United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
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Honolulu, Hawaii 96850

In Reply Refer To: 1-2-2002-FW-04;

MEMORANDUM

To: Chief, Division of Consultation and Conservation Planning

From: Field Supervisor, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii

Subject: Biological Opinion on the Effects of the Issuance of an Incidental Take Permit Under section 10(a)(1)(B) of the Endangered Species Act of 1973, as Amended to Cyanotech Corporation, Keahole Point, Hawaii

Ref: Biological Opinion (Log Number 1-2-2002-FW-04)

This represents the biological opinion of the U.S. Fish and Wildlife Service (Service) in accordance with section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), as amended (Act) regarding potential effects to the endangered Hawaiian stilt (stilt) or aeo (*Himantopus mexicanus knudseni*) from the proposed issuance of an incidental take permit (permit) in association with the Habitat Conservation Plan (HCP) for Hawaiian Stilt at Cyanotech Aquaculture Facility, Keahole Point, Hawaii.

This biological opinion is based upon: 1) the application requesting an incidental take permit and draft HCP received by us on December 6, 2001; 2) information provided by the Service's Draft Revised Recovery Plan for Hawaiian Waterbirds, Second Revision; 3) other biological literature (see References at the end of the document); and, 4) information contained in our files. Our log number for this consultation is 1-2-2002-FW-04. A complete administrative record of this consultation is on file in this office.

Consultation History

December 6, 2001: The Service's Pacific Islands Field Office received a complete application from Cyanotech Corporation (Cyanotech) to obtain an incidental take permit for the stilt.

December 18, 2001: The Service provided the Office of the Federal Register a letter and three signed copies of a Federal Register Notice of Availability (NOA) announcing the availability of a draft Environmental Action Statement (EAS), and the receipt of a permit application.

January 2, 2002: The Federal Register published the NOA of the draft HCP and draft EAS.

January 30, 2002: The Service's Portland Regional Office initiated request for formal consultation with the Pacific Islands Field Office.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Cyanotech has applied to the Service for an incidental take permit pursuant to section 10(a)(1)(B) of the Act. The permit would authorize take of the Hawaiian stilt at the Cyanotech Aquaculture Facility, Keahole Point, Kona, Hawaii. The proposed take would be incidental to the operation and maintenance of Cyanotech's microalgae facility at Keahole Point, Hawaii (TMK 3:4-1-06-6). The proposed permit term is three years.

The project site lies within the Natural Energy Lab of Hawaii (NELHA), a marine research and development area set aside by the State of Hawaii on the Kona coast, approximately 8 miles north of the town of Kailua-Kona on the island of Hawaii (Big Island). The Cyanotech aquaculture facility is located at Keahole Point below Makako Bay, west of the Kona Airport adjacent to other NELHA aquaculture facilities (Figure 1).

Cyanotech cultivates and harvests microalgae for commercial sale. The Cyanotech facility currently occupies approximately 90 acres of land and includes a series of man-made ponds or "raceway ponds" where the microalgae is grown, and office, maintenance, laboratory, research and processing buildings. The nutrient-rich ponds support high-density invertebrate populations, which provide a primary food source for the endangered Hawaiian stilt. Stilts are attracted to and nest within and adjacent to the aquaculture facility. Hawaiian stilt chicks that hatch at the facility are led by parent stilts to the ponds to feed where they are suspected either of drowning in the rapidly flowing waters or dying from adverse physiological reactions (*e.g.*, acute dehydration) associated with ingesting the hypersaline, high-alkaline alga medium required for microalgae production. As a result, Cyanotech's aquaculture operation inadvertently attracts stilts to a man-made habitat that is unsuitable for successful stilt reproduction.

Under the HCP, Cyanotech will minimize incidental take of the Hawaiian stilt by implementing deterrence measures designed to eliminate stilt foraging and nesting at the Cyanotech facility. The following non-lethal deterrence measures will be evaluated for effectiveness and may be implemented: 1) reduce or eliminate the invertebrate food source, 2) reconfigure raceway ponds to make them unattractive to the Hawaiian stilt, 3) net ponds to exclude the Hawaiian stilt, 4) use biodegradable bird repellents, and 5) implement various non-lethal hazing methods. Cyanotech will mitigate for incidental take of Hawaiian stilt eggs and chicks by creating suitable nesting habitat onsite. These measures are expected to ensure 1) Hawaiian stilt reproductive success, 2) recruitment of fledged birds into the overall population, and 3) the Cyanotech facility does not become a reproductive sink for stilts.

STATUS OF THE SPECIES

The stilt is a slender wading bird, black above (except for the forehead), white below, and with distinctive long, pink legs. The total length of an adult Hawaiian stilt is about 16 inches. The average weight of an adult is 202.6 grams (7.1 ounces). The Hawaiian stilt differs from the black-necked stilt (*Himantopus mexicanus*) of North and South America, by having black extending lower on the forehead as well as around to the sides of the neck, and by having a longer bill, tarsus, wing chord and tail (Coleman 1981).

Stilts use fresh, brackish, and saltwater habitats. Preferred habitats include early successional marshlands interspersed with areas of mudflat or shallow open water; shallowly flooded (less than 6 inches), low-growing *Paspalum* or *Batis* flats; and exposed tidal mudflats. Feeding habitat also consists of shallow water that is fresh, brackish, or saline. Stilts eat a wide variety of aquatic organisms including polychaete worms, crustaceans, aquatic insects, and small fish (Shallenberger 1977). Loafing sites include open mudflats, *Batis* flats, and fresh or brackish-water ponds.

Stilts nest on mudflats, or adjacent to or on low-relief islands within bodies of fresh, brackish or salt water. Nesting season in Hawaii is March through August with peaks in May and June. Clutch size is three to four eggs, and the incubation period is approximately 25 days. The downy, precocial chicks are led by parents to feed in the shallow water within 24 hours of hatching. Parental care involves brooding, protection from predators, and selection and aggressive defense of foraging territories. Chicks fledge four to six weeks after hatching (Coleman 1981, Chang 1990).

