Schaus swallowtail butterfly
(*Heraclides aristodemus ponceanus*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Southeast Region
South Florida Ecological Services Office
Vero Beach, Florida

5-YEAR REVIEW
Schaus swallowtail butterfly/*Heraclides aristodemus ponceanus*

I. GENERAL INFORMATION

A. Methodology used to complete the review: This review is based on monitoring reports, surveys, and other scientific and management information, augmented by conversations and comments from biologists familiar with the species. The review was conducted by the lead recovery biologist for this species with the South Florida Ecological Services Office. Literature and documents used for this review are on file at the South Florida Ecological Services Office. All recommendations resulting from this review are a result of thoroughly reviewing the best available information on the Schaus swallowtail butterfly (SSB). Comments and suggestions regarding the review were received from peer reviewers from outside the Service. No part of the review was contracted to an outside party. The draft of this review document was distributed for peer review (see Summary of peer review) and comments received were addressed. The public notice for this review was published on April 26, 2007, with a 60 day public comment period.

B. Reviewers
Lead Region: Southeast Region, Kelly Bibb, 404-679-7132

Lead Field Office: Phillip Hughes, South Florida Ecological Services Office, 305-872-2753

C. Background

1. FR Notice citation announcing initiation of this review: April 26, 2007, 72 FR 20866.

2. Species status: Stable (2007 Recovery Data Call). The primary threats to SSB at the time of listing and through the present are habitat loss, overutilization, and pesticides used in mosquito abatement. We concluded that the trends in those threats were continuing at the same level. We considered the population trend to be stable.

3. Recovery achieved: 2 (26-50% recovery objectives achieved) (2007 Recovery Data Call)

4. Listing history
Original Listing
FR notice: 41 FR 17736
Date listed: April 28, 1976
Entity listed: Subspecies
Classification: Threatened

Revised Listing, if applicable
FR notice: 49 FR 34501
Date listed: August 31, 1984
Entity listed: Subspecies

Classification: Endangered

5. Associated rulemakings: N/A

6. Review History: 5-year review November 6, 1991 (56 FR 56882). In this review, different species were simultaneously evaluated with no species-specific, in-depth assessment of the five factors, threats, etc. as they pertained to the different species' recovery. The notices summarily listed these species and stated that no changes in the designation of these species were warranted at that time. In particular, no changes were proposed for the status of the SSB.
Final Recovery Plan: 1999
Recovery Data Call: 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007

7. Species' Recovery Priority Number at start of review (48 FR 43098): 3c (3 = high degree of threat, low to moderate recovery potential; c = there is some degree of conflict between the species recovery and economic development).

8. Recovery Plan or Outline
Name of plan: South Florida Multi-Species Recovery Plan (MSRP)
Date issued: May 18, 1999
Dates of previous plans: Original plan approved November 17, 1982 (Schaus Swallowtail Butterfly Recovery Plan with Recommendations Relative to Bahamian Swallowtail Butterfly)

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

1. Is the species under review listed as a DPS? No. The Endangered Species Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population of a species of vertebrate wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under review is an invertebrate, and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? Yes

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? No

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5 listing factors are not relevant to this species, please note that here.

Some criteria incorporate the terms suitable and occupied. However, for most of the historic range of the SSB, habitats that are either suitable or occupied are only loosely delineated on maps, otherwise quantified, or monitored. Accordingly, for those criteria, the degree of attainment can be generally assessed, but cannot be absolutely determined.

Criteria for delisting SSB:

1. Further loss, fragmentation, or degradation of suitable, occupied habitat within the butterfly's historic range in the Upper Florida Keys and Miami-Dade County has been prevented.

This criterion has been attained to a significant degree but not completely met. SSB are restricted to tropical hardwood hammock communities and ecotones. Consistently occupied habitat occurs on north Key Largo (Dagny Johnson Key Largo Hammock Botanical State Park [DJKLBSP] and Crocodile Lake National Wildlife Refuge [CLNWR]) and keys within Key Biscayne National Park (BNP). Within those areas the extent of occupied and suitable habitat, and the acreage of hardwood hammock itself, are poorly delineated. DJKLBSP and CLNWR encompass approximately 2,316 acres (937 hectares [ha]) and 6,050 acres (2,448 ha), respectively, excluding open water. Within BNP, Elliott, Adams, Old Rhodes, and Totten Keys together comprise approximately 2,927 acres (1,185 ha). BNP, particularly Elliott Key, constitutes the core of the range. North Key Largo (DJKLBSP and CLNWR), which lies adjacent to BNP, yields a number of observations of adults annually.

Other than existing residential subdivisions and areas within CLNWR or DJKLBSP, the entire north Key Largo area falls within the Florida Forever Project's North Key Largo Hammocks accession area. Since 1983, 3,964 (1,604 ha) of 4,621 acres (1,870 ha) within the project area has been acquired (Florida Department of Environmental Protection [FDEP] 2008). As of February 2008, FDEP (2008) reported that 657 of the targeted acres (266 ha) remain to be acquired. FDEP (2008) reported that all tracts offered by willing sellers have been acquired. The Governor and Cabinet authorized condemnation of the remainder of the project, and such proceedings are in progress (FDEP 2008). Roughly 400 acres (162 ha) of the remaining, un-acquired acreage are in-holdings within CLNWR (Service 2006a). However, the Service and

FDEP have acquired the last remaining tracts of land within the CLNWR's acquisition boundaries that could be subject to development under existing Monroe County land use regulations (Service 2006a). Following acquisition, remaining properties will be managed by DJKLBSP or CLNWR, depending upon the administrative boundaries in which they fall.

In Miami-Dade County, suitable, occasionally occupied habitat includes the Charles Deering Estate (CDE), which lies on the mainland adjacent to BNP. CDE encompasses approximately 444 acres (180 ha), within which hardwood hammock and other natural communities are preserved and managed, with oversight by Miami-Dade Parks and Recreation, to promote biodiversity.

In the remainder of the historical range (Upper Keys below northern Key Largo), it is difficult to confirm the extent to which this criterion has been accomplished. This area constitutes a major portion of the historical range. However, south of the BNP-DJKLBSP-CLNWR area, hardwood hammock is highly fragmented. Suitable habitat is not delineated at a high level of spatial resolution, and occupancy has not been assessed on a frequent or widespread basis. SSB have rarely been reported south of northern Key Largo in recent years. Accordingly, there is some possibility that development occurred on private parcels that may have contained suitable, occupied habitat where occupancy was not documented. However, this was unlikely, particularly prior to September 2005. In recent years, the Service provided technical assistance on projects that may impact federally listed species within Monroe County (all building applications that had a nexus to the Federal Emergency Management Agency's [FEMA] National Flood Insurance Program throughout Monroe County) (details provided in section II.C.2.d.). The Service consulted on all such projects, and SSB habitat suitability was assessed for each and occupancy was assessed as needed. In September 2005, an outcome of a Federal court order was the (non-final) suspension of the Service's review of such projects. Since that time, the Service has not consulted on building permits issued in upland habitats (possibly including SSB habitat) in Monroe County if there was no Federal nexus to the project. This criterion is relevant to factors A and E.

