Species Management Plan: Yellow-shouldered Amazon Parrot, *Amazona barbadensis*, Dutch Caribbean

1. Key Information and Recommendations for Managers

1.1. Conservation goals
   I. Rapidly increase the population growth rate to increase population size thereby decreasing vulnerability and maximizing retention of genetic diversity.

   II. Develop strategies to mitigate the likely impacts of environmental change resulting from global climate change.

   III. Mitigate the consequences of historic habitat loss and degradation while also implementing conservation management to restore habitat structure and plant diversity in the long-term.

   IV. Reintroduce the species to Aruba.

   V. Increase the effectiveness of existing protected areas and legislation; and stimulate the creation of new protected areas.

   VI. Change attitudes towards parrots and build community support for parrot conservation.

1.2. Key aspects of ecology
   • Found in several isolated populations including Venezuelan mainland and islands, Bonaire and formerly Aruba. On Bonaire population estimated to be at least 800 birds and increasing. Yellow-shouldered Amazon Parrots move seasonal on Bonaire probably to track available food.

   • Long-lived species with corresponding life history traits: e.g.: long-lived adults, single breeding attempts per season, few offspring, delayed maturity. Consequently changes in adult survival are therefore the most important determinants of population fluctuations and populations are slow to recover from perturbations.

   • Habitat degradation has caused the loss of nest cavities and plant diversity. Low nest and/or food availability could be a key limit for population growth.

   • Habitat degradation probably leads to observed seasonal movements to urban areas for foraging which in turn leads to conflict with humans.
1.3. Species management recommendations

Threat mitigation
- Boost population growth rate and address nest site limitation
- Reduce poaching

Habitat protection
- Grow plants for rural and urban restoration projects
- Secure strategic locations for restoration
- Control herbivores

Legislation
- Encourage increased implementation of legislation
- Develop additional protected areas

Surveillance and enforcement
- Reduce poaching

Outreach and education
- Increase awareness of habitat degradation
- Change community attitudes towards parrots

Research and monitoring
- Improve understanding of population dynamics
- Maximize out-breeding
- Identify key locations for habitat restoration
- Investigate the distribution of parrots and their food

Other recommendations
- Reintroduce YSAP to Aruba
- Increase National Park management organization capacity
- Maintain the YSAP management plan process
2. Background

2.1. Introduction

2.1.1. Conservation value
Parrots are an easily recognizable and charismatic group of birds that nature enthusiasts and the general public often wish to see. These features combined with the Yellow-shouldered Amazon Parrot’s (YSAP) large size and local familiarity make it an excellent flagship species for the dry forest ecosystem. Furthermore parrot viewing presents a great opportunity for eco-tourism and education.

Due to the apparent decline of the species in Venezuela as a result of intense poaching pressures (Rodrigues-Ferraro, 2009), Bonaire is an important stronghold for the long-term conservation of the YSAP globally.

Parrots are known to play important roles in other ecosystems and are likely to also do so on Bonaire.

2.1.2 Cultural value
Historically Bonaireans have kept YSAPs as pets, and people are widely familiar with parrots. Distinction between wild parrots and parakeets may be difficult for some members of the public, which may reduce or increase the cultural value (through perceived over abundance or more frequent sightings respectively).

The pride campaign of the early 1990s and the pet registration, which followed, has resulted in a high level of awareness among the general public of the YSAP’s protected status.

Poaching continues and is a source of revenue for poachers on Bonaire. No perceived monetary value is apparently given to feral parrots on Curaçao (Hoetjes and Van Baren, Pers. Comm.).

The YSAP is also an important part of Bonaire’s national identity having been caricatured or depicted in a carnival parade, as the mascot for the children’s softball team, and recently as Miss Bonaire’s beauty pageant costume.

2.1.3. Vulnerability
The YSAP is considered vulnerable to the threat of extinction (Birdlife, 2012). This status results from a complex range of extrinsic threats and intrinsic limits to recovery.

Historic habitat degradation leads to reduced food and nest-site availability, which in turn appear to drive “wilderness”/rural to urban to movements (Williams, 2009). In urban areas the YSAP are exposed to novel threats such as collisions with vehicles and buildings.

Urban foraging parrots eat from garden fruit trees, creating conflict and widespread negative attitudes towards parrots (Parks, 2010; Extra, 2012 – Appendix 1.). Conflict which lead to persecution of YSAP is reported as a significant contributing factor to the species’ extinction on Aruba (Voous, 1983).
Habitat degradation compounds the impact of drought periods where historically the YSAP population has suffered considerable mortality (Voous, 1983). Such events may become increasingly common with global climate change.

In addition to the usual range of environmental threats parrots are desired as pets worldwide because of their beauty, intelligence and charisma. Consequently parrots are collected from the wild, typically as chicks, to supply this trade.

Parrots nest in tree and cliff cavities, which offer protection, however, some are still predated by introduced cats and rats (Williams, 2009).

Bonaire's parrot population has experienced significant impacts since humans colonized the island and the population is now very small. It has also been maintained at a low level for many 10s of years. Consequently there is a strong chance that the population's genetics are compromised.

The number of breeding birds (the effective population size) in Bonaire's parrot population is also low. This creates a serious further limit to the population's ability to recover from threats (Williams, 2009).

Parrots exhibit classic slow life history traits: long-lived adults, single breeding attempts per season, few offspring, delayed maturity. These traits result in the YSAP, and parrots more generally, being highly vulnerability to the risk of extinction (Bennett and Owens, 1997). The YSAP's vulnerability increases the urgency with which strategic management actions need to be developed.

2.2. Ecology
2.2.1. Historic overall range and distribution
The YSAP is found in several isolated populations across the Southern Caribbean region. The disjunct distribution includes populations in costal areas of Venezuela and the Venezuelan islands of Margarita and La Blanquilla.

In the Dutch Caribbean the YSAP is currently extinct on Aruba, although a few individuals that have either been released or escaped from captivity do exist (D. Marquez, Pers. Comm.), and extant on Bonaire. Curiously there is only one vague suggestion from 1782 of YSAPs ever being present on Curacao (Voous, 1983). In recent years a population of escaped and released birds originating from Venezuela and Bonaire has established itself on Curacao (Newton, Pers. Comm.).

