<u>FINAL DRAFT</u>

HABITAT CONSERVATION PLAN

WindMar RE Project
Guayanilla, Puerto Rico

February 2005

Prepared for:

WindMar Renewable Energy, Inc.
Victor L. Gonzalez, President

Please Contact:

John Guarnaccia
Guarnaccia Associates
1407 Finntown Road
Waldoboro, ME 04572
(207) 832-7852 phone/fax
(787) 510-0928 cellular in Puerto Rico
JAGuarnaccia@aol.com

HABITAT CONSERVATION PLAN

WINDMAR RE PROJECT

GUAYANILLA, PUERTO RICO

Executive Summary

Puerto Rico's economic security is at risk from an overdependence on expensive and polluting fossil fuels imported to generate electricity. Recent technological advances, however, have made wind energy an extremely viable and cost-effective alternative for meeting national energy needs. Denmark, for example, generates over 15% of its electricity from wind at an economic and environmental cost far below traditional means. Unlike many countries, Puerto Rico has an abundant wind resource that can generate renewable, emission-free electricity in quantities that can significantly improve the island's economic competitiveness and quality of life.

Unlike fossil-fuel and nuclear-energy plants, wind-energy projects cannot be sited anywhere, only where there is abundant wind. One such place is the western side of Guayanilla Bay, where WindMar Renewable Energy, a locally owned company, owns a 290-hectare (725-acre) coastal property adjacent to the Guánica State Forest. This site has the best wind of four sites analyzed, including along Puerto Rico's northern and eastern coasts.

The land use surrounding the WindMar property includes heavy industrial, agricultural, and conservation uses. The output of clean energy from this 41.3-MW (megawatt) project would be 110,000,000 kWh/year, or the amount of electricity consumed by nearly 23,000 typical Puerto Rican households. This electricity would be generated without the annual emission of about 83,500 tons of greenhouse gasses, without other polluting emissions, and without the threat of oil spills to wildlife.

This project would erect approximately twenty-five 1.65 MW wind turbines on Punta Verraco, Cerro Toro, and Punta Ventana, the site's three upland areas. The widening of 8.7 km of existing roads, siting of 1.4 km of new roads, and preparation of construction areas to erect the wind turbines would affect a maximum of 12.2 ha of dry forest habitat, but the construction impact could be significantly less, perhaps as much as half (WindMar can only gauge this when construction is taking place; in the meantime, the potential impacts are based on a high estimate). 12.2 ha represent 4.2% of the entire property, and 4.9% of the property's dry forest. But, the project includes a mitigation plan that would restore 13.3 ha of dry forest (108% of impact), protect 245 ha of the property (84.5%), including nearly 210 ha of dry forest, in a conservation easement, and provide other significant benefits.

Baseline studies have documented the occurrence of federally listed species at the WindMar site, including the Puerto Rican Nightjar (*Caprimulgus noctitherus*), Brown

Pelican (*Pelecanus occidentalis*), and Roseate Tern (*Sterna dougallii*). The Brown Pelican and Roseate Tern have been studied with regard to wind-energy development (in Colombia and Massachusetts respectively), but the WindMar project is the first to look at potential impacts from wind-energy development on a nightjar.

The Endangered Species Act (ESA) contains a provision under Section 10 that allows for the "incidental take" of endangered and threatened species by non-federal entities. The ESA defines incidental take as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." Congress enacted this provision in order to reduce conflicts between listed species and economic development activities, and to provide a framework that would encourage "creative partnerships" between the public and private sectors and state, municipal, and Federal agencies in the interests of endangered and threatened species and habitat conservation.

Issued by the Fish and Wildlife Service (FWS) or National Marine Fisheries Service (NMFS), an Incidental Take Permit is the instrument that authorizes the taking of federally listed species if such taking occurs incidentally during otherwise legal activities. The ESA requires an applicant for an Incidental Take Permit to submit what is called a Habitat Conservation Plan (HCP). An HCP should specify the impacts that are likely to result from the proposed taking, the measures the applicant will undertake to minimize and mitigate these impacts, and the alternative actions the applicant has considered that would not result in the take, including the reasons why these alternatives were not adopted.

WindMar seeks an Incidental Take Permit that would allow the taking of a small and not biologically significant number of Puerto Rican Nightjars, Brown Pelicans, and Roseate Terns. While, as we demonstrate in this HCP, it is conceivable that none of these species will be harmed by the WindMar project, there are no specific studies of these species at operating wind energy projects to support such a conclusion. For this reason, WindMar seeks this permit in order to provide ample protection under Section 10 of the ESA for a project of high social and economic benefit.

In consultation with biologists from the Fish and Wildlife Service (FWS) and Department of Natural and Environmental Resources (DNER), top experts retained by WindMar designed and conducted studies that have ensured that adequate information existed to proceed with the HCP process. These studies have documented that virtually all of the site's plant communities had been significantly degraded by long-term human exploitation. An avian risk assessment found that risk to all birds, including night-migrating songbirds, raptors, waterfowl, shorebirds, herons and egrets, and endangered species, was likely to be low and not biologically significant. Nevertheless, detailed studies of site-use by endangered species were subsequently conducted.

WindMar conducted an intensive study of the Puerto Rican Nightjar during the 2003 and 2004 breeding seasons. In 2003, we mapped 33 singing males nightjars on 250 hectares of dry forest, yielding an abundance of 0.132 nightjars/ha. In 2004, the number of singing male nightjars increased to 42, for an abundance of 0.168 nightjars/ha. These values are nearly twice and more than twice than what was reported for the site more than ten years earlier (Vilella and Zwank 1993a; see table below).

Table 1: Nightjar Population Increase

Sector	Vilella and Zwank 1985-1992	WindMar 2003	WindMar 2004
Punta Verraco[1]	9	19	23
Cerro Toro[1]	3	5	6
Punta Ventana[2]	7	9	13
Total	19	33	42
Abundance (nightjars/ha)	0.076	0.132	0.168
Increase above Vilella and Zwank		74%	121%

[1] Vilella and Zwank lumped Punta Verraco and Cerro Toro together and recorded a maximum of 12 birds on an estimated 160 ha (0.075 nightjars/ha). On the basis of area, we have estimated the number of birds in each sector.

[2] The Punta Ventana value is based on Vilella and Zwank's census of the adjacent section of the Guanica State Forest, where they found 0.069 nightjars/ha.

See Vilella and Zwank 1993a

The most probable reason for the 27% increase in nightjar numbers between 2003 and 2004 is the establishment and widening of roads throughout the site in order to gain access to the different property sectors and conduct a geotechnical study of the bedrock. Our results strongly suggest that the introduction of limited edge habitat in continuous dry forest can enhance habitat conditions for the Puerto Rican Nightjar and benefit present and future breeding populations.

Our study also found that approximately 50% of the site's dry forest appears not to be occupied by singing male nightjars, and that, based on the 2004 nightjar distribution and project site plan, only 4.4% of each nightjar singing territory would be affected on average by project construction. Given these findings, in addition to the adaptability nightjars have demonstrated with regard to the 2004 road construction activities and to industrial activities in Ponce (including dynamite blasting and the operation of heavy machinery around quarries), WindMar is confident that nightjars will adjust their distribution in order to accommodate the wind turbine layout. But, given that the act of clearing dry forest vegetation to accomplish site preparation could result in harm to nightjars or temporarily displace birds, WindMar requests an Incidental Take Permit that would allow the taking of the 12 nightjar signing territories where the amount of affected habitat might surpass 6.9%. As explained below, WindMar has chosen 6.9% because its data appear to indicate that singing male nightjars can tolerate habitat loss at least to that level.

This amount of incidental take would in no way jeopardize the continued existence of the Puerto Rican Nightjar, because the bird's population has been documented to be expanding geographically and increasing in number throughout southern Puerto Rico as succession occurs in areas where forests had been removed. The bird has also increased in number as insect populations have rebounded with the reduction and elimination of pesticides and chemical pollutants, including emissions of upwind power plants.

Until very recently, there was no wind energy project within the normal range of the Brown Pelican. But, in April 2004, a coastal wind-energy project came on line in northeastern Colombia where the Brown Pelican is the most common bird. 47% of all birds observed during pre-construction studies at the site of the coastal Jepirachi Wind Park were pelicans, including 94% of all birds observed in flight. In September 2001, the rate of pelicans flying low over the water in front of this wind farm was recorded at 162 birds/hour (EEPPM 2002). This is 40 times greater than the average pelican flight rate in front of the WindMar site, and 27 times more than the rate of pelicans rounding the tip of the Punta Verraco peninsula in May 2004. During the first six months of operation of the Jepirachi project, no birds of any species have been recorded in mortality studies (A. Grecco, personal communication). Given the extremely high rate of pelicans flying in the vicinity of this wind farm at certain times of the year, this is highly significant, indicating that pelicans moving along the shore are unaffected by coastal wind-energy projects. Most of the pelicans observed at the WindMar site exhibit such a coastal flight pattern.

Unlike the Jepirachi project, however, pelicans at the WindMar site have been regularly recorded transiting the Punta Verraco peninsula on their way between the Caribbean and Guayanilla Bay. But, flight patterns indicate that few pelicans would be at risk from turbine collisions. WindMar has found that, to enter Guayanilla Bay, where they roost and feed, pelicans use three principal routes: 1) around the tip of the peninsula (2.2 birds/hr), 2) gliding "downhill" out of the updraft elevator at Cerro Toro (the *Cerro Toro crossing*, 1.4 birds/hr), and 3) at any point across the main part of the peninsula (0.2 birds/hr, but at 0.06 birds/hr at rotor height). Departing Guayanilla Bay for the Caribbean, where they also feed, most pelicans go around the peninsula tip (3.9 birds/hr), but some birds cross the main part of the peninsula (0.1 birds/hr, 0.08 birds/hr at rotor height) and some use the Cerro Toro crossing (0.1 birds/hr).

Two of these routes – around the peninsula tip and along the Cerro Toro crossing – do not put pelicans at risk from wind turbines. Pelican use of the airspace in the proposed turbine field on Punta Verraco is relatively low (0.2 observations/hr, or 0.3 birds/hr of which 0.1 birds/hr fly at rotor height) when compared with studies of raptors at sites with more than 100 turbines (range of 0.4 to 1.5 observations/hr, from Erickson et al. 2002). Mortality rates for raptors, which appear to be particularly susceptible to turbine collisions, range widely, from 0.000 to 0.053 mortalities/turbine/year at sites with over 100 turbines (Erickson et al. 2002). With 12 turbines on Punta Verraco, a high mortality rate of 0.053 birds/turbine/year would translate into one mortality every 1.6 years. The mortality rate for pelicans at the WindMar site is surely to be much lower, for the following reasons: 1) pelican use of the turbine field airspace on Punta Verraco is half or less than what has been documented for raptors in the studies referenced above; 2) pelicans are more likely to avoid turbines than raptors, because they do not forage over land and should be far less distracted by prey, particularly in the fish-poor waters surrounding the WindMar site (if pelicans will be distracted by feeding aggregations at all, given the height of Punta Verraco and the distance of the turbines from any potential feeding areas); and 3) a mortality rate of 0.053 birds/turbine/year is a high value, particularly when values as low as 0.000 birds/turbine/year have been recorded. With studies demonstrating that birds mostly recognize wind turbines as obstacles and regularly avoid flying into them, it is highly likely that collision mortality for pelicans at the WindMar site will be low or none.

Since there are no precedents for calculating incidental take for the pelican from a coastal wind energy project, WindMar requests an Incidental Take Permit that gives the project ample protection under Section 10 of the Endangered Species Act (ESA). In this regard, we request an incidental take of eight (8) pelicans over the forty-year lifespan of the WindMar project, or one pelican every five years. The action of granting such an Incidental Take Permit is not likely to jeopardize the continued existence of the Brown Pelican. According to a Population Viability Assessment (PVA) commissioned by WindMar (see Appendix XI), the Brown Pelican population in Puerto Rico and the US Virgin Islands is in serious trouble and is likely to disappear within a few decades. The main factor appears to be poor adult and juvenile survival, which is likely related to the declining health of marine ecosystems. According to the PVA, mortality at the incidental take level or higher does not accelerate the pelican's population decline in a meaningful way. In fact, the most likely incidental take scenario – where the affected pelicans come from a local population centered in Guayanilla Bay – is not statistically different than the projected population decline without the WindMar project.

If anything is to be done for the pelican that restores marine ecosystems and fish populations, a reorientation of Puerto Rican society toward sustainable development is required. One of the aspects of this reorientation will certainly be a conversion to renewable energy sources, such as the WindMar project is pioneering.

WindMar did not record Roseate Tern during our flight-use study or in recent years. FWS, however, has recorded the infrequent nesting of this species (four times in fourteen years) on Cayo Guayanilla, a small coral islet 600 m south of the tip of Punta Verraco peninsula. On only one occasion in fourteen years have breeders numbered in the hundreds of birds. Its congeners, the Royal and Sandwich terns, were recorded frequently during the flight-use study, but in every case they were observed low over the water at a distance from the peninsula. No tern was observed transiting the peninsula during the flight-use study. It is not inconceivable that Roseate Tern could transit the rotor zone, but our baseline study indicates that it is highly unlikely. Nevertheless, in order to give WindMar ample protection under Section 10 of the ESA, we request an incidental take permit for one Roseate Tern every twenty years. This level of take would not jeopardize this species given its population level and reproductive output in Puerto Rico.

With regard to other species of concern, field studies have determined that the Yellow-shouldered Blackbird (*Agelaius xanthomus*), the threatened lizard, *Anolis cooki*, and bats would not be at risk from the project. With regard to the blackbird, it was not detected in our studies, and the habitat in the vicinity of the wind turbines is unsuitable for it. With regard to the lizard, it occurs on the site, but its coastal, exposed rocky habitat zone does not intersect with the planned turbine locations. The bat population at the WindMar site is low and mainly composed of nectar and fruit-eating species that forage mainly below the forest canopy. The flying insect populations upon which insectivorous bats depend were found not to fly much above the forest canopy in low wind conditions. In high wind conditions, when rotor collisions would become a factor, it is highly unlikely that flying insects would ascend high above the canopy in numbers that attract bats. Therefore, insectivorous bats would not be at risk from rotor collisions.

Risk to other soaring birds – specifically the Magnificent Frigatebird (*Fregata magnificens*), Turkey Vulture (*Cathartes aura*), and Red-tailed Hawk (*Buteo jamaicensis*) – was also found to be low to none. The frigatebird exhibits a strong coastal flight pattern similar to pelican's with a low frequency entering the wind farm area. While the Turkey Vulture spends the most time of any species in wind farm area, studies at other wind-energy sites where the Turkey Vulture is common have found little or no mortality. In the case of the Red-tailed Hawk, it occurs infrequently at the WindMar site (0.06 birds/hr at Punta Verraco), presumably because the time and energy investment there does not result in enough captures of prey.

WindMar offers a mitigation plan that more than compensates for the incidental take we are requesting, should incidental take occur at those levels. The scope and generosity of this mitigation plan results from the deep, abiding interest WindMar's principal, Victor L. Gonzalez, has in conservation and sustainable development. He firmly believes that, with this mitigation plan, the wind energy project WindMar is proposing is, without question, good for Puerto Rico, good for the environment, good for endangered species, and appropriately sited on land WindMar owns adjacent to the Guánica State Forest. The major features of this plan are:

- A conservation easement on nearly 85% of the WindMar property; this easement will compensate for impacts to dry forest at a rate of 1700%.
- Restoration of up to 13.3 ha of dry forest, if 12.2 ha of dry forest is impacted by construction; this includes at least 2.6 ha of the 3.1-ha abandoned quarry at the base of the Punta Verraco peninsula and up to 10.7 ha in road margins and construction sites.
- Restoration of a 10-ha degraded mangrove area by improving drainage.
- Funding to support population research on the endangered Brown Pelican.
- An environmental education program focusing on endangered species and renewable energy for visitors to the project site and for schools in surrounding communities.

HABITAT CONSERVATION PLAN

WINDMAR RE PROJECT

GUAYANILLA, PUERTO RICO

<u>Table of Contents</u>

Tables, Figures, and Appendices

Figure 2: 1963 photograph showing roads and trails used to exploit Punta Verraco and Cerro Toro

HABITAT CONSERVATION PLAN

WINDMAR RE PROJECT

GUAYANILLA, PUERTO RICO

Introduction

WindMar Renewable Energy (WindMar RE) proposes to construct Puerto Rico's first commercial wind energy project, rated at 41.3 MW (megawatts), on a 290-ha (725-acre) property it owns in Guayanilla. A renewable and emission-free energy project of this nature and size is important to Puerto Rico, which is largely dependent on expensive and polluting fossil fuels imported to power its aging electric grid. Unlike fossil-fuel and nuclear-energy plants, wind farms can only be located where there is an abundant wind resource. WindMar has measured the wind resource at its Guayanilla property and at three other Puerto Rican sites. Of these four sites, Guayanilla has the best wind, averaging 6.2 m/s (15 mph), an amount that makes the site commercially viable. WindMar's data have been confirmed by Garrad Hassan, a top international wind-energy consultancy.

The potential occurrence of endangered species at a wind energy site is abundant reason to proceed with care in the siting and design of such projects. When purchasing this property, WindMar recognized that one endangered species likely nests on the site, and another occasionally flies over it and roosts on its sea cliffs. That these species share the property has been a welcome challenge to us, because we believe that endangered species and the wind power project we have conceived are highly compatible. In fact, through the wind power project and the conservation activities it will finance, WindMar aims to improve the prospects for any listed species that occurs on or adjacent to the site, as well as for the many rare and endemic species that occur there and in adjacent areas but are not formally protected.

This WindMar property is within the range of a number of federally listed endangered and threatened species (Díaz 2003; please see Appendix I):

Antillean manatee	*Trichechus manatus manatus*
Hawksbill sea turtle	*Eretmochelys imbricata*
Green sea turtle	*Chelonia mydas*
Brown Pelican	*Pelecanus occidentalis*
Roseate Tern	*Sterna dougallii dougallii*
Puerto Rican Nightjar	*Caprimulgus noctitherus*
Yellow-shouldered Blackbird	*Agelaius xanthomus*
Bariaco	*Trichilia triacantha*
Diablito de tres cuernos	*Buxus vahlii*
Palo de rosa	*Ottoschulzia rhodoxylon*

Two other endangered plant species – *Mitracarpus maxwelliae* and *M. polycladus* – are known from the Guánica State Forest adjacent to the WindMar property, but suitable habitat does not appear to occur on the WindMar site (Díaz 2003).

Since the proposed project does not include any activities affecting marine ecosystems, Fish and Wildlife Service (FWS) biologists have indicated that surveys for manatees and sea turtles in the water are not needed (Díaz 2003). The only exception would be if boundary or security lights are needed in the vicinity of the beach on the Punta Ventana side of the property, where turtles occasionally nest. The WindMar project will not require such lighting, and aviation warning lighting high atop the wind turbines will not affect turtle nesting. This is discussed in the main text.

Discussions with biologists at the Department of Natural and Environmental Resources (DNER) of the Commonwealth of Puerto Rico have highlighted an anole lizard, *Anolis cooki*, and bats as species of concern. For this reason, they are treated in this HCP.

Section 9 of the Endangered Species Act of 1973, as amended (ESA), prohibits the "take" of any federally listed endangered species. Take, as defined in the ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in such conduct." Harm in the definition of "take" in the ESA means an act that actually kills or injures wildlife. While such an act may include significant habitat modification or degradation, it must actually kill or injure endangered species by significantly impairing essential behavior patterns, including breeding, feeding or sheltering (50 CFR 17.3).

Amendments made in 1982 to the ESA, however, established a provision in Section 10 that allows for the "incidental take" of endangered and threatened species by non-federal entities. The ESA defines incidental take as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." Congress enacted this provision in order to reduce conflicts between listed species and economic development activities, and to provide a framework that would encourage "creative partnerships" between the public and private sectors and state, municipal, and Federal agencies in the interests of endangered and threatened species and habitat conservation (H.R. Rep. No. 97-835, 97th Congress, Second Session). Congress's intention was to "integrate non-Federal development and land use activities with conservation goals, resolve conflicts between endangered species protection and economic activities on non-Federal lands, and create a climate of partnership and cooperation" (FWS and NMFS 1996).

Issued by the Fish and Wildlife Service (FWS) or National Marine Fisheries Service (NMFS), an Incidental Take Permit (ITP) is the instrument that authorizes the taking of federally listed species if such taking occurs incidentally during otherwise legal activities. The ESA requires an applicant for an Incidental Take Permit to submit what is called a Habitat Conservation Plan (HCP). An HCP should specify the impacts that are likely to result from the proposed taking, the measures the applicant will undertake to minimize and mitigate these impacts, and the alternative actions the applicant has considered that would not result in the take, including the reasons why these alternatives were not adopted.

In the following sections, WindMar presents an HCP for its proposed wind energy project, following the guidelines detailed in the Habitat Conservation Planning Book (FWS and NMFS 1996) for preparing HCPs.

HABITAT CONSERVATION PLAN

WINDMAR RE PROJECT

GUAYANILLA, PUERTO RICO

I. Impacts likely to result from the proposed taking of the species for which permit coverage is requested

Scope of the Habitat Conservation Plan

Pursuant to Section 10(a)(1)(B) of the Endangered Species Act of 1973 as amended (ESA), WindMar RE seeks an incidental take permit for the endangered Brown Pelican (*Pelicanus occidentalis occidentalis*), threatened Roseate Tern (*Sterna dougallii dougallii*), and endangered Puerto Rican Nightjar (*Caprimulgus noctitherus*), all federally listed species, on a 290-hectare (725-acre) property it owns in Guayanilla, Puerto Rico. This permit would run for a period of 40 years. WindMar seeks this permit for the commercial wind energy project it proposes for this site because the construction of the wind farm and the operation of wind turbines could conceivably result in the incidental take of these species. On the other hand, baseline studies indicate that the limited clearing of dry forest habitat for the siting of roads and for the construction of turbine bases, plus the operation and maintenance of the wind turbines, will not affect the Yellow-shouldered Blackbird (*Agelaius xanthomus*), another federally listed species, nor the lizard *Anolis cooki* or bats, species highlighted by biologists at the Department of Natural and Environmental Resources (DNER) of the Commonwealth of Puerto Rico. The project site includes Punta Verraco, Cerro Toro, and Punta Ventana. It is bounded to the west by the Guánica State Forest, to the north by a commercial fruit plantation, to the east by Guayanilla Bay, and to the south by the Caribbean Sea. For the location of the site, please see Figure 1 (page 10).

Permit Baseline Information

In consultation with FWS and DNER biologists, WindMar has commissioned studies to ensure that adequate information exists to proceed with the HCP process. These studies include:

- A floristic and vegetational analysis of the site conducted by Dr. Alberto Areces, one of the foremost authorities on Caribbean botany (Areces 2003; please see Appendix II for a plant list).
- A Phase I Avian Risk Assessment conducted by Dr. Paul Kerlinger, one of the foremost authorities on the interactions of birds with wind energy development (Kerlinger 2003a; please see Appendix III).
- Specific studies directed by Dr. Kerlinger on nesting and/or site use by the nightjar, blackbird, pelican, tern, and other birds (Kerlinger 2003a, 2004, 2003b,

and 2004c; please see Appendices V, VI, VII, and VIII) as indicated in the Phase I Avian Risk Assessment and in FWS's letter of April 23, 2003 (Díaz 2003).

- Surveys conducted by Dr. Richard J. Thomas to assess the status of *Anolis cooki* and bat species and how they might be affected by the WindMar project (Thomas 2004; please see Appendix IX).

Zoning and present surrounding land use

The 290-hectare (725-acre) WindMar property is presently zoned R-0, which would permit construction of 360 single-family dwellings on two-acre lots. WindMar is in the process of applying to the Puerto Rico Planning Board to permit on this property the construction of the wind turbines mills and the implementation of the conservation plan described in this HCP.

The land use surrounding the property includes heavy industrial, agricultural, and conservation uses. To the east, about 2 km across Guayanilla Bay – in plain view from the project site and distinctly audible, particularly at night – is a heavily industrialized area that includes two electric power plants (the gas-fired EcoEléctrica and the oil-fired Costa Sur), a liquid natural gas offloading terminal and storage facility, and a large defunct oil refinery. In 1999, the Commonwealth of Puerto Rico proposed this area for a large-scale transshipment facility, know as the Port of the Americas, but it withdrew this project when FWS made clear its opposition on the grounds of impacts to threatened marine species.

