favorite food such as peanuts as bait.

10.5 Semi-Wild Release

The concept of “semi-wild release” may be the only way some species can persist or be re-introduced into human modified and occupied landscapes. It can be considered a version of a standard soft release protocol adapted to the specific conditions of a highly human-modified landscape that necessitates on-going management of the released population. In a semi-wild release, the members of the target species – scarlet macaws, in our case - are released into a safe site and encouraged or trained to use a safe location as a home base while being free to range elsewhere in the landscape as they desire. This is effectively done in New Zealand where native birds and other animals have been released into locations surrounded by anti-predator fencing or onto islands from which introduced predators have been removed. The kakapo is an example of a

species that would have gone extinct if it were not for the, at the time controversial, initiative to capture and relocate all known members of the species from the mainland onto the four islands of Maud, Hauturu/Little Barrier, Codfish and Mana. It also has been effectively done by an unknown number of small organizations such as Asociación Amigos de las Aves in Costa Rica and Corporación DINANT on Isla Zacate Grande (Gulf of Fonseca) in Honduras (discussed in chapter 4).

In a semi-wild release, birds are released into a site, whether small or large, and then continuously managed through provision of safe roosting sites, perhaps provision of nest boxes, and possibly long term provision of supplemental food or planting of food plants. Recall training may be used, at least initially, to keep the birds around the safe location. Alternatively, the birds can be trained to return to a feeding station by teaching them to associate some sound such as a whistle with the provision of food, as was done in the echo parakeet project on Mauritius. (Woolaver et al. 2000). This type of release can be considered for an environment where human occupation is widespread and the associated poaching, hunting, or continued habitat modification pressures are so great that completely unmanaged populations of birds cannot persist. For example, a private landholder could introduce scarlet macaws into his lands but take measures to keep them coming back to his secure property for breeding and perhaps feeding and roosting. A landholder did this in Costa Rica with about eighteen captive raised scarlet macaws. His property is located across the Tempisque River from Palo Verde National Park, but the park suffers from considerable poaching pressure. He provides nesting boxes on his land as well as mature and young food trees. The released birds interact with the small population of macaws in Palo Verde but do much of their nesting in nest boxes on his property.

Another example is a large Costa Rican resort hotel that wishes to offer “eco-adventure” experiences. They have purchased large areas of surrounding land and are reforesting some of it, including with native shrubs and trees that provide food for scarlet macaws (as well as other birds and mammals). They are attempting to get permission from the government to release captive-bred macaws on the property. They already have a collection of macaws and have set some up for breeding.

Sound protocols for successfully implementing this approach in the various conditions that will be encountered in the real world have not been defined for macaws and other psittacines, nor most likely for most other avian species or other taxa. The birds to be released should certainly be examined and tested to insure health and minimal risk of introduction of disease to related species. They should be properly conditioned. Some practitioners have declared that the birds should not be conditioned in large flight cages so that when they are released they are not able initially to range too widely and become lost. Others might disagree. Alternatively, forms of recall training can be used to keep the birds from wandering off and getting lost until they are familiar with the surroundings. As with releases into the wild, the released birds should be provided with supplemental food at one or more feeding stations. Conditions might be such that they will need to be provided with supplemental food permanently, for reasons that might range from wanting to encourage them to remain in the safe area to insufficient wild foods for breeding or even adult maintenance. See Woolever et al. (2000) for a description of the many management interventions used for the echo parakeet. Supplemental foods are provided to female kakapos to increase breeding success and small amounts of a favorite supplemental food (sunflower seeds)

have been provided at sites in Costa Rica to encourage released scarlet macaws to remain in the release area. Another intervention that may be required in human modified habitats may be providing artificial nesting sites, since large trees with natural cavities may be scarce (all three projects described in Brightsmith, et al. 2005 provided artificial nest boxes).

This may – or may not – be the optimal approach for reintroducing scarlet macaws under the conditions in El Salvador (see Chapter 4). SalvaNATURA biologists will have to determine that. Considerable reflection, debate and experimentation will be needed before the appropriate situations and appropriate protocols for semi-wild releases can be set down. However, as truly wild places distant from human threats and human-associated predators such as feral cats and rats become more and more rare, the semi-wild release approach and the continued management of otherwise wild populations (see next section) may be the only way for some species to persist in such modified habitats.

10.6 Managed Populations

Because of human population pressure and attendant problems such as feral cats, habitat destruction, unbalanced ecological conditions, lack of nesting sites, and so on, some populations of birds, including macaws and other psittacines, may only continue to persist if they are managed. This is certainly the case with many other species in worldwide human-modified landscapes, e.g., provision of hay to bison and elk during winters in the United States. Some management measures may need to be continued indefinitely if the program is to be ultimately successful, so this should be taken into account before deciding to invest resources in a program. A number of management measures are described below. However, along with species management, environmental education to create more environmentally friendly attitudes and better enforcement of laws are very important. Without them, the technical management measures may only be holding actions.

- Anti-poaching measures. Just the presence of WCS-Guatemala personnel has drastically reduced poaching pressure on scarlet macaws in the Petén.
- Provision of sanctuaries surrounded Provision of sanctuaries surrounded by anti-predator fencing as is done, for example, in New Zealand and may be needed for survival of the Bahama parrot.
- Periodic treatment of nesting cavities to prevent Africanized bee infestations or high levels of parasites that reduce chick survival. For example, periodic treatment to prevent Africanized bee infestations may be required in some of the WCS monitored sites in the Petén and in locations in Bolivia where Bolivian NGO Armonía is working with blue throated macaws (*Ara glaucogularis*).
- Predator control measures may be required when predator levels are so high as to threaten the survival of the targeted population. This may be the case in the El Perú site where high population levels of forest falcons (*Micrastur spp.)* may be drastically reducing fledging rates of scarlet macaw chicks. Such control measures may be non-lethal such as modifying nest cavities or nest boxes so the falcons cannot see the chicks, or may occasionally involve lethal measures. Lethal measures and distant relocation of predators has been used in the Puerto Rican Parrot Recovery program.

- Increasing or maintaining the number of breeding sites through provision of nest boxes (e.g., for scarlet macaws in the Petén and for blue throated macaws in Bolivia), increasing the number of cliffside nesting holes (e.g., red fronted macaws in Bolivia), or targeted protection of nesting trees. The latter was attempted in Costa Rica for protecting large dipteryx trees (*Dipteryx panamensis)* used by great green macaws (*Ara ambiguus*) but the program was unable to continue the practice of paying landholders not to cut down the trees.
- Local habitat modification such as planting of additional food trees (an example is the Curú wildlife refuge in Costa Rica) or the creation of additional "forest islands" in periodically flooded landscapes in Bolivia as Armonía is considering..
- In some instances, provision of supplemental food during times of low food availability. In Brazil, Lear's macaws (*Anodorhynchus leari)* have taken to raiding farmers' cornfields to supplement their diet of Licuri palm nuts. A program has been instituted to give farmers sacks of corn to replace the corn destroyed by the macaws. This program will only be successful as long as the corn payments are continued. Some other program of providing supplemental food to the birds while increasing the availability of natural foods might have more long term impact.

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