Previously the subspecies Amazona barbadensis rothschildi was described based on traditional taxonomy. i.e. without genetic analysis (Low, 1981). This species was reported to be found on the Isla Margarita, La Blanquilla, and Bonaire. However this ‘traditional’ taxonomic classification was considered invalid, and/or inadequate by Juniper and Parr, 2003. Initial genetic studies indicate that the mainland Venezuelan populations are more closely related to those on the nearby islands of Isla Margarita and La Blanquilla than to those on Bonaire,
suggesting that there is little, if any, exchange between Bonaire and other populations (Rodrigues-Ferraro, Pers. Comm.).

Colleagues on Curaçao who have handled parrots of Venezuelan and Bonairean origin maintain there are physical differences. Unfortunately data to support this is however lacking.

Parrots around the world are in decline and it is difficult to determine how large the various YSAP populations would have been. In the Bahamas Columbus had the privilege of seeing flocks of parrots so large they would “obscure the sun” (Williams and Steadman, 2001). In Australia several parrot species are not in decline and there too they are incredibly abundant. Nonetheless it is impossible to know the historic population size of YSAP. It does, however seem probable that the current overall population could be orders of magnitude smaller than it once was.

2.2.2. Current overall range and distribution

With the exception of the YSAP’s extinction from Aruba their range is broadly the same as historically found (Figure 1.). It is believed that mainland populations are in decline but estimating mainland population sizes is difficult. This challenge also hinders a global population estimate. The Venezuelan eastern mainland population might be in the hundreds and although the western mainland population is possibly larger, little data is available (V. Sanz Pers. Comm. to R. Martin).

Having previously recovered to over 1,900 parrots (Sanz and Grajal, 1998), Venezuela’s largest YSAP population on Isla Margarita has apparently decreased again because of intense poaching (Briceño-Linares, 2011). The island populations on Isla Margarita, La Blanquilla and Bonaire are relatively well studied and hold approximately 1600 (Briceño-Linares, 2011), 80 (Rodríguez-Ferraro and Sanz, 2007), and 800 individual parrots respectively (DROB, 2012).

-Seasonal variability

In the past parrots rarely visited urban areas on Bonaire but were typically seen in northern “natural” areas such as Fontein, Dos Pos, Wasao, Juwa and Put Bronswinkel (R. Hensen, on Bonaire from 1981-1996, Pers. Comm.). Activity at urban or rural YSAP roosts in 2007 and 2008 was shown to correlate with the previous month’s rainfall (Williams, 2009). YSAP visit urban areas following periods of little or no rain.

YSAP movements are believed to be in response to habitat degradation and the resulting low food availability. YSAP show a preference for rural areas when there is food available. A phenological study is needed in combination with further urban and rural roost counts to investigate whether food availability does indeed drive this migration.
Figure 1. Current distribution of the Yellow-shouldered Amazon Parrot (indicated by arrows) across Bonaire, La Blanquilla and Isla Margarita and in eastern and western coastal areas of Venezuela, and Mainland South America (World Parrot Trust).

-Dispersal / migration patterns
Colleagues on Aruba suggest that movement between mainland populations and Aruba is very infrequent or not occurring (D. Marquez, Pers. Comm.). There are no records (but also no data being collected) of dispersal or migration of this species to or from Bonaire (or indeed Curaçao). However, given the species is present on Bonaire today we cannot discount this may occur occasionally.

2.2.3. Habitat
-Special habitat requirements: YSAP require cavities in large trees or in rock cliffs for nesting.

Large mature trees are preferred by the YSAP for roosting. More generally YSAP abundance is positively correlated with habitat maturity (a greater density of large, trunk diameter, and tall trees, and greater coverage from trees; Williams, 2009).

YSAP are able to feed and live seasonally in urban environments, however seasonal variation in roost site use indicates a preference for rural areas. The vast majority of observed breeding also occurs in rural areas (Williams and Martin, 2010). This most probably results from a lack of suitable nest cavities in urban areas.
**-Habitat availability:** Large areas of apparently undisturbed rural areas remain on Bonaire, however habitat degradation has reduced the number of mature trees, plant diversity and therefore ecosystem function (De Freitas et al., 2005). Habitat degradation has occurred in several forms that impact the YSAP:

- Historic loss of trees to logging.
- Introduced herbivores (goats, donkeys and pigs; hereafter: herbivores) have virtually halted regeneration of edible species and dramatically reduced plant diversity across the island. Several plant species negatively impacted are food and/or nest trees for parrots.
- Nest destruction by poachers who cut open trees to access chicks, preventing future use. Anecdotal tales from an ex-poacher suggest that poachers formally used different techniques to ensure nests remained intact for future breeding attempts (that could be poached; B. Frans, Pers. Comm.).

De Freitas et al. (2005) provide an illuminating account of anthropogenic impacts on the habitat, which is worth quoting here:

“During the second British interim government (1807-1816) exploitation of wood was so devastating, that hardly any trees were left (de Hullu 1923). Euwens (1907) indicates the disappearance of areas with dense cover of trees. In the course of the 19th and 20th centuries several official acts and resolutions were emitted, with the purpose of controlling the felling of trees, char-coal burning, collection of Caesalpinia coriaria pods and grazing by introduced mammals (Van Grol 1942; Westermann & Zonneveld 1956). However, the impact of these measures was limited due to the fact that they were not enforced and did not apply to private lands.”

Historic images also provide enlightening insights into the habitat that Bonaire had prior to colonization by Europeans. In Image 1 (below) it is possible to see a huge Lignum Vitae (Guaiacum officinale) from 1906-1910 on Klein Bonaire. This slow growing hardwood tree would have probably taken hundreds of years to reach this size, particularly as it was virtually growing out of rock. Such incredible trees would probably have been widespread across Bonaire. Parrots use Lignum Vitae as a nest tree and close inspection of this picture reveals what appears to be a perfectly sized nest entrance!

Different plant species respond differently to rainfall, for example Kibrahacha flowers within days of rainfall and then rapidly fruits whereas Calabash may take several weeks to produce fruit. Plant species able to withstand herbivore grazing have become dominant across the island whereas the regeneration of (herbivore) edible plants has all but stopped. The loss of plant diversity results in reduced variety and seasonal availability of different food items for the parrots. The migration of parrots from rural to urban areas is believed to occur when the food availability in rural areas is low (Williams, 2009). In urban environments YSAPs feed on native and introduced tropical plants (Lignum Vitae, Sea Grape, Mango and Almond). These are often in gardens which receive run off water or are irrigated.
Image 1. A mature Lignum Vitae on Klein Bonaire in 1906-1910. Few comparable trees remain even on Bonaire and there are none on Klein Bonaire. Note the perfectly sized parrot nest cavity! (Collection Tropenmuseum).