Stilts were historically found on all of the major Hawaiian islands except Lanai, Kahoolawe, and possibly the island of Hawaii where no sightings of stilts were documented until 1961 (Paton and Scott 1985). Prior to 1961, records of Hawaiian stilts on the Big Island were limited to three birds collected by S.B. Wilson in the late 1800s and possibly one collected by Collett prior to 1893 (Banko 1979).

Historic population numbers of Hawaiian stilts are unknown. Munro (1960) suggested that the population had declined to about 200 birds by the early 1940s; however, this may have been an underestimation, since Schwartz and Schwartz (1949) estimated about 1,000 birds in the late 1940s. Population counts from 1960 to 1979 fluctuated from a low of 253 in 1960 to a high of 1,476 in 1977.

Many factors, including indiscriminate hunting, predation by introduced species, and most importantly, the loss of wetland habitat, contributed to the decline of the Hawaiian stilt.
The Hawaiian stilt was federally listed as an endangered species in 1970 (USFWS 1970). Long-term population trends of the Hawaiian stilt indicate that for the last 30 years the statewide population is relatively stable, or slightly increasing, (Reed and Oring 1993). Since 1983, statewide surveys have documented 1,000 or more stilts in the islands. Stilts now occur on all of the main Hawaiian islands except Kahoolawe, but the majority of Hawaiian stilts are still found on the islands of Oahu, Maui, and Kauai. Engilis and Pratt (1993) estimate the current statewide population to be between 1,200 and 1,600 birds.

Within the main Hawaiian islands many of the larger natural wetlands are protected, but few of these areas are either naturally suited for stilts or actively managed for maximum stilt production. Due to degraded hydrology and invasive species, and a need for restoration, many of these wetlands in their present condition have reached the carrying capacity of the habitat for stilt reproduction. The lack of suitable habitat appears to be a key factor limiting the recovery of Hawaiian stilts (Reed *et al.* 1998a). Population viability analysis of the Hawaiian stilt suggests that not enough habitat exists in Hawaii to achieve the recovery goal of a minimum population size of 2,000 birds (Reed *et al.* 1998a).

With the severe reduction in the amount of wetland habitat throughout the main Hawaiian islands and the lack of management of protected wetland areas, the opportunistic nature of Hawaiian stilts led them to utilize artificial wetlands such as wastewater treatment facilities, aquaculture facilities and other industrial facilities. Artificial wetlands provide consistent food resources and possibly social opportunities; however, they may not be able to accommodate the reproductive needs of the stilt due to lack of suitable nesting habitat. Recent observations at these facilities suggest that successful stilt reproduction can occur with proper management. Thus, artificial wetlands will continue to attract stilts, and, with management of water levels, predator control, and limited human disturbance may complement natural wetland areas in recovery efforts.

ENVIRONMENTAL BASELINE

The environmental baseline describes the status of the species and factors affecting the environment of the species or critical habitat in the proposed action area contemporaneous with the consultation in process. The baseline includes State, local, and private actions that affect a species within the action area at the time the consultation begins. Unrelated Federal actions that have already undergone formal or informal consultation are also a part of the environmental baseline. Federal actions within the action area that may benefit listed species or critical habitat are also included in the environmental baseline.

Status of the species within the action area

Hawaiian stilts appear to exist as a metapopulation or a set of metapopulations among islands (Reed *et al.* 1994). Populations on Oahu, Maui, and Kauai are the most likely to function as source populations (i.e., more than self-sustaining) due to long-term (between 20 and 30 years) population growth observed (Reed and Oring 1993).

Along the Kona coast of the Big Island, stilt habitat was historically limited to two natural wetlands (Opaeula and Aimakapa ponds) and scattered anchialine (brackish water) pools. The population of Hawaiian stilts along the Kona coast remained relatively stable (mean = 24; SD +/- 11 birds) until 1996.

By 1996, a steady increase in the stilt population along the Kona coast was observed (Anthony McCafferty, personal communication, 1997), and by 1997 counts as high as 128 stilts had been documented. Over the past four years, the average monthly count of stilts at Cyanotech and the

Kealakehe WTP has increased each year from 108 adult stilts in 1998, to 220 adult stilts in 2001 (99 adult stilts at Cyanotech) (Table 1).

It is not believed that the significant increase in stilt numbers along the Kona coast could have resulted from an increase in stilt reproduction on the Big Island, as no increase in managed (predator-free) or restored habitat coincided with the increase in stilt observations. Because Hawaiian stilts are capable of interisland movements (Reed *et al.* 1998b) and are known to quickly colonize newly created wetlands (Pyle 1978, Engilis and Pratt 1993), the 1996 increase is believed to be the result of stilts moving from other islands within the Hawaiian islands chain to the Big Island in order to take advantage of the new foraging sites following opening of the Kealakehe Wastewater Treatment Plant (WTP) in 1994 and the expansion of operations at Cyanotech from 14 to 67 raceway ponds between 1990 and 1996. Loss of approximately 200 acres of settling basins on Waipio Peninsula on the island of Oahu (closure of Oahu Sugar Company, April 1995) and other declines in agricultural and natural wetlands during that period are believed to have contributed to the influx of Hawaiian stilts to the Kona coast. Observations on the island of Hawaii of banded birds from Maui and Oahu (Reed *et al.* 1998b) and similar observations of stilts dispersing to the dry island of Lanai to occupy artificial habitat at the Lanai WTP (Engilis and Pratt 1993) support this theory.

Except for Cyanotech, stilt nesting was not monitored regularly at other locations along the Kona coast between 1998 and 2001. However, one stilt fledgling was observed at Opaeula Pond during the 1998 breeding season and two fledglings were observed in 2001 (K. Uyehara, Ducks Unlimited, personal communication, 2002). Because stilts remain at the natal wetland site for a period of time after fledgling, it's believed these birds fledged from Opaeula Pond. It is likely that a few stilts produced fledglings at other wetlands along the Kona coast in 1998, 1999, and 2000 (Aimakapa and Hualalai wetlands). It is estimated that these wetlands (Opaeula, Aimakapa, Hualalai, and other small wetlands along the Kona Coast) can support up to 25 nesting pairs (Morin 1998; K. Uyehara, personal communication, 2002). However, at these sites, nesting habitat is limited, stilt nests are susceptible to predation, and water levels are not controlled to produce optimum foraging habitat to support chicks through the fledging stage.

