Creating a More Effective Protection of Endangered and Threatened Species Habitat Through Conservation Banking

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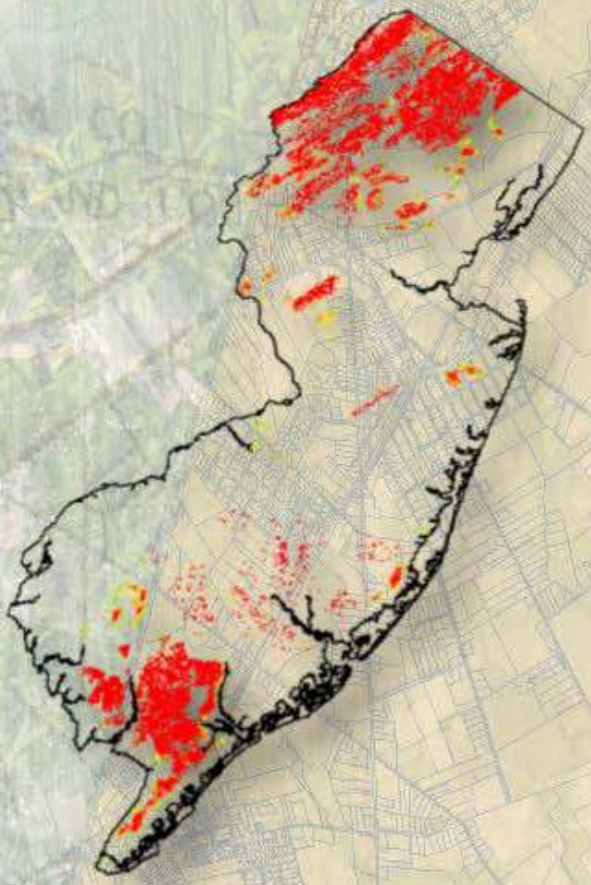

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Introduction

The New Jersey land use regulatory system is among the most stringent in the country. Land use laws like the Pinelands Act, the Wetlands Act, Coastal Area Facility Review Act and the Highlands Act have required nearly all land users, including landowners, developers, farmers, and foresters, to seek permits for nearly every activity that can alter land and water resources. Although the system has accomplished significant land protection in the last 25 years, the conversion of natural resource conservation lands to urban land uses has held consistent at 0.5% per year. Whereas in 1986 63% of the state was undeveloped farmland, forest, and wetlands, by 2007 it had been reduced to 56% (Hasse and Lathrop 2010). During this two-decade time period, New Jersey's urban growth rate was nearly twice as fast as its rate of population growth. Despite recent increased protective legislation, these losses are still increasing. The rate of loss increased from 14,886 acres per year from 1986-1995 to 16,061 acres per year from 2002-2007, and urbanization occurred at four times the growth rate of the population during this most recent time period (Figure 1).

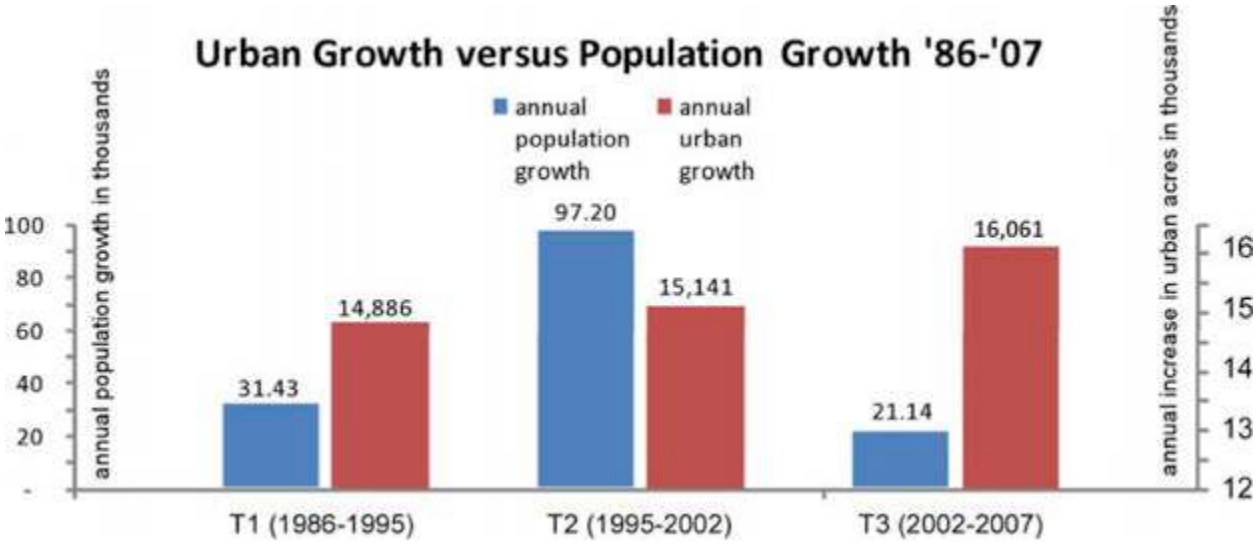

Figure 1. Population growth rates vs. urban growth, 1986-2007. The rate of urbanization has increased in recent years and is now over four times higher than the rate of population growth.

Large acreages of farmland, forest, and wetlands are all being lost every year to urban development (Figure 2). The toll on natural resources has been dramatic, especially the degradation and loss of critical wildlife habitats. The state's endangered species list has grown significantly over the last thirty years, while the number considered recovered has been largely restricted to a few raptors that were endangered for reasons other than dwindling habitat loss. The impact on wildlife is not fully understood.

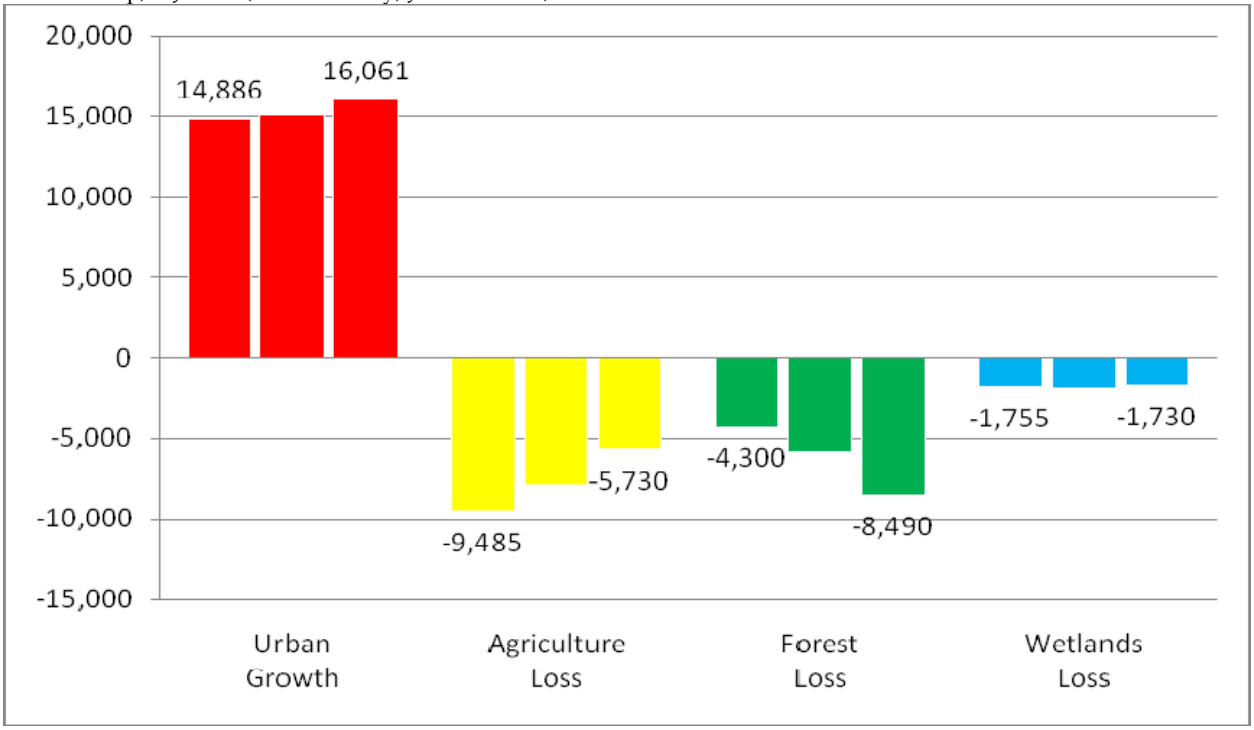

Figure 2. Annualized rates of land use change for the T1 ('86-'95), T2 ('95-'02), and T3 ('02-'07) time periods. This shows the rate of urbanization increasing over the period of increased regulation.