2.2.4. Life history outline
-Survivorship
Return rates: Information not available.
Juvenile survivorship: The exact rate of YSAP post fledging survival is unknown. Two of 68 ringed chicks that fledged from monitored nests have subsequently been discovered as pet birds (Pers. Obs.). There is also anecdotal evidence for additional undetected collection of fledglings. In 2011 four wild fledglings were found injured in urban areas. These losses are significant because of the life stage and because they represent mortality for the wild population.

Adult survivorship: No records exist for adult survival of wild individuals. In captivity Amazon parrots are claimed to have lived until 75, 99 and 117 years of age (Brouwer et al. 2000). These are most likely exceptional case. Wild YSAP are more likely to live for approximately 40 years.

-Breeding: YSAP pairs are socially monogamous and widely believed to be sexually monogamous. Pairs remain together over consecutive years, apparently maintaining their pair bond through the non-breeding season. They demonstrate high nest site fidelity and will exclude other pairs from the immediate vicinity of their nest in the breeding season (Martin, 2009; Williams, 2009, throughout this section).
Specific habitat requirements: YSAP require large cavities in mature trees or in
cliffs to breed. Both of these are typically found in the north of Bonaire, however breeding in an urban environment has been observed. In this single case the tree fell following use but a nest box erected in the vicinity was used in a following year.

**Seasonality:** Egg laying is reported to have occurred year round but typically takes place during May (Mellink. and Molina, 1984).

**Clutch/brood size:** Each year the female lays one clutch with an average of 2.93 eggs (n=117 nests; Williams and Evans 2010). The number of incubated eggs and chicks can range from one to five. On very rare occasions a second clutch following the early failure of the first clutch may occur.

**Productivity and breeding success:** Offspring mortality during nesting can result from introduced predators, native and introduced competitors, infanticide and poaching. Just under half of the nests monitored over the past six years successfully fledged at least one chick (n=64 nests). The pairs in those successful nests produced 1.89 chicks on average (Williams and Evans 2010).

**Growth and development of young:** YSAP chicks are helpless at hatching. They develop over two months before fledging. In the first two weeks they are brooded and fed only by the breeding female. After that time they are not brooded and the breeding male may also feed them. As with most bird species, recent fledglings are vulnerable because of their inexperience. They remain dependent on their parents for an unknown period of time (probably several months), and can be seen, sometimes even soliciting food from parents, at the nest in the following breeding season. Juveniles will remain in the company of siblings in their first years and sexual maturity is delayed. First breeding is unconfirmed but may be between four and eight years of age. Successful first breeding may possibly be some years later.

### 2.2.5. Feeding

**Primary food sources:** YSAP eat the flowers, fruit, seeds, bark and leaves of a wide variety of plant species both native (e.g., Lignum Vitae, West Indian Cherry and Mesquite) and introduced (e.g., West Indian Mahogany, Kenepa and Tan Tan; Voous, 1983; Ligon, Pers. Comm.; Pers. Obs).

**Seasonal variation:** YSAP are opportunists with respect to food availability. They do show selective preference for fruits such as introduced Mangos and native Calabash, when available, but they are not restricted to one food item.

**Food availability:** Historically the structure of the dry forest habitat on Bonaire, Aruba and Curacao was very different prior to human settlement (Nooren, 2008). In relatively recent times the parrot population on Bonaire has experienced extreme food shortages in drought periods (Voous, 1983). Such droughts are reported to cause high mortality (50% of the population; of both juveniles and adults presumably) despite attempts to provide food for starving birds (Hackenberg, Pers. Comm.). Breeding was probably not attempted during these periods. Population bottlenecks (when the number of individuals declines significantly) are particularly important for small populations as they can lead to compromised population genetics.
2.3. Threats - External factors

2.3.1. Physical

- **Global environment:** It is not possible to accurately predict how global climate change may impact Bonaire’s terrestrial ecology. There may be sustained environmental changes; or stochastic events may occur with increased frequency or intensity.

Sustained changes in climate towards a hotter and drier climate would surely lead to a reduced productivity and potentially lower survival. Considerable mortality has been observed during drought periods (Vous 1983). Such changes, pose a very important threat to YSAP population viability because of its small population size and intrinsic limits to recovery. These effects are likely to be buffered by the elimination of non-native herbivores and reforestation efforts on Bonaire.

2.3.2. Biological

- **Habitat loss:** There has been significant loss of habitat (coverage) to date. This has primarily been for the development of urban areas.

Much of the remaining habitat within and surrounding existing urban areas is degraded but if restored could potentially have a high ecological value for parrots.

Current rates of habitat loss on Bonaire are relatively low. A goal of Bonaire’s “Island Master Plan” is to increase the human population from the current 15,000 to 25,000 over the next 10 years. Fortunately a Zoning Plan has been produced and development will not be possible in important parrot areas under the current zoning. This plan is, however, reviewed every five years.

- **Habitat degradation:** The various forms of habitat degradation have important impacts on Bonaire’s YSAP population.

The historic loss of structurally mature habitat has broad impacts on the YSAP population on Bonaire. The spatial abundance of YSAP is associated with habitat maturity (Williams, 2009). More parrots are found in areas where tree canopy coverage and the size of trees are greater.

The historic loss of large trees has also caused a reduction in the availability of tree nest sites, which is believed to now limit the population.

Nest trees have been cut open by some poachers to access chicks. This shortsighted action reduced the long-term availability of nest sites. The number of damaged nest trees appears to depend on the area with more along side roads than in more remote areas.

Further nests may be cut open by poachers, however, the incidence of ongoing nest destruction is considered small.
The loss of plant diversity has broad impacts on the parrot population. YSAP on Bonaire are known to migrate seasonally between rural and urban areas with as much as 80% of the population (size estimated using roost counts) moving from rural to urban areas in periods of apparent low food availability. The behaviour of these birds is very different from the behaviour of individuals actively breeding and thus this group is considered a non-breeding contingent.