Based on surveys conducted from 1998 to 2001 along the Kona coast, approximately 90 percent of the stilts forage at Cyanotech and the Kealakehe WTP and nearly all successful stilt reproduction occurs at the 1.7-acre Cyanotech Lake (194 fledglings in 4 years) managed during the breeding season to attract birds away from raceway ponds (Kim Uyehara, personal communication, 2002) (Table 2). Because wetlands in the State of Hawaii are believed to have reached carrying capacity of habitat for stilt reproduction (Reed 1998 *et. al*), Cyanotech includes a large number of breeding birds that may not have otherwise located suitable nesting habitat or successfully reproduced on other islands within the chain (Kim Uyehara, personal communication, 2002). If the stilts nesting in the Cyanotech Lake were not able to locate suitable breeding habitat elsewhere, then the birds fledged at Cyanotech represent an increase in the overall population that would otherwise not have occurred. With this increase in the number of adult stilts observed over the past four years, the Kona coast subpopulation now represents about ten percent of the entire population of stilts within the Hawaiian islands.

Factors Affecting the Species' Environment Within the Action Area

In 1996, Cyanotech staff noticed Hawaiian stilt nests and hatched chicks at the facility. In 1997, a few stilt chicks were found dead in the raceway ponds. It was assumed the chicks died from drowning in the rapidly flowing raceways.

By 1997, Cyanotech recognized an increasing problem when seven Hawaiian stilt nests were documented at and adjacent to the facility and up to 50 adult stilts were observed foraging in the raceway ponds. The Service was contacted and informed that the stilts had established a nesting pattern and that a few chicks had hatched and presumably died in the ponds.

During a May 27, 1997, Service visit to Cyanotech, a dead stilt chick was retrieved from one of the raceway ponds, and a stilt nest with four eggs was observed on the lava field adjacent to the facility. In a letter dated June 18, 1997, the Service recommended Cyanotech strive to accommodate the breeding, feeding, and sheltering needs of the birds coincident with the ongoing algae farming operation rather than haze the birds from the project site. In August 1997, Cyanotech entered into an agreement with Ducks Unlimited, Incorporated (Ducks Unlimited) to provide a short-term plan to assess and manage the Cyanotech stilt population and, following this assessment, to provide a long-term plan for managing stilts at the aquaculture facility.

The initial plan was to provide suitable nesting habitat for stilts on-site so they would not nest near the raceways. To do this, Cyanotech attempted to convert a raceway pond into suitable nesting habitat by taking it out of alga production, flooding it to a shallow depth and placing crushed lava and microalgae sludge to mimic conditions favorable for stilts.

A second measure was to manage water levels in a 1.7-acre settling basin (Lake) to provide stilt nesting habitat. Water levels were managed to provide shallow water foraging habitat and conditions favorable for the invertebrate food source. Two nesting islands were created and reconfigured to maximize nesting habitat in close proximity to shallow water areas. The 15-foot high, steep-sided walls may also serve as a barrier that restricts access by predators such as mongoose and cats. While this was successful at attracting most of the birds and producing fledglings, it didn't eliminate take. As a result, Cyanotech decided to develop an HCP and apply for an incidental take permit.

For four breeding seasons (1998 to 2001), Cyanotech has implemented interim measures to minimize incidental take of stilts while the HCP was being developed. These measures include: 1) modifying raceway berms, 2) increasing human activity adjacent to raceway ponds, 3) placing visual bird deterrence devices near raceway ponds, and 4) managing an artificial, predator-free nesting site (Lake) away from raceway ponds in order to attract stilts away from the raceway ponds where incidental take is inevitable.

In addition, Cyanotech has monitored stilt breeding activity at the facility and adjacent lava fields, and conducted monthly surveys of nearby wetland areas that are known to support Hawaiian stilts. During the four breeding seasons 194 stilts fledged from Cyanotech and the

number of Hawaiian stilts along the Kona coast continues to rise, with a mean of 145 (SD +/- 44) adult and subadult stilts observed during the 1998-2001 survey period (see Table 1).

Throughout the four-year period, incidental take of Hawaiian stilt chicks was reported to the Service (Cyanotech 1998; Cyanotech 1999a; Cyanotech 1999b; Cyanotech 1999c; Cyanotech 1999d; Cyanotech 2000; Cyanotech 2001a; Cyanotech 2001b) (see Table 1). Because it is believed all take cannot be verified, an estimate for incidental take was developed based on the number of stilts believed to be incidentally taken per year from 1998 to 2001: mean = 14; median = 12; range 1 to 29; during four years of active Lake management with no bird deterrent program in place.

In 1999, due to crowding caused by improper Lake configuration and human disturbance caused by banding stilts in the Lake, a higher number of chicks (29) were incidentally taken than in any other year (see Table 1). Chicks were walked by parents out of the Lake to raceway ponds and perished. The factors contributing to this increased take have been rectified and are not anticipated to occur again.

During the 2000 breeding season, one adult stilt and two fledglings were recovered from three separate raceway ponds on two separate dates. These birds were transported to the National Wildlife Health Center for examination. The adult stilt was fairly decomposed and found unsuitable for necropsy. Nothing unusual was revealed in the gross necropsy of the fledglings, and tests for avian botulism were negative. The histopathology reports were inconclusive and the causes of death were not determinable. There was no apparent link between operations at Cyanotech and the death of these birds.

Results of monitoring show it is not possible to accommodate stilt nesting at Cyanotech under the existing operating conditions without incidentally taking Hawaiian stilt chicks. Thus, the HCP identifies minimization and mitigation measures to reduce incidental take of Hawaiian stilt chicks at Cyanotech and contribute to stilt recovery, while developing and implementing methods to deter stilts from nesting and foraging at the facility.

EFFECTS OF THE ACTION

Overview

The proposed HCP implements short-term management at Cyanotech to reduce and offset incidental take of stilt eggs and chicks while long-term strategies to exclude stilts at Cyanotech are developed and implemented. Cyanotech will aggressively explore options and pursue solutions to reduce the invertebrate food source from its ponds in order to limit the number of stilts attracted to the site. Nest site fidelity in the raceway ponds will be discouraged and minimized by deterring birds from nesting in these unprotected and hazardous sites. Non-lethal bird deterrents such as netting and biodegradable repellents will be investigated and, if

appropriate, used at raceway ponds with the intent of finding an effective method to deter stilts from nesting and foraging in the ponds.