The existing system of land use regulation has not always adequately protected endangered and threatened species habitat and needs both greater flexibility as well as substantive improvement. In considering the appropriateness of development activity, priority should always be given to the avoidance of negative environmental impacts to threatened and endangered wildlife species' habitat, followed by minimization and lastly by compensation. Habitat mitigation, as a form of compensation, consists of the conservation or restoration of high biodiversity value habitat as a means of offsetting degradation of natural habitat of relatively low biodiversity value. We propose a new regulatory system for the protection of habitat of endangered and threatened species based on establishing habitat conservation banks using procedures already established in other states, with the enhancement being guided by a GIS evaluation model based on the principal of no net loss of habitat value. The system can be distinguished from the current system in four ways:

1. We will propose that new regulations be based on a new system of recovering lost habitat value estimated by a relatively simple model composed of five estimates of habitat value: the percentage of endangered and threatened species habitat in a defined area, the area of core habitat, the connectedness of habitat, the degree of protection, and the state of habitat management for the species of concern. This new regulatory paradigm allows for a transfer of value from lands that will be developed to lands that are best suited for protection and management. We envision that the proposed regulatory system be implemented for those areas of the state that are not already covered by regulations protecting threatened and endangered species habitat (i.e., areas outside the Pinelands Comprehensive Management Plan zone).

2. In our proposal, lost value from development can be regained with increased protection or better land management. The economic value of the loss can therefore be calculated by the cost of its replacement – buying land, buying development rights, habitat restoration, and other methods of improving protection and habitat quality. We propose a system of trading habitat values with a new conservation banking system overseen by a conservation banking trust housed in an existing governmental trust, the Natural Lands Trust. The Trust will allow new mitigation banks to be established throughout the state. We will suggest ways to improve the current system of mitigation banking to create more competitive pricing and improved assurance of results.
3. This new regulatory system will create a scientifically defensible way to evaluate the success of habitat protection, the efficacy of the methods used to improve protection and management, and the economic impact of the system on local communities. It allows an ecological and economic accounting that will provide communities, state agencies, and conservation and development interests with a practical method to monitor small and large scale changes to the ecological integrity of the wildlife habitat. This monitoring creates feedback that managers can use to adaptively manage the planning, protection and management to insure good results for the money spent on species in need of protection. The proposed approach is not dependent on the prior existence of species recovery plans, but these can be developed and implemented in tandem.
4. Although this system must be managed by agencies and thus requires regulations, it is far different from the existing system of land use regulation. This new system allows landowners greater flexibility concerning development decisions by providing them with the opportunity to offset losses in wildlife habitat value on one property with enhanced protection or management on another property. The goal is to conserve and enhance high value habitat as a means of offsetting degradation of natural habitat of lower biodiversity value. It also provides the basis for other landowners who wish to keep their land in good ecological condition by enrolling these lands in a conservation bank and selling the value of improvements in ecological value.

The purpose of this project is to test the efficacy of this new regulatory system in real world conditions and the likelihood that it will achieve its intended purpose through iterative meetings with a stakeholders group composed of leaders from within the conservation, land use planning, and land use professions. Simultaneously, we subjected the system to both an academic review and a preliminary assessment by municipal planners, consultants and other land planning specialists. Ostensibly, the purpose of this work was to assist the NJDEP in developing new regulations to implement no net loss system of conservation planning. To that end, this paper presents a preliminary structure for a new regulatory program and reflects the opinion of the structure by the leaders involved in the project.

Overview of the Project Process to Date

Throughout the development of this proposal, a number of stakeholders (including planning officials, government regulators, and scientists) were consulted and invited to provide their comments and feedback on the process. A total of seven meetings were held. Three consisted of

the entire stakeholder group, while the remaining four were comprised of various subsets of the group.

The first meeting took place on September 27, 2012 and was attended by the entire stakeholder group. After introducing the stakeholders, the meeting then laid out the problems with the current regulatory system for protecting threatened and endangered species and introduced the conservation banking concept. The meeting concluded with a strategy for the implementation of the new system, as well as the plan for the stakeholder group and a tentative schedule for upcoming meetings.

A private meeting with Eric Snyder of the Sussex County planning department occurred on May 7, 2013. The goal was to develop a pilot version of the conservation banking project to test the protocols and would occur in three selected towns (Vernon, Sparta, and Frankford). The project would be presented to the communities as an extension of the ongoing Water Quality Management planning that is happening statewide, and would allow the pilot communities the opportunity to get a head start on the conservation banking system at no cost to them.

A sub-meeting of the scientific advisory panel was held on August 16, 2013. The purpose was to gather feedback on the model used to calculate habitat values, identify potential loopholes, and garner suggestions for improvement. Ultimately, further evaluation was suggested for multiple variables, as well as the addition of two components: a measurement of the "irreplaceability" of habitat, as well as a measurement of the cumulative impact of development (for example, higher mitigation ratios would be required for rarer species, as well as for situations where a particular parcel represents a larger percentage of the total habitat available to a species). The update interval of the habitat value mapping was also discussed, with near real-time updating established as a goal with quarterly or twice annual updating at the start.

A meeting with the Sussex County Planning Department occurred on September 4, 2013. The meeting focused on the potential impact and methodology of the implementation of a conservation banking approach on county and municipal planning. In general, the group supported the idea, though had reservations based on the failings of the current system and the unlikelihood of change. When asked to describe the most expeditious process to transition to the conservation banking process, the group suggested creating the mapping and model and making it available to all qualified users, having it reviewed by the county and municipal planning authorities, and then sending it to the planning boards to be put into use. They also suggested creating a process for adding new information at the county level to allow continual updates.

The second stakeholders' meeting was held on September 26, 2013. The meeting again opened with an overview of the conservation banking concept, then provided an update on the sub-meetings that taken place since the initial stakeholders meeting. The stakeholders expressed concern about a number of different facets of the project. Aside from echoing concerns about the frequency of the land use updates used in calculating habitat values, they also questioned what to do if a municipality was unable (or unwilling) to carry out the program. The stakeholders also presented the idea that a third party would control the mitigation bank with the purpose of consolidating larger and more contiguous sites, restoring preserved land, and assuming responsibility for the long-term maintenance of preserved lands, but raised concern over the potential for the creation of a monopoly.

On December 5, 2013, a sub-meeting of the planners was held to further discuss the mitigation banking system. The participants discussed at length the proper locations for mitigation activity, as well as potential ideas for the mitigation bank itself. Following the stakeholders' suggestion, it was agreed that a separate entity (such as Natural Lands Trust) could service as the mitigation bank. However, to prevent the bank from gaining a monopoly, it was important that there was a way for developers to produce their own projects and that an external entity (for example, NJDEP Division of Land Use Regulation) reviewed mitigation projects. The difficulty of ensuring the success of mitigation projects was discussed, with the most plausible suggestion being the creation of an endowment from the purchase price of land going towards managing it in perpetuity. Lastly, the fear of conservation groups that the project would result in the removal of old protective regulations without the creation of new ones was addressed, with the consummation of the discussion being the comment that the planned "test-rollouts" in Cumberland and Sussex counties would help to alleviate with these fears.