2. Breeding sites of the Schaus swallowtail butterfly have been protected from mosquito spraying.

This criterion has been partially attained. Habitat on DJKLBSP, CLNWR, and BNP are excluded from direct applications of pesticides to control mosquitoes. On CLNWR (Service 2006a) and apparently the other two sites, there are no plans to allow for mosquito control. However, on northern Key Largo, subdivisions interspersed within DJKLBSP and CLNWR are treated with both ground and aerial pesticide spraying to control mosquitoes. Residues of these adulticide applications drift onto DJKLBSP and CLNWR (Hennessey et al. 1992, Zhong 2008). Subdivisions do not occur on keys within BNP, and no direct or indirect pesticide applications occur. This criterion is relevant to factor E.

3. Mosquito spraying in other areas used by the Schaus swallowtail butterfly has been reduced by 90 percent.

We are unable to confirm whether this criterion has been attained. We have no information to suggest that mosquito spraying outside of BNP and northern Key Largo has been reduced by 90 percent. In those areas, neither suitable nor occupied habitat has been delineated at a high level of spatial resolution. Additionally, the Service has not engaged in routine, spatially explicit monitoring and assessments of mosquito control applications throughout the range. However, the Service is working with local partners regarding mosquito control and its potential effects on SSB and other Lepidoptera. Information exchange between the Service and the Florida Keys Mosquito Control District (FKMCD) and has increased in recent years. The Subcommittee on Imperiled Species of the Florida Coordinating Council on Mosquito Control (FCCMC) is currently assessing questions of mosquito control impacts on rare butterflies in Monroe County (Florida Department of Agriculture and Consumer Services 2008). FCCMC includes a Council Member from the Service, and additional Service personnel participate on the Subcommittee on Imperiled Species. Both the Service and the FCCMC are working with the FKMCD to attain and assess spatially explicit pesticide application data as part of this process. This criterion is relevant to factor E.

4. All suitable, occupied habitat on priority acquisition lists for the Schaus swallowtail butterfly is protected either through land acquisition or cooperative agreements.

See description under criteria number 1. This criterion is relevant to factor A.

5. Hardwood hammocks that form the habitat for the Schaus swallowtail butterfly are managed, restored, or rehabilitated on protected lands.

On protected lands, approximately 65 percent of hardwood hammocks and acquired areas that were hardwood hammock prior to historical disturbances have been restored or rehabilitated. Details regarding these rehabilitated areas are provided in Keys Environmental Restoration Fund (KERF) (2006) and Service (2006a). Within some of those areas on CLNWR and DJKLBSP, approximately 1,000 wild lime (*Zanthoxylum fagara*) trees, which along with torchwood (*Amyris elemifera*) is a host plant for SSB larvae, were planted to enhance SSB habitat (Service 2006a). Active management and protection of intact and restored lands, including invasive exotic plant (IEP) control, closed areas, and law enforcement, occurs on BNP, CLNWR, and DJKLBSP (Service 2006a, KERF 2006, FDEP 2008). Available data does not allow for quantifying acreages of infected areas or that of areas that have been treated. Where restoration or rehabilitation occurs, IEP control is a routine component of efforts. On CLNWR, many of the dense stands of exotics have been removed, but controlling reestablishment requires ongoing management (Service 2006a). Undisturbed hardwood hammock has relatively limited susceptibility to current IEP

threats, and IEP are not a major threat to SSB at the present. This criterion is relevant to factors A and C.

6. Stable populations of the Schaus swallowtail butterfly are distributed throughout its historic range.

This criterion has not been met. The historic range extended to Upper and Lower Matacumbe Keys and adjacent Lignumvitae Key, as well as the mainland in the Miami area. SSB do not inhabit those areas. The SSB has not been able to reclaim areas outside of the habitat- and demographic-based core of the range, which is BNP. Outside of the core, persistent subpopulations occur only adjacent to BNP, on north Key Largo. This is despite the SSB proclivity for rather long-distance movements, including over-water flights, which affords a potential mechanism for recolonization of areas outside the core where it is extirpated. Such movements continue to result in immigrants or vagrants occasionally reaching such areas (Emmel 1997, Emmel and Daniels 2005). However, these events have not culminated in the establishment of viable subpopulations. It is possible that not enough emigrants are produced to allow for colonization. Alternatively, a factor or combination of factors such as habitat fragmentation, mosquito control pesticides, or predation (see II.C.2. for threat factors) may be precluding establishment. In either case, drought regimes may also play a role. This criterion is relevant to factors C and E.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends: SSB abundance and range declined throughout the 20th century (Service 1999, Swengel 2004). In recent years, significant numbers were consistently seen only within BNP, particularly on Elliott Key (Emmel 1995, Service 1999, Swengel 2004, Emmel and Daniels 2005). Earlier losses of range were largely attributed to habitat destruction (Service 1999, Swengel 2004). Reduced abundance and habitat occupancy after 1972 have been largely attributed to collateral effects of mosquito control (Emmel 1995, Service 1999). Hurricane Andrew struck south Florida in August 1992. In BNP, relatively few individuals (less than 60) were detected in 1993 (Emmel 1997, Emmel and Daniels 2005). However, numbers appeared to rebound to approximately 600 as of 1994 (Emmel and Daniels 2005).

From 1995 to 1997, captive propagated SSB were reintroduced into 8 sites: one site on the mainland in Miami-Dade County (CDE), four sites in northern Key Largo (DJKLBSP and CLNWR), one site in central Key Largo (John Pennekamp Coral Reef State Park), one site in southern Key Largo (Curry Tract, Florida Keys Wildlife and Environmental Area), and one site on Lower

Matecumbe Key (Klopp Tract, Lignumvitae Key Botanical State Park) (Emmel 1997). The results of limited, short-term monitoring conducted immediately after the reintroductions indicated successful re-establishment of SSB at reintroduction sites, and that conclusion has been widely cited (Service 1999, Swengel 2004, Black and Vaughan 2005). Introductions of pupae resulted in adult emergence and subsequent reproduction. Introductions of adults also yielded reproduction (Emmel 1997). However, more long-term observations indicated that the reintroductions did not alter long-term trends in abundance or distribution. For example, in both 2002 and 2003, investigators were not able to locate adult SSB at any of the reintroduction sites except for some ova detected at the Port Bougainville site (DJKLBSP) in 2002 (Emmel and Daniels 2005). SSB persistence at the Port Bougainville site prior to reintroductions is unknown. Emmel and Daniels (2005) reported that drought conditions prevailed from 1998 through 2002. An additional factor that may have hindered reintroduction success was mosquito control pesticides, as the southern sites included hammock fragments in urban settings that were subjected to spraying, and the northern sites were variously subject to insecticide drift (Emmel 1997, Service 1999).

For many areas and years, survey and monitoring efforts have been highly variable and methodologies not reported in detail. However, mark-recapture (Schnabel method) population estimates include those for Elliott Key (BNP) from 1999 to 2003 (Emmel and Daniels 2005). Abundance estimates were in the 200s, except for the low of 115 in 2001 (Figure 1). Additionally, Emmel (1995) derived estimates from mark-recapture efforts on Elliott Key from 1984 to 1988: 30, 700–850, 750–1,000, 500–1,000, and 700–850, respectively. Emmel and Daniels (2005) provide rough estimates of total population abundance at BNP for 1993 to 2003 (Figure 2). The last year for which we have survey reports is 2003.