Where YSAP have been observed breeding, clutch size is larger in areas of greater food resource and proximity to a food hotspot (Williams, 2009), and chick growth is greater when supplemental food is provided (Dunn, 2009).

The different forms of habitat degradation (tree loss and reduced plant diversity) appear to limit the number of breeding birds, through either a limit of nest sites or food resource. Habitat degradation is therefore a very important conservation issue.

- **Introduced and native nest competitors:** Parrots face competition for nest sites from introduced European honey-bee (*Apis mellifera*), the indigenous Pearly-eyed thrasher (*Margarops fuscatus*) and other parrot pairs. Bees and Thrashers are found throughout parrot breeding areas. Of the 80 nests monitored over the past six years bees have taken over seven, and thrasher interference prevented breeding in three nests. Both these competitor species have also been observed causing chick mortality. Competition with other parrot pairs may not prevent a breeding attempt but infanticide has been observed, thus reducing productivity.

- **Potential food resource competitors:** The diet of the Brown-throated Conure and the introduced Troupial overlap with that of the YSAP. Both species are widespread and abundant and may compete for food resource, however no data is available on the possibility or extent of such competition.

- **Introduced predators:** Exotic rats and cats cause egg and chick mortality. Losses to predators may be as high as 30%, however it is very difficult to determine the source of egg and chick mortality and other factors probably also contribute. Clear cases where a predator can be confirmed are rare although rat droppings have been found in tree nests and cats have been photographed visiting nests at the time chicks were killed.

2.3.3. Anthropogenic

- **Poaching:** In the past 10s of years poaching on Bonaire has been intense. Since 2002 the level of poaching has apparently reduced (but not eliminated) thanks to a world leading pet parrot registration campaign and ongoing law enforcement.

Approximately 30% of chicks reaching fledging age (i.e. 62 days old) are lost to poaching, from nests monitored in the last 6 years. Furthermore some nests are poached annually. In 2008 and 2009 there were also cases of inexperienced fledglings being collected from gardens and telegraph wires in Rincon (Montanus, Pers. Comm.; Pers. Obs.).
The market for parrot chicks from Bonaire was believed to be Bonaire and neighbouring Curaçao. The latter represents a potentially much larger market with its human population of 142,000. The discovery of a large collection of parrot and conure chicks in 2011 however suggests international trade is also occurring.

Awareness campaigns have been conducted on Bonaire regarding the parrots for over a decade. These have contributed to a generally high level of awareness. Even so a remarkable 45% of fruit growers, interviewed as part of a 2010 parrot/human conflict study, said they did not know of the parrot’s endangered status (Parks, 2010).

**Conflict:** Crop (fruit) eating parrots feature worldwide in human-wildlife conflict (Parks, 2010). The persecution of crop eating parrots on Aruba contributed to their extinction (Voous, 1983), and at one time on Bonaire there was a bounty on parrots (B. Frans, Pers. Comm.).

Increasing numbers of YSAP are visiting urban areas and this is occurring for increasingly long durations than previously seen (De Meyer, Henson, Montanus, Pers. Obs.). This could be attributed to a growing YSAP population combined with habitat degradation.

Attitudes towards parrots are generally negative among fruit growers with 55% (n = 44) of those interviewed disliking or strongly disliking parrots in their gardens (Parks, 2010). Negative attitudes towards the parrots are also found in the close-knit community, as perfectly demonstrated by a recent Article in Extra newspaper (Appendix 1). This has the potential to lead to a resurgence in poaching and persecution. Furthermore negative attitudes may also undermine other (parrot) conservation efforts. Persecution of adult parrots has occurred previously (8 parrots in 2006 and various anecdotal reports in 2010, one shot parrot rescued in 2012; Pers. Obs.).

**Novel causes of mortality:** YSAP are vulnerable to anthropogenic threats in urban areas such as collisions with vehicles, windows or electricity wires. This has involved nine parrots between 2006-2009, and six parrots within four months of 2011 and 2012, four of which were recent fledglings Pers. Obs.

Mortality in urban areas may be specific to a particular age class such as juveniles and non-breeding adults but there is a lack of data to determine this. Although there are fewer such threats in rural areas the detection of mortality is also likely to be much lower.

**2.3.4. Assessment of threats**

Threats identified in this section were scored on their extent, impact and permanence and then ranked following an adaptation of WWF’s RAPPAM method. See Table 2. below for scores and Appendix 2 for more details on the methodology.
## Table 1. Threats and data needs for YSAP management on Bonaire sorted by threat priority.

<table>
<thead>
<tr>
<th>Threat</th>
<th>Threat detail</th>
<th>Extent</th>
<th>Impact</th>
<th>Permanence</th>
<th>Score</th>
<th>Data needed to confirm possibility of threat</th>
<th>Data needed on extent or specifics of threat</th>
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<td>Global environment</td>
<td>Sustained environmental change</td>
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<td>4</td>
<td>4</td>
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<td>4</td>
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<td>Historic loss of mature trees</td>
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<td>Reduced plant diversity</td>
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<td>3</td>
<td>2</td>
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<td>Conure (Native)</td>
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<td>3</td>
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<td>Cats</td>
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<td>Collisions (juv. and adult mortality)</td>
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### 2.4. Status

#### 2.4.1 Population and intrinsic limits to recovery

- **Minimum viable population** – Not known

- **Population viability analysis**: Echo, is developing a population model for the Bonaire YSAP population through collaborations with researchers at the
University of Sheffield, UK, and Alterra researchers at Wageningen University, NL. However, the lack of post fledging survival data for this, or any parrot species, presents a significant gap, which limits the development of a population model.

- **Population trends:** There has almost certainly been a dramatic decline in YSAP population size since humans colonized Bonaire.

Population estimates have been made with the help of volunteers through simultaneous non-breeding season roost counts. These have taken place frequently since 1980 and almost annually since 1998 (Figure 2).

Although there are dramatic fluctuations in estimates the overall trend indicates the population is recovering. This is supported by several anecdotal reports of increasing YSAP numbers (De Meyer, Henson, Montanus Pers. Comm., Pers. Obs.).

The roost count methodology is well suited to rainy-season parrot behaviour where large numbers of parrots gather at known roost locations. The low vegetation on Bonaire also aids roost counting and vantage points can easily be found. Roost counts are a well-established, widely employed and accepted means to estimate wild parrot population numbers and trends (Casagrande and Beissinger, 1997; Snyder et al, 2000).