A final meeting of the entire stakeholder group was held on January 21, 2014. The purpose was to update the group about the most recent developments and to discuss the first draft of this white paper. The meeting began with an overview of the proposed wildlife habitat conservation and mitigation program and continued with a summary of the individual components of the system and the roles of the involved agencies and organizations. Some of the advantages of a conservation banking system were presented, and lastly, some options for achieving the desired "no net loss" of habitat value were examined. Throughout, questions and comments from the stakeholders were welcomed, and five main issues they brought up were revisited based on their feedback.

Overview of Endangered and Threatened Species Habitat Conservation Bank Permitting and Mitigation Process

The system proposed in this report is composed of two important processes: the estimation of habitat value lost through development or other forms of land use that cause habitat destruction or degradation, and a process for recovering those losses. The estimation of habitat loss will be done with the use of a peer-reviewed geographic information system model composed of three variables that describe the landscape scale ecological value of the habitat for each species. To achieve no net loss of habitat value, the estimated habitat value lost (debit) must be offset by a gain in habitat value (credit) elsewhere. Habitat value can be gained through increased preservation protection of habitat or by increasing the habitat value to the species through habitat enhancement. Once estimated, a landowner or developer can seek the lost value through the next stage of this process, outlined in greater detail under the Conservation Banking/Habitat Mitigation Program section.

It is important to recognize that while the value lost can be offset on an individual trade basis, in the short term, habitat area is a zero sum game; once destroyed the area of lost habitat for a species has been decreased and cannot be regained (in the short term). Moreover, while putting existing habitat area under improved protection (i.e., through enrolling in a conservation bank) increases the certainty that the habitat will not be converted or developed in the future, it does

not create new habitat. It is feasible to increase the value of some habitats through new or improved management but the increase in carrying capacity for rare species may be limited to within a relatively modest range. In the longer term, it may be possible to increase certain types of habitat through habitat restoration activities (i.e., and thereby create new habitat area). Once created and properly functioning as habitat for a target species, this new habitat area could be used to offset lost habitat value (debits).

The model used in this proposed system attempts to create an objective estimate of loss of value (i.e., debit) and subsequent gain (i.e., credit) from protection and management. The proposed habitat valuation model has been vetted by both a scientific technical advisory group as well as a stakeholders group and represents a Version 1.0. We recommend that this model be continually refined in an adaptive management framework as experience is gained through implementation and advances in scientific understanding.

The following is the proposed habitat mitigation process highlighting key components as well as roles and responsibilities of state, county and municipal agencies and non-profit organizations in the New Jersey species conservation banking program. A more detailed outline is provided in Appendix A.

The following graphic provides an overview of the proposed conservation banking system (Figure 3).

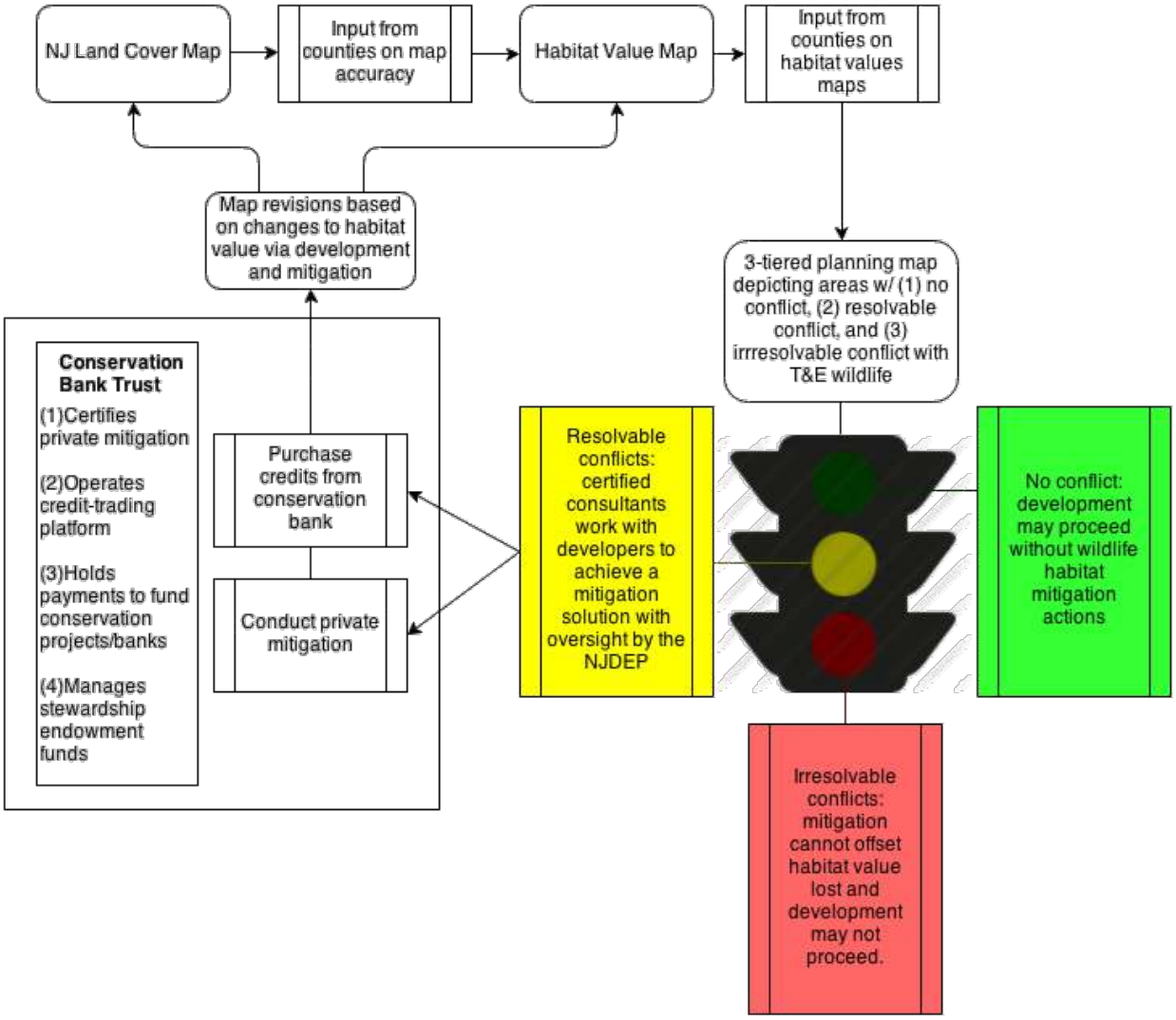

Figure 3. Conservation Bank permitting and mitigation process.

New Jersey Land Cover Map

The first step in the process of implementing no-net-loss habitat conservation planning is to allow every county to review NJDEP land use/land cover mapping and to coordinate municipal and public input. The map that counties will review is the 2012 land use/land cover map. This map will represent the baseline for future no-net-loss planning.

The New Jersey Office of GIS will compile and review all of the proposed updates made by counties and modify the 2012 map as appropriate.

Wildlife Habitat Value Modeling

The state will designate the entity responsible for wildlife habitat value (WHV) mapping. This could be New Jersey Department of Environmental Protection Division of Fish and Wildlife Endangered & Nongame Species Program (hereafter ENSP) or some third party under contract.

Working with land cover maps, the designated wildlife habitat value mapping entity will undertake the habitat value modeling and mapping and will release draft wildlife habitat value maps. Overall values and weights in the model will be set by the mapping entity under the advisement of the scientific review committee. These model outputs will be reviewed, modified as needed and approved by the ENSP. Habitat value maps will be periodically reviewed and updated to ensure that the best available information is incorporated into models. This includes both updated land use and land cover data as well as improved wildlife habitat value models that incorporate new data and techniques as they become available.

Once the first iteration of wildlife habitat value mapping is complete, every county will have the opportunity to review and coordinate municipal and public input regarding the maps. This input will be forwarded to wildlife habitat value mapping entity for consideration.

The wildlife habitat value mapping entity will compile and assess the input from stakeholders, modify the maps as appropriate, and release draft final wildlife habitat value maps. Disputes will be settled by the ENSP. The final maps will be certified and then released by ENSP.