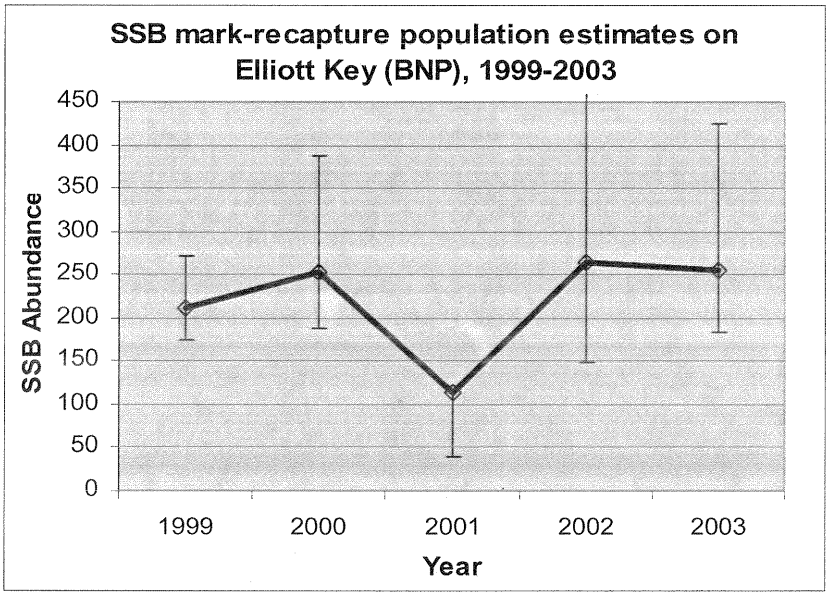

Figure 1. SSB population estimates for Elliott Key (BNP), 1999 to 2003. Upper and lower 95% confidence intervals for the population estimates are illustrated, except for 2001 (no upper interval available). From Emmel and Daniels (2005).

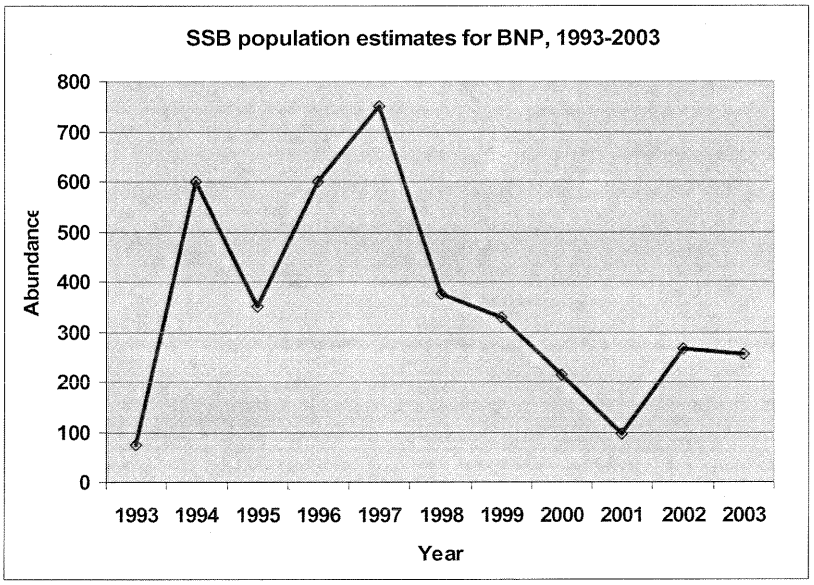

Figure 2. SSB population estimates for BNP, 1993 to 2003. Confidence intervals are not available. From Emmel and Daniels (2005).

Consistent with the pattern in the core (BNP), the rangewide numerical peak during the last 12 years occurred in 1996 to 1997. Emmel and Daniels (2005) estimated that 1,200-1,400 SSB occurred rangewide, but those estimates included released individuals (captive-raised SSB associated with reintroduction efforts). As in preceding and subsequent years, most SSB occurred in BNP (Figure 2). Emmel and Daniels (2005) reported that normal rains occurred during the peak and years preceding the peak. Available evidence suggests that population abundance in BNP rebounded after Hurricane Andrew, in normal rain years, to numbers (i.e., at least 600 in 1994) approaching those observed there in the mid-1980s (Emmel 1995). Numbers subsequently declined during drought conditions. Reintroduction efforts occurred concomitant with the natural peak in population abundance over the last decade. At reintroduction sites in areas where SSB had clearly been extirpated, numbers returned to zero, despite the successful husbandry procedures developed and implemented by the researchers, and strong initial responses in some areas (e.g., a "thriving" population at CDE as of 1997 [Emmel 1997]). Emmel (1997) suggested that Lignumvitae Key (Lignumvitae Key Botanical State Park; adjacent to Lower Matecumbe Key) should be a focus if further reintroductions are considered. Lignumvitae Key is an off-highway island with significant hammock area and no mosquito spraying. Thus, unlike most of the other areas where reintroductions had been attempted, it is not a fragment within an urban setting or susceptible to drift from mosquito control spraying efforts.

SSB count data from official North American Butterfly Association (NABA) butterfly counts are available from 2003 through 2008 for Elliott Key (BNP). For those years, NABA counts (all conducted in early-mid May) were 28, 24, 2, 26, 22, and 4 respectively. NABA counts (conducted in June) were conducted from 2000 to 2007 on Key Largo. Results were as follows: 0, 0, 0, 0, 8, 0, 3, and 2, respectively (M. Salvato, Service, pers. comm. 2008).

A single SSB was photographed at CDE on May 31, 2006 (M. Salvato, pers. comm. 2006). The individual likely represented a vagrant from BNP.

Mark-recapture techniques potentially provide necessary data to generate rigorous estimates of population size. However, mark-recapture techniques are labor-intensive, require rigid assumptions to be met, and potentially may be complicated by handling effects on the butterflies. In lieu of mark-recapture, there are options for tracking SSB population demographics using various other techniques, especially since demographic parameters have already been estimated with mark-recapture (Haddad et al. 2008). Some of the newer methods that have been developed to analyze capture-recapture data could possibly be applied to existing data in order to improve historical estimates of SSB abundance and survival, and be applied in future efforts for the same purpose. New methods provide for estimates of emergences and deaths in open populations, and thus allow for estimating population size for all butterflies over a flight season. Reliance on estimators that assume a closed population, as has occurred in the past, is likely inappropriate for butterflies and may underestimate true population size. Because butterflies emerge and die each day, they should not be modeled as having closed populations. That is especially true for short-lived species like SSB. SSB have been shown to move very long distances. That is an additional factor that may result in violation of the assumption that populations are closed. Additionally, in order to derive a population estimate for an entire flight season using mark-recapture, daily estimates of both population size and survivorship are required (Haddad et al. 2008).

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding): We have no new information pertaining to genetics of the SSB.

c. Taxonomic classification or changes in nomenclature: The Integrated Taxonomic Information System (ITIS) (2008) was checked while conducting this review. ITIS (2008) continues to recognize this taxon as a subspecies, *Heraclides aristodemus ponceanus*. Simon and Miller (1986) regard *H. a. driophilus* from the Bahamas to be a synonym of *H. a. ponceanus*. However, the Service is unaware of any formal taxonomic revision confirming that *H. a. ponceanus* is a synonym.