![Figure 2](image.png)

**Figure 2.** Estimates of YSAP population size using roost count methodology on Bonaire from 1980 to 2012

The use of roost counts to estimate the YSAP population size on Bonaire has recently been criticized because of “incomplete coverage of roost sites and imperfect detection of roosting birds” (Rivera–Milán and Simal, 2009). It is also recognized that count event preparation and volunteer experience influence the estimate. Moreover the weather preceding the count event can dramatically influence parrot distribution and may lead to considerable underestimates of
population size. This margin of error can be as high as 57% between years (2005 and 2006). As the direction of the potential error is an underestimate roost counts are generally deemed conservative.

One of the key elements with the roost count technique is that it is standardized and thus when used consistently provides a means to assess population trends. On Bonaire new (to the data set) roosts have appeared (or become re-active) and have been added into the annual count. Count organizers (DROB, STINAPA and formerly Salba Nos Lora but since 2012 Echo) were happy to include these roosts as it was believed that these new roosts were unlikely to have remained undetected for several years given the obvious nature of a large parrot roosts, the community’s high awareness and the extent of recent fieldwork conducted by parrot biologists. The use (or re-use) of new roosts would correspond with a growing population but the uncertainty in this assumption relates to the criticism of incomplete coverage made by Rivera–Milán and Simal. If so wished it would of course be possible to exclude such new roosts from the data set for a between year comparison of a sub set of known roosts.

Recent work by Rivera–Milán and Simal has been conducted using distance sampling and count-removal techniques. This approach has yielded much higher population estimates (Table 1). These methods could be useful for establishing relative estimates of population size and detecting trends but they are less effective for making estimates of absolute population size as they have produced wide confidence intervals. As with roost counts this methodology is not perfect and concerns have been raised with Rivera–Milán and Simal’s approach, particularly the sample design and data collection (Saunders, 2011). Unlike roost counts the distance and removal count approach is not conservative and can produce overestimates of population size. This is concerning on Bonaire where there is a considerable risk of exaggerated population estimates leading to increased negative attitudes towards parrots.

**Table 2.** Population estimates and confidence intervals for distance and removal counts of Yellow-shouldered Amazon Parrots on Bonaire (Rivera–Milán and Simal, 2009, 2010a, 2010b).

<table>
<thead>
<tr>
<th>Report</th>
<th>Technique</th>
<th>Estimate</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>Range between Lower and Upper CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec-09</td>
<td>Distance</td>
<td>2872</td>
<td>1757</td>
<td>4694</td>
<td>2937</td>
</tr>
<tr>
<td>Dec-09</td>
<td>Removal count</td>
<td>2981</td>
<td>1938</td>
<td>4583</td>
<td>2645</td>
</tr>
<tr>
<td>Mar-10</td>
<td>Distance</td>
<td>2829</td>
<td>2083</td>
<td>3842</td>
<td>1759</td>
</tr>
<tr>
<td>Mar-10</td>
<td>Removal count</td>
<td>2895</td>
<td>2079</td>
<td>4033</td>
<td>1954</td>
</tr>
<tr>
<td>Dec-10</td>
<td>Combined</td>
<td>3322</td>
<td>2572</td>
<td>4291</td>
<td>1719</td>
</tr>
</tbody>
</table>

**Effective population size**

Effective population size (the number of individuals in a population that breed) is important for population growth, particularly in species such as parrots with a slow life history (low productivity). On Bonaire, the clumped distribution of
known nests, correspondingly large areas of low nest density and the high proportion of apparently non-breeding individuals in urban areas during the breeding season suggests the effective population size is small (Williams, 2009). In other parrot populations the effective population size has also been observed to be small (approximately one tenth of the total population; Gilardi, Pers. Comm.), however those populations may also experience limiting factors. The relative importance of the factors that impact upon Bonaire’s YSAP population depend on whether the observed small effective population size is a natural or limited state.

If the Bonaire YSAP’s effective population size is limited there are four potential casual factors
a. Population sex ratio,
b. Population age structure,
c. Nest site limitation,
d. Food resource limitation.

Points c. and d. are discussed above, so only points a. and b. are discussed further here:  

a. DNA analysis of 129 chicks between 2006 and 2007 indicated that sex ratio was equal (67M/62F) and consequently the broader population sex ratio is not believed to be a concern.

b. A large non-breeding contingent could be the result of an elderly or immature population. Little is known from wild populations but captive Amazon Parrots are typically at least three or four years old before they first breed and there is no data on when breeding ceases in wild parrots. Furthermore there is no data on the YSAP population age structure on Bonaire. It is likely that until the early 2000s the population was aging because of the intensive poaching of chicks. Since that time the population has grown adding more (temporarily non-breeding) juvenile birds as the parrot population. So while the total population size may have increased the effective population size probably has not.

The relative importance of different threats depends on whether effective population size is limiting. If it is limiting then nest site competition would prevent YSAPs in the non-breeding contingent from becoming breeders. By contrast the poaching of chicks under the same conditions only prevents additional individuals entering the non-breeding contingent. Poaching would therefore not be the key limit to population growth. Low productivity does remain important in the long-term because future breeders are needed, however it may not be the key factor limiting the population at this moment. Determining whether effective population size is limiting, as suspected, is of critical importance for YSAP conservation management.

- Population genetics: Bonaire’s parrot population has experienced frequent population bottlenecks, where the population has been reduced to a small number, due to high mortality during drought periods. This may have led to inbreeding depression, which appears the most likely factor driving the observed poor hatchability (the number of viable eggs that hatch; 78%; (Richards, 2010,
Williams and Evans, 2011). This measure is typically much higher in other birds (92%; Koenig, 1982).

Inbreeding depression is an intrinsic limit that would rank highly (if scored with threats) as it has moderately high extent and impact, and presents a long-term management challenge. If inbred pairs are breeding when other out-bred pairs could then this is a high-priority limit to address.

Endangered species populations are prone to having low genetic diversity. This is recognized an important constraint that can, for example, effect the populations resistance to disease or ability to adapt to large scale changes (Frankham, et al. 2004).