The Cyanotech Lake will be managed at carrying capacity to support 20 to 25 nesting stilt pairs during the breeding season to minimize and offset take at the raceway ponds. The Lake will be maintained dry in the nonbreeding season to encourage stilt dispersal to other wetlands. Based on past breeding success with management of the Lake, it is anticipated that between 20 and 30 stilt fledglings will be produced per year. Some fledged birds will stay on Hawaii while others will likely disperse to other islands.

Management of the Lake as a stilt breeding area may be discontinued prior to the end of the permit period (i.e. after the first or second year) if Cyanotech fledges more stilts than are incidentally taken during the permit term, and bird deterrents are found to be effective. For example, if the total number of fledglings produced in the first year is greater than the sum of the incidental take in the first year plus the anticipated incidental take in the second and third years, management of the Lake as a stilt nesting habitat may be discontinued with approval of the Service.

Direct Effects

Incidental take of Hawaiian stilt eggs, chicks, fledglings, subadults and adults at Cyanotech is anticipated during the permit term. Based on the limited amount of natural stilt-breeding habitat available along the Kona coast and the amount of shallow open water at Cyanotech, it is anticipated that the facility will continue to attract the majority of Hawaiian stilts along the Kona coast, especially during the breeding season, until effective bird deterrents are identified and utilized. Incidental take of eggs and chicks caused by Cyanotech operations and implementation of deterrence measures is anticipated during the breeding season, and incidental take of adults, subadults, and fledglings caused by implementation of deterrence measures is anticipated throughout the year.

<u>Routine Maintenance in Raceways and Emergency Maintenance in Lake During the Stilt Nesting Season</u>

Routine maintenance of the raceways includes activities such as microalgae harvesting, cleaning of raceways, and maintenance of paddle wheels. The microalgae crop cycle is seven days. Because stilt eggs and chicks are cryptic, Cyanotech employees conducting these activities could accidentally crush eggs and chicks. Emergency activities (*e.g.*, waterline repair), although very rare, may require Cyanotech staff to work inside the bermed areas of the Lake near active nests with eggs and chicks. Although, no Hawaiian stilt eggs or chicks have been lost as a result of routine or emergency maintenance during the past four years, incidental take of no more than one nest with up to four eggs and/or chicks is reasonably anticipated during the three-year permit term.

Bird Deterrents in Raceways

Implementation of bird deterrent measures will help to discourage birds from the facility in the long-term, and in the short-term will deter adults from nesting in areas where successful reproduction is not possible. Bird deterrent measures proposed are not intended to cause harm to stilts. However, implementation of bird deterrents may result in incidental take in the form of harassment of Hawaiian stilts. Adults observed in early nest-building activities will be hazed from the site. Other proposed deterrents such as 1) increasing microalgae harvests, 2) reducing gravel berms, 3) increasing human activity adjacent to raceways, 4) using bird repellents, and 5) netting raceways may also result in incidental take.

Implementation of bird deterrent measures to reduce nesting and chick mortality near raceways will result in the harassment of up to 30 pairs of adult stilts per year over the proposed three-year permit term. Harassment of breeding birds caused by increased human activity associated with implementation of bird deterrents may result in nest abandonment of up to two nests per year resulting in the mortality of up to eight eggs or chicks. Harm caused by evaluation and/or implementation of netting, bird repellents, or more rigorous hazing measures (*e.g.* lasers, predator call devices) may result in mortality or injury of three adult or subadult birds and three fledglings over the proposed three-year permit term. Based on the average monthly count of stilts observed at Cyanotech in 2001 (Cyanotech 2001c), implementation of bird deterrent measures to reduce foraging at the raceways during the non-breeding season will result in the harassment of up to 99 adult or subadult stilts per year over the proposed three-year permit term.

Chicks Hatched in Unprotected Areas of the Facility

Based on four years of monitoring, it is estimated that between 26 and 75 stilt breeding pairs will attempt to nest in protected and unprotected sites at Cyanotech. Unprotected areas at the facility where stilt nests have been documented include the areas along the top and sides of the raceway berms and on gravel roads. Chicks hatched in unprotected areas are susceptible to accidental crushing by vehicles moving between the raceways. In addition, chicks hatched in unprotected areas are likely to be led by parent stilts into raceway ponds where they will not survive. Suspected causes of death are drowning and physiological reactions to the hypersaline microalgal medium.

Incidental Take Estimate 1:

Using the highest estimate of 75 stilt breeding pairs, a 36.7 percent average nest success (nest hatching at least one chick) near raceways over the last four years (see Table 1), an average clutch size of 3.6 eggs per nest (Coleman 1981), and an egg viability of 86.1 percent (1998–2001 average of Cyanotech's managed habitats), approximately 85 stilt chicks per year could be incidentally taken (chicks hatched in adjacent to raceways that perish in raceways or on roads) if the HCP is not implemented (no Lake management, no bird deterrent measures). This estimate does not take into account natural chick mortality or predation of chicks. However, predation is expected to be low, because Cyanotech conducts predator control around the facility to minimize

contamination of the microalgae product by potential predators. It does take into account loss of chicks from Hawaiian stilt pairs that may attempt to renest after initial nest failure.

Based on four years of observations of nesting behavior of Hawaiian stilts at Cyanotech, not all birds are expected to nest adjacent to the raceway ponds. Four years of monitoring data show that an average of 55 percent of the nesting pairs (minimum = 38 percent, maximum = 61 percent) are accommodated at the Lake, 33 percent (minimum = 22 percent, maximum = 45 percent) at the raceways, and 12 percent (minimum = 7 percent, max = 23 percent) nest in the lava. These averages include stilt nesting data from last year (2001) with management of the Lake and preliminary implementation of efforts to reduce stilt nesting in unprotected areas. With implementation of the minimization and mitigation measures proposed in the HCP, we anticipate similar nesting behavior and estimate that 28 eggs or chicks (85 chicks/eggs x 33 percent stilt eggs/chicks in unprotected areas) may be incidentally taken due to nesting in unprotected areas.