The NJ Department of Environmental Protection will create an online resource that will allow counties, municipalities, the development community and other stakeholders access to wildlife habitat value maps for land use and habitat mitigation planning.

Planning at the County and Municipal Level

One component of WHV mapping will be the creation of a map layer that identifies conflicts between existing planning and zoning maps and WHV mapping. Maps will provide planners guidance on degree of conflict using a 3-tier approach (Green: no conflict; Yellow: resolvable conflict, tradeable habitat; and Red: irresolvable conflict, irreplaceable habitat). Municipalities and counties will update their master planning as they deem appropriate.

Permitting

The state will develop regulations to establish the species conservation banking program. Participation will be enforced by regulation rather than voluntary in nature. We envision that the proposed conservation banking system be implemented for those areas of the state that are not already covered by regulations protecting threatened and endangered species habitat (i.e., areas outside the Pinelands Comprehensive Management Plan zone).

The state will create a process for training or certifying consultants and create a list of qualified consultants to work with the wildlife habitat mapping and debit/credit calculation protocol.

These qualified consultants and planners will work with counties, municipalities and developers. Consultants will assist these groups in the use of wildlife habitat value mapping to calculate the required habitat value credits for identified threatened and endangered species for proposed development plans to offset the debits caused by the development.

Developers will submit habitat value debit calculations to the New Jersey Department of Environmental Protection Division of Land Use Regulation (hereafter NJDEP Land Use) for certification as part of the permitting process. The Land Use Division will approve or disapprove the calculation of lost value.

The developer will then either (a) apply to a conservation bank to purchase the required number of habitat value credits for the identified threatened and endangered species, or (b) undertake a permittee-responsible on- or off-site private mitigation. To be most effective, the conservation banks as well as alternative habitat mitigation should be conducted within priority sites as identified by the species conservation plan and approved by the Conservation Bank Review Trust. Where extensive habitat enhancement/restoration is required as part of the mitigation, the mitigation should be enrolled formally as a conservation bank to ensure that management continues long-term under a responsible party.

The developer will submit evidence of meeting the WHV mitigation credit obligation to the NJDEP Land Use for final certification of meeting the no-net-loss of WHV requirements. Counties (or NJDEP Land Use) will maintain a GIS database of each WHV transaction and will provide the GIS database and a yearly summary values gained and lost for each municipality to the NJDEP.

Conservation Banking System

A statewide entity called the Conservation Bank Trust (CBT) will be responsible for oversight of conservation banking. Part of the trust's responsibilities will be to create a registry of certified mitigation banks. A conservation bank sponsor will need to meet standards stated by the CBT in order to be certified for inclusion on the registry. Conservation banks may be certified for one or multiple species depending on the configuration of the bank's capacity for mitigation. The CBT will solicit new projects to guide the activities of conservation banks.

The CBT will offer two alternative methods of purchasing credits.

1. Establishing and operating a trading platform for the orderly exchange of credits between developers and conservation banks
2. Receiving and holding payment that would then fund conservation banks/projects submitted by conservation banks

The CBT will work with ENSP to determine best management practices for all threatened and endangered species. The ENSP will provide technical guidance and training to conservation banks and consultants to implement species-specific habitat management techniques, as well as to help identify priority sites where conservation banks should be preferentially located (i.e. through the state Wildlife Action Plan, Habitat Connectivity planning framework or individual species recovery plans). Conservation banks will be required to follow established best

management practices when proposing active management projects. These activities will be outlined in mitigation plans that will be evaluated and approved by the CBT before initiation of a selected mitigation project.

The CBT will certify the number of credits earned for each project. Conservation banks will be responsible for ensuring that management plans are implemented. ENSP and CBT will review the conservation banks' projects every three years to ensure that the projects are following best management practices for the target species. This review would provide the basis for adaptive management of individual species' habitats and revision of best management practices. The CBT will notify conservation banks that are out of compliance. Noncompliance will threaten the conservation bank's certification.

Funding Mechanism

The conservation bank credit costs will incorporate stewardship endowment monies to support long-term management for individual conservation banks. The CBT will be responsible for the stewardship endowment. The CBT will be funded by a fee assessed for each conservation banking transaction. The State (e.g., NJDEP Land Use, ENSP, NJDEP OIG, the Habitat Value Mapping Entity) will be funded by fees associated with the permitting process.

Background on Species Conservation Banking

We are proposing that the state of New Jersey implement new policies and regulations to promote the use of conservation banking as a means of protecting and restoring the state's wildlife. The proposed policy is based on the premise that we as a society accept that development activity must and should take place – the question is how to minimize the consequent environmental damage and to optimize conservation outcomes. The federal Endangered Species Act (ESA) was passed in 1973 to protect those species that are threatened or in danger of extinction nationwide. New Jersey passed similar legislation also in 1973 to protect and restore threatened and endangered (T&E) wildlife in the Garden State. Both Endangered Species Acts rely heavily upon command-and-control regulation to protect species populations from direct and/or incidental take (Nash 2008). The ESA also regulates actions that may negatively impact habitat that is deemed critical to listed T&E species' survival. The ESA may prohibit such activity from taking place or require that impacts to any listed species be mitigated by offsetting actions to benefit that same species.

In considering the appropriateness of development activity, priority should be given to the avoidance of negative environmental impacts to threatened and endangered wildlife species' habitat, followed by minimization and lastly by compensation. Habitat mitigation, as a form of compensation, consists of the conservation or restoration of high biodiversity value habitat as a means of offsetting degradation of natural habitat of relatively low biodiversity value (ten Kate et al. 2004). One approach to habitat mitigation that has seen expanding use nationwide as well as worldwide, is referred to as species mitigation or conservation banking (Bayon 2008; Madsen et al. 2011). Conservation banking refers to the process of setting up species credits via a banking agreement and the "trading" (i.e., using or selling) of those credits (Bonnie 1999; Fox

and Nino-Murcia 2005). In contrast to the regulatory approach that penalizes landowners for harming protected species, conservation banking creates a market incentive for landowners to conserve wildlife (Wilcove and Lee 2004; Bunn et al. 2013). In considering habitat mitigation, the US Fish & Wildlife Service (USFWS 2003) recognizes the following hierarchy of choices:

1) **Conservation Banking –** Credits can be purchased at an approved bank appropriate for the species. The bank sponsor takes on the liability of the success of the mitigation.
2) **In Lieu Fee Program –** Permittees pay a fee to an approved compensation fund in lieu of implementing their own mitigation. The in-lieu fee sponsor provides the mitigation when sufficient funds have been collected to implement a mitigation project in an approved conservation bank and takes on the liability of the success of the mitigation. This option is used only if appropriate for the species and no existing conservation bank opportunities are available.
3) **Permittee-Responsible Mitigation –** Permittees implement their own mitigation projects, either on-site or offsite, often through third party providers. The permittee is always responsible for the success of the mitigation, regardless of who does the work.

Any conservation strategy should address the factors which caused the species to be listed and must be based on sound scientific principles. Habitat mitigation is not appropriate in circumstances where development should not proceed in the first place. Some wildlife habitat areas are recognized as irreplaceable and should be avoided, i.e., areas or locations that are critical to a species life cycle such as breeding, nesting, or overwintering and that have such unique characteristics that make them rare on the landscape. Examples include timber rattlesnake hibernacula, tiger salamander vernal pond breeding sites, bald eagle nests. Where habitat is deemed critical but not irreplaceable, conservation banking or in-lieu fee programs are considered as preferred options in light of the fact that the main threat to a majority of listed species is habitat loss and fragmentation of the remaining habitat (Fahrig 2003). In recognition of this threat, the New Jersey Endangered & Nongame Species Program (ENSP) initiated the New Jersey Landscape Project in the late 1990s in recognition that wildlife populations are mobile and need contiguous tracts of habitat to survive. Our expanding knowledge of conservation biology suggests that single habitat tracts or reserves are usually insufficient; thriving populations of species are best conserved in a reserve network consisting of core populations that are interconnected by dispersal corridors. The New Jersey Endangered & Nongame Species Program (ENSP) is presently coordinating the Habitat Connectivity project to model and map such a reserve network/corridor design.