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem): Land acquisition efforts were described above. Acquisition of parcels within the administrative boundaries of protected areas on north Key Largo has advanced substantially. The amount, distribution, and suitability of the habitat and ecosystem components have been poorly monitored. Regulatory constraints have substantially reduced the occurrence of hammock destruction for development projects. However, further fragmentation of privately owned hammock fragments in the more urban settings south of northern Key Largo occasionally occurs following the issuance of limited building permits by Monroe County (see II.C.2.a. and II.C.2.b. below).

Additionally, management and monitoring of important habitat resources for SSB is somewhat constrained due to information voids. We have no new data on the spatial or demographic trends of the larval host plants or adult food (nectar) plants. Overall, important habitat requirements for SSB are not fully identified and understood. Earlier studies suggested that forage plant availability and distribution may limit potential SSB populations (Service 1999). Some host plants were subsequently planted (Service 2006a). However, subsequent monitoring efforts have been sporadic. Weather and climatic characteristics (precipitation levels, hurricanes, sea-level rise, and climate change) are expected to influence the abundance and distribution of forage plants over various seasons and multi-annual time periods.

Cheeca Lodge, University of Florida, and the Service finalized a Safe Harbor Agreement, and the Service issued an Enhancement of Survival Permit, in 2001 (expiring 2011). Cheeca Lodge is a golf course and resort on Upper Matecumbe Key. Wild lime and torchwood, as well as a variety of nectar-producing trees, were planted on the golf course. These efforts sought to establish dispersal corridors for SSB, which might serve to facilitate recolonization of other habitat in the southern portions of the historical range. Monitoring has been sporadic. We are not aware of SSB use of the site to date.

2. Five-Factor Analysis

a. Present or threatened destruction, modification or curtailment of its habitat or range:

Development—The SSB range consists of disjunct populations distributed among different islands. Habitat destruction and fragmentation eliminated some habitat patches and may have caused others to be too small to support persistent SSB populations. Past habitat loss resulted in a reduction of the area of contiguous habitat, reduction in total habitat area, and degradation of dispersal corridors (Service 1999). Accordingly, the probability of demographic or genetic rescue by successful dispersal among isolated habitats, and probabilities for successful recolonization of any habitat areas

that are extirpated, has likely declined.

In the last 20 years, loss or fragmentation of SSB habitat due to development has been greatly reduced. Extensive land acquisitions and regulations such as Monroe County's Rate of Growth Ordinance (ROGO) have contributed substantially to this outcome. The State's Florida Forever program continues to acquire conservation land within the range of SSB. Targeted areas encompass the entire remaining privately owned SSB habitat in north Key Largo. As of February, 2008, 3,964 (1,604 ha) of 4,621 (1,870 ha) acres within the Florida Forever Project's North Key Largo Hammocks accession area had been acquired, leaving about 657 acres (266 ha) to be acquired (FDEP 2008). Most of those acquisitions included hardwood hammock. CLNWR and DJKLBSP manage those lands acquired on north Key Largo. In the rest of the historical range (Upper Keys below northern Key Largo), potential SSB habitat in private ownership remains at risk of being developed. In that area, suitable habitat is not well delineated, and we do not have specific estimates of acreage at risk. Overall, both the magnitude and imminence of this threat are moderate.

Invasive exotic plants (IEP)—Significant resources have been applied to IEP control in the Keys. The Service, National Park Service, and the State carry out IEP control programs throughout CLNWR, BNP, DJKLBSP, other State Parks, and the Florida Keys Wildlife and Environmental Area, with assistance of the Florida Keys Invasive Exotics Task Force. Consistent records of control efforts and outcomes have not been produced for each of the different IEP species, and specific risk or cost trajectories have not been projected. However, IEP currently do not appear to be an imminent threat to SSB habitat, and the magnitude of this threat to the SSB is low.

b. Overutilization for commercial, recreational, scientific, or educational purposes: We are not aware of recent take of SSB due to commercial, recreational, or educational purposes. Recreational activities in upland areas of CLNWR, DJKLBSP, and BNP are highly restricted. Capturing and marking SSB for research purposes may result in unintentional take. Emmel and Daniels (2005) did not report any SSB mortality in the subjects of their mark-recapture efforts funded by the Service through the 2003 field season. The magnitude and imminence of threats in this category are low.

However, SSB poaching has occurred in the past (Emmel 1995), and remains a potentially significant threat to SSB (Service 1999). Rare butterflies and moths are highly prized by collectors and an international trade exists in specimens for both live and decorative markets, as well as the specialist trade that supplies hobbyists, collectors, and researchers (Morris et al. 1991, Williams 1996). At present, even limited collection from the small populations in BNP or CLNWR, or the spotty occurrences elsewhere, could have deleterious effects on reproductive and genetic viability and thus could

contribute to the extinction of SSB.

SSB largely occur on protected Federal and State lands, which may help protect it from collectors. However, patrols by law enforcement personnel are limited and variable. The potential for unauthorized or illegal collection of SSB eggs, larvae, pupae, or adults exists despite Federal and State protection provisions. Though SSB colonies are dispersed, the individual colony sites are localized, and most lie close to road access points. Therefore, illegal collection could occur without being detected. We do not have evidence of recent collection of SSB. However, in 2008, a Florida Fish and Wildlife Conservation Commission (FWC) Law Enforcement Officer caught a butterfly collector allegedly engaged in illegal trespass and collecting of butterflies at CLNWR without a permit (D. Pharo, Service, pers. comm. 2008). The perpetrator was in possession of various butterflies including a swallowtail. However, the specimens were not confiscated and the swallowtail specimen was not identified at the species level. Accordingly, the potential for unauthorized or illegal collection of eggs, larvae, pupae, and/or adults exists, despite the protection provided on public lands.

We do not have an adequate basis to conclude that the species is currently threatened by overutilization for commercial, recreational, scientific, or educational purposes at this time. However, because of limited population size and geographic range, we believe that poaching has the potential to be a significant threat to SSB. We believe that the magnitude and imminence of that threat is low at present.

c. Disease or predation: Earlier studies found evidence of substantial predation on SSB life stages by insectivorous birds and other predators (Emmel 1995, 1997). Parasitism and predation are a natural part of the species' life history, but their impacts are subject to change when habitat composition and native and non-native predator abundance and composition patterns are altered. Because SSB is restricted in range and abundance these factors could pose a threat to its survival. Disease is not known to be a threat in the wild.

The Mexican twig ant, *Pseudomyrmex mexicanus* is a non-native species that is widespread in the Keys. Deyrup et al. (1988) observed it in natural habitats on Elliott Key, Key Largo, Lower Matecumbe Key, and Big Pine Key. It appears to be a highly efficient predator of swallowtail eggs on wild lime, as evidenced by the findings of Cannon (2006) on Big Pine Key. There, an influx of the Cuban subspecies of the Bahamian swallowtail (*Papilio andraemon andraemon*) occurred in 2006. While observing the swallowtails and various host plants, Cannon (2006) found that a twig ant removed all five Bahamian swallowtail and over 20 giant swallowtail (*P. cresphontes*) eggs that were on a single wild lime tree. Additional ants and wasps depredated other eggs. Cannon (2006) concluded that the twig ants have a symbiotic

relationship with wild lime.