Incidental Take Estimate 2:

A separate analysis was performed by Ducks Unlimited to estimate the number of raceway hatchlings using actual (1998 to 2001) and hypothetical (four-year weighted means) datasets for nest success (number of nests hatching at least one chick), average clutch size, and egg viability with considerations to natural mortality, and predation. This estimate of incidental take, using the actual raceway monitoring data showed a mean of 13, median of 12, and range of 7 to 22 eggs or chicks during four years of active Lake management with no bird deterrent program in place.

Hypothetical examples to determine the number of hatchlings in the raceways using a mean (36.7 percent), low (19.2 percent), and high (50 percent) nest success from 1998 to 2001 yielded respective means of 13, 17, and 18 stilts hatched at the raceways. A small number of estimates (16) for potential raceway hatchlings was derived from actual and hypothetical datasets ranging from one to 39. Of the 16 calculations, 14 (88 percent) estimated 22 chicks or less, and 12 (75 percent) fell between three and 15 (Table 3). When using the mean nest success (36.7 percent) in the year with the largest number of nesting pairs in the raceways (21 nesting pairs in 2000), 29 is the estimate of the number of chicks hatched in raceways. Therefore, Ducks Unlimited estimates that injury or mortality of 29 eggs or chicks per year over the three year permit term will result from nesting in unprotected areas.

There are many interacting variables that could affect the level of incidental take. The affect variables such as the success of bird deterrent measures, predator populations, infertility, inexperienced breeders, number of microalgae ponds in production, and weather patterns will have on incidental take of chicks and eggs cannot be quantified with any level of confidence at this time. However, it is believed that these variables would decrease the amount of incidental take and therefore, the incidental take estimate of 28 to 29 eggs/chicks is accurate.

In summary, it is highly unlikely that any chicks hatched in the unprotected nesting sites at Cyanotech will survive to fledging. Based on the two methods of calculating take, the Service

anticipates that up to 29 eggs and/or chicks may be incidentally taken per year during the proposed three-year permit term. However, even in other managed wetlands, not all hatchlings are expected to survive and be recruited into the population (Robinson *et al.* 1999).

Indirect Effects

Hawaiian stilts attracted to the Cyanotech facility may nest in adjacent areas such as the lava fields. Nesting in the lava is believed to have started in 1997 based on old nests that were located during the 1998 breeding season. Adults are able to fly to raceway ponds to forage, however, it is nearly impossible for chicks to traverse the rough lava terrain. Between incubation periods, adult stilts with nests out in the lava fields were observed flying to the Cyanotech ponds to feed. It is reasonable to believe, therefore, that adults will attempt to move chicks hatched from the lava-field nesting site to the Cyanotech ponds to feed. The lava fields are characteristic rugged terrain, include innumerable crevices and deep ravines, and support rats and mongooses. In the event eggs successfully hatch from nests out in the lava field, it is inconceivable that the chicks could survive the move across the lava to the Cyanotech ponds. As was documented during the past four breeding seasons, all nests constructed out in the lava fields will likely fail due to predation, starvation, or falling into a lava crevice. Furthermore, any chicks successfully moved from lava nesting sites to the Cyanotech ponds would likely perish in the raceways.

As previously stated, it is estimated that up to 75 pairs of stilts will attempt to breed at Cyanotech. This includes the adjacent lava field, although the lava field is not within the Cyanotech boundary. Four years of monitoring data from Cyanotech show an average of 12 percent (minimum = 7 percent, maximum = 23 percent) nest in the lava. These averages also include stilt nesting data from 2001 when Cyanotech created nesting habitat at the Lake and implemented some deterrence measures to reduce stilt nesting near the raceways.

Similar nesting behavior is anticipated with implementation of the minimization and mitigation measures proposed in the HCP. The Lake will be managed to provide nesting habitat for 20 to 25 stilt pairs. Some of the excess pairs will attempt to nest adjacent to the raceways and the others will likely nest in the lava. Using the averages calculated from four years of nesting behavior at Cyanotech, we estimate the loss of up to 10 eggs or chicks (85 chicks/eggs x 12 percent of eggs/chicks in lava) per year will result from nesting in adjacent areas such as the lava fields.

The level of human disturbance around the raceway ponds, rather than the lack of available nesting habitat at the Lake, is suspected as the reason stilts established a nesting colony so far away from the foraging sites. Increase in human activity, reduction of suitable nesting substrate, and implementation of bird deterrence measures around the raceway ponds may cause an increase in the number of nesting attempts by Hawaiian stilts in the lava fields.

While a portion of the birds may attempt to renest at other wetland sites or within the Lake when space becomes available later in the breeding season, the mortality of chicks hatched from nests in the lava fields is viewed as an indirect adverse effect related to the construction and operation of the aquaculture facility. Loss of these nests is not considered incidental take as defined under

the Act. Nevertheless, with implementation of the HCP, it is hoped that the established nesting sites out in the lava fields will eventually be abandoned for more favorable nesting sites on the Big Island or other islands.

Summary

Actions taken by Cyanotech during the past four breeding seasons demonstrates that implementing the HCP can minimize stilt breeding activity in hazardous areas and thus minimize take of stilts as well as mitigate for the take that does occur. The HCP is expected to eventually eliminate the incidental take of Hawaiian stilts at Cyanotech by eliminating the "attractive nuisance" problem created by the expanse of open-water ponds, invertebrate food resources, and remote nesting areas, which inadvertently attract Hawaiian stilts to the facility. The HCP includes identification and implementation of non-lethal bird deterrent measures to reduce and eliminate stilt foraging and nesting at the facility. In addition, the HCP includes an adaptive mitigation strategy to create a protected and managed nesting area on-site during the breeding season in order to ensure some reproductive success for the birds attracted to Cyanotech.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Opaeula Pond is privately owned and located four miles north of the Cyanotech facility along the Kona coast. Opaeula Pond is 7.5 acres in size and has been identified in the draft revised waterbird recovery plan as a key breeding area for the stilt and the endangered Hawaiian coot (*Fulica alai*), and represents one of only two natural wetlands essential to endangered and migratory waterbird populations along the Kona coast on the island of Hawaii (USFWS 1999). The plan also identifies Opaeula Pond as a primary habitat for which protection and management is required in order to delist the four endangered waterbird species. Funding has been secured to clear alien vegetation, restore nesting habitat and to conduct periodic monitoring of the area, and the landowner has agreed to conduct ongoing predator control. These habitat improvements are expected to support nesting of six to eight pairs of Hawaiian stilts and five pairs of Hawaiian coots, and increase feeding and loafing habitat for the two other endangered waterbirds, Hawaiian moorhen (*Gallinula chloropus sandvicensis*) and Hawaiian duck (*Anas wyvilliana*), and numerous species of migratory waterbirds.