Conservation banking can aid in such a strategy by adding conservation areas that are permanently managed to the reserve network (USFWS 2003). The goal of any habitat mitigation strategy should be to promote the conservation or restoration of high biodiversity value habitat (e.g. focusing on priority sites or ecological corridors). Banks should be evaluated for their regional conservation value and their contribution to the designed reserve network of the regional plans (Bunn et al. 2013). This goal can be more readily accomplished by a properly designed conservation banking and/or in-lieu fee program that concentrates mitigation in larger areas of habitat where conservation outcomes are more secure, rather than by trading small, highly compromised sites (ten Kate et al. 2004; Bunn et al. 2013). Such a properly designed program could also be informed by as well as advance the goals of New Jersey's state

wildlife action plan (Bean et al. 2008) and the Habitat Connectivity plan. The general consensus of the conservation banking literature is that on-site mitigation has a lower chance of success and often does not promote the broader goals of the permanent conservation of larger more viable preserves and improving habitat connectivity (Ruhl et al. 2005; Bunn et al. 2013). Further, conservation banks can take advantage of economies of scale that are often not available to individual, on-site mitigation projects (Wheeler and Strock 1995).

Recent reviews of habitat mitigation programs worldwide (Bean et al. 2008; Madsen et al. 2011; USFWS 2013a and b; Bunn et al. 2013) conclude that habitat conservation banking/mitigation programs will only achieve results for conservation if they are adequately designed, implemented and enforced. Further, these programs must be mandated by regulation, rather than voluntary in nature. The state of California provides a good example in that "California has well-defined laws that create the infrastructure for species conservation banking. Therefore it has fifty endangered species/habitat banks while the rest of country has ten" (ten Kate et al. 2004). In their recent review of California's conservation banking program, Bunn et al. (2013) cited the strengthening of standards for approving new banks, designing and evaluating monitoring programs and reviewing conservation performance through either statute or regulation as a needed reform.

In order to avoid arbitrary project-by-project decisions, conservation banking requirements must be undertaken in accordance with consistently applied principles (Bean et al. 2008). Accordingly, conservation banking requires the determination of what will be counted as "currency" (Bean and Dwyer 2000; Sohn and Cohen 1996) in what is referred to as the habitat transaction method (Nash 2008). The two main types of currency "traded" to date in other programs across the United States are acres and habitat functions. The method of calculating bank credits should be the same for calculating matching project impact debits.

A general rule is that the compensatory mitigation should be in place concurrent with, and preferably before, permitted activity. The creation and certification of conservation banks should be in place prior to the sale of mitigation credits (Bean et al. 2008). This will decrease the regulated community's uncertainty regarding the availability of endangered species mitigation and reduce the time delay associated with getting permit approval (Bonnie 1999). In addition, this will provide the conservation community greater certainty as to the success of the habitat enhancement/restoration actions before any "loss" from development activity takes place.

Another consideration is the determination of the service area for a species conservation bank, i.e., the geographic region where the adverse impacts of development projects can be covered by a particular conservation bank. While undertaking habitat mitigation in close proximity to the impacted location is preferred, in practice, service areas should be as large as possible so as not to have "thin" non-competitive markets (i.e., too few players). The USFWS Guidance (2003) suggests that the service area should be justified based on species conservation considerations. Ideally, the banks should be located within areas designated by species recovery plans as "recovery units." If there is no official recovery plan for the species, the bank location and service area should be based on considerations such as the population structure and distribution of listed species. Additional geographic considerations such as ecoregional or watershed boundaries may also be incorporated (Bean et al. 2008).

Our goal of many species conservation banking is the no net loss of habitat value, not necessarily habitat area. No net loss implies that development actions may proceed only if the mitigation offsets used provide for a 'net maintain or improve outcome' in terms of habitat value. Basically what results is a form of "cap-and-trade" system with the cap being the existing amount of habitat value (Sohn and Cohen 1996). In some respects, the goal of the T&E species program is to increase the populations of listed species such that they are no longer in danger of extinction or extirpation. Thus one might consider that the goal of any conservation banking program should be a "net gain" in habitat area, rather than just maintaining the status quo. While there are no "hard and fast" rules, ratios of newly protected or restored habitat to impacted habitat of 1.5:1 or 2:1 are fairly typical (ten Kate et al. 2004). Even with 2:1 ratios, concern over the ability to meet no net loss mandates is warranted. Critiques of the US wetlands mitigation programs suggest that wetlands mitigation has not succeeded in its no net loss goals, in that the reduced quality of the "restored" areas does not balance that of the converted or impacted wetlands (Turner et al. 2001). Similarly, concerns about Australia's biobanking program (similar to species conservation banking but expanded to consider whole ecosystem biodiversity) suggest that the concept of no net loss is flawed in that a trade between areas (i.e., preservation protection alone) does not necessarily result in a net gain (Burgin 2008). Gardner et al. (2013) suggest that biodiversity offsets are rarely adequate for achieving no net loss of biodiversity alone. To hope to be successful, biodiversity gains must be comparable to losses, be in addition to conservation gains that may have occurred in absence of the offset, and be lasting and protected from risk of failure. Our proposed conservation banking system for T&E species tries to incorporate these recommendations and takes a precautionary approach in advocating for no net loss of habitat value.

In conclusion, conservation banking provides many advantages to the development community in that it simplifies mitigation requirements and reduces costs. The following is based on the state of California's nearly twenty years of experience with conservation banking (CDFW 2012). There is no need to:

- secure a habitat mitigation project site,
- legally protect the mitigation site in perpetuity,
- develop and implement a mitigation project plan, or
- monitor and maintain the mitigation.

This in turn leads to:

- Greater flexibility in initial development siting,
- Cost reductions over "do it yourself" mitigation together with greater cost certainty,
- "One stop" permit compliance,
- Decreased permit wait time as purchase of bank credits immediately satisfies the mitigation requirements of the permit.

The advantages of the proposed conservation banking program to New Jersey's T&E species is:

- Incentives to develop marginal, lower value vs. higher habitat value areas,
- Protection and restoration of larger, more functional and viable wildlife habitat areas,

- No temporal loss of habitat value because protection/restoration is completed before the impacts occur,
- Management and ownership by endangered species professionals,
- ''No Net Loss'' in habitat value at minimum, often with a gain of habitat acres,
- Permanent protection in the form of a conservation easement or fee title held by a qualified conservation entity, enforced by a qualified third party.

The advantages of the proposed conservation banking program to New Jersey's conservation and natural resources management community is:

- Proactive planning to identify core habitat and connecting landscape corridors,
- Enhanced funding for fee simple purchase/conservation easements to protect priority habitat and corridors,
- Enhanced and stable source of stewardship funding for ecological restoration and habitat enhancement actions.

Components of the Proposed New Jersey Conservation Banking/Habitat Mitigation Program

The following are recommended components for New Jersey's Conservation Banking/Habitat Mitigation Program for all of New Jersey's listed T&E species (NJDEP 2013). Where NJ listed species are also federally listed species, federal ESA law supersedes New Jersey law. The proposed conservation banking program is for New Jersey listed species only, though there may be advantages for the state to work with the USFWS to develop a coordinated state-federal program. The terminology is adapted from USFWS 2012, California Department of Fish & Wildlife 2012 and Bunn et al. 2013.

Conservation Bank Trust (CBT)

A CBT is similar to the role of the Conservation Bank Review Team in the USFWS 2003 guidance. The New Jersey CBT should be established to act as signatories to bank agreements, be responsible for handling endowments, and oversee the establishment, use, and operation of conservation banks. Similar to the Wetlands Mitigation Council established by the New Jersey Freshwater Wetlands Protection Act, the CBT should be independent of the NJDEP. The Natural Lands Trust could serve in the role of a CBT to coordinate and oversee the state's Conservation Banking/Habitat Mitigation Program. Rather than establishing multiple CBTs with one team for each conservation bank project (as originally proposed in the USFWS 2003 guidance), we are proposing the establishment of a single CBT with oversight of the entire statewide program or alternatively, one CBT per service area.