2.4.2. Conservation
-Protected areas
The only protected area where the parrot is found on Bonaire is the Washington-Slagbaai National Park. However, the National Park actually does not currently provide any protection to the YSAP and threats to the population are consistent inside and outside the park. The National Park is recognised in the BirdLife Important Bird Area (IBA) program. There are also two IBAs outside the park that are important for parrots. These are Dos Pos and Washikemba-Fontein-Onima. These do not however, offer any legal protection.

-Management actions

Salba Nos Lora: Annual parrot count, Protected status awareness campaign (posters), Tree Planting

STINAPA: Annual parrot count, distance estimates, Education in schools, Fencing of Slagbaai completed in 2009, enforcement of protected status (along with Police and others).

Echo: Population monitoring, Nest site management (reduced entrance size to prevent cat predation, removal of bees), Provision of nest boxes, native plant propagation, development of tree awareness campaign and monitoring in progress, rescue and release of confiscated or injured YSAP.

2.4.3. Legal status
-International
The YSAP is protected internationally by the Convention on International Trade in Endangered Species - CITES (Appendix I) and the Specially Protected Areas and Wildlife protocol - SPAW (Annex II). The recent passing of a ministerial decree in the Netherlands makes it possible for customs officials on Bonaire to now enforce CITES.
Although the YSAP’s protected status is recognized on Curaçao and there has been a ringing program for pet birds, there has not been any enforcement. On Aruba there is no ratified environmental protection law but this is in progress.

-National
On Bonaire the YSAP receives local protection under the Island’s Nature Ordinance. The YSAP has been protected by law since 1952, however, a number of early studies (c1980s-1990s) found that the poaching of chicks continued to occur.

A Pride campaign selected the YSAP as the focal species (Scholtens, 2001) and this built support for a world leading conservation measure in 2002: an illegal pet parrot amnesty and registration (Montanus, 2003). All captive parrots at that time were registered and ringed. If a person was subsequently found to have an un-ringed parrot the bird could be confiscated and the person prosecuted. In 2009 the parrot’s protected status was enforced and confiscations of un-registered (un-ringed) pet parrots were made. It is intended that there will be further enforcement.
3. Species Management Plan

3.1. Conservation Goals

3.1.1. YSAP conservation vision:
A stable population of Yellow-shouldered Amazon Parrots maintained by restored habitat throughout its historical range, safeguarded by a network of protected areas, legal protection and the support of local communities.

3.1.2. YSAP management goals
To achieve the conservation vision it will be necessary to:

VII. Rapidly increase the population growth rate to increase population size thereby decreasing vulnerability and maximizing retention of genetic diversity.

VIII. Develop strategies to mitigate the likely impacts of environmental change resulting from global climate change.

IX. Mitigate the consequences of historic habitat loss and degradation while also implementing conservation management to restore habitat structure and plant diversity in the long-term.

X. Reintroduce the species to Aruba.

XI. Increase the effectiveness of existing protected areas and legislation; and stimulate the creation of new protected areas.

XII. Change attitudes towards parrots and build community support for parrot conservation.

3.2. Conservation Objectives

3.2.1. Objectives to address intrinsic limits to population growth:

i. Increase effective population size to boost population growth rate and maximize genetic diversity through experimental management of suspected limits.

ii. Improve understanding of population dynamics and limits through continuing the development of integrated population monitoring (See: Williams, 2012) and a population model.

iii. Ensure maximum representation of out-bred pairs through the investigation of breeding pair genetics and the development of management strategies if needed.

3.2.2. Objectives to address high priority threats (Table 2):

iv. Develop strategies to mitigate impacts of sustained environmental change scenarios that may result from global climate change.
v. Investigate the likelihood of increased occurrence or severity of droughts (resulting from global climate change) and the likely impacts of these on the parrots.

vi. Increase the ecological value of urban areas for parrots by planting a diverse range of parrot-important food trees across private and public areas.

vii. Safeguard the long-term/structural restoration of the dry forest habitat through ensuring legal and ground level protection of existing mature habitat areas and key trees.

viii. Increase nest site availability through the provision of nest boxes in the short-term and island wide dry forest habitat restoration in the long-term.

ix. Restore plant diversity initially in prioritized “wilderness” areas of dry forest habitat and ultimately across all forested areas through the propagation of native plants and control of mammalian herbivores.

x. Bring about a positive shift in attitudes towards parrots and their conservation among the local community through increasing awareness of ecological issues and supporting community members experiencing conflict with parrots.

xi. Determine the extent of competition for food resources from introduced troupials and native parakeets and if necessary develop and implement science-based mitigation strategies.

xii. Reduce demand for parrots as pets through increasing awareness and supporting enforcement of the parrot’s protected status; and reduce willingness to collect wild parrots through surveillance and enforcement.

3.2.3. Objectives to address other elements of the conservation goal or strategic management needs:

xiii. Restore the parrot to its former range through reintroduction on Aruba.

xiv. Build capacity for relevant conservation objectives identified in the plan in the National Park management organization on Bonaire.

xv. Encourage and support relevant capacity building in local government, police and customs to enable increased implementation of existing legislation.

xvi. Ensure management effectiveness and efficiency across the whole YSAP range through conducting a comparison of conservation actions, successes and lessons learned; and population demographics with other YSAP populations.
Maintain the species management planning process through periodically reviewing priority issues and management goals as additional information becomes available.

### 3.3. Management Options

Conservation practitioners on Bonaire are clearly not able to address climate change issues. However, investigating the potential impacts of these threats and possible mitigation strategies is possible. Rather than aim to conduct this research conservationists should stimulate the interest of research institutions in this topic and then facilitate a students research project. Such as study would also provide a better understanding of probable environmental changes, which would benefit management of other species and the ecosystem as a whole.

Investigating food resource competition should be dealt with in a similar way: by collaborating with an overseas research institute. This study would provide additional data on YSAP food resource requirements. This study would probably also benefit the endemic (to ABC) Yellow Oriole subspecies, which is believed to be in decline because of the troupial.

Improving the dialogue between managers working with the YSAP elsewhere in its range may be beneficial for the conservation of the species as a whole. This might be achieved through completing a report that compares conservation actions/successes/lessons learned and population demographics between Bonairean and Venezuelan populations.