The County of Hawaii is planning to create wetland habitat for endangered Hawaiian waterbirds at the Kealakehe WTP located 5 miles south of the Cyanotech facility along the Kona coast. Ten acres of wetlands are being designed to provide feeding and nesting habitat for stilts and the Hawaiian coot. Management of water levels, development of food base for target species, planting of appropriate aquatic vegetation, and predator control is described in initial project plans. At this time, the project remains in the planning and design stage. Because the County has not obtained necessary approvals

or secured funding, wetland construction is not likely to occur within the next three years or (the proposed term of the incidental take permit) (J. Thullen, personal communication, 2002).

The projects at Opaeula Pond and Kealakehe WTP will benefit the recovery of Hawaiian stilts by increasing the amount of suitable foraging and nesting habitat for the species along the Kona coast. However, during the proposed three-year permit term, only Opaeula Pond can be expected to provide habitat for stilts dispersing from Cyanotech.

CONCLUSION

After reviewing the current status of the Hawaiian stilt, the environmental baseline of the species in the action area, the effects of the proposed HCP and incidental take permit, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Hawaiian stilt. No critical habitat has been designated for this species, therefore none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The proposed Cyanotech HCP and its associated documents clearly identify anticipated impacts to affected species likely to result from the proposed taking and the measures that are necessary to minimize those impacts. All conservation measures described in the proposed HCP, together with the terms and conditions described in any section 10(a)(1)(B) permit issued with respect to the proposed HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR 402.14(I). Such terms and conditions are non-discretionary, and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the Act to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take anticipated under the proposed Cyanotech HCP, associated

reporting requirements, and provisions for disposition of dead or injured animals are as described in the HCP and its accompanying section 10(a)(1)(B) permit. The Service has a continuing duty to regulate the activity covered by this Incidental Take Statement.

AMOUNT OR EXTENT OF TAKE

Based on the proposed Cyanotech HCP and on the analysis of the effects of the proposed action provided above, the Service anticipates the following take may occur as a result of the proposed action:

1. One (1) Hawaiian stilt nest with up to four (4) eggs and/or chicks could be incidentally taken over the three-year permit term in the form of mortality or injury as a result of emergency maintenance activities in the Cyanotech Lake or routine maintenance at the Cyanotech raceways.

2. Three (3) Hawaiian stilt adults and three (3) fledglings could be incidentally taken over the three-year permit term in the form of injury or mortality from implementation of bird deterrence measures (*e.g.*, netting, bird repellents, predator calls) and hazing activities (*e.g.*, increased human activity, lasers).

3. Thirty (30) pairs of Hawaiian stilt adults could be incidentally taken each year in the form of harassment from implementation of bird deterrence measures (*e.g.*, netting, bird repellents, predator calls) and hazing activities (*e.g.*, increased human activity, lasers) during the stilt breeding season.

4. Ninety-nine (99) Hawaiian stilt adults or subadults could be incidentally taken each year in the form of harassment from implementation of bird deterrence measures (*e.g.*, netting, bird repellents, predator calls) and hazing activities (*e.g.*, increased human activity, lasers) during the non-breeding season.

5. Two (2) Hawaiian stilt nests with up to eight (8) eggs and/or chicks could be incidentally taken each year in the form of mortality as a result of implementation of bird deterrence measures (*e.g.*, netting, repellents, predator calls) and hazing activities (*e.g.*, increased human activity, lasers).

6. Twenty-nine (29) stilt eggs or chicks could be incidentally taken each year in the form of injury or mortality as a result of drowning, adverse physiological reactions to the microalgae medium, or on-going maintenance activities in the vicinity of the Cyanotech raceway ponds.

EFFECT OF TAKE

In the accompanying biological opinion, the Service determined that the maximum level of incidental take authorized under the proposed HCP and permit is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Reasonable and prudent measures, and terms and conditions

The Cyanotech's HCP prescribes methods to minimize and mitigate impacts, to fund such methods, and to deal with unforeseen future circumstances. These actions represent reasonable and prudent measures the Service believes are necessary and appropriate to minimize impacts. Measures as described in the HCP and incorporated in the incidental take permit constitute non-discretionary, binding terms and conditions of the authorizing permit that Cyanotech must implement for the exemptions to the section 9 prohibitions against take to apply.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a) (1) of the Act direct Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are Service suggestions regarding discretionary agency activities to promote the recovery of listed species. However, the process of developing an HCP essentially necessitates the incorporation of this approach into the planning process. Accordingly, there are no additional conservation recommendations.

RE-INITIATION NOTICE

This concludes formal consultation on the proposed issuance of a section 10(a)(1)(B) incidental take permit to Cyanotech. As required in 50 CFR 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an adverse affect to the listed species that was not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by this action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

If you have any questions regarding any of the information contained in this biological opinion, please contact James Kwon of my staff (phone: 808/541-3441; fax: 808/541-3470).