Conservation Bank Sponsors

Conservation Bank Sponsors could be any public or private entity responsible for establishing and, in most circumstances, operating a conservation bank. While permittee-responsible

mitigation (either on-site or off-site) would be allowed, where there would be extensive habitat enhancement (as compared to strictly habitat preservation via purchase/easement) as part of the mitigation, then the mitigation should be enrolled formally as a conservation bank to ensure that management continues long-term under a responsible party.

Fee Title or Easement

Conservation banks should be protected in perpetuity either by purchase of fee title or by easements on the land to ensure it is managed for conservation values. A key decision is who will own the land or hold the easement. A conservation bank sponsor may initially own a bank but later transfer ownership to the state or to a nonprofit land management firm.

Credit and Debit Values

A credit is a unit used to quantify the species or habitat conservation values within a conservation bank. A debit is a unit used to quantify adverse impact to species or habitats of concern on lands being developed. We are proposing that credits/debits be based on a quantification of "wildlife habitat value" grounded in sound conservation biology principles as measured by species habitat area, intactness, and contiguity. Implicitly, areas of higher habitat value are able to support larger, more viable populations for a species in question. We posit that 1) not all land areas have equal habitat value; and 2) the value of a tract of land as habitat for listed T&E species may be raised in many cases through enhancement or restoration actions.

The responsible state agencies (NJDEP Land Use Regulation Program in consultation with the Endangered & Nongame Species Program) decide how many credits must be purchased to offset the impact of a development project, and these terms are a requirement for mitigation and permit approvals. Alternatively, in-lieu fees may be assessed for development projects that do not meet a pre-determined threshold in terms of project area or impacted habitat value. These in-lieu fees would go into an account held by the CBT to purchase conservation bank credits.

Fees may be levied by the responsible state agency to support the permit review and approval process.

As a general rule, a single development project may impact more than one species and thereby generate the debits for multiple listed T&E species. Similarly, a conservation bank may house more than one listed species and thereby also sell credits for more than one species. A conservation bank may sell credits to offset debits incurred by more than one development project, however an individual species credit can only be sold once. A conservation bank can only sell credits after it is up and running and certified as meeting the habitat needs for the target species.

In light of these concerns, we advocate that the state of New Jersey take a measured, phased approach to conservation banking and err on the side of caution by advocating for a "net gain" in habitat value. This could be accomplished by ratios of newly protected/enhanced habitat to impacted habitat of 2:1 at a minimum.

To more fully understand the economic ramifications of the proposed debit/credit offset system and the resulting monetary prices for credits, we propose that an economic analysis be undertaken.

Service Area

The service area is a geographic region where the adverse impacts of development projects can be covered by a particular conservation bank. The service area should be justified based on ecological considerations, including eco/physiographic region boundaries as well as the population structure and distribution of listed species. As there are no official recovery plans for New Jersey state-listed threatened and endangered species, geographic recovery units have not been designated for individual species. As a starting point, we propose that the service areas for individual listed species follow either the ENSP Landscape Project Landscape Regions (Figure 4) or the NJDEP Division of Land Use Regulation ecoregions (Figure 5) and must be approved by the NJ ENSP. We also advocate that the service areas should be somewhat flexible such that the services areas for an individual species might be modified based on that species needs (i.e., individual regions in Figure 4 might be combined or split as needed).

Endowment and Financial Commitments

To cover the costs of management and monitoring in perpetuity, conservation banks should establish a non-wasting management endowment (i.e., a fund that generates enough interest each year to cover the costs of the yearly management and in which only the interest on the endowment funds is spent each year). This endowment could be established by including the cost of management into the price per credit. A key issue to address in bank agreements is how to ensure funding of management and monitoring in the first few years of the bank operation, prior to full investment in the endowment from the sale of credits. In addition, if a bank is failing to meet conservation performance goals, financial commitments for managing the bank site may be secured with bonds or other means. The CBT will be responsible for holding and managing stewardship endowments. In addition, the CBT will hold and manage in-lieu fee payments for investments in conservation banks.

The CBT will be funded by a fee assessed for each conservation banking transaction.

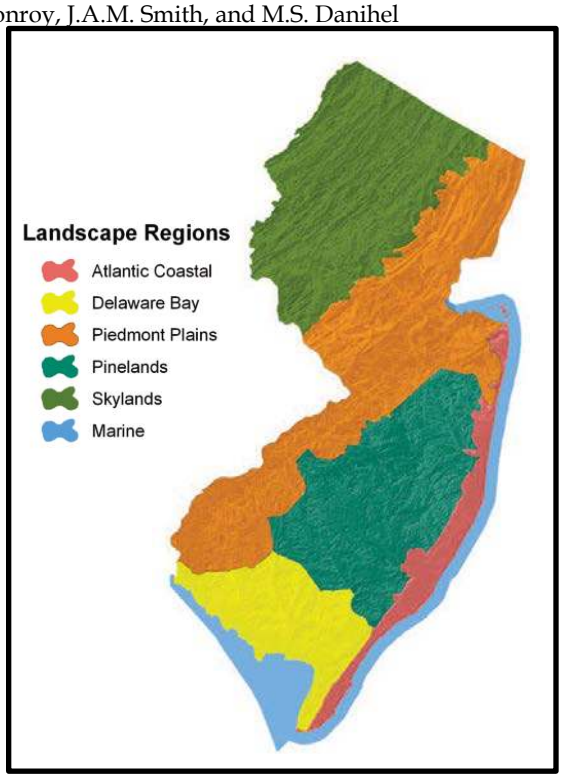

Figure 4. Map of ENSP Landscape Project landscape regions.

Figure 5. Map of Land Use Regulation Program ecoregions.

Site Management Plan

Bank agreements must include a management plan and designated management entity (bank sponsor), usually a third-party organization that is responsible for implementing conservation measures — such as habitat management, restoration or creation — and for managing the site in perpetuity. Implementation of habitat mitigation should only be outsourced to a third party organization, either governmental or nongovernmental, with appropriate interest and qualifications in conservation.

These management responsibilities may be transferred. For example, a bank sponsor may provide management during the habitat creation phase and then transfer management to the state or a nonprofit for ongoing maintenance of the site. Bank agreements should require that annual management reports be submitted to wildlife agencies.

Monitoring Plan

Conservation banks should establish a monitoring program to determine whether biological goals are being met as well as to inform adaptive management (adjusting management actions in the field based on changes detected through monitoring). Monitoring results are included in the annual management reports.

Conservation Banking Glossary (adapted from USFWS 2003 and 2012)

Bank Sponsor - any public or private entity responsible for establishing and, in most circumstances, operating a conservation bank.

Conservation Actions - the restoration, enhancement, or preservation of species habitat for the purpose of reducing adverse impacts to listed species populations.

Conservation Bank - a site where habitat and/or other ecosystem resources are conserved and managed in perpetuity for listed species expressly for the purpose of offsetting impacts occurring elsewhere to the same resource values.

Conservation bank review team - an interagency group of Federal, State, and/or local regulatory, resource agency or other representatives that are signatory to bank agreements and oversee the establishment, use, and operation of conservation banks. In the case on New Jersey, we are proposing to name this entity as the Conservation Bank Trust.

Conservation Easement - a recorded legal document established to conserve biological resources in perpetuity, and which requires certain habitat management obligations for the conservation bank lands.

Credit - a unit of measure representing the quantification of species or habitat conservation values with in a conservation bank.

Endowment Fund - an investment fund maintained by a designated party approved by the Service as a non-wasting endowment to be used exclusively for the management of the conservation bank lands in accordance with the management plan and the conservation easement.

Debit - a unit of measure representing the adverse impact to a listed or sensitive species at an impact or project site.

Enhancement - activities conducted in existing species habitat, or other resources, that increase one or more ecosystem functions.

Fee title - a fee title estate is the least limited interest and the most complete and absolute ownership in land; it is of indefinite duration, freely transferable and inheritable.