To the north of the WindMar property is Tropical Fruit, a 400-hectare (1,000-acre) commercial fruit plantation established on the site of an old sugar mill. Tropical Fruit grows mangoes and bananas for export. WindMar owns the access road through the fruit plantation to its project site.

To the west is the Guánica State Forest, a 4,400-hectare (11,000-acre) forest reserve owned and managed by the Department of Natural and Environmental Resources (DNER) of the Commonwealth of Puerto Rico. Established in 1919, the Guánica State Forest contains the most species-rich example of the dry forest habitat type in Puerto Rico. The reserve also protects considerable shoreline in a natural state. UNESCO has designated the Guánica State Forest as a Biosphere Reserve.

The nearest human settlement to the WindMar project site is Barrio Indio, a cluster of single-family residences about 1.5 km (one mile) distant, at the entrance to the fruit plantation. Like the WindMar property, Barrio Indio is located in the Boca Ward of the Municipality of Guayanilla.

In socioeconomic terms, Guayanilla is significantly behind the rest of the island, but Barrio Indio lags even further, as Table 2 documents. Unemployment is particularly high. This makes the WindMar project singularly attractive because it will provide jobs, preserve natural features and habitats, and not generate environmental contamination. Health studies demonstrate that Guayanilla has been severely impacted by the downwind emissions of petroleum refineries that used to operate nearby. Both the Costa Sur and EcoEléctrica power plants continue to affect air quality in the municipality.

Table 2: Socioeconomic Data

Parameter *U.S. Census source*	**Puerto Rico** *2000*	**Guayanilla** *2000*	**Barrio Indio** *1990**
Population	3,808,610	23,072	1,064
per capita income	$ 8,185	$ 5,954	$ 2,080
Family income	$ 16,543	$ 13,187	$ 6,516
% families below poverty line	44.6%	55.9%	85.4%
% unemployment	19.2%	27.3%	54.0%
% graduated high school	22.3%	24.8%	20.7%
% graduated college	13.6%	11.0%	4.2%

* 2000 data not yet available

Description of the WindMar property

The WindMar property is dominated by three upland areas – Punta Verraco, Cerro Toro, and Punta Ventana. From the point of view of this HCP, these upland areas are a focus because: 1) they are perfectly oriented to catch the abundant wind resource present at the site; 2) they are the only areas that will have wind turbines and supporting infrastructure; 3) they are covered almost entirely by dry forest, the principal habitat of the Puerto Rican Nightjar; and 4) the updrafts that occur along their seaward edges are frequently used by birds that soar along the coast, predominantly the Brown Pelican, Magnificent Frigatebird, and Turkey Vulture. For the dimensions of these areas, and other particulars, please see Table 3.

Punta Verraco and Cerro Toro are grouped together on the eastern side of the property (please see Figure 1, page 10). They are separated from Punta Ventana by an ancient floodplain of the Yauco River. Punta Ventana abuts the Guánica State Forest and is part of the tableland that contains the State Forest.

Adjacent to the WindMar property, to the north of Cerro Toro, is a 10-ha (25-acre) degraded mangrove swamp. Within the property, there are two disturbed level areas dominated by invasive plant species along the Caribbean shore. One is between Punta Verraco and Cerro Toro. The other is between Cerro Toro and Punta Ventana.

Table 3: Dimensions of Upland Areas, WindMar site

Landform	Orientation	Area (ha)	Area %*	Length (m)	Width (m)	Height (m)
Punta Verraco	SW-NE	125	43%	2,100	750	43
Cerro Toro	SW-NE	46	16%	1,100	450	56
Punta Ventana	SSE-NNW	79	27%	1,900	600	98
		250	86%			

* of property

Previous land management activities

To the casual visitor, the WindMar property may well evoke the wild Puerto Rico of Pre-Columbian times. Its hills are covered with dry forest. Its lowland areas are open and undeveloped. Cliffs edge the Caribbean, providing exhilarating views of the sea. But the practiced eye of a naturalist sees a tortured landscape that has suffered centuries of intense human exploitation.

When the sugar business collapsed in the Lesser Antilles in the late 18th Century and in Haiti after the Haitian Revolution, Puerto Rico received the sugar planters from those areas as immigrants. These experienced growers settled the major valleys along Puerto Rico's south coast. Areas such as Guayanilla, which had been dedicated to cattle ranches, were transformed into sugar plantations. First human and animal power, then steam, provided the energy to transport, grind, and transform cane into sugar. Subsistence farmers were pushed into forested areas, where they practiced slash and burn agriculture.

The growing sugar plantations needed more and more virgin land. Fuel for the mills, for cooking, and for the railroads was supplied from the nearby dry forest, when closer sources in the lowlands were exhausted. Lime kilns were also set up to produce the quicklime needed for the construction of the sugar factories and for the lime needed to clarify the sugar juice. Walking through the forest on the WindMar property, one can see the remains of the old lime pits, the patches where charcoal was produced, and the cut stumps of the timber trees. As discussed below, the floristic composition and structure of the vegetation clearly indicate the selective logging of the timber and dense wood species favored in charcoal making and as a fuel for the lime kilns.

Until 1964, the WindMar property belonged to the sugar mill owners. Then, the Verraco side was sold to Texaco Petroleum Industries, and the Ventana side was sold to the Commonwealth Oil Refining Corporation (CORCO). These petroleum companies planned to build refineries on the site because the deep draft and protected waters of

Guayanilla Bay were ideal for large oil tankers. Since then, several other development projects have been contemplated for the area.

In 1998, WindMar purchased the property from Texaco and CORCO. Both had shelved their plans to construct oil refineries on the site when the oil refinery business collapsed in Puerto Rico in the 1970's (the environmental scars of that era have not yet even started to heal, as the extensive abandoned oil refineries in Peñuelas bear testimony). The oil refinery business, nevertheless, did leave its mark on the Punta Verraco: in the 1970's, Texaco cleared a 3.1-hectare (7.5-acre) section of dry forest on Punta Verraco to quarry limestone in order to construct a causeway to Verraco peninsula for its proposed refinery. Siltation of the causeway's culverts in turn degraded 10 hectares (25 acres) of mangrove by restricting water flow.

Existing vegetation

Sixteen plant communities occur on the WindMar site, but three predominate (Areces 2003). These three fall within the habitat type commonly known as "dry forest" (*bosque seco* in Spanish). Dry forest accounts for 86% of the vegetation at the project site. It is the principal nesting habitat of the Puerto Rican Nightjar, and the only habitat that will be impacted by the placement of wind turbines and related infrastructure. For these reasons, the project's impact on dry forest is a focus of this HCP.

WindMar has documented that virtually all of the site's plant communities have been significantly degraded by long-term human exploitation (Areces 2003). In the dry forest, this is reflected by an impoverished species composition, the unusual coppice growth habit of many of its trees, and an abundant evidence of fire. While we did not expect to find a pristine dry forest, the level of degradation surprised us.

Selective cutting has significantly altered the species composition of the site's dry forests. For example, the Aceitillo (*Zanthoxylum flavum*), a much sought after furniture wood, should be better represented in this plant association. Botanists, however, only counted three small individuals along many kilometers of transects through the areas where roads and wind turbines would be placed. One would also expect a high representation of the Mabí (*Colubrina elliptica*), but this species is one of the rarest plants. Opportunistic species, on the other hand, particularly those of rapid growth and little value for their wood, such as the Pale Acacia (*Leucaena leucocephala*), Corcho (*Pisonia albida*), and Palo de Vaca (*Bourreria succulenta*) are much better represented on the site than they would have been in a native forest.

Compared with the Guánica State Forest, the dry forest association on Punta Verraco, Cerro Toro, and Punta Ventana is notably poor floristically. Despite careful searches throughout the WindMar property, not one Bariaco (*Trichilia triacantha*), Palo de Rosa (*Ottoschulzia rhodoxylon*), or *Mitracarpus maxwelliae* has been found – to mention only some of the rarest and most threatened species in the Guánica State Forest. This has led botanists to conclude that anthropogenic impacts were more severe historically in the WindMar site than in the Guánica State Forest (Areces 2003), including in the Punta Ventana sector adjacent to the Guánica State Forest.

With regard to the structure of the dry forest vegetation, the WindMar site also shows signs that it was severely overexploited. Depending on the area, between 25% and 75% of the trees show a coppice pattern of growth, where multiple shoots originate from a stump. This is rarely seen in undisturbed forests, where the closest phenomenon would be a line of shoots from a trunk blown down by a hurricane. Trees were hacked repeatedly to harvest their scant shoots to fuel the economic activities that dominated the adjacent area.

The size of the trees is also telling. With the exception of the fast-growing, opportunistic species, whose trunks reach a foot in diameter in the study area, the large majority of hardwood trees do not reach a basal diameter of 6-7 cm. Mature *Krugiodendron ferreum*, *Coccoloba diversifolia*, *Pictetia aculeata*, and *Gymnanthes lucida* should have easily exceeded this size. It is as if, about a half century ago, the WindMar property was deforested to a high degree, and only since then has this dry forest had a chance to recover.

In addition, there is significant evidence that fire has contributed as much to the imbalance and impoverishment of the site's dry forests as has selective cutting. Signs include charred stumps, abundant pieces of charcoal on the ground, and an unusually high frequency of dense mats of fire-resistant grasses. Shrub and tree communities in the Caribbean's dry coastal zone have not evolved fire resistance, and many species do not recover after repeated fires and end up disappearing.

Interviews with the area's older residents have confirmed these anthropogenic impacts on the vegetation (Areces 2003). Our sources tell us that, when they were young in the 1930's to 1950's, the project site was heavily cut over to supply wood for house construction, furniture, and fence posts. Another economic activity was charcoal production; ovens were set up in the forest to be fed directly by the trees in their vicinity, including mangrove. In addition, much wood was hauled out by oxen to feed the fire under the cauldrons of the old sugar mills, whose ruins still dominate the area.

Lime kilns erected on the site also took a heavy toll on the forest, as all the wood in their vicinity was felled to heat the ovens that converted the limestone rock into quicklime. Other areas were apparently burned and deforested completely in order to plant tubers and other crops. With so much fire to clear areas for crops, and to produce charcoal and lime, uncontrolled fires were not unusual. Our sources also told us that cows and goats were allowed to roam wherever. They also took their toll on the vegetation, particularly on the seedlings.

This anecdotal evidence confirms the scientific analysis that the dry forest that today exists on Punta Verraco, Cerro Toro, and Punta Ventana is highly disturbed. Nevertheless, it is also in a process of slow succession, dating from about the 1950's, that will tend to reestablish nearly the original plant associations that occupied this site. Nevertheless, some species may never come back unless reintroduced.

So far, botanists have recorded nearly 170 species of vascular plants at the WindMar site (see Appendix II), a diversity far below the over 700 species recorded in the Guánica State Forest. They have also found that the Minimal Area (the area where 95% of the plant community's species can be found) for the dry forest on Punta Verraco is significantly small, only 200 m^2. In other Caribbean regions, including the Guánica State Forest, the Minimal Area for dry forest is usually larger than 500 m^2. This confirms that the dry forest plant community on the WindMar site is poor and has been severely impacted. A management plan to help these forests recuperate is clearly in order.

In 1983, Dr. Frank H. Wadsworth, the former Director of the International Institute of Tropical Forestry, briefly visited Punta Verraco at the request of The Nature Conservancy (TNC) to evaluate the property. Texaco had approached TNC to see if TNC would receive the property as a donation. Wadsworth's brief report confirms the results of our thorough analysis. He wrote the following to TNC, which apparently refused the donation:

> "Three alternatives occur to me as open to the Conservancy:
> 1. Refuse to accept the donation on the grounds that it is not of sufficiently outstanding environmental value.
> 2. Accept the tract if authorized to dispose of it for purposes of using the proceeds to acquire other more valuable environment in Puerto Rico.
> 3. Accept it for donation to the Puerto Rico Conservation Trust or the Department of Natural Resources to be added to the Guanica State Forest and Biosphere Reserve."

Site use by birds, particularly federally listed species

In 2002, WindMar contracted Dr. Paul Kerlinger, a leading authority on the interactions of birds and wind power development, to conduct a Phase I Avian Risk Assessment of the project site. This assessment included a site visit, interviews with local and regional experts, including FWS staff, and a literature search. The site visit took place on December 3-5, 2002, and included a meeting on site with FWS and DNER biologists. Phase I assessments are designed to indicate the type of habitat present and the kinds and numbers of birds that are know to, or suspected to, use a project site and surrounding areas. This information is then used to assess the potential degree of risk to birds from wind power development at a particular site. In addition, the concerns of agency biologists and regulators are determined and incorporated into the risk assessment.

Dr. Kerlinger assessed avian risk from turbine layouts that would generate 50 megawatts of electricity. These layouts included 28 and 60 turbines of 1.8 MW and 0.9 MW capacity respectively. He issued his report in March 2003 (please see Appendix III). His assessment found two federally listed bird species that inhabit the project site, and another two federally listed bird species have been recorded near the project site. They are listed in Table 4. A bird list for the site can be found in Appendix IV.

Table 4: Federally Listed Birds Occurring at or near the WindMar Site

Species	Habitat Suitability/Occurrence
Brown Pelican *Pelecanus occidentals*	Habitat on site not suitable, but this species forages in waters adjacent to the site and occasionally flies over Punta Verraco to cross between the Caribbean and Guayanilla Bay
Roseate Tern *Sterna dougallii*	Habitat on site not suitable, but this species has been recorded nesting on small coral cays about 600 m offshore; none were recorded during the Phase I Assessment or subsequent study
Puerto Rican Nightjar *Caprimulgus noctitherus*	Habitat suitable over much of site; the nightjar nests in dry forest and is apparently a year-round resident
Yellow-shouldered Blackbird *Agelaius xanthomus*	Habitat marginally suitable to suitable in low areas of site, where turbines would not be placed; the blackbird is not presently known to nest on or visit the site, but it could in the future

The principal findings of Dr. Kerlinger's assessment were:

1. Human use of this privately owned property is minimal and is currently not being used for economic activity. No major land-use changes, other than wind turbine presence and maintenance, are anticipated.

2. The WindMar site has several different habitats including Caribbean beach and dune, dry scrub forest, mangrove swamp, marsh and ponds, rocky outcroppings along the Caribbean, and some degraded areas. The site is not classified by FWS as critical habitat for any endangered species, but it does support the federally endangered Puerto Rican Nightjar.

3. The WindMar site supports a diverse array of mostly common, forest and scrub-nesting bird species, as well as some birds of wetlands (marsh and mangrove swamp). The Guánica State Forest immediately to the west of the project site indicates that the general area (including the project site) is an important area for birds that nest in dry forests.

4. Significant hawk, songbird, waterfowl, or other migration is not known to occur over the project site, nor is the habitat there suggestive of migration stopover habitat. It is likely that small numbers of songbirds do stopover during migration. Shorebirds do stopover in migration and winter in the wetland habitats on and adjacent to the project site, although there is no information on their numbers during migration (particularly autumn). The habitats present are unlikely to support large numbers of migrating shorebirds.

5. Winter bird use at the project site is likely to be greater than nesting season use, with species present being common residents, migrant songbirds, and shorebirds from the North American mainland in relatively small numbers.

6. The presence of endangered and threatened species on and adjacent to the project site is of particular importance. Puerto Rican Nightjars nest on the site in apparently significant numbers. Brown Pelicans fly over the site at times and forage in shallow waters adjacent to the site. Roseate Terns have nested about 2,000 ft (600 m) from the site and forage nearby at times. And, Yellow-shouldered Blackbirds may, on rare occasions, visit the lowland areas of the site at times, but are not known to nest within several miles of it. The presence of these species calls for further investigation and potential mitigation (i.e., a Habitat Conservation Plan) if incidental takings are anticipated as a result of wind turbine construction and operation.

7. Risk of avian collisions at the WindMar RE Project is low and not likely to be biologically significant. The footprint of the project and the presence of new infrastructure are likely to cause some disturbance and potential displacement impacts to nesting forest birds, including the endangered Puerto Rican Nightjar. A forest management plan that incorporated some sort of mitigation and restoration would help minimize disturbance and fragmentation of the habitats.

In summary, with the exception of undetermined impacts to endangered species, risk to birds occurring at the project site was deemed low and not likely biologically significant. With respect to fatality collisions with turbines at the WindMar site, overall risk was considered likely to be low and not biologically significant. This included night migrating songbirds, raptors, waterfowl, shorebirds, herons and egrets, and endangered species. This assessment was based on what is known about avian risk factors at wind power plants in North America and Europe, the species (type and numbers of individuals) that frequent the project site, and what was learned from the literature, site visits, and interviews.

Dr. Kerlinger’s report recommends:

- Electrical lines on site should be underground. If necessary, above ground transmission lines and interconnects, as well as substations, should be insulated and configured per APLIC (Avian Power Line Interaction Committee) guidelines. These guidelines are accepted by FWS as the best means for avoiding electrocution and collision fatalities.

- Consistent with FAA guidelines, obstruction lighting should be white strobes (FWS voluntary guidelines) or red strobes with the longest possible off cycle permissible and lighting should be kept to a minimum number of turbines (if possible no turbines should be lit).

- Permanent meteorology towers should be free-standing, i.e., without guy wires, in order to prevent avian collision fatalities.

- Wetland delineation should be conducted to determine where wetlands are present within the project footprint so that they may be buffered by the project.

- A forest management plan that promotes the long-term safety of the forest for birds and other wildlife is recommended. That plan would provide for minimization of forest fragmentation resulting from clearing and cutting for turbines and roads. The forest management plan should take into consideration the reduction of the major threats to the forest community, including fire, feral animals, and invasive species. Clearings and cuttings should be managed not only to serve as fire brakes but also to increase species diversity and particularly plant species that would augment the insect population. In this regard, reforestation with rare, listed, endemic, and under represented plant species would be highly desirable.

- Restoration of the mangrove swamp (~25 acres), degraded upland site on Punta Verraco (~7.5 acres), and the mildly degraded freshwater wetland habitat on site may be considered as potential remediation for project impacts to upland habitats. Post construction monitoring of these sites would determine whether these projects were successful.

- Because the Puerto Rican Nightjar nests on the project site, a complete survey of the property to determine nightjar abundance and distribution during the nesting season, when habitat requirements are most stringent, is needed. Section 10 consultation with FWS is recommended. A Habitat Conservation Plan (HCP) is likely in order because of potential disturbance to the nesting habitat of this species.

- A survey for Yellow-shouldered Blackbirds (federally endangered) is needed at the lower elevations of the project site.

- A study of flight behavior by Brown Pelicans and Roseate Terns (both federally listed) over the project site at Punta Verraco is recommended. The study would examine the flight behavior of these birds when and if they fly over the project site.

Results of field studies of federally listed and other species

WindMar then contracted Dr. Kerlinger to direct field studies in order to assess avian risk sufficiently for the federally listed species occurring at or near the WindMar site. The methodologies for these studies were submitted to FWS biologists and experts for their input and revised accordingly. These studies included nesting studies of the Puerto Rican Nightjar and Yellow-shouldered Blackbird, and a study of site use by Brown Pelicans, Roseate Terns, and other birds that fly over the site.

Trained by Dr. Kerlinger, research technicians collected data for the various studies from late April to late June, 2003. On the basis of this data, Kerlinger issued reports during the summer and fall of 2003. These reports can be found in Appendices V, VII, and VIII.

It is important to note, however, that additional data was collected from September 2003 to June 2004 in order to: 1) meet a request from FWS to analyze the annual cycle of flight patterns at the site, including flight patterns at the tip of the Punta Verraco peninsula, and 2) look at how the Puerto Rican Nightjar responded to site development activities that took place in early 2004. The results of Dr. Kerlinger's analysis of this additional research are reported below.

Puerto Rican Nightjar

In order to collect baseline information on the nightjar population, Dr. Kerlinger directed population surveys during both the 2003 and 2004 breeding seasons. Between these seasons, WindMar established or widened roads to access different parts of the property and conduct a geotechnical study of the bedrock. How the nightjar population appears to have responded to these roads and clearings is reported below.

At the start of the 2003 breeding season, Dr. Kerlinger designed a protocol for surveying the nightjar population by defining and mapping the locations throughout the site where male nightjars sing. This was accomplished by determining the compass bearing and approximate distance of singing birds from fixed listening stations along transects at the height of the breeding season. Survey transects sampled all suitable nightjar habitat within the project footprint and out to about 300 m from where turbines and roads would be constructed. The resulting data were mapped in ArcView by a GIS specialist and interpreted by Dr. Kerlinger to determine nightjar abundance and density in each of the three sectors of the project site. The protocol was reviewed and commented upon by Dr. Francisco Vilella, the recognized authority on the Puerto Rican Nightjar. This methodology is detailed in Appendix V.

Figure 3a (page 11) displays the transects established in 2003. Figure 4a (page 12) shows the distribution of the 369 data points collected during the 2003 field season and Dr. Kerlinger's interpretation of territory distribution. Tables 5 and 6 summarize data gathering and calling rates of nightjars.

Table 6: Nightjar Data Comparison, 2003 and 2004

	2003	2004	% Change
Survey Dates	April 28 to June 23	April 30 to June 19	
Number of Listening Stations	95	78	-18%
Survey Hours	27.0	23.0	-15%
Hours before Dawn	12.3	11.2	-9%
Hours after Dusk	14.7	11.8	-20%
Birds Calling			
Total	369	392	6%
Before Tape Playback	214	244	14%
After Tape Playback	155	148	-5%
Before Dawn	174	168	-3%
After Dusk	195	224	15%
Rate Birds Calling (birds/hour)			
Total	13.7	17.0	25%
Before Tape Playback	7.9	10.6	34%
After Tape Playback	5.7	6.4	12%
Before Dawn	14.1	15.0	6%
After Dusk	13.3	19.0	43%

Table 7: Nightjar Calling Rates by Sector

			2003		
Sector	**# records**	**hours**	**birds/hour**	**# stations**	**birds/station**
Punta Verraco	245	17.5	14.0	63	3.9
Cerro Toro	38	3.1	12.3	11	3.5
Punta Ventana	86	6.4	13.4	21	4.1
Total	**369**	**27.0**	**13.7**	**95**	**3.9**
			2004		
Sector	**# records**	**hours**	**birds/hour**	**# stations**	**birds/station**
Punta Verraco	207	11.8	17.5	42	4.9
Cerro Toro	46	2.6	17.7	9	5.1
Punta Ventana	139	8.7	16.0	27	5.1
Total	**392**	**23.1**	**17.0**	**78**	**5.0**
			% change		
Sector	**# records**	**hours**	**birds/hour**	**# stations**	**birds/station**
Punta Verraco	-16%	-33%	25%	-33%	27%
Cerro Toro	21%	-16%	44%	-18%	48%
Punta Ventana	62%	36%	19%	29%	26%
Total	**6%**	**-14%**	**24%**	**-18%**	**29%**

In defining the areas where male nightjars sing (hereafter called singing territories) Kerlinger paid particular attention to where two of more birds were heard singing spontaneously before a playback tape was played (i.e., not induced to sing by a tape recording of their call) from the same listening station at the same time. This is the best means of determining the approximate boundaries of two or more singing territories. He also defined singing territories by analyzing clusters of data points that accrued over the four sampling sessions along each transect in each year. For 2003 data, these techniques revealed 33 probable nightjar singing territories on the WindMar site (19 territories on Punta Verraco, 5 on Cerro Toro, and 9 on Punta Ventana), resulting in an overall density of 0.132 nightjars/ha or 33 nightjars on 250 ha surveyed). Mean densities for the different upland sections of the WindMar site were 0.152 nightjars/ha on Punta Verraco (19 singing nightjars on 125 ha), 0.109 on Cerro Toro (5 singing nightjars on 46 ha), and 0.115 on Punta Ventana (9 singing nightjars on 79 ha). Please see Table 7.