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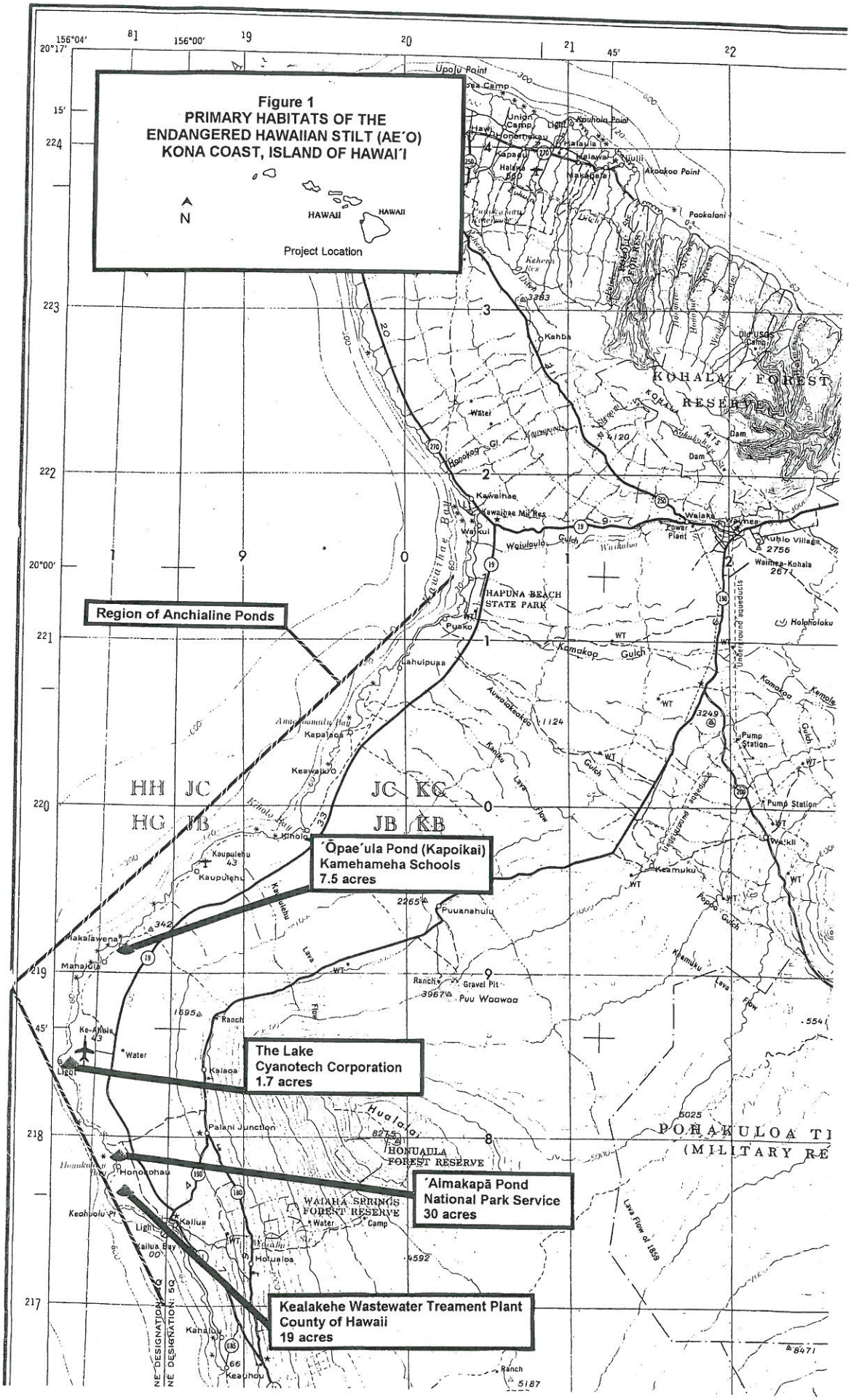

Table 1: Hawaiian Stilt Breeding Summary at Cyanotech 1998-2001

	1998	1999	2000	2001
Average monthly count of adult stilts (Cyanotech and Kealakehe Wastewater Treatment Plant)	108	132	182	220
Average monthly count of adult stilts (Cyanotech only)	53	56	84	99
Nesting Pairs @ Cyanotech (Est.)[a]	20	34	61	43
Eggs Salvaged[b]	10	23	0	0
Incidental Take of Chicks	1	29	10	14

1998	LAKE	DU POND	RACEWAYS	LAVA
No. of Nesting Pairs per Site (Est.)[c]	10	1	6	9
No. of Nests	10	1	6	9
No. of Successful Nests (known)	10	1	2	1
Nest Success	100.0%	100.0%	33.3%	11.1%
No. of Eggs[c]	39	4	23 (est.)	33 (est.)
No. of Hatchlings (known)	35	4	8	2
Fledglings Produced	**33**	**5[d]**	**0**	**0**
Hatching Success	89.7%	100.0%	34.7%	6.0%
Fledging Success	**94.3%**	**100.0%**	**0.0%**	**0.0%**
1999	**LAKE**	**DU POND**	**RACEWAYS**	**LAVA**
No. of Nesting Pairs per Site (Est.)[c]	25	5	9	2
No. of Nests	29	5	9[e]	3
No. of Successful Nests (known)	26	4	4	0
Nest Success	89.7%	80.0%	44.4% (est.)	0.0% (est.)
No. of Eggs (Est.)[c]	109	20	30	9
No. of Hatchlings (known)	80	11	12	0
Fledglings Produced	**31**	**0**	**0**	**0**
Hatching Success	73.4%	55.0%	40.0%	0.0%
Fledging Success	**38.8%**	**0.0%**	**0.0%**	**0.0%**
2000	**LAKE**	**DU POND[f]**	**RACEWAYS**	**LAVA**
No. of Nesting Pairs per Site (Est.)[c]	40	6	21	8
No. of Nests	48	8	26	8
No. of Successful Nests (known)	36	4	5	3
Nest Success	75.0%	50.0%	19.2% (est.)	37.5% (est.)
No. of Eggs (Est.)[c]	167	24	92	28
No. of Hatchlings (known)	100	9	14	4
Fledglings Produced	**84**	**0**	**0**	**0**
Hatching Success	59.9%	37.5%	15.2%	14.3%
Fledging Success	**84.0%**	**0.0%**	**0.0%**	**0.0%**
2001	**LAKE**	**DU POND[g]**	**RACEWAYS**	**LAVA**
No. of Nesting Pairs per Site (Est.)[c]	26	0	14	3
No. of Nests	26	0	14	3
No. of Successful Nests	24	0	7	1
Nest Success	92.3%	0.0%	50.0%	33.3%
No. of Eggs (Est.)[c]	81	0	47	11
No. of Hatchlings (known)	65	0	20	1
Fledglings Produced	**41**	**0**	**0**	**0**
Hatching Success	80.2%	0.0%	42.6%	9.1%
Fledging Success	**63.1%**	**0.0%**	**0.0%**	**0.0%**

[ac]Est. no. of nesting pairs at Cyanotech not equal to total est. no. of nesting pairs/site due to intersite movement and renes

[b]Egg salvage discontinued

[c]Includes hatched, infertile, flooded, predated, and abandoned eggs.