Management Plan - the plan prepared to manage the conservation bank to, at a minimum, maintain the listed species value on the bank. This includes on-the-ground management activities, funding, and monitoring and reporting requirements.

Non-wasting management endowment - an account that generates enough interest each year to cover the costs of the yearly management.

Off-site conservation - conservation actions occurring outside the boundaries of a project site.

On-site conservation - conservation actions occurring within the boundaries of a project site.

Preservation - the protection of existing ecologically important habitat or other ecosystem resources in perpetuity through the implementation of appropriate legal and physical mechanisms.

Restoration - reestablishment of ecologically important habitat and/or other ecosystem resource characteristics and function(s) at a site where they have ceased to exist, or exist in a substantially degraded state.

Service area - the geographic area (e.g., watershed, county) wherein a bank can reasonably be expected to provide appropriate conservation benefits for impacts to habitat and off-site impacts can be offset by purchase of credits in the bank. The geographic area for which a conservation bank's credits may be applied to offset debits associated with development activities.

Wildlife Habitat Value - the unit of measure of species or habitat conservation values impacted at a development project site (as a debit) or contained within a conservation bank (as a credit).

Wildlife Habitat Value Debit/Credit Quantification Model

We are proposing a quantification of "wildlife habitat value" to serve as the "currency" to determine credits/debits for the proposed wildlife habitat value trading system. Our metric of *habitat value* is grounded in sound conservation biology principles as measured by species habitat area, intactness, and contiguity. Implicitly, areas of higher *habitat value* are able to support larger, more viable populations for a species in question. We posit that 1) not all land areas have equal *habitat value*; and 2) the value of a tract of land as habitat for listed T&E species may be raised in many cases through preservation, enhancement, or restoration actions. To calculate and map *habitat value* we have created a geographic information system (GIS) model that can be easily replicated and refined in the future. This model has two parts: 1) quantifying the *habitat value* of existing documented habitat areas; and, 2) quantifying the potential for increasing *habitat value* through conservation actions.

The first part of the model creates a consistent and quantitative map of *habitat value* for listed threatened and endangered species in New Jersey for the entire state of New Jersey. This model not just delineates habitat, but also scores all habitat with a relative value of 0 to 100 on a per acre basis. From the map, one can identify the extent and value at risk for any piece of property in New Jersey. This is the value that would be lost if the property were developed, thereby representing a debit that must be matched with an equivalent credit value multiplied by the selected multiplier such that there is a no net loss of habitat value. Credits can be earned in two ways; by increasing either the preservation status of another property by changing ownership to some sort of permanent conservation ownership or easement, or through some sort of habitat enhancement or restoration action on that other property to benefit the species in question. Each of these options is quantified in the model. All of this is on a per species basis.

Habitat Value Quantification Model

The habitat value model has two main components (Figure 6). The first component determines habitat value statewide by scoring each acre on a value scale from 0 to 100 with 0 = non-habitat and 100 = excellent habitat for each listed T&E species of wildlife, given that the species is known to reside there. The resulting map forms the basis for the quantification of the habitat value debits and credits. Given a GIS file of the prospective development boundaries, the impacted habitat value for listed T&E species can be quantified (i.e., the debit). By changing the boundaries of the development footprint, a developer could potentially decrease the amount of impacted habitat value. The Habitat Value Model can also be used to assess potential conservation bank locations and the potential credits gained from a change in preservation value such as a change in ownership to a permanent conservation easement or some other type of permanent conservation ownership or an enhancement of habitat quality for the species in question.

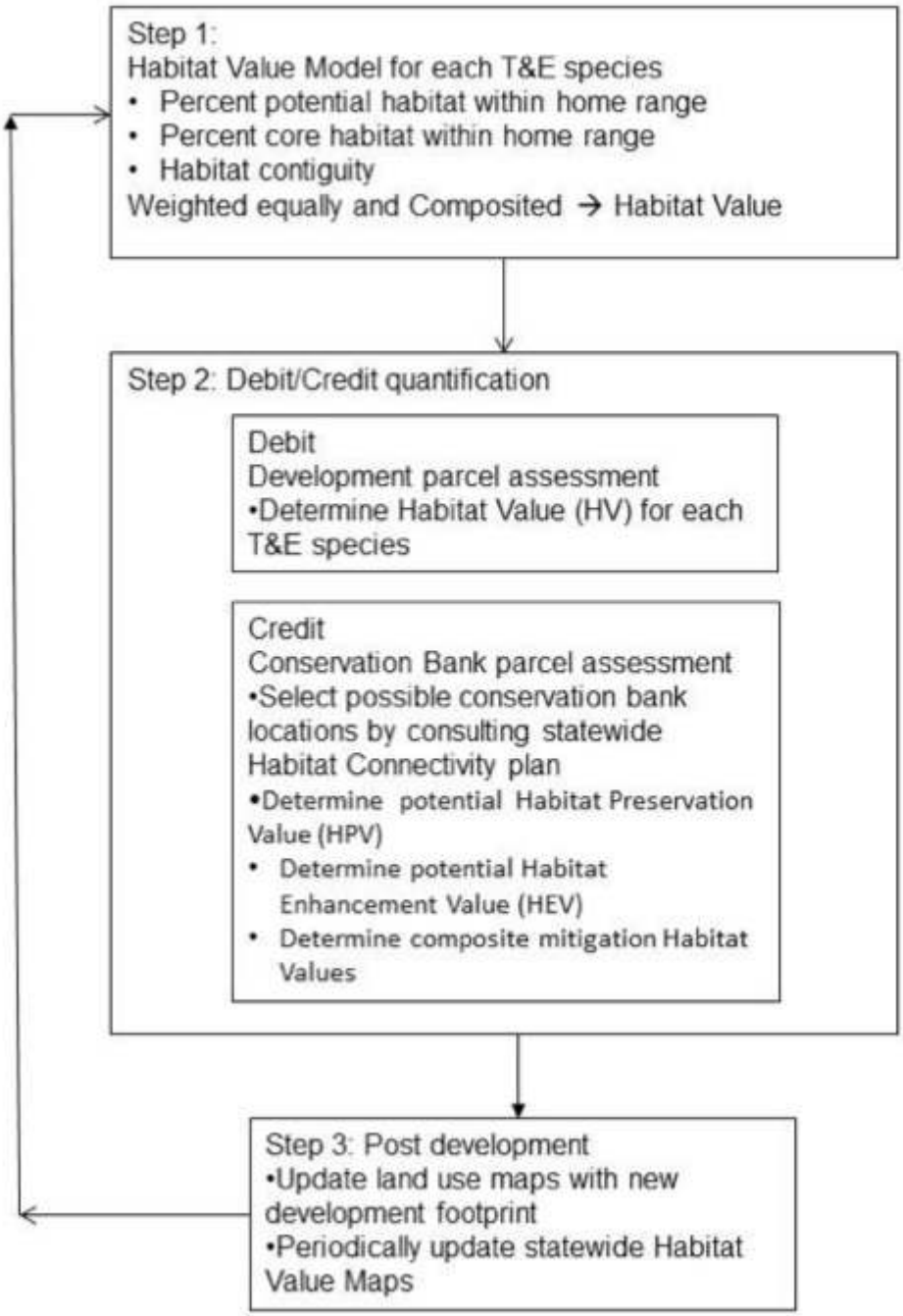

Figure 6. Flowchart of Habitat Valuation modeling and Debit/Credit Quantification.

Habitat Value

The habitat model calculates a habitat value for selected T&E species. The modeled species were those that are more wide-ranging (i.e., have larger home range sizes) or have greater spatial distribution across the state. Some species that are very rarely occurring or have restricted habitat requirements were deemed to be irreplaceable and not "tradeable" in a species conservation banking context, and thus were not modeled. The existing Landscape Project 3 habitat mapping would serve "as is" to characterize the habitat value for those species. The descriptions and procedures below apply to each of the modeled species individually. For more detailed information please refer to Appendix B.