Table 7: Nightjar Territory Comparison, 2003 and 2004

2003				
Sector	**number territories**	**mean density**	**average territory size**	**% habitat Occupied**
Punta Verraco	19	0.152	3.0	46%
Cerro Toro	5	0.109	2.7	29%
Punta Ventana*	9	0.115	3.6	41%
Total	33	0.132	3.1	41%

2004				
Sector	**number territories**	**mean density**	**average territory size**	**% habitat Occupied**
Punta Verraco	23	0.184	2.8	52%
Cerro Toro	6	0.130	2.9	38%
Punta Ventana*	13	0.165	3.6	59%
Total	42	0.168	3.2	53%

Change				
Sector	**number territories**	**mean density**	**average territory size**	**% habitat Occupied**
Punta Verraco	21%	21%	-7%	13%
Cerro Toro	20%	19%	7%	31%
Punta Ventana*	44%	43%	0%	44%
Total	27%	27%	3%	29%

* Territories mostly or entirely within project site

For Punta Verraco and Cerro Toro combined, Vilella and Zwank recorded 0.075 nightjars/ha from five surveys of 160 hectares that recorded between 9 and 12 nightjars (Vilella and Zwank 1993a). Our 2003 results for these two areas together were 0.140, nearly double. In the section of the Guánica State Forest adjacent to Punta Ventana, Vilella and Zwank (1993a) found a similar 0.069 nightjars/ha. Our value of 0.115 is significantly greater.

Whereas Vilella and Zwank only counted different singing birds, we attempted to pinpoint and map them via GIS in order to understand singing territory distribution and density, in addition to estimating the population. Our results, however, appear to indicate a significant increase in the Puerto Rican Nightjar population at the WindMar site in the more than ten years since Vilella and Zwank conducted their study (please see Table 1 on page 4). Such an increase could have resulted from natural population growth, habitat succession that improved habitat structure for nightjars, habitat manipulation that improved habitat structure for nightjars, or a combination of the three.

Our territory maps (Figure 4a) strongly suggest that singing male nightjars defend core areas, leaving gaps that appear not to be defended. When the 2003 territory polygons are measured using GIS, their size ranges from about 1.7 ha to about 5.6 ha, averaging 3.1 ha. This 3.1-ha average is 41% of a 7.6-ha site density (250 ha for 33 territorial males), a value similar to those reported in Vilella's study of home ranges (Vilella 1989). Using radio telemetry, Vilella calculated home ranges of 4.8 hectares and 5.6 hectares for two birds. These home range estimates are 62% and 72% of the 7.8 hectare density Vilella obtained from call counts for that section of the Guánica State Forest. Vilella also documented that male Puerto Rican Nightjars play a major role in incubation (Vilella 1989). All of the nests he discovered were found within 75 meters of singing males. This suggests that dry forest habitat is not saturated with nightjar territories, and that a significant amount of "buffer" habitat exists around these territories.

The 2004 survey results showed a significant change in nightjar calling frequency and in mean abundance and density, with a 24% increase in birds recorded per hour (a 29% increase in birds recorded per listening station; see Table 6) and a 27% increase in the number of nightjar territories (see Table 7).

Figure 3b (page 11) displays the 2004 transects and listening stations. Compared with 2003, the distribution of listening stations was only markedly different in Punta Ventana, where researchers established new ones along roads that did not exist the year before. Listening stations were also spaced differently in 2004 – at 100 meter intervals as measured on a GPS unit. In 2003, they were spaced at 100 paces (approximately 88 meters apart). As a result, there were 18% fewer listening stations overall, although Punta Ventana had 29% more, because the roads allowed us to access more of the property.

Coverage of each section, however, remained essentially the same. While Noble et al. (1986) have determined that nightjars can be heard up to 300 meters away, none of our records have exceeded an estimated 250 meters. Nevertheless, our listening station layouts in both years ensured that we could cover the entire project footprint and nearly all the dry forest habitat even with a 250-meter listening limit. In Punta Ventana, an increased listening range extended mainly west into the Guánica State Forest.

Data collection in 2004 was conducted by the same field team and in the same manner as in 2003. Dr. Kerlinger interpreted the mapped data points using the same approach as the previous before. In defining singing territories, he relied mostly on where two of more data points of birds singing (without being induced to do so by the playback tape) from the same listening station at the same time – an indication of the borders between two or more singing territories. He also looked at the location of clusters of singing birds over the four sampling sessions along each transect.

Tables 5 and 6 compare 2003 and 2004 data. The date span for the surveys was roughly the same, from late April to late June. All transects were surveyed a total of four times, including after dusk and before dawn and during light and dark moon phases (our data show no correlation between moon phase and calling frequency). As noted above, calling rate in birds/hour increased 24% overall in 2004, with the highest increase (44%) in Cerro Toro. The lowest increase was recorded in Punta Ventana (19%), which was similar to the increase at Punta Verraco (25%). Calling rate was also higher in all categories, including before tape playback (34%), after tape playback (12%), before dawn (6%), and after dusk (42%). More birds were calling spontaneously in 2004, especially in the evening hours.

Table 7 compares results derived from the 2003 and 2004 singing territory interpretations. In 2004, the mean abundance of nightjars increased in all three property sections. The overall increase was 27%, with the highest increase in Punta Ventana (43%). The Ventana increase does not include three of Dr. Kerlinger's singing territories that were mainly within the Guánica State Forest, and one singing territory to the north of the proposed turbine field (see Figure 4b, page 12). The mean abundance at Punta Verraco increased 21% to 0.184 nightjars/ha, a value in line with the highest densities Vilella and Zwank (1993a) recorded in the Guánica Forest – between 0.182 and 0.201 nightjars/ha in the western section.

Despite an increase in the number of singing territories, average singing territory size appears to have increased slightly overall, by 3%. Whereas singing territory size decreased 7% in Punta Verraco, it increased 7% in Cerro Toro. At Punta Ventana, singing territory size did not change appreciably. Nevertheless, since there were more singing territories of roughly equal size, the amount of dry forest habitat occupied by singing nightjars increased from 41% in 2003 to 53% in 2004, a 29% increase overall. 44% more habitat was occupied in Punta Ventana, while only 13% more was occupied in Punta Verraco. At Cerro Toro, 31% more habitat was occupied in 2004.

Defining nightjar singing territories based on our methodology was, in part, subjective. Nevertheless, the fact that multiple birds were heard singing from the same listening point was the foundation for determining the approximate location of core singing territories and the number of territorial birds. This part of the methodology is not subjective, and provides a robust estimate of these metrics. The shape and exact size of the singing territories could be different from those provided in this report, although the number and approximate size could not be much different. Thus, the subjective portion of our analysis is not nearly as important as determining the core singing territory locations and number of singing territories present. It should also be mentioned that previous studies have relied on very small samples sizes to determine territorial size and densities. This study relies on a much larger number of territories and a more intensive and longer study than have earlier studies.

In their 1993 paper on Puerto Rican Nightjar distribution, Vilella and Zwank state, “In many avian species the frequency and duration of singing activity is directly related to density (Krebs 1971, Kroodsma 1976).” They use this statement to support the use of tape playback to locate birds that would otherwise have gone undetected. But, increased call frequency reinforces the conclusion that there were significantly more nightjars on the WindMar site during the 2004 breeding season. Nevertheless, call frequency and density varied among sectors. On Cerro Toro, call frequency increased the most (44%), but density increased the least (20%). On Punta Ventana, call frequency increased the least (19%), while density increased the most (43%). On Punta Verraco, call frequency increased 25%, but density only increased 21%.

What caused this significant increase in nightjars? In his memo on the results of the 2004 nightjar surveys (see Appendix VI), Dr. Kerlinger discounts increased observer efficiency, because it is easy to hear the nightjar and observers needed little training to conduct the survey in 2003. An overall increase in the nightjar population from one year to the next is also unlikely because one would expect that birds would disperse to other locations with lower densities than pack the WindMar site more densely. The WindMar site already had some of the highest densities recorded in Puerto Rico (see Vilella and Zwank 1993a). Besides, singing territory size did not decrease as one would expect in more densely packed habitat (Weeden 1965). Instead, it appeared to increase slightly.

Kerlinger favors the explanation that the new access roads cut through the forest at the WindMar site provided better foraging habitat such that more singing birds could occupy the site, particularly in new areas. He believes it is possible that these openings in the forest make foraging easier. North American nightjars forage in openings and edges of the forest (Paul Kerlinger, personal observation). Orlando Garrido, the Cuban ornithologist, has told WindMar that the closely related Greater Antillean Nightjar (*Caprimulgus cubanensis*) has become more common in areas of dense forest where roads have been cut, such as in the Zapata Swamp (Orlando Garrido, personal communication). Vilella’s own research appears to support this hypothesis as well.

According to Vilella (1989), optimal nightjar habitat has abundant leaf litter, protective cover directly above the nest (i.e., a closed canopy), an open understory and midstory (good for foraging), and a relatively high number of tree species in the midstory (good for insect diversity). Curiously, the best nightjar habitat within the Guánica State Forest is not dry forest, but mahogany plantations, which have these characteristics. Nightjars appear to prefer plantation forests for nesting sites 35 to 1 over deciduous (dry) forest. This ratio is derived from Vilella’s having found 6 nightjar nests in mahogany plantations covering 0.8% of the survey area versus 13 nests in deciduous forest covering 61% of the study area (Vilella 1989). Vilella also surmises that plantation forestry at Guanica may have played a key role in helping the nightjar hang on when its native habitats were severely cut over.

In our view, a plantation forest is much closer in structure to the nightjar's ancestral habitat than the scrubby dry forests that now predominate within the nightjar's range. The nightjar's ancestral habitat, with its tall, dense canopy, was probably quite open underneath, ideal for nightjars to sally up in pursuit of large moths and beetles. In comparison, it is hard to see how today's scrubby dry forests, with their tangles of small branches, are optimal for nightjar foraging or even easy to fly in for a bird the nightjar's size . It is not surprising, therefore, that the creation of edges or narrow roads in scrubby dry forest could benefit the nightjar population. The dense habitat nearby may not be good for foraging, but it may be good for nest sites. Thus, the presence of a dense dry forest for nesting and narrow roads and openings for foraging may provide better habitat for nightjars.

It is also compelling that, where the largest amount of habitat was affected, the better the nightjar population responded (see Figure 5, page 13). Punta Ventana and Cerro Toro largely lacked roads. Ventana had some old roads, but they were overgrown with light woodland. When measured using GIS, road introduction at Punta Ventana exceeded 5%. At Cerro Toro, it approached 2%. These areas saw increases in nightjar territories of 44% and 20% respectively.

Punta Verraco has always had the greatest nightjar density of the WindMar site. It now appears that this greater density is related to Verraco's extensive, established road network. Nevertheless, new roads and road widening at Verraco were measured at about 1%, and the nightjar population increased 21%.

The location of new nightjar territories at the WindMar site appears to be closely related to road placement. For example, the new nightjar territory on Cerro Toro happens to coincide with a 750 m^2 clearing made to conduct a geotechnical study of the bedrock. On Punta Verraco, most of the new territories are at the base of the peninsula, where a new access road was established. The territories on Punta Ventana also appear to align with, or be associated with, the new roads. Moreover, on one night on Punta Ventana, the data collection team reported an adult with two recent fledglings foraging along one of the access roads, and another older fledgling foraging along another. Birds were clearly making use of the roads to feed young (and perhaps teach them to forage) at a critical life history stage.

The two areas where Vilella and Zwank (1993a) recorded their highest nightjar densities were the lower Susúa Forest (mean abundances of 0.245 and 0.332 nightjars/hectare) and the western part of the main section of the Guánica State Forest (mean abundances ranging between 0.182 and 0.201 nightjars/hectare). According to maps, these areas contain a paved road in addition to dirt roads and trails, lending further support to the argument that the Puerto Rican Nightjar needs some edge habitat to thrive.

It appears that we may have discovered a new management technique for the Puerto Rican Nightjar – introduction of limited edge habitat in continuous dry forest, without significantly fragmenting the larger forest. Clearly, this technique must have a limit beyond which the nightjar population will begin to respond negatively. In other words, there is likely to be an optimal amount of clearing (as well as size and shape of clearings) above and below which fewer territories will be found. But, based on the Ventana response (a 44% increase in response to more than 5% of edge created), this limit may be quite high, perhaps over 10%. Thus, territory density seems to be related not only to the amount and type of forest, but also to the size and shape of clearings.

Yellow-shouldered Blackbird

Dr. Kerlinger's report on baseline site use by the Yellow-shouldered Blackbird (Kerlinger 2003c) is included in Appendix VII. In summary, a total of 15 rounds of surveys were conducted on ten different days between April 27 and June 10, 2003, to search for Yellow-shouldered Blackbirds in all likely habitats on the WindMar property. The study also took into account more than 100 visits to the site over the past five years by competent observers who were familiar with the bird.

No Yellow-shouldered Blackbirds were observed during the surveys conducted in April-June 2003, or during the field visits made by several biologists during the past five years. The species is relatively easy to identify, and the survey was conducted during the nesting season, when adults and young would have been present and would have been rather obvious and easy to detect (Rivera 1983, revised 1996 – Yellow-shouldered Blackbird Recovery Plan). If present, these birds would have made frequent foraging flights from nesting areas and would have been obvious as groups, following fledging. The open habitats that they frequent make them easy to detect. The methods used and sites surveyed were designed to detect these species on the WindMar site. It is unlikely that this species would have eluded detection, if it were present.

The absence of Yellow-shouldered Blackbirds at the WindMar was not unexpected. FWS and DNER had no records of this species at or near the project site (Díaz 2003, and personal communications with FWS and DNER biologists), nor has the species been reported from the project site during the previous decade. Nevertheless, habitat deemed marginally suitable to suitable for this species does occur in the low areas of the project site, outside of where the turbines and related infrastructure would be located. Should the species recolonize the area (we assume it occurred in the Yauco River delta at one time), it would not be at risk from habitat alteration or collision impacts related to the WindMar project. It is WindMar's hope, however, that ecological restoration activities at the site will attract Yellow-shouldered Blackbirds and reestablish the species as one of the area's breeding birds.

Brown Pelican, Roseate Tern, and other birds

Dr. Kerlinger's initial report on baseline site use by the Brown Pelican, Roseate Tern, and other birds (Kerlinger 2003d) can be found in Appendix VIII. The other species emphasized by FWS included Turkey Vulture, Red-tailed Hawk, Magnificent Frigatebird, Sandwich Tern, and Royal Tern (Díaz 2003).

Kerlinger's initial report analyzed 69.5 hours of observations conducted in May and June of 2003. The May-June observation period for this study was purposefully chosen to coincide with the nesting season of the Brown Pelican and Roseate Tern, the species for which there is greatest concern. Given that year-round measurements of wind direction and speed at the WindMar site do not vary greatly, the results of this study strongly indicate what bird use can be expected during other seasons. Nevertheless, at the suggestion of Dr. Jorge Saliva, a FWS biologist, WindMar continued its observations in order to confirm annual patterns. In this regard, we logged an additional 132 hours from September 2003 to May 2004. Also at Dr. Saliva's request, we conducted observations at the tip of Punta Verraco in order to understand flight patterns there. In this regard, we logged 17 hours of observations in May 2004.

For the WindMar site, Kerlinger adapted a methodology for bird flight-use studies in line with methodologies used at other wind-energy sites and has been accepted as a robust means of assessing risk to birds. This protocol was promptly submitted to FWS biologists for comment, but a response was not received until after the May and June 2003 observations had been completed. The protocol included choosing two vantage points on high ground from which avian flight-use could be determined. One was on the cliffs on the southeast side of Cerro Toro, providing a clear view of flight patterns around that promontory, including across the peninsula to Guayanilla Bay and along the Caribbean coast. The other was on a mound at Punta Verraco that provided a clear view of the proposed turbine field toward the peninsula tip. No observations were made at Punta Ventana because we have observed that the flights of pelicans and other seabirds there are almost entirely coastal, taking advantage of updrafts along the seaward facing cliffs. In addition, Guayanilla Bay is too distant from Punta Ventana and the winds do not assist birds to cross there. As we discuss below, our observations show that there are better places for birds to cross between the Caribbean and Guayanilla Bay.

Observations included noting the species, number of individuals, and the direction, height, and sector in which the flight occurred, including changes in direction, height, and sector. Height included: low (below the rotor-swept zone/height), medium (within the rotor-swept zone/height), and high (above the rotor-swept zone/height). Observations were made by competent observers during 90-minute observation periods that included early morning (0700-0900), midday (1100-1400), and afternoon (1600-1800) hours so that daily activity patterns could be determined.

The initial 69.5 hours of survey recorded 1,021 bird observations (an observation may include one or more birds of a single species), a rate of 14.7 observations/hour (obs/hr). The 132 additional survey hours recorded 1,236 observations, a rate of 9.4 obs/hr. Combining the two, the rate was 11.2 obs/hr. 17 hours of observations made in May 2004 at the Punta Verraco tip yielded 423 observations, a rate of 24.9 obs/hr.

A total of thirteen bird species were observed during the initial study. Three species were commonly observed at rates above 2.0 obs/hr. These were Brown Pelican (4.7), Magnificent Frigatebird (6.7), and Turkey Vulture (2.3). The other ten species were uncommonly observed at rates less than 0.5 obs/hr. These included Red-tailed Hawk (0.1), Royal Tern (0.5), and Sandwich Tern (0.1). Except for Royal Tern, the uncommon species were recorded at 0.1 obs/hr or less. The other species were American Kestrel, Brown Booby, Caribbean Martin, Peregrine Falcon, Gray Kingbird, Osprey, and Tricolored Heron.

The subsequent 132 hours added another 12 species (American Oystercatcher, Bahamas Pintail, Belted Kingfisher, Cliff Swallow, Great Blue Heron, Great Egret, Least Tern, Little Blue Heron, shorebird species, Snowy Egret, White-tailed Tropicbird, and White-winged Dove), but all were recorded well below 0.1 obs/hr and mostly flying over the water. Observations at the Punta Verraco tip added six species (Antillean Nighthawk, Cattle Egret, Laughing Gull, Sooty Tern, Yellow-crowned Night-Heron, and White-crowned Pigeon), but all were uncommon. Roseate Tern was not observed during any of the surveys.

What follows are descriptions of baseline site use by the Brown Pelican, Magnificent Frigatebird, Turkey Vulture, and other species highlighted by FWS for special attention. We also discuss the status of the Roseate Tern, based on information provided by FWS.

Brown Pelican

Because of its endangered status in Puerto Rico and common occurrence at the WindMar site, we focus most attention on the Brown Pelican. This description of baseline site use for this species is based on the 201.5 hours of combined observation at Cerro Toro and Punta Verraco, plus the 17 hours of observation at the tip of Punta Verraco.

A very large bird, the pelican takes every advantage it can from the wind updrafts from topography and thermal activity to power its flight along the coast. It is rare to see pelicans expending large amounts of energy by using flapping flight at the WindMar site, unless there is little or no wind, an uncommon occurrence.

Pelicans that frequent the WindMar site appear to know its wind patterns very well. They predominantly glide along the immediate coast heading east or west, using wind deflected upward by the low cliffs along most of the peninsula. But, whether they come from the east or west, pelicans nearly always pause at Cerro Toro to take advantage of the strong updrafts that deflect up this steep, seaward-facing promontory. The "updraft elevator" at Cerro Toro (please see Figure 6, page 14) allows birds to gain height quickly, and then glide downward toward their destination. Birds use this "downhill" glide to either: 1) continue in the direction they were headed, 2) return in the direction from which they came, or 3) cross over into Guayanilla Bay in front of Cerro Toro. It is not uncommon to see pelicans linger in the updraft elevator for more than a minute.

Based on all data from the Cerro Toro and Punta Verraco observation points (excluding the tip; please see below), pelicans moved along the coast at a rate of 4.1

birds/hr (based on 201.5 hours of observation, 2.7 obs/hr, 1.5 birds/obs). This varied from 6.8 birds/hr in June 2003 to 1.9 birds/hr in December 2003 (please see Table 8). The coastal flight is predominantly over the sea, except for birds heading east out of the Cerro Toro updraft elevator, which fly over a short stretch of beach before reaching the water. Beyond the beach area, they again take advantage of updrafts along the seaward cliffs.

Table 8: Pelican Flight Rates

Month	Observation Hours	Coastal Flight (birds/hour)	Cerro Toro Crossing (birds/hour)	Turbine Field (birds/hour)	Rotor Zone/Height (birds/hour)
May-03	39.0	3.7	0.6	0.4	0.2
Jun-03	30.5	6.8	0.2	0.1	-
Sep-03	15.0	4.3	1.6	-	-
Oct-03	15.0	3.7	2.3	1.8	0.3
Nov-03	12.0	3.9	1.7	-	-
Dec-03	15.0	1.9	0.3	0.4	0.1
Jan-04	15.0	2.3	1.3	0.3	-
Feb-04	15.0	3.7	2.4	0.4	0.4
Mar-04	15.0	3.5	2.8	-	-
Apr-04	15.0	5.8	1.1	0.3	0.3
May-04	15.0	3.6	1.3	0.3	0.1
Total	**201.5**	**4.1**	**1.4**	**0.3**	**0.1**

The second most common flight pattern at the Punta Verraco peninsula is what we call the "Cerro Toro crossing." Using height gained in the updraft elevator, some birds glide to Guayanilla Bay across the peninsula along a narrow corridor over the eastern edge of Cerro Toro, losing altitude as they approach the bay. This behavior is highly significant because most birds that cross the peninsula to reach Guayanilla Bay use this route. Of the 159 pelicans we recorded crossing the Punta Verraco peninsula excluding the very tip, 79% (126) used the Cerro Toro crossing. The overall rate of this flight pattern was 1.4 birds/hr (based on 93.0 hours of observation, 1.0 obs/hr, 1.4 birds/obs), but the rate varied from 2.8 birds/hr in March 2004 to 0.2 birds/hr in June 2003.

Of the 126 birds recorded using the Cerro Toro crossing, 116 (92%) traveled north from the updraft elevator to Guayanilla Bay. Only 10 birds (8%) traveled south out of the bay to reach the Caribbean side. The strong northward flight pattern makes sense because it requires almost no effort – birds spiral up in the updraft elevator on the Caribbean side, then glide toward the bay. The reverse movement, however, would require energetically expensive flapping flight because strong updrafts are not as available on the bayside.

Pelicans also cross the Punta Verraco peninsula at nearly any point heading north into the bay or south to the Caribbean, but the frequency of these crossing flights is low when compared to other alternatives. The frequency of these crossing flights is 0.3 birds/hr (0.2 obs/hr, 1.5 birds/obs). Of the 33 birds recorded doing so in 108.5 hours, only 13 (0.1 birds/hr) were recorded at a height that would be swept by the rotors of the proposed wind farm. Birds flying north into the bay (22 birds, 0.2 birds/hr, 0.06 birds/hr at rotor height) outnumbered birds flying south out of the bay (11 birds, 0.1 birds/hr, 0.08 birds/hr at rotor height) two to one. This is not surprising given that the southward flight is against the wind. It should be remembered that though these birds were at rotor height, they were not necessarily flying through the actual locations of where rotors would be located. The reason for this is that the actual rotor swept zone/height (where turbine rotors would be located) is a very small proportion of the overall volume of air that is within this height zone.

The tip of the Punta Verraco peninsula presents a similar flight pattern. Based on 17 hours of observation conducted in late May 2004, we found a relatively high frequency of pelicans (6.1 birds/hour) rounding the tip mainly at low altitude on their way into or out of Guayanilla Bay. As displayed in Figure 6, this route is very narrow over the water, as birds take advantage of updrafts from the predominantly southeast winds. More pelicans (66 birds, 3.9 birds/hr) left the bay via this route than entered it (37 birds, 2.2 birds/hr). This may not be surprising because the Cerro Toro crossing is primarily a route to enter the bay.

There is another frequently used updraft elevator south-southeast of the peninsula tip. Forty pelicans were observed using it (2.4 birds/hr) to gain height to either round the peninsula, cross the mouth of the Guayanilla Bay in the direction of EcoEléctrica and Cayo María Langa, or continue down the coast toward the Cerro Toro updraft elevator. Given the mild slope of the peninsula tip, birds cannot gain anywhere near the height they do at Cerro Toro, and most were recorded at relatively low heights. Out of this elevator, however, some pelicans drift above the peninsula tip itself continuing to circle (12 birds, 0.7 birds/hr) at low (83%) and medium (17%) heights. From above the peninsula tip, these birds were recorded either crossing over into the bay (5 birds, 0.3 birds/hr) or returning to the elevator or heading down the coast (7 birds, 0.4 birds/hr).