Given the observed predatory efficiency of twig ants on both Bahamian and giant swallowtail eggs, and their widespread occurrence throughout the Keys including those areas occupied by SSB, this ant may be among the greatest threats to SSB. Emmel (1995, 1997) observed various ants to be the major predators of SSB larvae. First discovered in Florida in the 1960s, the Mexican twig ant may be responsible for additive mortality, and may have a differential impact on larvae depending upon their host plant.

The red imported fire ant (*Solenopsis invicta*) is a non-native species that may impact SSB as summarized by Forys et al. (2001) and Wojcik et al. (2001). Forys et al. (2001) used giant swallowtails as a surrogate for SSB to assess vulnerability of immature stages to fire ants. Eggs, larvae, and pupae were placed on a wild lime tree in close proximity to a fire ant colony. The fire ants rapidly discovered and preyed on all immature stages of giant swallowtails (Forys et al. 2001). Forys et al. (2001) also assessed the effects of chemical ant baits (applied on road shoulders) in reducing fire ant abundance in hammocks. They concluded that "chemical treatments were only partially effective in decreasing red imported fire ant abundance, and the effect was short-lived".

Forys et al. (2002) found that fire ants "were equally abundant in all habitat types". However, transects close to roads and development had the highest probability of fire ant presence (Forys et al. 2002). Roads and disturbance promote the spread and establishment of fire ants, even within or near generally intact hammock (or other cover types) (Forys et al. 2001, 2002). Within hardwood hammock, Forys et al. (2001) found fire ants at 50 percent of transects. The Forys et al. (2001) study included, and fire ants were found to be abundant in, the protected hammocks on north Key Largo where SSB occur and reintroductions were attempted. Though more abundant terrestrially, fire ants foraged arboreally as well, and were argued to be a threat to the long-term success of SSB reintroductions. This argument may be extended to extant populations and natural colonization attempts.

Forys et al. (2001) concluded that "habitat restoration that decreases red imported fire ant abundance may be the most cost effective and long-term method of decreasing impacts from red imported fire ants". They suggested that "the removal and restoration of abandoned roads and access paths, and limiting disturbance of road shoulders, will probably lower fire ant populations in the area".

Forys and Allen (2005) reported on the entire assemblage of ants detected on the bait transects in the fire ant studies. They found whereas "the native ant fauna of the Florida Keys does not appear to be dramatically influenced by sprawl, however, if development increases, the number of non-native ants

may increase, and many of these species have been documented as decreasing native ant diversity. If development plateaus, there is evidence that the native ant fauna could persist and could decrease non-native species richness through competition or predation" (Forys and Allen 2005). Accordingly, precluding or reversing the effects of disturbance may not only help to protect SSB from fire ants, but may also preclude the advent of additional non-native species and help to restore ant community composition.

In the vicinity of CLNWR, the Service acquires in-holdings, restores and protects habitat from disturbances that may facilitate fire ants, and treats nine miles of County Road 905 twice per year using long-lasting broadcast baits such as Extinguish (Service 2006a). The Service plans to expand effectiveness monitoring, and expand control efforts to the Port Bougainville, Keystone/Whiskey Bottle area, county auto salvage, and Nike missile sites, as appropriate.

Another tramp ant (transported via human commerce or trade) of concern is the little fire ant (*Wasmannia auropunctata*). This predatory ant has been documented throughout the Keys (Deyrup et al. 1988) and is likely an additional predator on the SSB.

The magnitude and imminence of predation threats from native predators has been shown to be high in some situations in the past, and is unknown at present. The magnitude and imminence of predation threats due to fire ants appears to remain moderate, at least. The magnitude and imminence of predation threats from twig ants appears to be high. The magnitude of threats from additional, non-native predators or parasitoids, should they become established in the Keys, is potentially very high.

d. Inadequacy of existing regulatory mechanisms: On August 25, 1994, the United States District Court for the Southern District of Florida directed FEMA to consult with the Service to determine whether implementation of the National Flood Insurance Program in Monroe County was likely to jeopardize the continued existence of federally listed species (Case No. 90-10037-CIV-MOORE). In 2003, the Service issued a jeopardy biological opinion with reasonable and prudent alternatives that required Monroe County to consult with the Service before issuing building permits in suitable habitat for listed species. Thus, in recent years, the Service provided technical assistance on pertinent projects (virtually all building applications on private parcels throughout the range of SSB, excluding Coastal Barrier Resource Act zones). On September 9, 2005, the Court ordered an injunction against FEMA issuing flood insurance on any new developments in suitable habitat of federally listed species, and required the Service to submit a revised biological opinion within nine months (deadline later extended to August 9, 2006). Because the Court ruled that the 2003 reasonable and prudent alternatives were invalid, Monroe County was no longer required to consult with the

Service before issuing building permits in suitable habitat and the Service suspended technical assistance on building permit applications.

The Service finalized its reanalysis of the National Flood Insurance Program in Monroe County, and provided a biological opinion to the Court on August 8, 2006 (Service 2006b). The biological opinion provides a revised strategy for implementing regulatory actions pertaining to threatened and endangered species. This strategy includes clarification of FEMA's oversight role and a more comprehensive strategy of evaluating potential impacts. The latter incorporates a lot-by-lot assessment of potential impacts that takes into account the limitations on development imposed by the County's ROGO system with its new designations of geographical tiers. In the biological opinion, the Service concluded that continued administration of the National Flood Insurance Program in Monroe County was not likely to jeopardize the continued existence of the SSB. The Court will determine whether to accept the biological opinion and whether to lift the prohibition on FEMA's issuance of flood insurance in Monroe County.

The SSB is listed by the FWC as endangered (Chapter 39-27, Florida Administrative Code). This legislation prohibits take, except under permit, but does not provide any direct habitat protection. Wildlife habitat is protected on FWC wildlife management and wildlife environmental areas according to Florida Administrative Code 68A-15.004.

The State of Florida has compelled the Monroe County Board of Commissioners to strengthen controls on land use since at least 1975 when the Keys were designated an Area of Critical State Concern. A critical regulatory factor is the level of service on U.S. Highway 1 as it relates to hurricane evacuation time. The County developed a ROGO that, as of March 2006, incorporated a land tier system that specifically designates areas of native habitat for listed species, including the SSB. The process made it more costly to destroy habitat and now discourages development in unfragmented habitat, steers available permit allocations to disturbed areas that are poor habitat for native fauna, and implements a land acquisition program for areas with native vegetation, including SSB habitat.

Throughout the Keys, development is subject to regulatory oversight by Monroe County (e.g., the ROGO), the State (e.g., designated an Area of Critical State Concern), and the Service (e.g., Endangered Species Act consultation, presumably including continued consultation with Monroe County regarding administration of the FEMA National Flood Insurance Program). Regulatory mechanisms have significantly reduced habitat loss in the Keys, including SSB habitat. However, pressure to develop remaining residential and commercial land within the range of the SSB continues.

For scientific research on SSB, a permit is required from the Service and

FWC, as well as the National Park Service or FDEP if the work is conducted on lands they administer. Although most of the range occupied by SSB occurs on State and Federal lands, which offers protection, these areas are large and open to the public. Signage prohibiting collection is largely lacking, and efforts to patrol or monitor activities are variable. Therefore, illegal collection could occur without being detected, as discussed under Factor B above.