Managers may also be interested to tackle lower scoring threats that were not given objectives, although several of the lower scoring threats will be mitigated in the long-term by addressing habitat issues. In the assessment, permanence was scored under the assumption that management actions would be taken for that threat. This presents a challenge because threats that can be managed quickly score poorly but in the absence of management they may become more permanent threats. Bee competition for parrot nests, for example, could be controlled quickly, however in the absence of management this threat will continue to reduce nest site availability. Bees can also be controlled easily and this is why Echo is in the process of addressing this threat.

Controlling introduced predators on the other hand would require considerable management and therefore not be a high value action for the purpose of protecting parrots alone despite a similar score to that given for bees. Predator control might be justified for the purpose of broader bird conservation with YSAP being a key component.

Dealing with YSAPs that have been injured either because of collisions or persecution has proven to be an important strategic component of Echo’s work. Parrot enthusiasts worldwide that follow Echo’s progress and provide financial support are very interested in these individual cases. As Echo now has facilities to accommodate confiscated parrots (a very different prospect to injured parrots) managing injured individuals is possible without great burden.
3.4. Working Together

With the transition from the former Netherlands Antilles to special municipalities of the Netherlands the responsibility for nature policy and management is changing. The Ministry of Economic Affairs, Agriculture and Innovation (EL&I) will now be ultimately responsible. They in turn delegate responsibility to the island governments of the Caribbean Netherlands.

Parties involved in parrot conservation on Bonaire include the:
• Dutch Caribbean Nature Alliance (DCNA)
• Echo
• Salba Nos Lora
• STINAPA
• Arikok National Park Foundation
• University of Sheffield
• Alterra
• CARMABI (indirectly involved because of their work on Bonaire's vegetation)

Despite the widely recognized limited capacity DROB’s achievements with policy and enforcement, specifically the pet registration campaign, have been crucial for the conservation of the YSAP. It is hoped this will be strengthened with the current restructuring.

Echo was founded in 2010 and is working to increase its capacity and funding security. Echo and their network bring research, hands on species conservation and parrot husbandry expertise to the island. The organization is developing their integrated population-monitoring program, science based adaptive management and outreach. Additionally Echo is involved with the rehabilitation and release of confiscated YSAP. Salba Nos Lora is no longer active and it has been agreed that “Salba Nos Lora” will become the brand of Echo’s Papiamentu outreach. Echo is collaborating with the University of Sheffield and Alterra.

STINAPA have stated an unwillingness to become involved in species-specific actions. Aspects of STINAPA’s bird monitoring is however, clearly focused on YSAP. Their efforts in habitat management contribute to addressing the habitat degradation threat facing the YSAP. STINAPA’s education program also features the YSAP and therefore contributes to greater awareness of the YSAP’s status. Furthermore STINAPA plays an important role in the confiscation and recovery of illegal and injured parrots.

3.5. Recommendations – 2012 to 2017

3.5.1. Threat Mitigation

*Boost population growth rate and address nest site limitation, Objective i. and viii., Echo*
Mitigate the loss of nest sites by increasing the provision of nest boxes to 30 per year, of various designs, over the next 5 years.

Repair damaged nest trees where known and then opportunistically where considered relatively safe from further poaching.

Mitigate food resource limitation by providing supplemental food in 10 locations over the next 5 years.

Use existing data on nest and food resource availability to stratify mitigation efforts thus maximizing effectiveness.

Monitor use of these resources and nest box productivity in relation to other variables e.g.: proximity to nearest roost sites, other nests, natural and supplemental food resource.

*Added value:* Nest boxes can be protected from rats, cats and bees, and easily monitored. Supplemental feeding may reduce the number of parrots in urban areas.

**Reduce poaching, Objective xii., Echo**

- Continue annual poster, radio and newspaper awareness campaign.
- Continue release program, making it possible to “accommodate” confiscated YSAPs.

*Added value:* The release program presents a great opportunity to develop parrot viewing for education and tourism. It can also be a strategic tool for raising awareness internationally. The release program has also resulted in the development of techniques that can be applied to reintroduction of YSAP on Aruba. Furthermore these otherwise dead-end birds can be easily managed and rehabilitated for release on Aruba.

### 3.5.2 Habitat protection

(Objective vi. *Reclaim lost habitat*; Objective vii. *Safeguard habitat structure*; Objective ix. *Restore plant diversity*)

**Grow plants for rural and urban restoration projects, Objective vi., vii., and ix., Echo**

- Increase capacity for nursery development and management.
- Increase the collection of seeds, at risk seedlings and cuttings for propagation, following Millennium Seed Bank best practice guidelines.
- Improve the functioning of the native plant nursery.

*Added value:* Involving the local community in the native plant nursery presents a great opportunity for outreach.

**Secure strategic locations for restoration, Objective vi., vii., and ix., Echo, D.U.P.S.D.**

Following identification of key areas – see 3.4.6. Research and Monitoring:

- Work with local government to secure strategic public urban areas, and to secure permission for exclusion fencing.
- Work with local government to secure a network of fenced areas that safeguard mature habitat, areas of important diversity and key tree species, while longer-term plans are developed.
- Maintain exclusion areas to ensure fence breaches are prevented or at least minimized.
Control herbivores, Objective vii. and ix., D.U.P.S.D., STINAPA, Echo
- Support efforts to remove herbivores from Slagbaai.
- Investigate options for part island herbivore control if island wide is not probable in the next 10 years, in particular fencing a few hundred meters from Gotomere to the coast to secure the areas of Labra and Brasil and fencing the existing 5km trail from Porto Spano to Witches hut, which would result in approximately 90km² of herbivore free habitat, without having to deal with the majority of "farmed" kunukus.
- Work with stakeholders to develop a plan for island wide herbivore control.

3.5.3. Legislation

Encourage increased implementation of legislation, Objective xvi., Echo
Explore where D.U.P.S.D.’s core interests overlap with the objectives of this plan, possibly: designating additional small protected exclusions areas and determine how to leverage funding or in kind expertise to support those objectives

Add value: Increasing Government support will benefit conservation in the long-term

Develop additional protected areas, Objective vii. and ix., D.U.P.S.D., Echo, STINAPA
- Advocate for protected status to be applied to parrot-important areas, including IBAs.