WindMar observers also made three boat trips into Guayanilla Bay in order to understand how pelicans use the bay. These trips were on November 8, 2003, March 20, 2004, and April 18, 2004. One the first trip, we were surprised to find over 50 pelicans roosting singly or in groups of up to four birds in the mangroves that fringed Guayanilla Bay. Abundant whitewash from pelican defecations was noted in the mangroves, indicating that Guayanilla Bay had at least recently been a regular roosting site for more than 50 birds. There were also another two dozen or more birds feeding in the bay and flying around it. During the three and a half hour observation period, one bird was noted transiting the Punta Verraco peninsula along the Cerro Toro crossing. On the same afternoon, another 20 pelicans were found at Cayo María Langa off EcoEléctrica outside the bay.

The March trip revealed 38 pelicans roosting in mangroves along the edge of the bay and about five birds feeding in the bay. No pelicans were observed crossing over the peninsula into the bay. The April trip found eleven roosting birds and about nine feeding birds. On this trip, two adults were observed entering the bay via the Cerro Toro crossing. They attempted to fish but appeared to be unsuccessful.

In summary, the Brown Pelican uses the wind to move as effortlessly as possible around the WindMar site. The pelican's predominant flight pattern is along the immediate coast, where there are updrafts. To enter Guayanilla Bay, where they roost and feed, pelicans use three principal routes: 1) around the tip of the peninsula (2.2 birds/hr), 2) gliding "downhill" out of the updraft elevator at Cerro Toro (the *Cerro Toro crossing*, 1.4 birds/hr), and 3) at any point across the main part of the peninsula (0.2 birds/hr, but at 0.06 birds/hr at rotor height). Departing Guayanilla Bay for the Caribbean, where they also feed, most pelicans go around the peninsula tip (3.9 birds/hr), but some birds cross the main part of the peninsula (0.1 birds/hr, 0.08 birds/hr at rotor height) and some use the Cerro Toro crossing (0.1 birds/hr). Based on observations at Cerro Toro and Punta Verraco, observers have estimated that it is likely that between twelve and twenty pelicans regularly fly and feed around the WindMar site. But, surveys of Guayanilla Bay and adjacent areas have recorded as many as 100 individuals, though half this number or less are normally present.

In his initial assessment of flight use (Kerlinger 2003d), Dr. Kerlinger analyzed May and June 2003 data without regard to flight patterns. His main index for assessing collision risk to flying birds was to look at flight frequency at rotor height over land. This assessment technique yielded risk assessments of low to none for all birds. But, the numbers and risk assessments are driven still lower for the pelican when flight patterns are taken into account. For example, the Cerro Toro crossing avoids the line of turbines atop Cerro Toro and the turbine at the base of the Texaco quarry. The only pelicans at risk from collision are the ones crossing the main part of Punta Verraco. These were measured at 0.3 birds/hr overall, and 0.1 birds/hr at rotor height.

Risk to the pelican will be discussed in more detail later in this report, when determining the anticipated level of incidental take.

Magnificent Frigatebird

The Magnificent Frigatebird was the bird most frequently observed flying at the WindMar site. During the May-June 2003 flight study, it accounted for 46% of observations, more than Brown Pelican (32%) and Turkey Vulture (15%), but most of these observations were of birds above the water (Kerlinger 2003d). A masterful soaring bird, the frigatebird avoids effort when it flies, relying entirely on the wind deflected and thermal updrafts for gaining altitude and then using the potential energy generated via downward gliding. Searching for food at sea, the frigatebird has a flight pattern that strongly resembles the pelican's – predominantly coastal, with use of the Cerro Toro crossing mostly north into Guayanilla Bay, and occasional flights over the Punta Verraco turbine field. These flights are at about the same frequency as the pelican, but with fewer birds at rotor height (Kerlinger 2003d).

Based on the initial 69.5 hours of observation, Kerlinger assessed risk to the frigatebird as low to none. His reasons were: 1) the incidence of frigatebirds in the WindMar turbine field is below that of raptors at a wide variety of well studied sites (Erickson et al. 2002), and 2) the frigatebird is a superb flier that does not forage over land (i.e., unlike raptors, it is not likely to be distracted by foraging within the turbine field). This assessment did not take flight patterns into account, however. Frigatebirds using the Cerro Toro crossing would essentially not be at risk from turbines, thereby decreasing the potential for risk to these birds.

Turkey Vulture

The Turkey Vulture is the third most common bird observed at the WindMar site. Like the more common pelican and frigatebird, Turkey Vultures rely almost entirely on updrafts to generate lift for flight. But, as a terrestrial carrion feeder, the vulture spends much more time soaring over land in circuitous patterns, potentially putting them at greater risk than are pelicans or frigatebirds. During the May-June 2003 flight study, 90.5% of Turkey Vulture observations were over land, compared with 10.4% for the Brown Pelican (Kerlinger 2003d).

Turkey Vulture is the species that would spend the most time flying within the WindMar turbine fields at rotor height. The fact that nearly one-sixth of all May and June 2003 observations of vultures were within the rotor-swept height-zone suggests that vultures could be at some level of risk. But, based on studies conducted at the Altamont Pass Wind Resource Area in California (Orloff and Flannery 1992 and 1996) and at other projects (Erickson et al. 2002), it has been demonstrated that this species is not likely to collide with wind turbines, even with use estimates comparable or higher that the WindMar site. Turkey Vultures have been recorded flying among turbines for hours without colliding (Kerlinger, personal observations), and only on very rare occasions have these birds been found dead under the 5,400 wind turbines in the Altamont. Therefore, the assessed risk for this species, which spends more time in the rotor zone than other species at the WindMar site, is estimated at low to none.

Red-tailed Hawk

Singled out by FWS as a species of concern, the Red-tailed Hawk was observed infrequently at Cerro Toro and Punta Verraco – six observations, each of single birds, in 218.5 hours (0.03 birds/hr), including three observations of what must have been the same bird on December 13 and 14, 2003, and two observations of what might have been the same bird on April 17 and 19, 2004. It appears that single birds enter the Punta Verraco peninsula infrequently and do not remain, presumably because the time and energy investment does not result in enough captures of prey.

The Red-tailed Hawk has also been recorded at Punta Ventana, but even there it is uncommon. Observers do not see it every day. When it is seen, it is usually a single bird. The frequency of this raptor at any part of the WindMar site is well below the 0.4 to 1.5 birds/hr that Erickson et al. (2002) have recorded for raptors at larger wind farms.

Recorded raptor mortalities at those wind farms have ranged between 0.000 and 0.053 birds/turbine/year. Clearly, Red-tailed Hawk mortalities, even among the nine turbines proposed for the Punta Ventana sector, would not rise anywhere close to the level of biological significance.

Royal and Sandwich Terns

During the May-June 2003 flight-use study (Kerlinger 2003d) and subsequent observations, Royal and Sandwich Terns were only observed flying at low altitudes over the sea. At the Punta Verraco tip, no terns were observed transiting the tip itself, but there were numerous sightings of both species rounding the tip low over the water. We conducted our observations at the Punta Verraco tip in late May because this is when tern nesting is at its peak.

Unpublished data from FWS confirm that Least, Royal, and Sandwich terns have nested in seven of the past thirteen years on "Cayo Guayanilla," a small island about 600 m south of the Punta Verraco tip. Composed of coral rubble and disturbed by wave action, Cayo Guayanilla is not used for nesting every year. Some years, it barely breaks the surface of the sea and is unsuitable for nesting. Other years, it is high enough to allow successful nesting. Since 2001, it has been largely unsuitable, but 13 Least Terns attempted to nest there in 2003. In some years, nesting on this island may also be affected by landings by local boaters.

The biggest recorded nesting event on Cayo Guayanilla in the past fourteen years was in 1994, when hundreds of pairs of Sandwich and Roseate Terns were recorded there. The other years in which hundreds of tern pairs were recorded were 1993 (110 Least Tern pairs) and 1998 (346 Sandwich Tern nests along with one Roseate Tern nest).

Should the cay again become suitable for nesting, would the proposed wind farm, particularly the turbines at the Punta Verraco tip 600 m distant, unsettle birds or cause the colony to be abandoned? We believe not. While there are no studies documenting disturbance or displacement of terns or other colonial nesting birds by operating wind turbines, there is ample information on other types of disturbances. One study from Belgium showed that terns nested very close to a turbine field with no apparent displacement. There were many hundred terns nesting almost beneath the turbines and some collision fatalities were noted. Most noteworthy are the heron rookeries in Jamaica Bay adjacent to the runways at JFK International Airport in New York City. Many colonial nesting birds seem to become accustomed to the noisy overhead comings and goings of large commercial aircraft, including until recently SST's. A tern colony on a public beach in Far Rockaway, New York, also appears not to be affected by low aircraft departing or approaching nearby JFK. We would also like to point out that the rising sea level recorded in Puerto Rico and the Caribbean may soon make this point moot. Indeed, Cayo Guayanilla has not been high enough in recent years to support significant tern nesting.

Should significant nesting again occur on Cayo Guayanilla, would terns be at particular risk from the turbines at the tip of Punta Verraco? The concern here is that birds feeding in Guayanilla Bay would take the shortest distance back to the colony (i.e., over the peninsula tip) to feed young and return to the feeding area. We strongly believe that, should this phenomenon occur, terns would mostly do so at a low altitude (much below 100 feet) that would not approach the spinning rotors, thereby shortening the distance back to the colony even more. This is characteristic of tern flight during foraging and travel between foraging areas in many parts of the world and for many species. In addition, during our flight-use study, we never observed terns over the peninsula tip. All were recorded either low or very low above the water in the vicinity of the tip. This would likely be the predominant flight pattern back to the colony from feeding areas within the bay.

Roseate Tern

Roseate Tern was not observed at any time during the surveys, despite careful observations. Regular examination of the islands off Punta Verraco in the Caribbean did not detect this species, nor did the regular behavioral observations conducted at Cerro Toro and Punta Verraco, nor observations at the Punta Verraco tip. Furthermore, regular visits to the site during the past five years by several competent observers (Orlando Garrido, John Guarnaccia, Alfonso Silva, and others) have not revealed the presence of this species.

FWS, however, has recorded Roseate Tern nesting at Cayo Guayanilla in four of the last fourteen years. These years were: 1994 (200 pairs), 1995 (17 pairs), 1998 (1 pair), and 1999 (1 pair). Clearly, Roseate Tern is an uncommon nesting species in Guayanilla Bay in the past decade. On rare occasions do breeders number into the hundreds of birds.

We believe that the discussion of risks to Royal and Sandwich Terns also applies to the Roseate Tern. Since the Roseate Tern visits Guayanilla Bay infrequently, its risk of being adversely affected by wind turbines is no greater than that of the more common tern species, which Kerlinger assessed at none.

Other species of concern

At the request of DNER biologists, WindMar has analyzed potential impacts on the threatened lizard, *Anolis cooki*, and on bats. WindMar contracted zoologist Dr. Richard Thomas to conduct an assessment. His report can be found in Appendix IX.

Anolis cooki

Thomas found that *Anolis cooki* occurs in sunny, open habitats with exposed rocky substrate along the immediate coast and near cliff edges within the WindMar site. Inside closed-canopy dry forest, it is replaced by the common *Anolis cristatellus*. Figure

7 (page 15) illustrates how *cooki* and *cristatellus* replace each other ecologically and how the *cooki* distribution will not coincide with the wind turbine placements.

<u>Bats</u>

Of the seven species of bats that have been recorded in the Guánica State Forest, Thomas mist-netted or observed four of them on the WindMar site. Three of these four are nectar of fruit feeders. Only one is insectivorous. Including the other three Guánica species brings the total of insectivores up to three.

Thomas has concluded that bats are of negligible risk from the WindMar project. His reasons are: 1) Bat frequency at the WindMar site is low to begin with. 2) The nectar and fruit feeders tend to fly below the canopy, a flight pattern that does not intersect the rotor-swept zone, which begins 100 feet above the ground. And 3) Thomas observed insect activity on a near windless night and found almost no insect activity above the canopy. If insects are not flying high on windless nights, when the rotors would be barely spinning and would not present a collision risk to bats, they are less likely to fly high on windy nights, when rotor collisions with bats could become an issue.

Evidence of archaeological and historic sites

Archaeological sites have been recorded on the WindMar property. Six sites are described in a published study of the Yauco River drainage (Maíz 1984). The two sites on Punta Ventana – one of which is a cave with petroglyphs – will certainly not be affected by wind turbine placements and related infrastructure. Based on Maíz's published coordinates, three of the four sites on Punta Verraco (principally shell middens with some pottery shards) are outside of the project footprint. The fourth site, however, was intersected decades ago by the principal Verraco access road. Should any sites be found to intersect the project footprint, WindMar will take appropriate measures to protect them or have them professionally excavated by archaeologists.

Wetland delineation

All of the wind turbines and related infrastructure, including the substation, will be located in upland areas. None will be located in any flood area indicated on the Flood Insurance Rate Map that includes the project site (FEMA 1999). Additionally, no project component will be located in any designated wetland areas, such as mangrove swamps.

<u>Determination of Proposed Activities</u>

The HCP Handbook (FWS and NMFS 1996) requires "a description of all actions within the planning area that: (1) are likely to result in incidental take; (2) are reasonably certain to occur over the life of the permit; and (3) for which the applicant or landowner has some form of control."

Below we describe four proposed activities that could conceivably result in incidental take of Brown Pelican, Roseate Tern, and Puerto Rican Nightjar.

1. Cutting back of dry forest habitat to site access roads and wind tower bases

This activity precedes construction of the wind farm. Related to the site plan, (Figure 8, page 16), Table 9 presents the amount of dry forest that must be cut back to construct the project. Tree rootstocks would not be removed except at the turbine pad and where roads would be constructed. By leaving rootstock and an inch or two of stem intact, trees and shrubs would regenerate quickly following construction and be allowed to grow to more than 5 m. This would minimize the actual footprint of the project.

In summary, a maximum of approximately 12.2 ha of dry forest will be affected in order to create new roads and establish construction sites to erect the wind turbines. This represents 4.2% of the total site (290 ha) and 4.9% of the total dry forest (250 ha). Nevertheless, as explained below, the project impact is likely to be less.

Roads

The WindMar project requires 10.1 km of roads through dry forest in order to construct and maintain 25 wind turbines (see Figure 8). But, WindMar has sited the project in order to take advantage of 8.7 km of existing roads, 2.5 km of which were sited in early 2004. Only 1.4 km of roads remains to be sited.

WindMar has calculated the road impact based on a 10-m road width (Table 9). Road impacts include the widening of 8.7 km (5.4 miles) of existing roads from 4m to 10m, and the siting of 1.4 km (.87 mile) of new roads for a total of impacts of 5.8 ha (14.5 acres) of forested habitat. Nevertheless, according to the wind turbine manufacturer (Vestas, personal communication), in most instances, the construction phase of this project only requires 5 m wide roads plus turning areas. The largest vehicles to use these roads will be:

- <u>Two cranes to construct the turbines</u>: One of minimum 300-ton capacity with a telescoping arm that can reach 80 m in height (the main crane), the other of maximum 100-ton capacity (the helper crane). Both can operate on 5-m roads.
- <u>Trailer trucks to deliver wind turbine components to the construction sites</u>. Given the length of some of these components – 40-m rotor blades and a 30.2-m tower section – the turning radius of the delivery trailer can be considerable. WindMar will use a rear-wheel-steer trailer for delivery, because it has a shorter turning

radius than a normal long trailer (15 m *versus* 30 m). The 5-m road width will allow this type of trailer to negotiate most curves, even with a 40-m rotor blade. But, widening the roads to up to 10-m in a limited number of places will allow these vehicles to negotiate all right and left turns, construction sites, and turning areas. Once a rear-wheel-steer trailer has made its delivery, it can be collapsed in order to decrease the turning area required for its return to the staging area.

The limestone bedrock that forms the upland portions of the WindMar site is an excellent substrate for vehicular traffic, with more than adequate ground bearing capacity (Metropolitan Soils 2004). Given the nature of the bedrock, roads are self draining and do not require paving. Road conditioning is minimal. Jutting pieces of limestone rock can be pushed aside by a bulldozer or crushed flat using a rock-crusher attachment. For vehicular transit, roads must be level sideways to within 1%, but most of the roads already meet this criterion. Where they do not, they will be leveled with crushed limestone originating from the excavation of the turbine bases (see below). There are no creeks, ditches, or culverts that need to be filled and made drivable.

Except in one area, slopes where roads have been sited are within the specifications of the wind turbine manufacturer – less than 10% as measured over 30 m. The area where roadwork is required to moderate the slope is the final section of the access road leading up to Ventana (to the west of turbine 25; see Figure 8, page 16). WindMar plans to accomplish this by removing the final steep section. This will require the excavation of approximately 100 m^3 of limestone rock, which WindMar will use for various purposes on site (see discussion below).

A bulldozer is used to clear roads of vegetation. This machine scrapes the vegetation at the surface, leaving the rootstalks intact for the vegetation to recover. In every instance where WindMar has widened or established access roads using bulldozers, the vegetation has come back vigorously from the root stalks. This technique will allow the recovery of dry forest along road margins and around turbine bases in the 40-year interval between construction and complete tower replacement.

Construction Sites

According to the wind turbine manufacturer (Vestas, personal communication), turbine assembly can be accomplished with an 840 m^2 construction site. This site includes a turbine base, crane pad, and delivery area (see Appendix X), plus the rotor assembly area. Nevertheless, in order to have an ample margin in the construction process and avoid surprises, WindMar is calculating the construction site impact at 2,000 m^2 per turbine (0.2 ha/turbine). Vegetation will be cleared from the construction site by the bulldozer scraping method.

Table 9: Construction Impacts versus Mitigation

Activity	Detail	Punta Verraco 125 ha	Cerro Toro 46 ha	Punta Ventana 79 ha	Other Areas 40 ha	Total	% of Impact 12.2 ha	% of Dry Forest 250 ha	% of Property 290 ha
Construction Impacts									
Roads required to service wind farm (ha)	10,067 m x 10 m	(4.8)	(1.2)	(4.1)	-	(10.1)		-4.0%	-3.5%
Staging areas/substation (ha)	Note 1	-	(0.5)	(1.0)	-	(1.5)		-0.6%	-0.5%
Existing roads (ha)	8,656 m x 4 m	2.0	0.5	1.8	-	4.3		1.7%	1.5%
New Road Impact, Construction Phase		(2.8)	(1.2)	(3.2)	-	(7.2)	59.1%	-2.9%	-2.5%
Turbines to be erected		12	4	9	-	25			
Construction areas to erect turbines (ha)	2,000 m^2/turbine	(2.4)	(0.8)	(1.8)	-	(5.0)		-2.0%	-1.7%
Other Impacts, Construction Phase		(2.4)	(0.8)	(1.8)	-	(5.0)	40.9%	-2.0%	-1.7%
Total Impact, Roads + Construction (ha)		**(5.2)**	**(2.0)**	**(5.0)**	**-**	**(12.2)**	**100.0%**	**-4.9%**	**-4.2**
Dry Forest Restoration									
Texaco quarry (ha)		2.6	-	-	-	2.6	21.2%	1.0%	0.9%
Road margins to grow in (ha)	10,067 m x 5 m	2.4	0.6	2.0	-	5.0	41.1%	2.0%	1.7%
Staging/substation areas to grow in (ha)	Note 2	-	0.4	0.8	-	1.2	10.0%	0.5%	0.4%
Construction areas to grow in (ha)	1,760 m^2/turbine	2.1	0.7	1.6	-	4.4	36.0%	1.8%	1.5%
Total Dry Forest Restoration		7.1	1.7	4.4	-	13.2	108.3%	5.3%	4.6%
Net Gain in Dry Forest Habitat		**1.9**	**(0.2)**	**(0.6)**	**-**	**1.0**	**8.3%**	**0.4%**	**0.3%**
Other Mitigation Projects									
Conservation Easement (ha)	See Table 13	98.0	42.0	67.0	38.0	245.0	2002%		84.5%
Mangrove Restoration (ha)	Note 3	-	-	-	10.0	10.0			
Total Other Mitigation Projects		98.0	42.0	67.0	48.0	255.0			
Net Gain in Protection		**99.9**	**41.8**	**66.4**	**48.0**	**256.0**	**2092%**	**102.4%**	**88.3%**

Note 1: The main staging area will be in the 3.1 ha abandoned quarry on Punta Verraco. Secondary staging areas measuring 5,000 m^2 (0.5 ha) each will be located: 1) at the base of Cerro Toro in the substation area, 2) near the highest elevation of Punta Ventana, and 3) above Playa Sucia on Punta Ventana.

Note 2: The footprint for the substation is 800 m^2. In each of the staging areas on Punta Ventana(2), WindMar will use 1,000 m^2 for satellite offices/research stations.

Note 3: The mangrove restoration will benefit an area outside, but adjacent to, the WindMar property.

The rotor, including a hub and three 40-m blades, must be assembled on the ground. But, when attached to the hub, the blades sit off the ground at a height of 0.4 m. In order to minimize impacts to vegetation, WindMar will attempt to use machetes and chainsaws to cut vegetation to a height of 0.3 m in triangular corridors 40 m long and 3.5 m at the base for the two blades that extend above the tower foundation (the blade below will lie in the cleared staging area). This accounts for 140 m^2 of the 840 m^2 impact per turbine site calculated by Vestas.

Staging Areas and Substation

Turbine components will be delivered to four staging areas, indicated in the color beige in Figure 8 and included in Table 9 as Note 1 and Note 2. The main staging area will be in the abandoned, 3.1-ha Texaco quarry at the base of the Punta Verraco peninsula. Most turbine components will be delivered here, and then moved as required to secondary staging areas.

The secondary staging areas will measure about 5,000 m^2 (0.5 ha) each and be situated:

- At the base of Cerro Toro adjacent to the access causeway, where the project's electrical substation will be situated. This is an area of highly disturbed, secondary lowland vegetation, not dry forest.
- In the upper section of Punta Ventana, where the access road crests the hill. This area is already mostly cleared for this purpose.
- At the far end of the Punta Ventana access road above the Playa Sucia beach.

An electrical substation will eventually be established in the Cerro Toro staging area. It will have an 800-m^2 footprint when constructed.

WindMar estimates that it will take three months to widen and clear roads, clear construction sites, and condition roads and construction sites. Personnel will include a civil engineering team to design and direct the road conditioning, two field supervisors to oversee the bulldozer work, two bulldozer operators to accomplish the clearing, two off-highway truck operators to deliver fill, and four forestry technicians to clear vegetation for the rotor assembly.

2. Construction activities to erect wind turbines and other infrastructure

The following activities will take place during the first year of the project. It is conceivable that the noise, vibration, and activity of the construction itself could temporarily displace nightjars.

Construction of Turbine Bases

Soil and geologic data indicate that the WindMar site has adequate ground bearing capacity for the proposed 1.65 MW wind turbines (Metropolitan Soils 2004).

Constructing the bases for these turbines requires excavating a 15.5 m by 15.5 m area (240 m^2) down to a depth of 1.5 m (360 m^3) (for plans, please see Appendix X). First, the perimeter of the base is cut 1.5 m deep using a trencher. Then, a hammer attachment on a large backhoe loader or hydraulic excavator breaks up the bedrock and loads it onto 30-ton capacity trucks (approximately 25 m^3 per load). Excavated material will then be transported in approximately 14.5 truckloads per turbine base to a portable quarry machine set up in the main staging area at the base of Punta Verraco. The limestone rock will be ground and subsequently used for: 1) road conditioning, 2) leveling the crane pad at the construction site, 3) providing aggregate to construct the concrete turbine bases, and 4) backfilling the turbine bases once constructed. The total excavated material (approximately 9,000 m^3 of crushed limestone rock) will not cover all these needs, and more will have to be imported to the site. WindMar estimates that approximately 1,000 truck trips will be required to accomplish site work.

The bases are constructed of reinforced concrete. Concrete will be produced at the staging areas and delivered by cement trucks with an 8 m^3 capacity. Approximately 320 m^3 of concrete (40 cement truck loads) is required for each turbine base. The construction of all the turbine bases is estimated to take 150 days.