Currently, regulatory mechanisms provide significant protections to SSB. However, some of the suitable habitat below northern Key Largo remains vulnerable to development pressure. SSB in any area, where management on adjacent lands do not include control of fire ants, may result in vulnerability to that threat. Regulatory mechanisms have not eliminated potential threats from mosquito control (e.g., spray drift) (Factor E below). Therefore, we conclude that existing regulatory mechanisms are inadequate to fully protect SSB and its habitat.

e. Other natural or manmade factors affecting its continued existence: *Mosquito control (insecticides)*—As human activity and population size increased in south Florida, so has the control of mosquitoes such as the salt marsh mosquitoes, *Aedes sollicitans* (Walker) and *A. taeniorhynchus* (Wiedemann). To suppress mosquitoes, second-generation organophosphate (naled) and pyrethroid (permethrin) adulticides may be used year-round (particularly May to November in the Keys) by Mosquito Control Districts (Hennessey et al. 1992, Salvato 2001, Zhong 2008). Despite improved mosquito control practices, the use of adulticides applied using both aerial and ground-based methods may result in collateral effects on non-target species, including lethal and sub-lethal effects on butterflies such as the SSB (Service 1999). FKMCD and the Mosquito Control Division of Miami-Dade Public Works Department conduct aerial and or ground spraying of mosquito adulticides over most of Miami-Dade and Monroe Counties. Additionally, the Ocean Reef Club (a residential and golf resort) may conduct or contract ground-based adulticide spraying within their borders. The Service currently does not have specific insecticide application records from those entities for the majority of the SSB range. Emmel (1997) concluded that the SSB "was reduced to its tiny range between 1972 and 1984 by widespread use of Dibrom and Baytex mosquito adulticides in the Keys".

Conclusions such as those of Emmel (1997) are based on earlier studies including Baggett (1982), Emmel (1986, 1995), Eliazar (1992), and Hennessey et al. (1992). Those studies described actual toxicity and the potential lethal effects second-generation organophosphate pesticides (i.e., naled, fenthion) on Lepidoptera including SSB surrogates, and explored factors such as spray drift and the persistence of residues, and the temporal trends in SSB populations relative to the history of mosquito abatement in the Keys. Among the inferences, which are reflected in recovery criteria in the

MSRP, are that the core resides on BNP because it is not sprayed, the north Key Largo population is limited due to spray drift, and recolonization of other areas is precluded because of standard mosquito control practices in those areas. Walker (2001) drew similar conclusions regarding mosquito control and the decline of a wood cricket, *Gryllus cayensis*, which was newly described in the same paper. The cricket had occupied hardwood hammock in north Key Largo, but was apparently extirpated after 1972. Subsequently, it was only reported in pinelands at Everglades National Park (Walker 2001). Potential relationships between mosquito control spraying and other threats to SSB are poorly described.

More recently, as additional species have declined further, related questions have been explored in a variety of other Lepidoptera in the Keys and elsewhere in south Florida. As for the SSB, results for those species in general comprise a substantial body of evidence, although predominantly correlative, that mosquito abatement efforts contributed significantly to declines and continue to pose a threat to population viability. Available information for other south Florida taxa is summarized by the Service (2008a, b, c).

Sea-level rise—Sea-level rise in the 20th century has been shown to affect conversions of upland communities (i.e., hardwood hammock, pine rockland) with low soil and moisture salinities to communities comprised of more salt tolerant plant species and higher soil and groundwater salinities in the Florida Keys (Ross et al. 1994). This phenomenon may result in loss of suitable SSB habitat. Over time, the ultimate effect of sea-level rise may be total inundation in some areas. The general effects of sea-level rise within the range of the SSB will depend upon the rate of rise and landform topography. However, the specific effects across the landscape will be affected by complex interactions between geomorphology, tides, and fluctuations in energy and matter. These effects have yet to be simulated and projected for the range of the SSB. However, rising sea-level exacerbates effects of salt-water storm surges. The magnitude of this threat is potentially very high, but imminence is low.

Hurricanes and tropical storms—Hurricanes may impact SSB populations and their habitat due to wind and salt-water storm surges. In August 1992, Hurricane Andrew impacted extreme southeastern Florida where SSB populations were concentrated. Such major hurricanes not only cause widespread mortality of adults, presumably, but also destroy/damage the foliage that holds the larval SSB that should comprise the next generation. Hurricane Andrew defoliated hardwood hammocks including SSB larval host plants (Loope et al. 1994) and, as anticipated, the 1993 SSB flight was sparse (e.g., on Elliott Key) (Swengel 2004). Winds associated with Hurricane Andrew downed approximately 20 to 30 percent of large trees on Elliott Key, and sheared large branches off almost all large trees (Loope et al. 1994). The

woody structure of smaller trees was impacted less radically. However, for trees of all sizes, "... defoliation was virtually complete, even near ground level" (Loope et al. 1994). This condition included both of the larval host plants that SSB are restricted to, torchwood and wild lime. The lost foliage had held larval SSB that would otherwise constitute the 1993 adult generation. In contrast to direct impacts of major hurricanes, hurricane winds may serve a beneficial function for SSB over longer time-frames. Torchwood and wild lime may readily resprout following catastrophic wind disturbances. Both of the SSB larval host plants are considered to be seral-stage components of hammock communities. Hurricane winds apparently facilitate the maintenance of such components in the landscape. Storm surges associated with Hurricane Andrew influenced the distribution of leaf litter and storm debris on Elliott Key and other areas within the SSB range (Loope et al. 1994). However, "...erosion due to the storm surge was found to be minimal" (Loope et al. 1994). Data on the long-term effects of storm surges is not available.

The SSB has relatively good long-range dispersal capabilities, thus their potential for natural recolonization of suitable sites after a catastrophic event may be better than for less vagile species. Given sufficient distribution and overall resiliency in SSB populations, certain storm regimes may benefit populations over time if they result in disturbances that favor habitat components including host plants and adult nectar sources. However, the magnitude of threats from stochastic events such as hurricanes is exacerbated by small population sizes and the limited range of SSB and the lack of recolonization in actuality. Given the small size of SSB populations, especially residual populations following major disturbances, such events are a threat of high magnitude due to catastrophic loss of adults and larvae. Like low abundance, the reduced range of the SSB further serves to increase risk associated with stochastic events. Because catastrophic events affect further reductions in abundance over some period of time, they increase the probability that detrimental impacts may subsequently arise due to demographic or genetic stochasticity, or from additional, adverse, environmental conditions (e.g., drought). According to the National Oceanographic and Atmospheric Administration, Miami-Dade County, the Keys, and western Cuba are the most storm-prone areas in the Caribbean so this threat is expected to continue. Depending on the location and intensity of catastrophic winds, it is possible that the SSB could be extirpated or become extinct. Accordingly, we consider the magnitude of this threat high and the imminence moderate.

Small population size—The SSB appears to be vulnerable to extinction due to limited range, populations, and abundances. In general, isolation, whether caused by geographic distance, ecological factors, or reproductive strategy, will likely prevent the influx of new genetic material and can result in a highly inbred population with low viability and/or fecundity (Chesser 1983).