3.5.4. Surveillance and enforcement

Reduce poaching, Objective xii., Echo, D.U.P.S.D., STINAPA, Carmabi?
- Implement surveillance to catch poachers “red handed”.
- Explore how it might be possible to support enforcement of the YSAP’s protected status and the prosecution of offenders on Bonaire.
- Explore possibilities for increased surveillance by authorities on Bonaire and Curaçao in July, August and September when chicks are most probably traded.
- Explore possibilities for enforcement of existing laws on Curaçao.

Add value: Improving relations and awareness in the police force and customs may help the enforcement of other nature laws, particularly where there is poaching (Turtle and Conch). Developing a dialogue with relevant authorities on Curaçao could benefit Bonaire endemic Brown-throated Parakeet, which traded because it is more colourful than the subspecies found on Curaçao.

3.5.5. Outreach and education

Increase awareness of habitat degradation, Objective vi., vii. and ix., Echo, STINAPA - NME
• Continue education efforts to raise awareness of habitat degradation and its ecological impacts
• Encourage the planting of native trees in gardens and plant trees in secure public areas.
• Develop communication campaign to build support for area/tree protection. 
  
  Added value: Getting individuals directly involved with habitat restoration may cultivate increased interest in conservation and the value of nature.

**Change community attitudes towards parrots, Objective x, Echo, STINAPA-NME**

• Raise awareness of the consequences of habitat degradation for parrots.
• Realize the non-consumptive economical value of parrots through developing sustainable tourism that supports the local community.
• Develop a program to support local community members experiencing conflict with parrots, if possible without reducing the food resource available for parrots.
  
  Added value: Parrots make excellent flagship species for the dry forest ecosystem and can be used to promote a broader conservation message.

### 3.5.6. Research and Monitoring

**Improve understanding of population dynamics, Objective ii. (Echo, Sheffield, Alterra)**

• Continue development of integrated monitoring, which will monitor trends in population size and demographic parameters, threats, and management actions.
• Continue the development of the population model, which will be able to predict the impacts of management options on demographic parameters, along with a cost-benefit analysis of proposed management. The model should also estimate the population size required to be robust to threats, and enable ongoing data input.
  
  Added value: Population monitoring and indeed modeling presents great opportunities for outreach activities (a game model for outreach is currently being developed). Monitoring activities can also facilitate addition research interests.

**Maximize out-breeding, Objective iii., (Echo, Sheffield)**

• Develop a research project to investigate levels of inbreeding in different pairs, which can be compared to their hatchability. This would be a lab based MSc project building on the existing genetic data set and therefore would require catching breeding birds and sampling prior to the student’s involvement.
  
  Added value: If inbreeding causes the observed low hatchability the managing pairs will help boost population growth (if effective population size is addressed or is not a limit). Catching breeding parrots enables ringing which is required for integrated population modeling.

**Identify key locations for habitat restoration, Objective vi., vii. and ix., Echo, CARMABI.**

• Augment existing data to identify 30 mature, diverse or strategically important areas.
• Augment existing data to identify up to 100 large or important-but-locally rare individual trees.

*Investigate the distribution of parrots and their food*, Objective ix, Echo.
• Investigate whether the availability of specific plant species are of exceptional importance for parrots, through a combined phenology and YSAP distribution study.

3.5.7. Other
*Reintroduce YSAP to Aruba*, Objective xiv, Echo, Arikok National Park Foundation:
Complete a project plan including a SWOT analysis (White et al. 2012, in press) to examine the viability of species reintroduction on Aruba. The plan would include: extensive public relations campaigning to maximize the project’s value, preparing a cohort of parrots on Bonaire, ongoing population management and the long-term need for habitat restoration.

*Added value: Reintroduction presents a great opportunity to raise awareness of extinction and conservation. Creating a second population increases effective population size and presents further opportunities to manage population genetics. Demonstrating that confiscated birds can be released is a powerful message that can be important for parrot conservation worldwide.*

*Increase National Park management organization capacity*, Objective xv, DCNA
• Explore where the core interests of the National Park management organisation on Bonaire overlaps with the objectives of this plan, in particular: herbivore removal from Slagbaai, and determine how to leverage funding or in-kind expertise to support those objectives.

*Added value: Increasing the capacity of the National Park management organisation will benefit conservation in the long-term.*

*Maintain the YSAP management plan process*, Objective xviii, DCNA
• Repeat the process of compiling this species management plan for the YSAP populations in three years.
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Appendix 1. Clipping from Extra Bonaire on 27th March 2012

Approximate text translation: There are currently Loras in residential areas. It is nice to protect the lora, but who is protecting our things. A group of lora’s landed in a garden and destroyed a Mispel tree in less than 5 minutes. After that they just sat on the fence.
Appendix 2. Threat classification method

Threats in the Species Management Plan were scored out of 4 for their Extent, Impact and Permanence. These are then multiplied and the resulting score gives importance of that threat. This method is loosely based on WWF’s RAPPAM (Ervin, 2003)

**Extent** is the proportion of the population affected by the impact. The extent of an activity should be assessed in relation to its possible occurrence. For example, the extent of competition with another species would be assessed relative to the areas where the competitor is found.

- 4 = “Throughout” means that a threat affects 50% or more of the population
- 3 = “Widespread” means between 15 and 50% of the population is affected
- 2 = “Scattered” means between 5 and 15% of the population is affected
- 1 = “Localised” occurs in less than 5% of the population is affected

**Impact** is the degree to which a threat, either directly or indirectly, affects the affected proportion of the population. For example: Target species may severely impacted by predators where they occur (regardless of the fact that predators may only be found over 50% of the target species’ range).

- 4 = “Severe” impact is serious damage or loss to the target species population
- 3 = “High” impact is significant damage to the target species population
- 2 = “Moderate” impact is damage to target species that is obviously detectable, but not considered significant
- 1 = “Low” impact is damage that may or may not be easily detectable, and is considered slight or insignificant.

**Permanence** is the length of time needed for the population to recover with realistic conservation management for that threat when all other threats remain the same. Recovery is defined as the restoration of ecological structures, functions and processes to levels that existed prior to the activities occurrence at an impact moderate or above. Recovery time includes that taken for the activity to cease, for management interventions take place, and for natural processes to resume.

- 4 = “Permanent” is damage to a resource that cannot recover naturally, or with human intervention, within 100 years
- 3 = “Long term” damage can recover in 20 to 100 years.
- 2 = “Medium term” damage can recover in 5 to 20 years.
- 1 = “Short term” damage can recover in less than 5 years