Situation of Cranes to Construct Wind Turbine

WindMar anticipates using a main crane of minimum 300-ton capacity and a helper crane of maximum 100-ton capacity to construct the wind turbines. With a telescoping arm that can reach 80 m above the ground, the main crane does all the heavy lifting of the tower sections, nacelle components, and rotor. The helper crane assists with the rotor installation.

The main crane requires firm, level support to operate safely. This is accomplished by preparing a level crane pad measuring 24.4 m by 15.9 m (388 m^2) with a maximum slope of 1% in any direction. Crane pads will be leveled using crushed limestone rock excavated from the turbine bases. Crane pads may be further reinforced with removable steel grillage.

The helper crane moves on tires and uses extended outriggers to station itself securely. Designed to operate in rough terrain, it does not require a special crane pad.

Delivery and Assembly of Wind Turbine Components

The figures in Appendix X give some idea of how a wind turbine is constructed. This appendix also provides the weights and dimensions of the various major components of the V82 wind turbine.

The four tower sections will be delivered one at a time by a rear wheel steer trailer. The trailer will deliver each section next to the main crane. When the crane lifts the tower section, the trailer will return to the staging area for the next section.

Once the tower is constructed, the nacelle (a “gondola" that houses the generator and other working parts) is constructed on the ground in three steps: 1) machine base frame, 2) gears, and 3) generator, then lifted into place. Once the nacelle is in place, the rotor is assembled on the ground and lifted as a unit to be attached to the nacelle.

Once a turbine is assembled, the cranes will move to the next site. Work will begin at the far end of the site and progress toward the near end.

Connection to Substation and PREPA Grid

Interconnection of the wind turbines and connection to the project substation will be accomplished via underground cables. A trenching machine will excavate a trench approximately 40 cm wide and 70 cm deep within the road footprint to lay the cables. Cables from the three property sections will run to a substation with a footprint of 800 m^2 (38 m x 21 m) located in a highly disturbed, non-dry forest area at the base of Cerro Toro, adjacent to the causeway. The purpose of the substation is to condition electricity for delivery to the Puerto Rico Electric Power Authority (PREPA) grid.

From the substation, there are two options for connecting to the PREPA grid. The closest connection is the 115 kV line, located less than 2 km distant. The other is the 35-kV switchyard, which is located approximately 5 km away in the town of Guayanilla.

Within the project site, WindMar will use underground cables in order to avoid bird collisions and electrocutions, as well as visual impacts. Outside of the WindMar site, electrical lines will run aboveground on electrical posts along state roads.

A building to house the project office and a scientific research station will be constructed within the main staging area. The quarry area to be occupied by this building and parking will not exceed 5,000 m^2. Small satellite offices/research stations will be constructed in the two staging areas in the Ventana section. Each of these facilities, including rustic parking, will occupy no more than 1,000 m^2.

The construction of the wind turbine bases, the opening and closing of the trenches for the electrical cables, and the construction of the substation and office will require a work force of approximately 50 people. The erection of the wind turbines and electrical work will require 30 people: 3 supervisors and specialists from the wind turbine manufacturer, 12 local workmen (4 for each supervisor/specialist), 5 crane operators or assistants, and 10 electricians.

WindMar will support this work force with a portable workshop, a dining trailer, an office, and an appropriate number of chemical toilets located in the different staging areas.

3. Operation of wind turbines

Once constructed, the wind farm begins its operational phase. The wind turbines will operate day and night. Their operation will affect the Brown Pelican and other birds that fly over the site. Studies demonstrate that birds tend to avoid the wind turbines (Kerlinger 2003a). It is highly unlikely that the noise of operation of the turbines will displace any birds.

Detailed in Appendix X, the V82 wind turbine we anticipate using has a rotor diameter of 82 m (270 ft), a rotor swept area of 5,281 m^2 (57,000 ft^2), and a rated power of 1.65 MW. The hub height for the rotor will depend on what is finally indicated by the wind energy consultants, but rotor zone will likely begin at 30 m (100 ft) or above and not extend higher than 120 m (400 ft). Rotors are made of glass fiber reinforced epoxy with steel rod inserts. Each rotor blade measures 40 m (131 ft) long and weighs 7.5 tons. Spinning rotors operate at a maximum of 14.4 rpm.

The V82 begins to generate electricity at 3.5 m/s (8 mph). Above 20 m/s (45 mph), the rotor stops spinning by feathering its blades, much like a sail boat pointing into the wind. Strongly built, the turbines and their towers are rated to withstand hurricane-force winds. When Hurricane Ivan brushed by Jamaica in September 2004, the Wigton Wind Farm above Kingston recorded gusts of 100 m/s (250 mph) (Vestas, personal communication). This 20.7 MW wind farm contains twenty-three 900 kW wind turbines. Yet, all the turbines stood up to these extreme winds, suffering little in the way of damage.

Made of corrosion resistant steel and measuring 4.2 m (13.8 ft) in diameter at the base, the tubular tower is slightly conical in shape. Of solid construction, birds cannot nest on the tower. Free standing, the tower does not require guy wires for support. Both of these features decrease avian risk of collision. Regarding the possibility of birds putting themselves at risk by perching on the nacelle, the top of the nacelle is smooth, and birds have rarely perched successfully on the nacelles of modern turbines (Paul Kerlinger, personal communication).

The noise generated by wind turbines measures at about 45-50 decibels. In comparison, the sound of the wind in vegetation commonly measures at 45-60 decibels, and frequently drowns out the “Woosh, woosh, woosh…” of the spinning rotors. Studies show that turbine noise does not affect birds (Kerlinger 2003a).

Consistent with FAA guidelines, and following FWS voluntary guidelines to minimize bird collisions, we will light the top of the turbine nacelle (some 72 m, or 240 ft, above the ground) with white strobes with the longest possible off cycle permissible. Typically, however, these strobes blink about 24 times per minute and go completely black between successive on-cycles. We will also keep lighting to a minimum number of turbines possible. If white strobes are not permitted by the FAA – or if FWS prefers we not use white lighting because of the possibility of disorienting any nesting or hatching sea turtles – we will use red strobes, or red LEDs, with the longest off cycle permitted (about 24 blinks per minute). It should be noted that recent studies presented at the National Wind Coordinating Committee have demonstrated that red strobe-like lights or red flashing lights do not attract night migrating songbirds or other birds. No other lights will be used, except perhaps for minimal security lighting at the substation, which will not be located near any turtle nesting beach. In addition, our project will have no boundary lighting, except at any access gates, but these will not be visible from Playa Ventana or the property's other beaches.

The nearest turbines to Playa Ventana would be Turbine 16 on the crown of Cerro Toro, some 200 m distant, and Turbine 18 on Punta Ventana, some 200 m distant. Given the height and distance of these lights, and their long off cycles, we believe it is unlikely that they will affect the sea turtles that make infrequent use of Playa Ventana for nesting or their hatchlings.

4. Maintenance of wind turbines

Maintenance will take place periodically during the entire life of the project and at different levels of intensity, including a) periodic repairs, b) full replacement of turbine parts, c) replacement of the blades, and d) replacement of the entire unit, including the tower. Only the replacement of the entire wind turbine will impact dry forest habitat in a significant way and conceivably affect the nightjar population. The other activities should not affect the nightjar.

a) Periodic repairs

The rated reliability of wind turbines is 98%. Nevertheless, units may be brought offline remotely via computer so that maintenance technicians can drive to the unit, ascend the tower to the nacelle to conduct repairs. This activity will be no more disruptive than biologists driving into the site to conduct surveys. It will not disturb nightjars.

b) Full replacement of turbine parts

The turbines are rated to operate 20 years, when their internal parts (generator, gear box, and other mechanical and electrical equipment) require replacement. This service is like the maintenance disruption, requiring only a flatbed truck to operate on the 5-m wide road. The parts are hoisted up to the nacelle from a winch inside the nacelle.

c) Replacement of the rotors

Rotors normally need to be replaced every 20 years. Replacing the rotors is a more intensive operation than the replacement of the turbine parts, but it is not as disruptive as the initial installation. A small crane is required to lower and hoist the 7.5-ton, 40 m (130 ft) rotor blades. This equipment requires a 5-m road width and only 100 m^2 clearing at the base of the turbine. The noise and activity of this operation is nowhere near as intensive as the initial installation. Consequently, it is unlikely to affect nightjars.

d) Replacement of the entire unit, including the tower

Wind turbine towers are rated to last a minimum of 40 years. When the towers are replaced, it makes sense to replace the entire unit, nacelle included, with the latest in wind turbine technology. This replacement would be as disruptive as the initial installation, but it would occur 40 years into the project.

Determination of Anticipated Incidental Take Levels

In order to arrive at the level of incidental take that will be authorized during the life of an Incidental Take Permit, the HCP Handbook (FWS and NMFS 1996) directs agency biologists and applicants to determine: 1) how incidental take will be calculated, 2) the level of incidental take and related impacts expected to result from the proposed project activities; and 3) the level of incidental take that the Section 10 permit will actually authorize.

In the case of the species under consideration in the WindMar project, it is important to note that no incidental take permits have been issued for them. Nevertheless, WindMar now has empirically demonstrated how the Puerto Rican Nightjar responds to site development activities, and a project has recently come on line in coastal Colombia where the Brown Pelican is the most common bird. In addition, there are more and more studies published on how birds react to wind-energy development. Most of the research is on birds of prey, but a study in Vermont recently looked specifically at wind energy's affects on forest-dwelling birds. WindMar has consulted this growing body of evidence in order to estimate incidental take levels. Our advisor, Dr. Paul Kerlinger, is thoroughly up to date on this research.

As we discuss, it is conceivable that no incidental take will result from the WindMar project. Nightjars at the WindMar site have already demonstrated that they can adapt positively to roads. No birds, including pelicans, have been recorded in mortality surveys during the first six months of operation of the Jepirachi wind-energy project in Colombia (A. Grecco, personal communication). A few species of forest nesting birds in Vermont were temporarily displaced by the construction of a wind farm on a mountain ridge, but they have apparently habituated to the presence of turbines within about five years, and avoidance/displacement in the year after construction appeared to be minimal. After the turbines were erected, several species were observed singing and foraging at the forest edge nearest the turbines. This response is quite different from the avoidance/displacement that has been demonstrated among various species of open country and grassland birds in both the United States and Europe, where birds are either slower to recolonize habitat around the turbines or may not recolonize, but long-term habituation has not been examined.

While we suspect that post-construction studies will show that the nightjar and pelican have adapted or habituated to the WindMar project, we take a conservative tack in estimating incidental take. Our main reason is the lack of precedent in predicting how nightjars, pelicans, and other threatened species will react, and be impacted by, a coastal wind-energy project, situated in a dry forest habitat. Therefore, WindMar requests an

Incidental Take Permit that will give it ample protection under Section 10 of the Endangered Species Act.

Table 10: Incidental Take Request

While, as we discuss below, it is conceivable that no incidental take will result from the proposed wind energy project, there are no precedents for accurately forecasting incidental take for any of the following species. This being the case, WindMar requests an Incidental Take Permit that gives it ample protection under Section 10 of the Endangered Species Act (ESA).

Species	Requested incidental take
Brown Pelican *Pelecanus occidentalis*	Eight (8) pelicans over the 40-year project lifespan (one pelican every 5 years); incidental take could occur if a pelican collides with a wind turbine
Roseate Tern *Sterna dougallii*	Two (2) terns over the 40-year project lifespan (one tern every 20 years); incidental take could occur if a tern collides with a wind turbine.
Puerto Rican Nightjar *Caprimulgus noctitherus*	The 12 of 46 nightjar territories that may be impacted above 6.9% by vegetation clearing activities to occur at different times during the 40-year project lifespan.
Yellow-shouldered Blackbird *Agelaius xanthomus*	No incidental take is requested because this species is unlikely to use habitats and areas where wind turbines and related infrastructure will be situated
Anolis cooki	No incidental take is requested because the project footprint will be outside this species habitat.

Incidental take of the Puerto Rican Nightjar

WindMar calculates that it will clear as much as 12.2 ha (4.9%) of the site's dry forest in order to construct its wind farm. This site work will include the creation of 1.4 km of new roads to access some turbine sites, the possible widening of 8.7 km of existing roads from 5 m to 10 m, and the clearing of twenty-five sites measuring between 840 m^2 and 2,000 m^2 to erect the wind turbines. In addition, there will be an intensive period of heavy machinery operation to erect the wind turbines.

WindMar's two-year baseline study of the nightjar (reported above) and other evidence appear to indicate that the site's nightjar population is capable of adapting to the construction and operation of a wind farm. Certainly, displacement of nightjars by the activity and effects of bulldozer work to clear vegetation appears to be much less of a concern than some biologists have expressed. In early 2004, some bulldozer work to create access roads may have overlapped with the beginning of the nightjar breeding season, but it showed no signs of displacing nightjars. Instead, birds filled in immediately along the new roads at apparently higher densities.

The concentrated activity of turbine construction, including the excavation of the turbine bases and the vibration of large cranes along the roads, could displace nightjars. But, we are reasonably confident that displacement, should it occur, would be temporary. Evidence is the apparent positive reaction of birds to the bulldozer work that took place close to the beginning of the 2004 breeding season. In addition, nightjars residing around active quarries in the Ponce area have become accustomed to the dynamite blasting and heavy machinery operation implicit in quarrying.

The operation of the turbines themselves – particularly the spinning rotors and related sound – is not likely to displace nightjars. In addition to the bulldozer and quarry examples already cited, there are: 1) the present concentration of calling birds around the wind measurement tower (a tall structure that makes noise as the wind passes through its guy wires) in the heart of the Punta Verraco peninsula; 2) recent records of nightjars residing next to industrial and commercial activities in the Ponce area, including a cement plant, hotel, and golf course (San Juan Star 2002); and 3) studies documenting habituation of forest birds to a wind-energy project in Vermont (Kerlinger 2003a).

WindMar is reasonably confident that the construction and operation of its wind farm is unlikely to result in harm to nightjars, as this word is defined in the Endangered Species Act (ESA). Harm in the ESA's definition of "take" means an act that actually kills or injures wildlife. While such an act may include significant habitat modification or degradation, it must actually kill or injure endangered species by significantly impairing essential behavior patterns, including breeding, feeding or sheltering (50 CFR 17.3). In WindMar's case, limited vegetation removal appears not to have impaired nightjar breeding or feeding. Rather, it appears to have improved them. Regarding shelter, we have documented that nightjars do not occupy all available habitat; therefore, a small reduction in dry forest should have little effect.

Nevertheless, there is a chance that the removal of vegetation for construction of the wind farm in the 1st year, replacement of the rotors in about the 20th year, and replacement of the entire turbine, including the tower, in about the 40th year may result in harm to one or more nightjars. In this regard, WindMar requests an incidental take permit for the nightjar in order to protect its project under Section 10 of the ESA.

In order to calculate incidental take of the Puerto Rican Nightjar, FWS (Edwin Muñiz letter of December 20, 2004) has encouraged WindMar to use its nightjar distribution maps to look at project effects where nightjars occur. Figure 9 (page 17) shows how the project site plan overlaps the 2004 nightjar singing territories determined by Dr. Kerlinger. Table 11 (below) shows the specific vegetation removal impact on each nightjar singing territory.

Table 11: Site Plan Overlap with 2004 Nightjar Territories

Sector	Territory Number	Territory Area (m2)	Road Impact (m2)	Turbine Impact (m2)	Total Impact (m2)	% Impact
Punta Verraco	1	39,956	1,661	2,000	3,661	9.2%
	2	33,054	-	-	-	0.0%
	3	31,616	-	-	-	0.0%
	4	25,766	523	-	523	2.0%
	5	31,841	971	2,000	2,971	9.3%
	6	35,283	-	-	-	0.0%
	7	21,425	967	2,000	2,967	13.8%
	8	36,784	-	-	-	0.0%
	9	31,482	550	-	550	1.7%
	10	23,025	-	-	-	0.0%
	11	31,149	1,181	-	1,181	3.8%
	12	39,570	-	-	-	0.0%
	13	29,100	-	-	-	0.0%
	14	32,290	1,333	-	1,333	4.1%
	15	29,513	1,426	2,000	3,426	11.6%
	16	20,616	1,155	-	1,155	5.6%
	17	16,275	847	-	847	5.2%
	18	20,311	734	-	734	3.6%
	19	32,848	1,772	-	1,772	5.4%
	20	22,674	1,019	2,000	3,019	13.3%
	21	25,883	-	-	-	0.0%
	22	26,736	972	-	972	3.6%
	23	17,039	1,361	2,000	3,361	19.7%
Cerro Toro	24	35,249	1,202	-	1,202	3.4%
	25	32,909	738	-	738	2.2%
	26	29,120	1,142	2,000	3,142	10.8%
	27	36,069	843	-	843	2.3%
	28	26,614	933	-	933	3.5%
	29	15,822	548	2,000	2,548	16.1%
Punta Ventana	30	29,846	1,022	2,000	3,022	10.1%
	31	36,394	648	-	648	1.8%
	32	30,355	1,181	-	1,181	3.9%
	33	53,498	1,350	-	1,350	2.5%
	34	31,126	728	2,000	2,728	8.8%
	35	25,599	1,314	-	1,314	5.1%
	36	38,355	1,871	2,000	3,871	10.1%
	37	40,874	1,786	-	1,786	4.4%
	38	27,088	426	-	426	1.6%
	39	48,227	476	2,000	2,476	5.1%
	40	31,876	822	-	822	2.6%
	41	32,909	261	-	261	0.8%
	42	30,968	457	-	457	1.5%
	43	34,095	-	-	-	0.0%
	44	40,052	1,722	2,000	3,722	9.3%
	45	11,698	196	-	196	1.7%
	46	31,674	-	-	-	0.0%
Total	46	1,404,655	36,138	26,000	62,138	4.4%
Average		30,536	786	565	1,351	4.4%

Based on the maximum possible impact, Table 11 shows that the average amount of dry forest habitat impacted per singing territory is 4.4%. Of the 46 singing territories identified in 2004, 10 (22%) would not be intersected by the site plan, and 19 (41%) would be intersected less than 5%. In these 19 singing territories, the intersection is generally along their edges. Nine singing territories (20%), however, would be intersected at levels between 5% and 10%, and 8 above 10%. Above 7.5%, all territories include a turbine location, the impact of which is estimated at a maximum of 2,000 m^2.

Thanks to its two-year baseline study of the nightjar population and the intervening road work, WindMar has some data that indicate how much vegetation removal a male nightjar can tolerate. Figure 5a (page 13) shows how the how access road construction in early 2004 overlapped the 2003 distribution of singing territories. Two of the Ventana territories were clearly impacted much more than the others. When calculated using GIS, singing territory # 27 was impacted 6.9% (2,835 m^2 of roads in a 41,380 m^2 territory), and # 33 was impacted 5.5% (2,460 m^2 of roads in a 44,650 m^2 territory). Both these singing territories appear to have survived the road construction (2003-27 shows up as 2004-34, and 2003-33 shows up as 2004-44). Therefore, it appears that male nightjars can handle vegetation impacts of at least 6.9%.

Given this finding, WindMar requests an incidental take permit for every territory impacted above 6.9%. This is a total of 12 territories, or 26% of the 46 nightjar territories recorded, including those mostly in the Guánica State Forest. As we argue at the beginning of this discussion, it is conceivable that no nightjar will be technically harmed by the WindMar project. But, available data only support impacts of up to 6.9%. Post-construction surveys of the nightjar population will allow WindMar to refine the estimate of nightjar tolerance to the creation of roads and clearings in essentially closed-canopy dry forest.

Incidental take of the Yellow-shouldered Blackbird

No Yellow-shouldered Blackbirds were recorded during the baseline survey summarized above. Should the species colonize the WindMar RE site during project operations, nesting and foraging activity would almost exclusively occur in the low-lying areas outside of upland areas where wind turbines and roads would be situated. Because Yellow-shouldered Blackbirds do not use the types of habitats and areas occupied by wind turbines and related infrastructure, incidental take resulting from displacement or collisions will, in all likelihood, be zero.

Incidental take of the Brown Pelican

To our knowledge, incidental take has never been calculated for the Brown Pelican for a wind-energy or communications-tower project. And, until very recently, there was no wind energy project within the normal range of the Brown Pelican.

In April 2004, however, a coastal wind-energy project came on line in northeastern Colombia where the Brown Pelican is the most common bird. The Jepirachi Wind Park (also known as the Cabo de la Vela Wind Park) is located within 200 m of the Caribbean in Colombia's La Guajira Department, between the towns of Puerto Bolivar and Cabo de la Vela. Winds at this site average an impressive 10 m/s. Initially, fifteen 1.3-MW wind turbines have been constructed for a total nameplate capacity of 19.5 MW, but more wind turbines are planned to be installed. For comparison, WindMar proposes to install 19.8 MW on Punta Verraco itself (12 turbines of 1.65 MW each). Cerro Toro will have an additional four turbines with a total nameplate capacity of 6.6 MW.

Pre-construction surveys recorded 36 bird species at the Jepirachi wind farm site and in wildlife areas up to 50 km away. The most common bird overall was the Brown Pelican (22% of all birds observed), followed by the Roseate Flamingo (12%) and Neotropical Cormorant (8%) (EEPPM 2002).

At the wind farm site itself, the pelican was the most commonly sighted bird. 47% of all birds observed at the wind farm were pelicans, including 94% of all birds observed in flight. In September 2001, the rate of pelicans flying low over the water in front of the wind farm was recorded at 162 birds/hour (EEPPM 2002). This is 40 times greater than the average pelican flight rate in front of Cerro Toro and Punta Verraco, and 27 times more than the rate of pelicans rounding the tip of the Punta Verraco peninsula in May 2004. In February 2002, during the strongest wind period, no pelicans were observed at the Jepirachi site.

Within 10 km of the Jepirachi wind farm, there is a major pelican roosting site on sea cliffs. 50 km away is the Los Flamencos Floral and Faunal Sanctuary, where pelicans frequent the coastal lagoons (EEPPM 2002).

In pre-construction studies, researchers never observed pelicans flying within the airspace of the proposed wind farm, but total observation time amounted to only 2.6 hours. All birds were observed over the water, most within a few meters of the shore. But, local residents have reported an overland flight some kilometers behind the wind farm that pelicans use to cut across the base of the Cabo de la Vela peninsula (A. Grecco, personal communication).

The Jepirachi project has been in operation for six months. During that period, no birds of any species have been recorded in mortality studies (A. Grecco, personal communication). Given the extremely high rate of pelicans flying in the vicinity of the wind farm at certain times of the year, this is a significant finding, one that indicates that pelicans moving along the shore are unaffected by coastal wind-energy projects. Most of the pelicans observed at the WindMar site exhibit such a coastal flight pattern, but even the highest recorded coastal flight rate (6.8 birds/hour in June 2003) is only 4% of Jepirachi's September 2001 flight rate.

While it is conceivable that, prior to the construction of the Jepirachi project, pelicans used to frequent the wind farm's airspace at a low frequency, this phenomenon was not recorded in 2.6 hours of observation. At the WindMar site, however, pelicans have been regularly recorded transiting the Punta Verraco peninsula and the proposed wind farm's airspace on their way between the Caribbean and Guayanilla Bay.

WindMar has found that, to enter Guayanilla Bay, where they roost and feed, pelicans use three principal routes: 1) around the tip of the peninsula (2.2 birds/hr), 2) gliding "downhill" out of the updraft elevator at Cerro Toro (the *Cerro Toro crossing*, 1.4 birds/hr), and 3) at any point across the main part of the peninsula (0.2 birds/hr, but at 0.06 birds/hr at rotor height). Departing Guayanilla Bay for the Caribbean, where they also feed, most pelicans go around the peninsula tip (3.9 birds/hr), but some birds cross the main part of the peninsula (0.1 birds/hr, 0.08 birds/hr at rotor height) and some use the Cerro Toro crossing (0.1 birds/hr).