Variability in environmental conditions periodically results in adverse affects on SSB. Natural fluctuations in rainfall, hostplant vigor, or predation may weaken a population to such an extent that recovery to a viable level would be impossible. Isolation of habitat can prevent recolonization from other sites and result in extinction. SSB is known to consistently occupy only the far upper Keys. At BNP and north Key Largo combined, SSB appear to be restricted to several hundred individuals. Within its historical range, which once extended from mainland Miami-Dade County south to Lower Matecumbe Key, the species occurrence is now severely reduced. Distance between the populations, environmental threats, and the small size of populations make recolonization less certain when populations are extirpated. Fragmentation of habitat and environmental threats (e.g., pesticides, predators) leads us to believe this species is vulnerable due to the small number of populations, their small size, and their relative isolation. In addition, the extent of habitat fragmentation leads us to believe that SSB is vulnerable due to their apparent inability, in recent years, to re-colonize habitat in significant portions of the historical range. We consider the magnitude of this threat high and the imminence moderate.

Vehicle-related mortality—One reference to SSB road-kills was given in the MSRP (Service 1999). No additional information is available, but this is potentially an ongoing source of mortality except on the islands of BNP, which lack roads and vehicles. We believe that the magnitude and imminence of this threat is low.

Utility corridors—The Florida Keys Electric Cooperative regularly clears vegetation from their power line right-of-way along Card Sound Road. The effect of this process on SSB habitat components has apparently not been assessed.

D. Synthesis: The predominant threats described at the time SSB was listed were habitat destruction, mosquito control practices, and illegal collecting. None of these threats has been eliminated, although each has been reduced. Habitat destruction due to human population growth and associated development has been significantly reduced. However, detrimental habitat effects associated with earlier development, including fragmentation, persists over much of the historic range. IEP are largely actively controlled and currently do not appear to be an imminent threat. Poaching has the potential to be a significant threat. Predation due to fire ants appears to remain at least a moderate threat, while the threat of predation from twig ants appears to be high. In fact, non-native predators, including Mexican twig ants as well as fire ants and other tramp ants, may be among the greatest threats to SSB. Mosquito abatement efforts appear to have contributed significantly to SSB declines and continue to pose a threat to population viability. Currently, regulatory mechanisms provide significant protections to SSB. However, some of the suitable habitat outside of the core (BNP) remains vulnerable to development pressure and regulatory mechanisms do not provide protection from non-native ants or mosquito control practices at any location. The threat of sea-level rise is potentially very high, but these effects have yet to be simulated and projected for the

range of the SSB. Hurricanes and tropical storms, depending on location and intensity of catastrophic winds, could result in SSB extirpation or extinction. The SSB appears to be vulnerable to extinction due to limited range, populations, and abundances. Vehicle-related mortality and clearing along utility corridors are also cause for concern, but require further investigation to determine the full extent of their impact on SSB. The SSB has exhibited an overall consistent decline in abundance over the long-term. Additionally, information spanning at least 70 years indicates that the extent of the range has consistently declined without any significant and enduring reversals. This profound decline in range and abundance has not been substantially reversed in any portion of the range despite substantial efforts. Accordingly, SSB continues to meet the definition of endangered.

III. RESULTS

A. Recommended Classification:

__X__ **No change is needed**

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Assess the current and projected impact of Mexican twig ants, fire ants, and other tramp ants, and respond accordingly.
- Determine whether additional non-native predators and parasitoids have become established, and whether predators and parasitoids in general are a limiting factor in either occupied and potentially occupied areas.
- Continue to work with partners and take measures to limit or prohibit mosquito control pesticide drift on protected State and Federal lands, avoid the use of broad spectrum mosquito control pesticides in other conservation areas such as CDE, and seek cooperative ways to reduce application levels throughout the remainder of the SSB range.
- Routinely obtain, monitor and assess temporally and spatially explicit data regarding mosquito control applications throughout the SSB range.
- Continue to plant torchwood and wild lime in disturbed areas within CLNWR and other conservation lands that have yet to be rehabilitated.
- Assess the current distribution and abundance of both host plant species.
- Assess the land use and ecological characteristics that affect host plant abundance and distribution, and predict the future trajectory of host plant distribution and abundance. Conduct assessments of nectar plant distribution, relative to host plants, concurrently.
- Based on assessments of host plant abundance and distribution, estimate if and where host plants are a limiting resource, use these assessments along with a consideration of financial resource potentials to determine an optimal response and guide actions, and implement actions accordingly.
- Identify and implement a viable means to obtain a representative, annual sample of SSB distribution and abundance throughout the range.
- In obtaining demographic data, consider additional options other than, or in addition to, those that rely on mark-recapture techniques.
- Re-assess the statistical estimators and model assumptions applied to past and future population data that has or will be derived from mark-recapture techniques.

- Assess whether reintroductions of SSB onto Lignumvitae Key would be a viable option.
- Assess alternative forms of husbandry and propagation, including on-site assistance of expansion and survival.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of SCHAUS SWALLOWTAIL BUTTERFLY

Current Classification: Endangered
Recommendation resulting from the 5-Year Review

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist**
_X_ **No change is needed**

Appropriate Listing/Reclassification Priority Number, if applicable _____

Review Conducted By: Phillip Hughes

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 7-15-08

The lead Field Office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead field office should document this coordination in the agency record.

REGIONAL OFFICE APPROVAL:

The Regional Director or the Assistant Regional Director, if authority has been delegated to the Assistant Regional Director, must sign all 5-year reviews.

for **Lead Regional Director, Fish and Wildlife Service**

Approve _____ Date 9/23/08

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. If a change in classification is recommended, written concurrence from other regions is required.

Cooperating Regional Director, Fish and Wildlife Service

_____Concur _____Do Not Concur

Signature_____Date_____

Summary of peer review for the 5-year review of Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*)

A. Peer Review Method: The Service conducted peer review. Recommendations for peer reviewers were solicited from Florida Department of Environmental Protection and Florida Fish and Wildlife Conservation Commission. Additionally, peer reviewers were selected by the Service. Five peer reviewers were asked to participate in this review. Individual responses were requested and received from each peer reviewers.

B. Peer Review Charge: See attached guidance.

C. Summary of Peer Review Comments/Report: One reviewer indicated that Swengel (2004) only interprets other data and provides no first hand information about SSB, and recommended that Swengel (2004) not be cited. One reviewer indicated that the review used the best available science. Some reviewers commented that the review was well-prepared and thorough. One reviewer commented that the use of wild lime as host plants is widely cited in the literature, but that in the wild, SSB only use torchwoods. The reviewer noted that Dr. Thomas Emmel and staff (University of Florida, Gainesville) reared captive SSB on wild lime. One reviewer questioned the historical and present importance to the SSB of areas, including historical sites on the mainland and south of northern Key Largo, that lie outside of the current range. One reviewer stated that SSB occurs not only in Florida, but also in the northern Bahamas.

One reviewer stated that there are no field data to support the claim that population declines of butterflies in the Keys are due to mosquito control pesticides. That reviewer stated that "butterflies have declined and disappeared from Everglades National Park and Biscayne National Park which are not sprayed", and that the "main causes of the declines are most likely to be habitat destruction and exotic predatory ants such as red imported fire ants". Statements from the other reviewers indicated that they viewed mosquito control pesticides to be among the most prominent threats. One stated that "The work linking pesticides to population declines is compelling".