[d]Includes 1 fledgling from raceway-hatched brood (see Sec. 2.3.1)

[e]6 of 15 nests were collected by FWS, numbers reflect the 9 uncollected nests.

[f]DU pond was drained and in the process of being returned to production. 8 nests were laid on dry substrate.

[g]DU Pond used as a test site for Mylar. No nests were laid on dry substrate

Successful Nest = at least 1 egg hatched

Nest Success = #successful nests / #nests

Hatching success = #hatchlings / #eggs

Fledging success = #fledglings / #hatchlings

Table 2: Hawaiian Stilt Reproductive Success at Various Managed Wetlands

Time Period	Aimakapa Pond, Hawaii	Cyanotech Lake, Hawaii[a]	Chevron Oil Refinery, Oahu[a]	Honouliuli Unit, JCNWR, Oahu	Kii Unit, JCNWR, Oahu	Kii Unit, JCNWR, Oahu	Kealia Pond NWR, Maui	Nuupia Ponds, Oahu	Waiawa Unit, JCNWR, Oahu
	1993-1994 (2 years)	1998-2001 (4 years)	1992-98, 00, 01 (9 years)	1978-1980 (3 years)	1978-1980 (3 years)	1985-1988 (4 years)	1995-2000 (6 years)	1979-1980 (2 years)	1978-1980 (3 years)
No. of nests	34	113	179	66	164	243	307	73	74
No. of successful nests	17	96	no data	no data	no data	137	170	no data	no data
% nest success	50.0%	89.3%	55%[d]	no data	no data	56.4%	54.5%	no data	no data
% hatching success	no data	75.8%	71.4%	53.3%	50.0%	54.0%	no data	40.0%	70.0%
% fledging success	no data	70.0%	68.9%	12.0%	20.6%	24.3%[b]	no data	22.0%	22.5%
No. of fledglings	40	189	291	17	64	9[b]	no data	34	45
Mean fledglings/nest	1.1	1.7	1.64	0.28	0.39	no data	no data	0.52	0.59
Mean fledglings/year	20	47.3	32.3	5.7	21.3	9[b]	no data	17	15
% egg viability[c]	no data	86.1%	no data	no data	no data	no data	no data	no data	no data
Sources	Morin 1998	DU unpubl.	USFWS unpubl.	Coleman 1981	Coleman 1981	Chang 1990	Nishimoto unpl.	Coleman 1981	Coleman 1981

[a]Manmade wetlands intensively managed for Hawaiian stilt reproduction. All other sites are wetland bird sanctuaries managed for multiple species and uses by the National Park Service, U.S. Fish and Wildlife Service, or Marine Corps Base Hawaii.

[b]1988 data only

[c]Cyanotech Lake 1998-2001 and DU Pond 1998-1999 (when managed)

[d]2001 data only

Note: Data summarized from published sources and USFWS and DU files. We believe that reproductive success has increased in recent years at bird sanctuaries Requests have been placed for more recent data and we anticipate filling in the gaps.

Definitions:

successful nest = hatched at least 1 chick

% nest success = # nests that hatched at least 1 chick / total # of nests

% hatching success = # chicks hatched / # of eggs

% fledging success = # of fledglings / # of chicks hatched

% egg viability = # hatchlings / # of eggs incubated to full term

Table 3: Assessment of Incidental Take Using Raceway-Hatched Chicks

Est. No. of Raceway Hatchlings Only														
Raceway (RW) Data Only									Assessment of Incidental Take Chicks Hatched in RWs Only					
									Actual Data			Hypothetical Data		
		Nest Success (%)				Average No. of Eggs of Successful Nests						Nest Success (%) 1998-2001		
Year	Actual No. of Nests (N_A)	Actual (NS_A)	Mean (NS_M)	Low (NS_L)	High (NS_H)	Actual (E_A)	Mean (E_M)	Egg Viability (EV)	Take[a] Reported	Adjusted[b] Take Reported	$N_ANS_AE_AEV$	36.7 (Mean) $N_ANS_ME_MEV$	19.2 (Low) $N_ANS_LE_MEV$	50.0 (High) $N_ANS_HE_MEV$
1998	6	33.3	36.7	19.2	50	4	3.5	86.1	1	1	7	7	3	9
1999	9	44.4	36.7	19.2	50	3	3.5	86.1	29	10	10	10	5	14
2000	26	19.2	36.7	19.2	50	3.2	3.5	86.1	10	5	14	29	15	39
2001	14	50	36.7	19.2	50	3.7	3.5	86.1	14	10	22	15	8	21
								Mean	14	7	13	15	8	21
								Median	12	8	12	13	7	18
								Range	1-29	1-10	7-22	7-29	3-15	9-39

[a]Includes chicks hatched in RWs, Lava, Lake and of Unknown origin

1998 (1 RWs); 1999 (29 hatchlings=10 RWs, 12 Lake, 7 Unknown);
2000 (10 hatchlings=5 RWs, 3 Lava, 2 Unknown);

2001 (14 hatchlings=10 RWs, 1 Lava, 3 Unknown).

[b]Adjusted to present raceway hatched chicks only for comparison.

Est. No. of RW Hatchlings Only = (Actual No. of RW Nests)(% RW Nest Success)(Avg. No. of Eggs of Succ. RW Nests)(Egg Viability)

Est. No. of RW Hatchlings Only = $N_ANS_XE_XEV$

Less 30-50% est. chick mortality from natural causes or ongoing predation (Chang 1990)

Plus 30-50% est. chick movement from lava or uknown origin to raceways

see Table 1 and 3 for raw data and definitions