Two of these routes – around the peninsula tip and along the Cerro Toro crossing – do not coincide with wind turbine placements. The Cerro Toro crossing is most noteworthy because the height gained out of the Cerro Toro updraft elevator and the updrafts along the southeast slope of the landform carry birds in front of what would be the line of turbines along the Cerro Toro ridge line. In addition, the orientation of the turbine rotors atop Cerro Toro will be parallel to this flight line, because of the prevailing wind direction. At the other end of the crossing, observations from the proposed location of a wind turbine in the Texaco quarry area confirm that pelicans cross behind it on their way into the bay. Again, the orientation of the rotors will be parallel to the flight line during a vast majority of the time they are operating.

We are confident that pelicans will continue to use the Cerro Toro crossing once the WindMar wind farm is constructed. The risk to pelicans will be low to none at this crossing because: 1) the crossing is aerodynamically well defined and narrow, east of the line of turbines atop Cerro Toro and west of the turbine at the base of Punta Verraco; and 2) the turbines will have their rotors almost parallel to the flight line and be plainly visible to the pelicans.

The frequency of pelicans crossing the turbine field at Punta Verraco itself is low, 0.3 birds/hr overall, with 0.1 birds/hr recorded in the rotor-zone height. Since the rotor swept area is only 16% of total area in cross-section (twelve 82-m diameter rotors, or 12 x 5,281 m^2, distributed within 200 m of height along the 2.0 km dogleg spanning the base of Punta Verraco to the peninsula tip), the number of birds in the rotor zone decreases to 0.016 birds/hour (one bird every 62.5 hours of observation, or one bird approximately every five days). Because it has been demonstrated that birds mostly recognize wind turbines as obstacles and regularly avoid flying into them, it is highly likely that collision mortality for pelicans, even within the Punta Verraco turbine field, will also be low or none.

In a letter dated March 4, 2004, Dr. Jorge Saliva, a FWS Wildlife Biologist, makes a valid point that feeding aggregations of pelicans and other seabirds attract more birds that feed on the same resource. In other words, if a group of pelicans has located a school of fish in Guayanilla Bay or in the Caribbean, their feeding behavior would attract other pelicans. It is reasonable to assume that pelicans crossing the Punta Verraco peninsula would be on the lookout for such feeding aggregations and would change their course in order to take advantage of an opportunity to feed. This action could conceivably distract birds from keeping an eye on the spinning rotors and lead to a collision.

While plausible, we believe that the collision rate from such behavior at the WindMar site is exceedingly low, if it is a factor at all. First of all, a pelican's best vantage point to assess feeding opportunities would be in the Cerro Toro updraft elevator, which conducts directly into the aerodynamically preferred Cerro Toro crossing between turbine rows. From all other coastal flight locations, except perhaps the Punta Verraco updraft elevator, pelicans cannot see over Punta Verraco and, therefore, cannot be induced to cross. Moreover, Punta Verraco is a high landform, and the turbine location on it would be quite distant from any potential feeding aggregations.

Secondly, in over 200 hours of observations, WindMar biologists have never observed a pelican make a course change after it has initiated a crossing flight, which would indicate the type of behavior Dr. Saliva is concerned about. And, while WindMar biologists have not specifically studied feeding aggregations in Guayanilla Bay, they have surveyed pelican use of the bay. In an estimated five hours of boat surveys, pelicans were always observed feeding either singly or in small dispersed groups, never in the kind of mad-dash feeding aggregations involving gulls and terns that Dr. Saliva is concerned about. In addition, local fishermen have told WindMar biologists that the sardine fishery in Guayanilla Bay has declined significantly over the decades. In other words, Guayanilla Bay no longer, or rarely, supports or attracts large enough schools of sardines and other bait fish to trigger significant feeding aggregations of birds. This is no doubt the result of the widespread degradation of coastal ecosystems in Puerto Rico.

A comparison can be made between the pelican and a bird that has been well studied at wind energy sites. This is with the Turkey Vulture. Nearly one-sixth of all May and June 2003 vulture observations at the WindMar project site were within the rotor-swept height-zone. This suggests that this species could be at risk. Nevertheless, studies conducted in the Altamont Pass Wind Resource Area of California (Orloff and Flannery 1992, 1996) and at other sites (Erickson et al. 2002) demonstrate that this species is not likely to collide with wind turbines, even with use estimates comparable or higher than found at the WindMar site. Turkey Vultures have been recorded flying among turbines for hours without colliding (Paul Kerlinger, personal observations), and only on very rare occasions have these birds have been found dead under the 5,400 wind turbines in the Altamont or elsewhere (Erickson et al. 2001). Therefore, the assessed risk for the vulture, which spends the most time of any bird in the rotor zone at the WindMar site, is estimated as low to none. Pelicans, granted, have a different flight style than Turkey Vultures, but this comparison gives some indication of the capacity birds have to avoid wind turbines.

Pelican use of the airspace in the proposed turbine field on Punta Verraco is relatively low (0.2 observations/hr, or 0.3 birds/hr of which 0.1 birds/hr fly at rotor height) when compared with studies of raptors at sites with more than 100 turbines (range of 0.4 to 1.5 observations/hr, from Erickson et al. 2002). Mortality rates for raptors, which appear to be particularly susceptible to turbine collisions, range widely, from 0.000 to 0.053 mortalities/turbine/year at sites with over 100 turbines. With 12 turbines on Punta Verraco, a high mortality rate of 0.053 mortalities per turbine per year would translate into one mortality every 1.6 years. The mortality rate for pelicans at the WindMar site would surely to be much lower, for the following reasons: 1) pelican use of the turbine field airspace on Punta Verraco is half or less than what has been documented for raptors in the studies referenced above; 2) pelicans are more likely to avoid turbines than raptors, because they do not forage over land and should be far less distracted by prey, particularly in the fish-poor waters surrounding the WindMar site (if crossing pelicans will be distracted at all); and 3) a mortality rate of 0.053 birds/turbine/year is a high value, particularly with values as low as 0.000 birds/turbine/year.

While the arguments outlined in the preceding paragraphs support Dr. Kerlinger's risk assessment of low to none for the Brown Pelican, it is difficult to predict how many, if any, pelicans will be killed by the WindMar project. The only way to know is to conduct use and mortality studies once the project has been constructed. WindMar pledges to do this because the expansion of wind power in Puerto Rico and the USVI will likely depend on how the WindMar project affects the population of the federally listed Brown Pelican and other species.

Since there are no precedents for calculating incidental take for the pelican from a coastal wind energy project, we request an Incidental Take Permit that gives WindMar ample protection under Section 10 of the Endangered Species Act (ESA). In this regard, we request an incidental take of eight (8) pelicans over the forty-year lifespan of the WindMar project, or one pelican every five years.

Incidental take of the Roseate Tern

As noted above, we did not record Roseate Tern during the flight-use study, nor have other observers recorded the bird during field trips to the site over the last five years. FWS, however, has recorded Roseate Terns nesting on Cayo Guayanilla, the small coral islet 600 m south of the Punta Verraco peninsula (Saliva 1993 and Jorge Saliva personal communication), in four of the last fourteen years. These years were: 1994 (200 pairs), 1995 (17 pairs), 1998 (1 pair), and 1999 (1 pair). Clearly, Roseate Tern is an uncommon nesting species in Guayanilla Bay in the past decade. On only one recorded occasion have breeders numbered in the hundreds of birds.

At best, the Roseate Tern is an occasional nesting species in the vicinity of the WindMar project site, perhaps nesting in the hundreds on Cayo Guayanilla once every ten or twenty years. Its congeners, the Royal and Sandwich terns, were observed during the flight-use study, but in every case they were observed low over the water at a distance from the peninsula. No tern was observed transiting the peninsula during the flight-use study.

It is not inconceivable that Roseate Tern could transit the rotor zone, but our baseline study indicates that it is highly unlikely. Nevertheless, in order to give WindMar ample protection under Section 10 of the ESA, we request an incidental take permit for one Roseate Tern every twenty years.

***Incidental take of* Anolis cooki**

We have documented that *Anolis cooki* occurs at the WindMar site in sunny, open habitats with exposed rocky substrate along the immediate coast and near cliff edges. Inside closed-canopy dry forest, it is replaced by the common *Anolis cristatellus* (Richard Thomas 2004; see Appendix IX). Since we will construct no wind turbines or access roads in the habitat zone of *cooki*, there will be no incidental take of this species. In fact, the lower line of turbine bases along Punta Verraco may prove to be ideal *cooki* habitat and attract the species, particularly if we landscape the turbine bases as rock gardens and plant the typical shrubby plants of its habitat zone. In this regard, we would likely be increasing *cooki* habitat on the site.

Section 7 Consultation

A Section 7 consultation is the responsibility of FWS, but the applicant is encouraged to address these considerations in the HCP. Section 7 consultation ensures that “any action authorized, funded, or carried out by a Federal agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction of adverse modification” of designated critical habitat (FWS and NMFS 1996).

The applicant firmly believes that, even without mitigation actions to counterbalance the requested incidental take, the project will not impact populations of the Puerto Rican Nightjar, Brown Pelican, or Roseate Tern in a biologically significant way. The WindMar project, either directly or indirectly, or through cumulative impacts, will not jeopardize any of these species. In fact, as described below, some of the indirect effects of this project will be beneficial to some of the species in question, and for other endangered and wildlife species.

Puerto Rican Nightjar

All indications are that the Puerto Rican Nightjar is expanding its range rapidly as areas released from agriculture over the past fifty years have succeeded into dry forest habitat. For example, nightjars have been recorded to the west in the Parguera Hills and the Sierra Bermeja (Collar et al. 1992), and to the east in Ponce, around a cement plant, hotel, and golf course to the west of the city (San Juan Star 2002). WindMar biologists have recorded high densities of singing male nightjars around active quarries below the Cerrillos Reservoir in eastern Ponce, and one bird was heard and seen in eastern Juana Díaz near the border with Coamo. It is highly likely that the nightjar’s range now extends to Coamo and even Guayama. In addition, WindMar’s data indicate that nightjar numbers in areas where it was previously recorded have increased substantially (see Table 1, page 4).

It is conceivable that this range expansion and density increase have already resulted in the nightjar having surpassed the number of pairs targeted by FWS for the recovery of the species (Díaz 1984). This suggestion is based on the availability of seemingly suitable habitat along the southern coast of Puerto Rico within the historical nightjar range. No comprehensive or even informal surveys have been conducted in more than a decade to evaluate the nightjar’s status, however.

The incidental take requested by WindMar will have an insignificant effect on the total nightjar population, and it will certainly not jeopardize the continued existence of the nightjar in Puerto Rico, or even at the WindMar site. No critical habitat has been designated for this species. On the contrary, the nightjar appears to be more of a habitat generalist than previously believed, responds positively to some habitat modification (i.e., introduction of edge habitat into continuous dry forest), and seems to be expanding geographically as a diversity of habitats becomes suitable and forested areas return to Puerto Rico.

Brown Pelican

The situation with the Brown Pelican is much different than that with the nightjar. While indicators show the nightjar heading in the positive direction of full recovery, the indicators for the pelican are clearly heading in the opposite direction. Population levels decreased 74% from 2,289 wintering individuals in 1980-1982 to 593 wintering individuals in 1992-1995. Mean young per successful nest was lower as well, down 31%, from 1.65 in 1980-82 to 1.14 in 1992-93 (Collazo and Klaas 1986, Collazo et al. 1998).

Contaminants, which decimated continental populations, continue to be ruled out as a causative factor in the Caribbean. Collazo et al. (1998) owe the Caribbean decrease to two main factors: 1) the effect of widespread coastal degradation on pelican feeding habitats, and 2) human disturbance and the loss and degradation of roosting and nesting habitat. They conclude that their findings underscore "the need for long-term data (i.e., over six to eight years) to define a range of acceptable population parameter fluctuations for Caribbean pelicans" (Collazo et al. 1998). Nevertheless, to WindMar's knowledge, there are no research programs underway to collect this data.

In order to assess if the granting of an incidental take permit of one pelican every five years would be likely to jeopardize the continued existence of the Caribbean Brown Pelican, WindMar contracted Dr. Chris Elphick, a population biologist at the University of Connecticut at Storrs, to conduct a Population Viability Assessment (PVA). Elphick attracted WindMar's attention because he had conducted a PVA on the endangered Hawaiian Stilt (*Himantopus mexicanus knudseni*), another island archipelago species. This PVA showed that the Hawaiian Stilt was likely to increase and fill available habitat, but downlisting was not warranted because wetland management and predator control are necessary for the population's persistence (Reed, Elphick & Oring 1998).

Elphick's full report on the pelican can be found in Appendix XI. In summary, he and his team created a population model for the pelican population in Puerto Rico and the US Virgin Islands and used the model to predict population dynamics under a variety of scenarios. Under the estimated current conditions, the model predicts that the pelican population will decrease rapidly and approach extinction within a few decades. Although limited data were available for testing this prediction, the available published data closely match the model's qualitative predictions, although they suggest that the rate of decline in the model is slightly greater than in the real population.

Elphick then used the model to determine whether additional pelican mortality due to the proposed WindMar wind farm is likely to exacerbate the population's decline. He examined five scenarios, with differing levels of mortality, derived from an early draft of this Habitat Conservation Plan and from Kerlinger's risk assessment (see Appendix VIII). Three of these scenarios assessed mortality at requested incidental take levels (one pelican every five years). The other two looked at mortalities above the incidental take request.

Under all but one scenario, the rate of decline was statistically significantly higher than in the basic model, but the magnitude of the difference was very small and probably not biologically significant, even under the two increased mortality scenarios. The one scenario that was not statistically significantly higher was the one that most likely matches local conditions – where additional mortality would be linked to the size of the population in the vicinity of the WindMar site (Scenario 2), not to the total population. In this scenario, Elphick used a local population figure of 100 individuals derived from WindMar's highest census in November 2003. But other censuses WindMar has conducted indicate that local pelican numbers are usually below 50 individuals. If the typical number of birds present at the site is lower than 100, then this scenario over-estimates the impact of the turbines, which was statistically insignificant to begin.

These results suggest that the Caribbean Brown Pelican is likely to be heading toward extinction under current conditions. Assuming that additional mortality does not greatly exceed that requested for an Incidental Take Permit, the model suggests that the installation of wind turbines near Guayanilla Bay will have only a minor effect on the pelican population.

Elphick also conducted a sensitivity analysis to determine whether his results are robust to potential errors in the parameter value estimates. He found that for all of the variables considered, only large errors would result in different conclusions, suggesting that the general findings are likely to be accurate. He also found that the population trajectory is more sensitive to survival parameters that to breeding parameters. Based on the model, increasing the size of the pelican population will not be possible without an increase in the survival of birds after they have fledged. Improved nest productivity might also be necessary, but it is unlikely to be sufficient to attain population increases.

In order to refine the model's results, research is needed that would provide better information about pelican survival. In addition, information about the movements of individual pelicans throughout the population would allow one to evaluate details of the model's structure more thoroughly.

The Elphick report paints a bleak picture for the Puerto Rico and USVI population of the Caribbean Brown Pelican. If survival of juvenile and adult birds is essential for reversing the pelican's downward population trend, then ecosystem-level changes that restore fish populations are probably in order. This is a tall order, given the impact of nearly four million people on Puerto Rico's marine ecosystems.

In conclusion, the Elphick study demonstrates that, should FWS grant the Incidental Take Permit that WindMar is requesting, this action is not likely to jeopardize the continued existence of the endangered Caribbean Brown Pelican. Mortality at the incidental take levels will not be biologically significant, even when added to larger factors that are driving the local Brown Pelican population to extinction. Furthermore, as the pelican population decreases, the species' frequency at the WindMar site, and its potential for colliding with wind turbines, will also decrease. The chance of pelican collisions may well decrease to zero within twenty years of the initiation of the WindMar project.

If anything is to be done for the pelican that restores marine ecosystems and fish populations, a reorientation of Puerto Rican society toward sustainable development is required. One of the aspects of this reorientation will certainly be a conversion to renewable energy sources, such as the WindMar project is pioneering.

Roseate Tern

Despite the fact that the Roseate Tern is an uncommon nesting species around the WindMar site and is unlikely to transit the turbine field on Punta Verraco (given the flight-use behavior of other terns, which has been well studied), surprising things can happen. In order to protect the WindMar project amply under the ESA, we are requesting an incidental take permit for one Roseate Tern every 20 years. Nevertheless, we anticipate that no Roseate Terns will be harmed as a result of the WindMar project, even if Cayo Guayanilla again becomes suitable as a nesting site.

Incidental take of one Roseate Tern every 20 years (0.05 birds/year) would be biologically insignificant and not jeopardize the population's continued existence. The principal reason is that the loss of 0.05 birds/year would not affect the population in a statistically significant way, given the population's reproductive output. Between 3,000 and 6,000 Roseate Tern pairs nest in the Caribbean region, including hundreds of pairs in Puerto Rico (Saliva 1993). In Puerto Rico, the largest and most reliable nesting colony is located off La Parguera, which is located about 10 km from the WindMar site. This colony registered a 45% fledging rate in the early 1990's (Saliva 1993).

It is likely that the La Parguera colony will be unaffected by the WindMar project, because La Parguera birds apparently do not forage around Punta Verraco. In three years of observation, WindMar has not recorded a single Roseate Tern in the waters around the site. This indicates that La Parguera birds don't forage in and around Guayanilla Bay.

Indirect Project Effects

WindMar understands that, in some cases, the development activities being considered in an HCP may result in indirect effects to listed species. According to the HCP Handbook (FWS and NMFS 1996), indirect effects are "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." The concern is that indirect effects may ultimately jeopardize a species.

In the case of the WindMar project, many of the indirect effects are positive, accruing benefits not only to the species being considered in this HCP but to all wildlife and their habitats in Puerto Rico.

The 41.3 MW wind farm that WindMar is proposing for the project site will replace the need to burn fossil fuels to generate the electricity for 23,000 households, thereby reducing pollution from greenhouse gases (implicated in global warming, ozone depletion, and acid rain) and from heavy metals and other noxious substances that are currently being blamed for reductions in birds, other wildlife populations, and their habitats. The annual avoided emissions for some pollutants from the WindMar project are displayed below.

Pollutant	Annual Avoided Emissions
CO_2	82,500 tons
SO_X	900 tons
NO_X	250 tons

It is interesting to note that the amount of CO_2 emissions avoided by the WindMar project would be equivalent to the amount of CO_2 that an 11,000-hectare (27,500-acre) dry forest would sequester every year.

The electricity produced by the WindMar project would also reduce the need to extract and transport petroleum, the main fuel used to generate electricity in Puerto Rico. Currently, PREPA imports 32,000,000 barrels of oil per year to Puerto Rico and stores 3,400,000 barrels in Guayanilla. According to PREPA (2003), one barrel of oil yields about 580 kWh of electricity. WindMar's electricity production, therefore, would decrease oil demand by 190,000 barrels annually, slightly reducing the threat of oil spills that can have disastrous effects on wildlife, particularly endangered species such as the Brown Pelican and Roseate Tern. Both these species have been severely impacted by oil spills in North America in recent years. In 2003, for example, in Buzzard's Bay off Cape Cod, Massachusetts, a small spill of oil bound for an electric generating plant on Cape Cod resulted in the hazing off of an entire colony of endangered Piping Plovers and Roseate Terns, and the probable loss of a large proportion of one year's breeding input from the colony (Paul Kerlinger, personal communication). This relatively small oil spill also killed hundreds of birds, including loons, seaducks, and other birds (including direct oiling of Piping Plovers that may have been lethal).

Downwind and down current from the treacherous entrance to Guayanilla Bay is a national wildlife refuge at Cabo Rojo. It is always at risk from tankers that regularly enter and leave Guayanilla Bay to deliver petroleum for the Guayanilla and Peñuelas refineries and fuel storage tanks. In the late 1960's, a tanker did run aground, and the resulting spill did severely impact coastal wildlife habitat around Cabo Rojo, where evidence of this spill can still be found.

These indirect benefits will have a net positive effect on wildlife and wildlife habitat over a large geographic area, including globally. They will also accrue incrementally over the years. Moreover, these indirect benefits may be magnified many times when one considers that the WindMar project, should it proceed, will be Puerto Rico's first commercial-scale wind power project. It will no doubt open the door for other wind power projects on the island. This could mean that many thousands of megawatts of wind power capacity could be installed in Puerto Rico, both onshore and offshore, over the next twenty years. Some countries – Denmark is the most notable example – have made a heavy investment in wind power and now generate as much as 15% of their national electricity need from this power source. This could easily occur in Puerto Rico, which has much better wind than most countries.

It cannot be denied that large-scale wind development in Puerto Rico will impact wildlife. But, as we have demonstrated in our incidental take calculations, these impacts will be small on a site-by-site basis. The major concern will be cumulative impacts of large-scale wind energy development on the Brown Pelican, should it escape extinction, but this will be addressed by post-construction use and mortality studies at the WindMar site.

Comparing these impacts with the benefits of a more significant decrease in greenhouse gas production, in other emissions, and in the threat of oil spills, the benefits to wildlife clearly outweigh the costs. For example, the planet is presently facing the threat of global warming as a result of fossil fuel consumption. It is highly likely that global warming will raise sea level and drown productive coastal wildlife habitat on a global scale, kill coral reefs on a global scale, eliminate pelican and tern nesting habitat, and change weather patterns, affecting species and habitats worldwide (McKibben 2003). While we agree that increased production of clean, renewable energy will not solve global warming on its own, it will play a highly significant role.

In addition, secure domestic energy sources, such as wind power, decrease the need to militarily protect vital national interests abroad. There is nothing more damaging to natural habitats in the short term than wars, particularly in areas where oil and gas wells and pipelines are the targets of military and terrorist operations. The conflict in Kuwait and the present conflict in Iraq are cases in point. The impact of oil spills resulting from the first Gulf War on the vast populations of Palearctic nesting species that migrate through the Middle East to Africa has still not yet been determined.

Regarding possible indirect impacts on the nightjar, FWS has brought to WindMar's attention the following concerns (FWS Office of Law Enforcement 2004):

- Modification of habitat conditions
- Loss of suitable nesting habitat for current and future breeding populations
- Invasion of exotic species that may degrade habitat suitability and may increase the possibility of fires
- Development of open corridors for predators such as mongooses, cats, and Short-eared Owls

As discussed above, our 2004 data strongly suggest that we have improved habitat conditions for nightjars. While a small fraction of dry forest has been removed, this loss appears to have benefited current and future breeding populations by providing better habitat in which to forage. Capture rates of insects would likely be better along roads than within the thick forest cover.

The possibility of invasion by exotic plant species is low for a number of reasons: 1) our experience shows that the rootstocks of the native species that were cleared produce new shoots that revegetate the edges quickly. 2) The likeliest species to colonize roadside edges are native opportunistic species, such as *Croton betulinus, Croton discolor*, *Krameria ixine*, *Lantana involucrata*, *Leucaena leucocephala,* and *Turnera diffusa*, for which there are abundant seed sources in the surrounding forest. 3) Guinea Grass (*Panicum maximum*), the principal concern, and another introduced grass, *Tricolina repens*, need some soil for establishment. Generally, the predominant substrate throughout the WindMar site is exposed limestone bedrock, which is not favorable for the establishment of these species. And, 4) these exotic grasses are easily managed with low concentrations of systemic, biodegradable herbicides, such as Round Up, which kill the plants.

A critical point, however, is that the roads themselves serve as fire brakes, thereby preventing or limiting the potential spread of fires. These new fire brakes are most important at Punta Ventana, where the forest is continuous with the Guánica State Forest and no fire brakes previously existed

Regarding predators, in their study of the Small Indian Mongoose (*Herpestes auropunctatus*) during the 1987 nightjar breeding season, Vilella and Zwank (1993b) found that the mongoose is not abundant in the Guánica State Forest, which is adjacent to the WindMar site. Nevertheless, the mongoose is most numerous at the forest's lower elevations, a distribution that Vilella and Zwank surmised probably reflects its preference for open grasslands and savannas with nearby sources of water. An inverse relationship between nightjar and mongoose numbers has led Vilella and Zwank to hypothesize that differences in habitat requirements restrict range overlap in these species, rather than mongoose predation eliminating nightjars from certain habitats. They also found that the fecal content of 34 mongooses consisted primarily of orthopterans, coleopterans, and centipedes, with no signs of avian prey (but they did see two mongooses carry off two open-country birds – a grackle and ground-dove). Moreover, in highly disturbed forested lands in the Guayanilla Hills, where streams, grazing lands, and agriculture would allow for dense mongoose numbers, they found the nightjar population able to maintain itself, although in smaller numbers. The smaller numbers in those areas may have been attributable to less than optimal habitat rather than to the presence of mongoose.