One reviewer stated that fire ant eradication needs to be initiated. One reviewer noted that invasive exotic plant control has occurred regularly on Elliott Key, focusing on hardwood hammock restoration. The reviewer also suggested that the recommendations include assessing and quantifying exotic plant control efforts. One reviewer stated that habitat loss and pesticides are clearly more prominent threats than overutilization. The reviewer found the draft review to suggest that overutilization was considered a "primary threat" and that very little evidence was provided to support this claim. The reviewer suggested that the recommendations section include "a bullet about getting a better estimate of the extent of illegal harvesting that might be occurring".

Regarding vehicle-related mortality, one reviewer asserted that it "needs to be clearly stated that this is only a very minor threat, if even a threat at all, especially considering that the core of the range is on Elliott Key, where there are no vehicles". Another reviewer stated that "High speed automotive traffic on CR-905 may contribute unnecessarily to SSB breeding adult morality". One reviewer noted that the Five-Factor Analysis fails to mention vegetation clearing by the

Florida Keys Electric Co-op. All reviewers expressed concern about the overall population status of SSB, consistent with findings in the review. One reviewer highlighted the enhancement of risk due to the combination of small population size and other threats. Two reviewers emphasized that monitoring of SSB populations to track its status was important and recommended consistent population monitoring.

One reviewer was encouraged by the existence of some detailed population estimates for SSB, reiterated the importance of status monitoring, inquired whether rigorous estimates are available since 2003, and provided some detailed considerations for conducting such monitoring. One reviewer stated that "it appears that some synthesis is needed about why restoration (of plants and butterflies) has not led to higher population sizes" and added that there is an "opportunity in adaptive management, whereby key hypotheses about factors needed for successful restoration can be controlled and tested through further reintroductions". One reviewer stated that the Service "needs to have an active role in ensuring that all remaining in-holdings (within State or federal properties) are acquired". In-holdings invite anthropogenic threats to SSB, such as mosquito spraying and fire ant facilitation. One reviewer commented on the pattern of abundance reported subsequent to Hurricane Andrew (1992) and posed the question: "Are disturbances needed to facilitate new vegetative growth, or other characteristic of habitats or host plants, that benefit Schaus' swallowtail?".

D. Response to Peer Review: We concur that Swengel (2004) only interprets other data and provides no new data about SSB. We included the article because it is a recent interpretation of existing information. Wild lime is documented to be a prominent host plant for SSB. Because we have no additional documentation to support the contention that SSB do not use it at present, we retain the position that wild lime remains a host plant for SSB. We do not find the existing information, including peer reviewer comments, sufficient to draw the conclusion that: "It is unlikely that restored hardwood hammocks outside of Biscayne National Park or northern Key Largo will ever be colonized by the Schaus swallowtail". We concur that likelihood is low under the current, overall circumstances, and we concur that hardwood hammock management is currently "problematic since no one knows their exact requirements". We do not concur that SSB is unable to survive outside of the current range or that habitat outside of currently occupied areas are without significance to the long-term viability and capacity for recovery. We acknowledge that some authorities regard *H. a. driophilus* to be a synonym of *H. a. ponceanus* and revised the review to reflect that.

We do not concur that available studies fail to support the conclusion that mosquito control pesticides are a threat to SSB. We do find that the inferences that tie those pesticides to population declines of butterflies in the Keys derive from correlative approaches, and stated so in the review. Additionally, we recommend further research. We also do not find the observation that "butterflies have declined and disappeared from Everglades National Park and Biscayne National Park which are not sprayed" to be compelling in this regard. The Service and collaborators seek more rigorous investigations that can effectively discriminate causes and effects. The review also highlights the importance of further elucidating impacts from predatory ants, and controlling such impacts as well as further habitat impacts. We concur that the Service should consistently monitor and review, with regard to SSB, FKMCD, MDPWD, and any other available records on mosquito control applications in northern Key Largo. We edited the review

to clarify that. We also edited the review to reflect observations that other entities, in addition to FKMCD, may conduct mosquito control efforts in northern Key Largo.

We edited the review to identify those actions as they pertain to fire ant control and thereby clarify that control efforts are already initiated and ongoing. We concur with a reviewer that affirmative, concerted action needs to be taken to control fire ants, and that monitoring for this species on Elliot Key, and elimination if it occurs there, needs to be undertaken. We do not know whether "eradication of fire ants in UKL" is necessary or feasible. We concur with the reviewer, recognize that the National Park Service provides for control on Elliott Key, and edited the review to reflect the recommendation. The Service maintains that poaching remains a threat to SSB. However, we believe that both the magnitude and imminence of threats from poaching are relatively low. We edited the review to clarify that.

We maintain that vehicle-related mortality is a threat to SSB outside of Biscayne National Park, but concur that it is likely only a minor threat under current circumstances and edited the review to reflect this evaluation. We edited the review to address the observation that the Florida Keys Electric Co-op regularly clears vegetation from their power line right-of-way along Card Sound Road. We concur with the comments about the overall population status of SSB. The review reflects the enhancement of risk derived from the combination of small population size and other threats, including catastrophic events. We concur with comments that consistent, statistically rigorous monitoring of SSB populations is of significant importance.

University of Florida personnel have continued to conduct SSB population surveys within Biscayne National Park subsequent to 2003. However, the Service does not have this data. Comments about mark-recapture techniques are acknowledged. We concur with the recommendations regarding the application of statistical estimators to existing and potential future mark-recapture efforts and data, and made edits to address this in the review. We concur with a suggestion that it is important to secure a comprehensive synthesis that assesses successes and failures of SSB reintroduction and habitat restoration efforts, and that adaptive management opportunities should be described and implemented if further restoration efforts are undertaken. This is reflected in the review.

The Service acquires land only from willing sellers. Willing sellers throughout UKL have an opportunity to sell their land to the State, as well as the Service. We concur with the suggestion that it is important to determine if and how natural habitat disturbances associated with hurricanes are of significance to SSB habitat, population fluctuations, and natural history characteristics over various time periods. This is reflected in the review.

Guidance for Peer Reviewers of Five-Year Status Reviews

U.S. Fish and Wildlife Service, South Florida Ecological Services Office

February 20, 2007

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with U.S. Fish and Wildlife Service (Service) policy.

Peer reviewers should:

1. Review all materials provided by the Service.

2. Identify, review, and provide other relevant data apparently not used by the Service.

3. Not provide recommendations on the Endangered Species Act classification (e.g., endangered, threatened) of the species.

4. Provide written comments on:
   - Validity of any models, data, or analyses used or relied on in the review.
   - Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.
   - Oversights, omissions, and inconsistencies.
   - Reasonableness of judgments made from the scientific evidence.
   - Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.
   - Strengths and limitation of the overall product.

5. Keep in mind the requirement that the Service must use the best available scientific data in determining the species' status. This does not mean the Service must have statistically significant data on population trends or data from all known populations.

All peer reviews and comments will be public documents and portions may be incorporated verbatim into the Service's final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to Cindy Schulz, Endangered Species Supervisor, South Florida Ecological Services Office, at 772-562-3909, extension 305, email: Cindy_Schulz@fws.gov.