These findings suggest that the mongoose does not pose a high predation threat to the nightjar, particularly in dry forest habitat. Regarding open corridors increasing this threat, it should be noted that Vilella and Zwank set their trap lines along established roads and trails similar to the ones on the WindMar site. Fecal contents from mongoose trapped along open corridors showed no sign of nightjar predation, despite the fact that Vilella and Zwank's study took place in an area of high nightjar density at the height of the 1987 nightjar breeding season, when nestlings and fledgling nightjars would be at risk. Nevertheless, one (4%) of the twenty-three nightjar nests Vilella studies failed because of feral cat or mongoose predation, but this may have been caused by the predator following in a researcher's trail from the afternoon before. In addition, while WindMar biologists have observed mongoose and cats in the flat, grassy lowland sections of the WindMar site, we have not yet recorded them in the dry forest sections, despite many hours of observation. These findings lead us to believe that road networks can significantly increase nightjar density and reproductive output without a significant increase in mammalian predation.

Despite the fact that Vilella once witnessed a Short-eared Owl capture a juvenile nightjar that flew across a trail (Vilella 1989, 1995), nightjar predation by the Short-eared Owl is incidental and does not constitute a significant indirect effect. The owl is an open-country predator, where the bird's moth-like hovering flight allows it to surprise small rodents on the ground. Its population exploded in Cuba and Puerto Rico as a result of the intensive clearing of forests for sugar cane production (Orlando Garrido, personal communication).

WindMar has recorded the Short-eared Owl on numerous occasions at Punta Verraco, where at least one pair may regularly nest. We suspect these birds use Punta Verraco for nesting because the rats that would prey on eggs and nestlings on the ground in pasture and marshy habitats cannot maintain populations in dry forest. While Punta Verraco has both a resident pair of Short-eared Owls and a well developed road network, it also has the highest nightjar density of the entire site and it has the highest reported density of any site yet studied. This leads to a conclusion that Short-eared Owl predation on nightjars is not biologically significant.

While it is possible that other Short-eared Owls may nest along isolated new roads at the WindMar site, it is likely that they will spend most of their time foraging in the more productive open habitats for which they are adapted. Occasionally, they may take a nightjar, but as the Punta Verraco case points out, this predation will likely not affect population levels.

Regarding the Brown Pelican, the restoration of mangrove habitat along the access causeway could conceivably draw more pelicans to roost behind Cerro Toro. This is unlikely to increase risk of rotor collisions for two reasons: 1) Pelicans will continue to take advantage of the Cerro Toro crossing, which requires no effort to move between the

Caribbean and Guayanilla Bay and avoids turbine placements. 2) Just after dawn, when there is normally little wind, pelicans have been observed on occasion crossing behind Cerro Toro over the degraded mangrove area to reach the Caribbean (Alfonso Silva, personal communication). This flight pattern also avoids turbine placements. Should pelicans roost in this mangrove area, they would likely depart it using this route.

Regarding indirect human impacts, wind energy development in Guayanilla is unlikely to result in more development that would increase human population densities. First of all, the WindMar project would preclude the development of over 350 residences on 290 ha presently zoned R-0 adjacent to the Guánica State Forest. Second, energy produced in southern Puerto Rico is mostly consumed in the more densely populated north of the island.

Interestingly, where wind energy could have a significant indirect effect on endangered species and other wildlife would be as a tourist attraction. If access were left uncontrolled, human visitation to the WindMar site would no doubt increase significantly and could adversely impact wildlife populations. But, this negative scenario can easily be turned into a positive one that benefits wildlife. By controlling access and providing environmental education, the WindMar project can increase understanding of wildlife's needs and rally support for a sustainable industrial development strategy that would have an enormous beneficial effect on wildlife in Puerto Rico and beyond.

Consideration of Plants in the HCP and Permit

According to the HCP handbook, Section 9(a)(2)(B) of the ESA prohibits the removal of listed plants or the malicious damage of such plants on non-Federal areas in violation of state law or regulation.

An exhaustive botanical inventory of the WindMar project footprint and other areas has uncovered none of the listed plants indicated by FWS (Díaz 2003). With regard to the Commonwealth of Puerto Rico's list of threatened plants, we have found one species, *Stahlia monosperma*, a tree that grows in coastal freshwater wetlands. Botanists have found a grove of *Stahlia* far outside the wind project's footprint, in a swamp at the base of the large eastward facing ravine of Punta Ventana.

Rather than threaten such plants, the WindMar project will clearly benefit them. As part of our mitigation plan, WindMar will seek permits to propagate listed, rare, and endemic plant species to revegetate the abandoned quarry site. One of the techniques Dr. Areces proposes to use is tissue culture to clone such inbred and highly rare species as *Trichilia*, *Ottoschulzia*, and *Mitracarpus*. This way, WindMar would promote the survival of these species by establishing safety-net populations on its site.

Addressing Effects on Critical Habitat

The HCP Handbook (FWS and NMFS 1996) directs applicants for Incidental Take Permits to address the effects their projects may have on designated critical habitat for federally listed species. In the case of this HCP, no critical habitat has been designated for any of the species in question.

II. Measures the applicant will undertake to monitor, minimize, and mitigate such impacts; the funding that will be made available to undertake such measures; and the procedures to deal with unforeseen circumstances

The biological goal of this HCP is to minimize and mitigate potential impacts to the Brown Pelican, Roseate Tern, and Puerto Rican Nightjar from the lawful construction of WindMar's wind farm. The wind farm itself will reduce environmental contamination, and its effects on wildlife, by meeting a portion of Puerto Rico's electricity needs with clean, renewable energy. The biological objectives of this HCP are: 1) achieve no net loss of nightjar singing territories, 2) provide information on pelican survival and movements in order to improve understanding of the bird's population trends and management needs, and 3) protect in perpetuity a large portion of a private, partially degraded coastal property adjacent to the Guánica State Forest.

Mitigation Actions to be Undertaken

WindMar believes that the following mitigation plan more than compensates for the incidental take we are requesting, should incidental take occur at those levels. Included in this plan are the significant, indirect beneficial effects that the project will accrue for both natural and human communities.

The scope and generosity of this mitigation plan results from the deep, abiding interest WindMar's principal, Victor L. Gonzalez, has in conservation and sustainable development. He firmly believes that, with this mitigation plan, the wind energy project WindMar is proposing is, without question, good for Puerto Rico, good for the environment, good for endangered species, and appropriately sited on land WindMar owns adjacent to the Guánica State Forest.

According to the HCP Handbook, mitigation actions under HCPs usually take one of the following forms: 1) avoiding the impact (to the extent practicable), 2) minimizing the impact, 3) rectifying the impact, 4) reducing or eliminating the impact over time, or 5) compensating for the impact.

Avoidance

1) Rezoning the property in order to develop a wind farm

The worst scenario for the WindMar site would be to develop it at its current zoning – R-0, single-family residences on two-acre lots. This zoning would allow up to 360 houses, but even a fraction of that number would likely have a disastrous effect on wildlife and its habitats, both on the WindMar site and in the adjacent Guánica State Forest. Impacts would include significant loss of dry forest on the WindMar site, a significant decrease in local populations of nightjars and other dry forest species, increased human-related activity, including dog and cat predation on wildlife, effects of pesticide and herbicide applications on adjacent habitat, noise pollution, etc.

Development of a wind farm with a 2% project footprint (after implementation of its mitigation plan) would preclude the residential development option and accrue significant benefits to wildlife, ecosystems, and the people of Puerto Rico.

2) Using wind to generate electricity

As explained in the section on indirect project effects, generating 110,000,000 kWh of electricity annually from the wind will avoid emission of 83,500 tons of greenhouse and toxic gases, avoid consumption of 47,200,000 gallons of water that would be used to generate electricity by traditional means, and reduce the threat of oil spills to wildlife through a slight reduction in oil imports.

3) Clearing vegetation outside of the nightjar nesting season, and using competent biologists to search for nightjar nests should vegetation need to be cleared during the nesting season

Nightjars may be harmed by habitat removal, but not by the actual construction of wind turbines. In this regard, WindMar will make every effort to conduct habitat removal activities (clearing of roads and construction sites) outside of the nightjar nesting season, following Vilella's nesting dates of February 24 to July 1 (Vilella 1995).

Nevertheless, in order for WindMar to limit vegetation removal (to road widths of 5 m and turbine construction areas of 840 m^2), occasions may arise where some additional vegetation may need to be removed during the nightjar nesting season (for example, if a particular curve proves too tight for turbine deliveries). In these events, WindMar will use competent biologists to search for nightjar nests prior to habitat removal during the nightjar nesting season. In the event a nest is found, WindMar will avoid it by redesigning the road or construction area, or by delaying the activity until the nightjar the nightjar fledges its young.

Minimization

WindMar will minimize the project's impact on nightjar habitat and on pelican use of the wind farm airspace in a number of ways, as described below.

1) Making use of existing roads

Our site plan calls for twenty-five 1.65 MW turbines distributed over the 290 ha WindMar property. Approximately 10.1 km of roads are required to construct and maintain such a wind farm. WindMar, however, has sited the project to take advantage of 8.7 km of existing roads, even though the power-generating efficiency of the project using these roads may be less. Although the existing roads would be widened from 4m to 10m, using existing roads decreases the project's road construction impacts to nightjar habitat by 37%.

Table 12: Summary of Mitigation Plan Benefits

(Implementation schedule in brackets)

Activities	Benefits
Avoidance	
1) Rezoning property in order to develop a wind farm (Year 1)	Avoids current R-0 zoning that would allow the construction of up to 360 single-family residences; this development option would devastate the site's dry forest ecosystem and significantly impact the adjoining Guánica State Forest
2) Using the wind to generate electricity (Years 1 to 40)	Avoids 83,500 tons of greenhouse and toxic emissions annually; avoids the consumption of 47,200,000 gallons of water annually that would be used to generate 110,000,000 kWh by traditional means; reduces the threat of oil spills to wildlife through a slight reduction in oil imports
3) Clearing vegetation outside of the nightjar nesting season; using competent biologists to search for nightjar nests should vegetation need to be cleared during the nesting season (Year 1)	Avoids harming nesting nightjars
Minimization	
1) Making use of existing roads (Year 1)	Decreases construction impacts by 37%
2) Using fewer, larger turbines (Year 1)	Decreases project footprint
Rectification	
1) Restoring at least 2.6 hectares of abandoned Texaco quarry (Years 1 to 15)	Fills in habitat in an area that can support more nightjar territories; compensates for 21% of dry forest habitat lost to construction; provides habitat with a structure preferred by nightjars
2) Allowing recovery of most vegetation affected by site development (Years 1 to 40)	Allows regeneration of 87% of habitat affected by construction
3) Restoring 10-hectare mangrove area by improving drainage (Years 1 and 2)	Restores nursery habitat for fish on which pelicans feed and improves the health of Guayanilla Bay
4) Research/monitoring program (Years 1 to 40)	Evaluates project impacts and mitigation plan benefits; identifies unforeseen consequences, if any
Reduction	
1) Painting rotor blades to make them more noticeable to birds (Year 1)	Reduces bird collisions with spinning rotors;
2) Predator control program (Years 1 to 40)	Reduces predation pressure on nightjar, *Anolis cooki*, and other native wildlife
3) Establishing roads as fire brakes (Year 1)	Reduces fire threat to nightjar and its habitat
4) Environmental education program (Years 1 to 40)	Reduces public ignorance of issues affecting endangered species and their habitats
5) Meeting APLIC guidelines (Year 1)	Reduces threat of collisions and electrocutions at power transmission lines
Compensation	
1) Conservation easement on 245 ha (85%) of WindMar site (Year 1)	Increases protection status of land adjacent to Guánica Dry Forest
2) Supporting research on Brown Pelican (Years 1 to 5)	Provides essential information to promote recovery of Brown Pelican

2) Using fewer, larger turbines

In developing the site plan over the last three years, WindMar has analyzed a number of turbine options, ranging from 600 KW machines to 3.0 MW machines. While the smaller machines are proven performers, they call for more turbines (e.g., sixty-six 900 KW turbines would be required) and a greater area of roads and turbine construction areas. In this regard, projects with smaller turbines would affect more nightjar habitat. They would also pose a greater challenge to Brown Pelicans, as the cross-sectional area of the project site inhabited by rotor blades would increase.

We are presently opting for 1.65 MW turbines because of their proven performance. This option requires 25 turbines, and the calculations in this HCP are based on this design. Nevertheless, even larger turbines have begun to come on line, but at this point in time their design has not been proven. Please see the discussion of 3.0 MW turbines in the Alternatives Analyzed section.

Rectification

WindMar proposes a number of rectification activities. These activities will benefit Puerto Rican Nightjars by restoring, and improving the quality of, their habitat. They will also benefit the Brown Pelican by improving the bird's foraging habitat in Guayanilla Bay.

1) Restoring at least 2.6 ha of the 3.1-ha Texaco quarry

WindMar will restore at least 2.6 ha of the 3.1-ha quarry area at the base of Punta Verraco with dry forest vegetation. This activity will rectify 21% of the dry forest lost due to construction impacts. When combined with the dry forest recovered by allowing the road margins and turbine construction areas to grow back, the total restoration of dry forest habitat will amount to 108% of the habitat impacted by the project.

We believe, however, that the quarry restoration will do more to benefit the site's nightjar population than a simple measure of the habitat restored. This restoration will fill in a key habitat gap at the base of the Verraco peninsula, allowing nightjars to establish territories in an area that is presently too fragmented for viable territories to be established. This restoration may allow for two or more additional nightjar territories, once dry forest with good structure has been established.

It is likely that WindMar will restore more than 2.6 ha, as the project office/scientific research station, including the parking area, will likely occupy less than the 5,000 m^2 (0.5 ha) (see page 53).

Please see the reforestation plan in Appendix XII.

2) Clearing vegetation in a way that allows it to recover

WindMar will clear new roads and clear the turbine construction areas in a way that allows their dry forest vegetation to recover. We will use small to midsize bulldozers to scrape the vegetation at the surface, leaving the rootstalks intact. Our experience shows that this technique results in a vigorous regrowth of the preexisting vegetation.

As already noted, the coppice pattern of growth of many dry forest trees on the site demonstrates that the vegetation can recover from being cut back to the rootstock. In fact, large sections of this dry forest have been cut back to ground level more than once during the 200 years when this area was intensely exploited by the sugar industry.

Allowing the regrowth of road edges, turning areas, staging areas, turbine construction areas, and rotor construction areas will recover 87% of the total construction impact to the dry forest habitat.

3) Restoring 10-hectare mangrove area by improving drainage

WindMar will restore the 10-hectare mangrove area destroyed by the construction of the causeway to Punta Verraco and subsequent silting in of its culverts. We will do so by constructing a series of bridges, or by adding a number of large culverts, along the causeway to reestablish tidal flushing of the ecosystem. We will also collect Black Mangrove seedlings and plant them in the mud in order to hasten the area's restoration.

This restoration will likely improve foraging habitat for the endangered Brown Pelican and threatened Roseate Tern. During the November 2003 pelican census, we noted that the mangroves fringing Guayanilla Bay close to this degraded area were poor in structure. We expect that once tidal flow is reestablished, an area of mangroves much larger than 10 hectares will benefit from this activity.

4) Research/monitoring program

WindMar will facilitate the monitoring of project impacts and their mitigation and promote scientific research of the site's and region's ecosystems by providing lodging and work space for staff and visiting researchers in a building to be constructed in the quarry area. This building will also house staff to monitor and maintain the wind farm. This two-story building, including parking, will occupy no more than 5,000 m^2, and may occupy significantly less quarry area, depending on final design. It will have five offices and a conference room, plus twelve bedrooms, kitchen facilities, and parking.

The research and monitoring program WindMar will implement will help to identify unforeseen consequences of the project, should there be any. Please see the discussion below on monitoring measures.

Reduction

WindMar plans to reduce project impacts and natural pressures on the nightjar, pelican, other species and their habitats through the following measures:

1) Painting rotor blades to make them more visible to birds

Research appears to demonstrate that, when the distal end of one rotor blade is painted with a visible pattern, birds are more likely to avoid the rotor. When WindMar is ready to erect the wind turbines, we will consult with Dr. Kerlinger on the tip pattern that appears to be most effective in promoting bird avoidance and paint the blades, either one or all, accordingly.

For the record, Dr. Jorge Saliva, a FWS Wildlife Biologist, has suggested two additional avoidance measures, but WindMar has concluded that they are not warranted. One is using pointed tops on the wind turbine nacelles to discourage perching. WindMar's expert, Dr. Paul Kerlinger, advises us that birds rarely attempt to perch on the aerodynamically smooth tops of modern wind turbines, and when they do they are not successful. Therefore, there is insufficient reason to redesign the nacelle.

The other suggestion is shutting down the wind turbines when more than twenty pelicans are foraging in Guayanilla Bay. The concern is that pelicans crossing Punta Verraco will be distracted by these feeding aggregations and may collide with rotors. WindMar addresses the distraction theory above. Nevertheless, the wind-energy industry has never adopted a shutdown policy because there have been no situations where it has been necessary. Shutdowns must be justified by demonstrated risk, with empirical evidence of significant fatalities, not implemented simply on a hunch of a wildlife agency.

2) Predator control

WindMar will institute a permanent program to trap mongoose, rats, and feral animals on the site in order to decrease predation pressure on the Puerto Rican Nightjar, *Anolis cooki*, and other native animals. Trap lines will be maintained and checked regularly by staff researchers.

Mongoose is commonly seen in the site's low areas, particularly behind the Ventana Beach, between Cerro Toro and Punta Ventana. We assume that the mongoose and other introduced predators make forays into the dry forest and exert some predation pressure on the nightjar. To document predator abundance, the trapping program will collect baseline data as the first step. Subsequently, it will record seasonal fluctuations in predator immigration to the area.

We will establish trap lines in a number of areas, including on the WindMar property's border with the Guánica State Forest and with the mango plantation. By reducing mongoose immigration from the Yauco River floodplain, the predator control program will benefit the nightjar population in the Guánica State Forest as well.

3) Establishing roads as fire brakes

The access roads to the wind turbine sites will serve as fire brakes, thereby decreasing the threat of fire to the nightjar and its habitat. WindMar will keep these roads clear in order to decrease the threat of the spread of fire.

4) Environmental education program

The WindMar project will draw people interested in seeing wind turbines up close. WindMar will use this opportunity to educate visitors about renewable energy and the plants and wildlife of southwest Puerto Rico. We will do so by controlling site access, scheduling visiting hours, and leading visitors on regularly scheduled tours. We will also produce a brochure to be handed out in schools, community centers, and hotels.

WindMar will also finance environmental education projects in surrounding communities. One priority project will be to educate residents and tourists about the marine environment and the measures required to improve its health. This project will focus on the plight of the Brown Pelican.

In addition, WindMar will provide facilities at the Ventana beach area for local visitors. This will include an informational kiosk with environmental education messages, shaded picnic tables, and trash collection and removal.

5) Meeting APLIC guidelines

With respect to the APLIC guidelines, WindMar will bury all electrical transmission lines on the site out to PR-335, where they will run aboveground along existing transmission line poles to the PREPA substation. APLIC most applies to situations where there are lots of larger raptors or other birds that could be electrocuted or collide with lines. For example, ducks, eagles, grebes, and similar birds are quite susceptible if lines go over a marsh or river. This is not the case at the WindMar site or in adjacent Guayanilla. WindMar, however, will fit aerial transmission lines with flight diverters in any situation where there may be an electrocution or collision risk for large birds (such as the Red-tailed Hawk or Turkey Vulture). More importantly, however, WindMar will insulate lines at the poles and make sure that phase to phase and phase to ground contact cannot be made by birds, such as vultures. WindMar will also space lines in order to avoid phase to phase contact.

Compensation

WindMar will compensate for project impacts in the following ways:

Table 13: Conservation Easement

All units in hectares

	Detail	Punta Verraco	Cerro Toro	Punta Ventana	Other Areas	Total	% Property
Total Area (from deeds)	Note 1	125.0	46.0	79.0	45.0	295.0	100.0%
Reserved for WindMar							
Access roads to wind turbine placements	12 m width	(6.0)	(1.5)	(5.0)	-	(12.5)	-4.2%
Wind turbine placements	0.5 ha/turbine	(6.0)	(2.0)	(4.5)	-	(12.5)	-4.2%
Staging areas/substation (m^2)	Note 2	-	(0.5)	(0.5)	-	(1.0)	-0.3%
Texaco quarry		(3.0)	-	-	-	(3.0)	-1.0%
Other reserved areas	Note 3	(12.0)	-	(2.0)	(7.0)	(21.0)	-7.1%
Total Reserved for WindMar		(27.0)	(4.0)	(12.0)	(7.0)	(50.0)	-16.9%
Conservation Easement	Note 4	98.0	42.0	67.0	38.0	245.0	83.1%
% of Total Area		78.4%	91.3%	84.8%	84.4%	83.1%	

Note 1: Includes 5.0 ha in principal access roads through the Tropical Fruit property. These are shown in the Other Areas column.

Note 2: Includes 0.5 ha at base of Cerro Toro, 0.5 ha at top of Punta Ventana

Note 3: Includes 12.0 ha at tip of Punta Verraco, 2.0 ha along shore at Punta Ventana, 2.0 ha at Playa Ventana, and 5.0 ha in principal access roads (see Note 1)

Note 4: Subject to legal work and final approval

1) Conservation easement

When the Project is constructed and begins to deliver electricity to PREPA, WindMar will grant a generous conservation easement that protects 83% of its property in perpetuity (85% when excluding 5.0 ha of access roads through the Topical Fruit property). Excluded from the easement will be access roads, wind turbine placements, staging and substation areas, the Texaco quarry (which will be restored; please see above), and other areas. Please see Table 13.

While reforestation activities will mitigate 108% of 12.2-ha direct impact to the dry forest habitat, the conservation easement will compensate for this impact at a rate of 1697% (207 ha of conservation easement on dry forest for 12.2 ha of impact).

The easement is being drafted in accordance with a law approved on December 27, 2001, by the Legislature of the Commonwealth of Puerto Rico (Law Number 183, Puerto Rico Conservation Law). The easement will be offered to a qualifying non-profit organization.

2) Support of Brown Pelican research

WindMar will contract Dr. Paul Kerlinger, Dr. Chris Elphick, and John Guarnaccia to work with pelican biologists to develop a research program that meets the priorities identified by Dr. Elphick in his Population Viability Assessment (PVA) for the Brown Pelican (see discussion above and Appendix XI). Based on the recommendation of the above mentioned consultants, WindMar will provide a $100,000 grant to accomplish the actions prioritized in the research program.

<u>Monitoring Measures</u>

According to the HCP handbook, Section 10 regulations require that an HCP specify the measures the applicant will take to monitor the impacts of the taking resulting from the project actions. These measures should be as specific as possible and be commensurate with the project's scope and severity of its effects.

The principal monitoring measures will be: 1) a regular censuses during the breeding season of the Puerto Rican Nightjar and 2) a use (abundance and flight behavior) and mortality study of the Brown Pelican and other birds at the WindMar project site.

For the nightjar, we will follow the methodology developed by Dr. Paul Kerlinger (2003b), which collected the data reported in this HCP. From fixed listening stations, we will estimate the bearing and distance of singing nightjars, map their locations, and define singing territories. We will report these results annually for the first five years after project construction, then once every five years.

For the pelican and other birds that use airspace within the turbine fields, a flight-use study will be conducted in a fashion similar to the preconstruction study reported herein. By using the same methodology, preconstruction abundance flight behavior of pelicans and other birds can be compared to post-construction abundance and flight behavior. Nevertheless, data collectors will have real spinning turbines to define the danger zone and will measure bird use within that zone.

To assess mortality, research technicians will search below the turbines on a regular basis to locate carcasses, if any. In addition to regular searches beneath the turbines, a study of observer efficiency (how many marked carcasses they find) and carcass removal (due to scavenging) will be conducted.

The protocol for the mortality study can be found in Appendix XIII.

Unforeseen Circumstances/Extraordinary Circumstances

The Incidental Take Permit WindMar is applying for would last 40 years. Unforeseen circumstances may arise during that period that will require consultation and problem solving among WindMar or its successor, FWS, and DNER. WindMar will draft, negotiate, and sign a Memorandum of Understanding (MOU) among the principal parties. The MOU will set forth a mechanism for reporting on the results of post-construction studies, alerting each other of unforeseen circumstances, meeting to discuss them, and developing solutions.

Funding

According to the HCP handbook, the ESA requires that an HCP detail the funding that will be made available to implement the proposed mitigation program. The mitigation program will have three phases, budgeted as follows (in 2004 dollars):

Phase I, Construction (Year 1)	$300,000 (includes construction of research station, improvement of water flow in mangrove area, development of water-delivery system for habitat restoration, and purchase of essential equipment)
Phase II, Restoration (Years 1-5)	$200,000/year (includes staff and materials for habitat restoration, monitoring, predator-control, and education activities)
Phase III, Maintenance (Years 6-40)	$100,000/year (includes staff and materials for habitat restoration, monitoring, predator-control, and education activities)

Funding for the mitigation program will be earmarked in the capital and annual operating budgets of the project. The total capital budget is estimated at $50 million. The total annual operating budget is estimated at $3 million. The real estate value of the WindMar property alone is presently estimated at $20 million.

III. Alternative actions the applicant considered that would not result in take, and the reasons why such alternatives are not being utilized

The ESA requires a description of "alternative actions to such taking." According to the HCP Handbook, two alternatives commonly included in the "Alternatives Analyzed" section of an HCP are: 1) any specific alternative, whether considered before or after the HCP process was begun, that would reduce such take below levels anticipated for the project proposal, and 2) a "no action" alternative, which means that no permit would be issued and take would be avoided or that the project would not be constructed or implemented. If economic considerations are the basis for rejecting alternatives, data supporting that decision must be provided.

Other Alternatives Analyzed

Slag-grinding facility and marine terminal

WindMar has analyzed other viable economic activities for the site. One was the permanent transformation of 12 hectares of dry forest habitat at the tip of the Punta Verraco peninsula into a marine terminal and grinding facility. Powered by wind-generated electricity, this facility would have been capable of grinding 2 million tons of slag annually to convert this industrial byproduct into cement. The beauty of this process is that it would: 1) avoid the emission of 2.4 million tons of carbon dioxide annually to produce an equivalent amount of cement by conventional means; 2) produce a cement that sets into a more durable concrete in the heat, humidity, and salinity of Puerto Rico than the type of cement currently produced on the island; and 3) avoid the destruction of hundreds of hectares of wildlife habitat on the island (including dry forest with Puerto Rican Nightjars at other sites) that now or in the future would be open-pit mined for limestone rock and building aggregate to produce cement.

Punta Verraco was an ideal site for such an operation because of its deep-water access to Guayanilla Bay, which would have permitted the docking of the large vessels required to transport industrial slag economically, its outstanding wind resource, which would have produced the inexpensive electricity required to make such an operation profitable, and its isolation from human communities. The Puerto Rican Industrial Development Company (PRIDCO) opposed this project on the grounds that it would have interfered with the proposed Port of the Americas transshipment port project across Guayanilla Bay. The major feature of PRIDCO's plan to mitigate marine environmental impacts was the expropriation of the terrestrial Punta Verraco. The local cement cartel also influenced this government agency in order to oppose a cement substitution project that would have gained significant market share.

With a properly designed HCP, the slag-grinding project would have decreased incidental take levels of the nightjar and pelican to the levels of the proposed project described in Section I. Nevertheless, the slag-grinding project would have accrued higher socioeconomic benefits than the proposed project.

Quarry to supply national building aggregate needs with the least impact

Another plan was to quarry the 70-hectare south-facing slope of Punta Verraco for sand and gravel to meet Puerto Rico's ongoing construction needs. This plan would have donated the remaining 220 hectares to DNER as an extension of the Guánica State Forest and have eventually restored the entire quarry area with native vegetation. Such a quarry would have allowed the closing of several quarries in the southwest region, which are currently negatively impacting not only wildlife habitats (including dry forest with nightjars), but vocal surrounding neighborhoods and communities that oppose their operations. The lack of human inhabitants near our site, and the feasibility of transporting this material by sea rather than by land, would have decreased the present impacts of meeting Puerto Rico's needs for such essential materials to construct houses, highways, hospitals, and other concrete structures on people, wildlife, and highway infrastructure throughout the island. It would not surprise us if, as a result of future socioeconomic analyses, the Government of Puerto Rico prioritized such a project for Punta Verraco in order to meet essential economic needs with the least impact to human and wildlife populations.

This project would have affected the Puerto Rican Nightjar, but it would not have affected the Brown Pelican. Incidental take of nightjars could have been mitigated by a properly designed HCP. Nevertheless, this project would have accrued higher socioeconomic benefits than the proposed project.

Other coastal uses

Past exploitation of Puerto Rico's limited timber resources in the coastal zone have essentially exhausted those resources. Soils in the coastal zone have also been depleted by over 100 years of intensive sugar production, making competitive agriculture or forestry unviable as economic activities. As a result, housing, tourism, and industrial uses are the principal development options in Puerto Rico's coastal zone.

Clearly, agriculture, forestry, housing development, tourism development, and likely any other industrial project outside of wind power, would result in increased incidental take levels above what are calculated in this HCP. Nevertheless, Puerto Rico's population continues to grow. Housing projects (*urbanizaciones*) are popping up everywhere, particularly in rural lands, such as the WindMar property, which is zoned for rural housing development. One of the factors pushing low-income families into rural areas is the high cost of land in urban areas. At the other end of the spectrum, wealthy Puerto Ricans and US residents are purchasing vacation properties with views of the sea. Therefore, there is significant pressure on open space to meet housing needs from both ends of the socioeconomic scale.

Tourism is one of Puerto Rico's top economic engines, and the government is dedicated to improving its tourism offerings, particularly along the ever popular coast and to meet growing demand for ecotourism. Industrial development is a top government priority, particularly for activities that generate high-paying jobs. The Port of the

Americas project is a prime example of the mega-projects government is willing to pursue along the coast in the cause of economic development.

The impacts of housing, tourism, and industrial development are well demonstrated around the WindMar site in the municipalities of Guánica, Guayanilla, Peñuelas, and Ponce. Since the pressures for these uses are only expected to increase, the WindMar property, if left undeveloped, will be subject to increasing pressure for some alternate economic activity that will severely compromise wildlife and their habitats.

Nevertheless, strong winds predominate along the coast. The value of the electricity produced from these winds at the WindMar site, at the current consumer price of $0.13/kWh, would be $13 million/year, or $16,250/acre/year. WindMar would hope to be paid half of this amount, or $8,000/acre/year, for the energy it would produce on its land. Wind production in the coastal zone, therefore, is a very significant economic activity by anyone's standards. As we have demonstrated that a small amount of incidental take resulting from wind energy development can be mitigated, wind energy development is an appropriate use of coastal lands, one that maintains natural communities. Housing, tourism, and other types of industrial development are likely to devastate natural communities in the coastal zone.

Other wind power sites analyzed

We have also looked at other sites in Puerto Rico to construct wind farms. While we measured the wind at Punta Verraco to determine the site's economic viability for a wind-power project, we also measured the wind resource at Cayo María Langa, one kilometer to the south-southwest of the EcoEléctrica power-generating facility across Guayanilla Bay from the WindMar site. Our idea here was to explore the feasibility of an offshore wind farm. We also installed wind-measuring towers in Yabucoa (southeastern Puerto Rico) and in Dorado (north-central Puerto Rico) for onshore wind farms.

Displayed in Table 14, these studies show that Punta Verraco has the best wind of the four sites. It had the best wind during the period of high winds in May and June of 2003, during the period of low winds in October and November of 2002, as well as during the entire measurement period, from March 2002 to July 2003.

We would like to point out that we have discarded the offshore wind farm option for a number of reasons: 1) compared with Punta Verraco, its wind resource is inferior; 2) given the nature of the offshore wind resource in the vicinity of Punta Verraco and present offshore wind turbine technology, an offshore wind installation would not presently be profitable (but this will likely change in the future, as wind turbine technology improves); and 3) it is highly likely that the marine impacts of the project would be closely scrutinized, as they were in the Port of the Americas project in Guayanilla Bay, which was stopped for reasons having to do with marine environmental impacts. Therefore, while an offshore wind farm would reduce incidental take of the nightjar to zero, it would transfer this take to what is considered critical marine habitat.

Table 14: Site Comparison

	2003 high-wind period May-June	2002 low-wind period Oct-Nov	2002-2003 all-data 8760 Hours/Year
Punta Verraco, Guayanilla			
Average wind speed (M/S)	7.9	5.5	6.5
Capacity Factor	40%	17%	27%
Estimated Annual production (KWH/Year)	5,234,792	2,304,985	3,560,843
Total hours	1,560	1,464	11,496
Percent Data used	98.5%	99.1%	99.0%
Percantage above Dorado	128%	151%	125%
Percentage above Yabucoa	140%	265%	152%
Beach at dairy farm, Dorado			
Average wind speed (M/S)	6.8	4.8	5.8
Capacity Factor	31%	12%	22%
Estimated Annual production (KWH/Year)	4,103,425	1,526,247	2,843,253
Total hours	1,560	1,464	10,344
Percent Data used	83.0%	99.5%	96.1%
Yabucoa Harbor, Yabucoa			
Average wind speed (M/S)	7.1	4.3	5.7
Capacity Factor	28%	7%	18%
Estimated Annual production (KWH/Year)	3,727,337	870,810	2,345,205
Total hours	1,560	1,464	11,400
Percent Data used	98.9%	99.7%	99.6%

We have also discarded Yabucoa and Dorado, because their wind resources are inferior to Punta Verraco's. Besides, WindMar owns the land to construct such a project in Guayanilla. At the other terrestrial sites, we would have to negotiate purchases or leases in areas where coastal real estate is significantly more expensive. Therefore, while constructing an onshore wind farm at an alternate site would reduce incidental take on the nightjar (both Yabucoa and Dorado do not have nightjar habitat), it would likely not reduce incidental take of the pelican (which is found coastally around the island). Besides, economic factors would come into play, the result of the inferior wind resource and the cost of purchasing or leasing land, which would make wind power projects at both sites infeasible.

The only other serious wind development project in Puerto Rico was one proposed by Kenetech (now GE Wind) for the ridges of the central cordillera at Cayey. An avian study of the site was carried by a prominent Puerto Rican ornithologist, who, we have been told, determined that there was no avian risk at the site from the turbines. The land where the Kenetech project was to be located is privately owned and used mainly for vacation homes. Kenetech has not been able to secure leases on the land to site its turbines.

Smaller wind power project

Could the WindMar project be done on a smaller portion of the project site, thus decreasing impacts to dry forest and decreasing the size of the rotor zone that pelicans would have to negotiate, thereby decreasing incidental take? This is a very good question.

The economic equation for wind power projects is complicated. Some upfront costs are easy to gauge, such as the cost of the turbines and substation and their installation. Other upfront costs, however, depend on negotiations with the local electric utility, in this case the Puerto Rico Electric Power Authority (PREPA).

One very significant cost depends on where we will be allowed to connect to the electric power grid. In the case of our project, there are two principal options. The first option would connect to the 115KV line and cost $6 million. The other would connect to the 38KV line and cost $4 million. The difference in cost is the distance to the connection site. The actual connection to the grid would cost the same in either option.

The 115KV line could handle a capacity of 150 MW, or three times the WindMar project. The 38 KV line, on the other hand, could only handle 60 MW. This presents an additional cost for connection capacity not used. If PREPA only permits the more expensive option, then the project must be larger in order to cover costs and generate a reasonable profit.

On the revenue side, there is one key variable – the long-term agreement WindMar would sign with PREPA that would guarantee how much we would be paid for the electricity we produce. Negotiations with PREPA have not proceeded very far. Therefore, we are basing our project design on a purchase price of $0.05.5/kWh (kilowatt-hour) produced. At a cost of $0.05.5/kWh, a project of twenty-five 1.65 MW wind turbines distributed over the entire WindMar property is the only viable economic option.

If PREPA were willing to subsidize WindMar for the connection capacity not used and pay more for the electricity that the WindMar project would produce, then the project could be scaled back, possibly to exclude Punta Ventana adjacent to the Guánica State Forest. If DNER could influence PREPA to make the project profitable without developing Punta Ventana, then WindMar would be willing to sell or exchange the Ventana property to include it in the State Forest. Until that happens, however, we cannot modify our project design.

Another consideration is using fewer, larger turbines. 3.0 megawatt turbines are beginning to come on line, but at this point in time their developers have not cleared them for commercial application. Using 3.0 MW turbines would decrease the number of turbines from 25 to 16, but they would have to be more widely spaced, and we would still need to use the entire site to ensure the project's profitability. Because fewer turbines would be involved, the number of turbine pads would be less, but the amount of roads would remain roughly the same. In fact, the roads may need to be slightly wider during the installation phase, because the blades are longer, and trucks may need more width to negotiate curves. This option would not really affect less nightjar habitat, but it would leave larger gaps for pelicans and other birds to negotiate in the rotor zone. For reasons of economic risk, however, we cannot adopt this option at this time, until the developers of these turbines release them for commercial use.

No Action

The *No Action* alternative assumes that the proposed development does not occur and that no application for incidental take is processed. This alternative would provide temporary protection to the Puerto Rican Nightjar and other species. It would not, however, address the statutory requirements of the ESA or address long-term management of either the affected species or the dry forest habitat. The land-use designation of this property allows for development, specifically the construction of approximately 400 single-family houses on two-acre lots. The financial impact of not developing this parcel would deny WindMar, or any other private owner, the economic value of the property.

The no-action alternative is unlikely because, as explained above, waterfront land along the Caribbean is valuable, and its value continues to increase as a result of mounting pressure on coastal land to meet housing, tourism and industrial development needs. The present high value of the subject property is reflected in the $40,000 in property taxes that are annually assessed. Yet, this land is currently not providing income. At some point, WindMar, or a subsequent private owner, will be forced to develop this land either as a single parcel or subdivide it.

An alternative land use under the no-action alternative is the sale of the subject property for conservation purposes. It is unlikely that the Commonwealth of Puerto Rico, a US government agency, or a private conservation organization will step forward to purchase this property as open space. Because of budgetary restraints, Puerto Rico is adding little new land as public open space. Most of the funds allocated for this purpose have been prioritized for projects in Metropolitan San Juan, where open space is fast giving way to urban sprawl and land prices are exorbitant.

As mentioned above, the WindMar property figured in the mitigation plan for the Port of the America's project, to be expropriated in order to compensate for marine environmental impacts. This plan is unlikely to go forward for two reasons: 1) the Port of the America's project has been withdrawn from Guayanilla Bay, and no significant environmental impacts are expected to result from its construction in Ponce; and 2) balancing what would have been significant impacts to critical marine habitat with expropriation of a terrestrial site is questionable and likely would not stand up in court.

To our knowledge, the US Government has never made an overture to purchase Punta Verraco or Punta Ventana. We believe it is unlikely to do so, even if asked, because the WindMar property would not rate high enough in terms of wildlife populations and other natural endowments to merit sufficient interest, and it is far from other federal holdings that would increase its value to the government.

Finally, private conservation organizations, such as The Nature Conservancy, Trust for Public Land, and the Puerto Rico Conservation Trust, are also unlikely to step forward. In 1983, TNC was offered Punta Verraco by Texaco, but TNC turned Texaco down apparently on the recommendation of Dr. Frank H. Wadsworth that the property was not deemed important enough. While we will admit that increasing pressure on coastal open space has increased the WindMar property's value as open space, it is still unlikely that a conservation organization will step forward with the millions of dollars required to purchase the site. These organizations are looking for higher returns in terms of biodiversity and scenic values than the WindMar site can offer.

The no-action alternative is also unacceptable to the applicant, because the financial impacts would be substantial and adverse. Since the land-use designation of this property allows for development, the applicant would be denied the economic value of the property.

Therefore, the no-action alternative would not be beneficial to the applicant. But we would also like to point out that it would neither be beneficial to the Puerto Rican Nightjar and other species. The nightjar presently experiences a "silent" take on the subject property, the result of unauthorized anthropogenic impacts such as hunting, harvesting of forest products, and fires, and the downwind negative impact on insect populations by power plant emissions. Moreover, since the no-action alternative cannot be implemented, portions of the subject property would eventually be developed, with disastrous effects on the nightjar and its habitat.

The WindMar wind energy project is clearly the best alternative, with its expansive mitigation plan and accruing indirect benefits to wildlife. We urge FWS to approve the requested Incidental Take Permit and let us get to work bringing clean renewable energy to the people of Puerto Rico and putting this energy to work for the benefit of endangered species and their habitats.

Literature Cited

Areces, Alberto. 2003. Consideraciones sobre la flora y vegetación del área de Punta Verraco/Ventana, Guayanilla, Puerto Rico. Consultant's Report. 20 pp.

Collar, N. J., L. P. Gonzaga, N. Krabbe, A. Madroño Nieto, L. G. Naranjo, T. A. Parker III, D. C. Wege. 1992. Threatened Birds of the Americas, ICBP/IUCN Red Data Book. Smithsonian Institution Press.

Collazo, J. A., and E. E. Klaas. 1986. Recovery plan for the Brown Pelican in Puerto Rico and the U. S. Virgin Islands. U. S. Fish and Wildlife Service, Atlanta, GA.

Collazo, J. A., T. Agardy, E. E. Klaas, J. E. Saliva, and J. Pierce. 1998. An interdecadal comparison of population parameters of Brown Pelicans in Puerto Rico and the U.S. Virgin Islands. Colonial Waterbirds 21(1): 61-65.

Collazo, J. A., J. E. Saliva, and J. Pierce. 2000. Conservation of the Brown Pelican in the West Indies. Society of Caribbean Ornithology. Special Publication. No. 1.

Díaz, C.A., 1984. Recovery plan for the Puerto Rican Whip-poor-will. U. S. Fish and Wildlife Service, Atlanta, GA.

Díaz, C.A. 2003. Letter re: avian risk assessment (ARA) for the WindMar RE project, Guayanilla, Puerto Rico. Fish and Wildlife Service, Boquerón Field Office. 4 pp.

Elphick, C. S., and M. Ellis. 2004. Modelling Brown Pelican Dynamics in the Caribbean, Final Reportto WindMar Renewable Energy, Inc., for the contract: "Modeling endangered brown pelican populations." 24 pp.

EEPPM (Empresas Públicas de Medellín). 2002. Proyecto Eólico: Evaluación complementaria del impacto sobre las aves. Medellín. 61 pp.

Erickson, W.P., G.D. Johnson, M.D. Strickland, K.J. Sernka, and R. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of collision mortality in the United States. White paper – National Wind Coordinating Committee, Avian Subcommittee, Washington, DC.

Erickson, W., G. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002. Synthesis and comparison of baseline avian and bat use, raptor nesting, and mortality information from proposed and existing wind developments. Bonneville Power Administration, Portland, OR (www.bpa.gov).

Federal Emergency Management Agency. 1999. Revised Flood Insurance Rate Map (FIRM), Community-Panel No. 720000 0275 F.

Fish and Wildlife Service Office of Law Enforcement. 2004. Report of Investigation: Punta Verraco, Punta Ventana (Inv #: 2004402386, Report #: 1). 7 pp.

Kerlinger, P. 2000. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Proceedings of the National Wind/Avian Planning Meeting III, San Diego, CA, May 1998.

Kerlinger, P. 2003a. Phase I Avian Risk Assessment for the WindMar RE, Guayanilla Project, Puerto Rico. Report to WindMar RE, San Juan, Puerto Rico. 43 pp.

Kerlinger, P. 2003b. A preconstruction study of the federally endangered Puerto Rican Nightjar at the WindMar RE project, Guayanilla, Puerto Rico. Consultant's Report. 20 pp.

Kerlinger, P. 2003c. Preconstruction surveys of the federally endangered Yellow-shouldered Blackbird (*Agelaius xanthomus*) at the WindMar RE project, Guayanilla, Puerto Rico. Consultant's Report. 11 pp.

Kerlinger, P. 2003d. Preconstruction studies of the abundance and behavior of the federally endangered Brown Pelican, Roseate Tern, and other birds at the WindMar RE project, Guayanilla, Puerto Rico. Consultant's Report. 26 pp.

Kerlinger, P. 2004. 2004 Territorial Boundaries of Puerto Rican Nightjars at the WindMar Project Site in Guayanilla, Puerto Rico. Consultant's Report. 6 pp.

Krebs, J. R. 1971. Territory and breeding density in the Great Tit (*Parus major* L.). Ecology 52: 2-22.

Kroodsma, D. E. 1976. The effect of large song repertoires on neighbor "recognition" in male Song Sparrows. Condor 78: 97-99.

Maíz, E. 1984. Reconocimiento arqueológico de la cuenca hidrográfica del río Yauco. Centro de Investigaciones Folklóricas de Puerto Rico, Oficina de Preservación Histórica de Puerto Rico. Documento #20.

McKibben, B. 2003. Serious wind. Orion. July/August 2003.

Metropolitan Soils. 2004. Report on Preliminary Geotechnical Investigation for Proposed Wind Farm, Punta Verraco-Cerro Toro-Punta Ventana, Guayanilla, Puerto Rico. Consultant's Report. 9 pp.

Noble, R. E., F. J. Vilella, and P. J. Zwank. 1986. Status of the endangered Puerto Rican Nightjar in 1985. Caribbean Journal of Science 22:137-143.

Orloff, S., and A. Flannery. 1992. Wind turbine effects on avian activity, habitat use, and mortality in Altamont Pass and Solano County wind resource areas, 1989-1991. California Energy Commission, CA.

Orloff, S., and A. Flannery. 1996. A continued examination of avian mortality in the Altamont Pass wind resource area. California Energy Commission, CA.

PREPA. 2003. Prospectus on Offering of $517,305,000 in Puerto Rico Electric Power Authority Power Revenue Bonds, Series NN. San Juan, PR.

Reed, J. M., C. S. Elphick, and L. W. Oring. 1998. Life-history and viability analysis of the endangered Hawaiian Stilt. Biological Conservation 84: 35-45.

Rivera, M. 1983. Yellow-shouldered Blackbird revised recovery plan. U. S. Fish and Wildlife Service, Atlanta, GA. (Approved and signed by Noreen K. Clough, Regional Director, Southeast Region, November 12, 1996)

Saliva, J. E. 1993. Caribbean Roseate Tern recovery plan. U. S. Fish and Wildlife Service, Boquerón, Puerto Rico.

San Juan Star. 2002. Biologist: Guabairo's population increasing. April 19, pg. 7, San Juan, Puerto Rico.

Shields, M. 2002. Brown Pelican (*Pelecanus occidentalis*). *In* Birds of North America, no. 609 A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Thomas, R. 2004 Report on the vertebrates (exclusive of birds) of Punta Verraco and Punta Ventana. Consultant's Report. 4 pp.

U.S. Fish and Wildlife Serice and National Marine Fisheries Service. 1996. Habitat Conservation Planning Handbook.

Vilella, F. J. 1989. The reproductive ecology and population biology of the Puerto Rican Nightjar, *Caprimulgus noctitherus*, Ph.D. dissertation. Louisiana State University. 160 pp.

Vilella, F. J. 1995. Reproductive ecology and behavior of the Puerto Rican Nightjar *Caprimulgus noctitherus*. Bird Conservation International 5: 349-366.

Vilella, F. J., and P. J. Zwank. 1993a. Geographic distribution and abundance of the Puerto Rican Nightjar. Journal of Field Ornithology 64(2): 223-238.

Vilella, F. J., and P. J. Zwank. 1993b. Ecology of the Small Indian Mongoose in a Coastal Dry Forest of Puerto Rico Where Sympatric with the Puerto Rican Nightjar. Caribbean Journal of Science, Vol. 29, No. 1-2, 24-29.

Wadsworth, F.H. 1983. Report to The Nature Conservancy on a site visit to Punta Verraco on June 11, 1983. 3 pp.

Weeden, J. S. 1965. Territorial behavior of the Tree Sparrow. Condor, 67: 193-209.