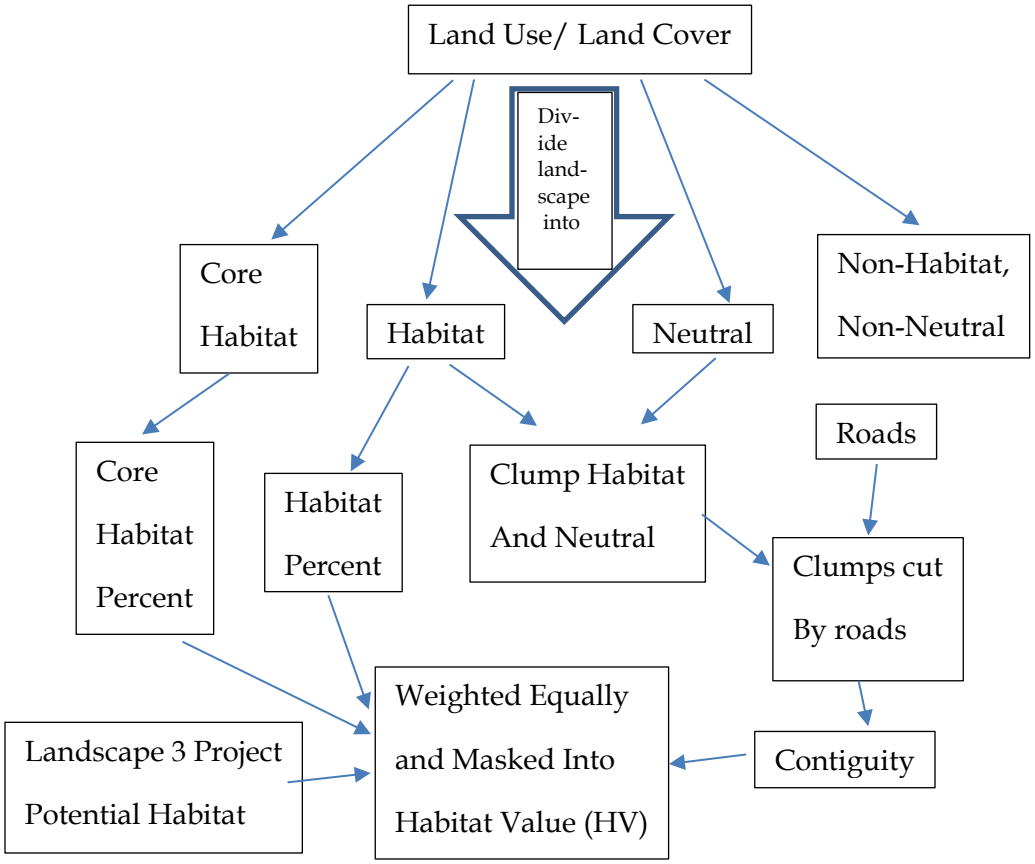

Figure 7. More detailed flowchart for Habitat Value model.

The Habitat Value is made up of three measures that are weighted together for the final Habitat Value (Figure 7). These measures are Percent Habitat, Percent Core Habitat, and Contiguity. The basis for all three measures is the land use/land cover map of New Jersey and surrounding states. In addition, information from the NJDEP ENSP Landscape 3 project is used. For the GIS modeling, a base layer of 50 ft. grid cells is used. (This grid cell resolutions was chosen to provide a reasonable degree of spatial detail but also allow for efficient statewide GIS processing.) The values are created for each 50 ft. square section (pixel) of New Jersey then aggregated to give a per acre measure.

The land use/land cover maps are used in conjunction with the Landscape 3 habitat definitions

to determine which areas are potential habitat, which are neutral (meaning the wildlife in question would likely travel through or not completely avoid the area in question but would not live there), and which are non-habitat. Furthermore, a buffer of 300 feet is calculated around the non-habitat and the habitat that does not fall within the buffer is deemed core habitat for this model. Thus, there are four categories of land for each species: non-habitat, neutral, edge habitat (habitat but not core habitat), and core habitat.

The percent habitat value is calculated per pixel by contemplating the scenario in which the pixel receiving the value is the center of a circular home range the size of the average home range of the species in NJ (based on Landscape 3 project documentation). The percentage of that circle that is habitat (core or edge) is then calculated and multiplied by 100 to provide the value for the pixel. Thus the values for percent habitat run from 0 to 100 with 100 signifying that the entire circular home range centered at that pixel is habitat for the species. 0 signifies that not one pixel within the circular home range centered at the pixel receiving the value falls into the habitat category.

The percent core habitat value is calculated analogously except by measuring the amount of core habitat in the circular home range surrounding each pixel.

The contiguity value is a measure of how large an area of habitat (core or otherwise) can be accessed by the species by travelling through habitat or neutral and by crossing roads of certain types. The larger the area of habitat accessed, the higher the contiguity value. Similar to the percent habitat and percent core habitat, the value is on a scale of 0 to 100. In order to quantify this value, core habitat, habitat, and neutral are clumped. Roads determined to be difficult for the species to cross are then subtracted from the clumps so that the original clumps are cut by the roads into smaller clumps. Please refer to Appendix B for more detail.

The amount of habitat in each of these smaller clumps is measured. Clumps with area less than one home range receive a contiguity value of 0. The contiguity value on a scale of 0 to 100 is the amount of habitat in each clump divided by the amount of habitat in a stated number of home ranges multiplied by 100 and limited to 100. These are rounded to whole numbers. Please refer to Appendix B for more detail.

The percent habitat value, core percent habitat value, and contiguity value are weighted equally and composited together to determine the Habitat Value for each species for each pixel. Landscape Project 3 GIS data for each species is used to "mask" the composited habitat value data such that only habitat designated as potential habitat in Landscape 3 Project GIS maps is given a nonzero value. The end result is a map layer with Habitat Values for each species. This value measures the quality of the habitat using a scale of 0 = non-habitat up to 100 = highest quality habitat.

The per pixel values are translated into per acre values. In determining the habitat value for an individual property, the values are additive. Thus a piece of property one acre in size has a Habitat Value between 0 and 100. A two-acre property has a Habitat Value between 0 and 200.

Calculation of Conservation Credits

The second section of the model calculates potential mitigation values that could be realized for prospective conservation bank properties. This section of the model starts with the Habitat Values from the previous section, which are then modified for Habitat Preservation Value and Enhancement Value. Preservation Value measures the protection afforded the property in terms of probability of change in use; it is a composite value based on the ownership of the property and the likelihood of property within such ownership to change land use to the detriment of endangered and threatened species. Lands enrolled in a conservation bank (i.e., put into permanent public ownership or easement with natural lands or wildlife habitat management as their highest priority) would receive the highest Habitat Preservation value of 1.0 or 100%. Lands preserved as public open space but not as a fully certified conservation bank could receive some lower weighting (i.e., < 100%). The Habitat Enhancement Value represents the incremental increase in the land's carrying capacity for the target species as a result of proactive habitat enhancement actions. For example, these actions could include vegetation management (e.g., maintaining early successional vegetation or invasive species removal), other species management (i.e., removal of deleterious competitors or predators) or by preserving/creating dispersal corridor connectivity. Habitat Enhancement Value ranges from 0% to 50% (0 – no additional value; 25% –positive but not optimal value; 50% - optimal value); these values are in addition to the Preservation Value allowing a total value of 150% of Habitat Value. Habitat Enhancement Value is a smaller portion of the total due to the comparative uncertainty of habitat enhancement actions on raising species population status. As greater knowledge and experience is developed, the Enhancement Values can be modified in the future.

Offsetting Debits with Credits

The debits calculated in the first section are then balanced with credits acquired through participation in the conservation banking system. Below is a simplified yet realistic example to explain how the calculation of debits and credits is done and to show a comparison of a development parcel and a conservation bank parcel that generates those debits and credits.

To begin our example, assume that a 25-acre parcel will be developed. This parcel contains a generic T&E species (Species A) habitat and no other endangered or threatened species are known to use this parcel of land. According to the Habitat Value model, this 25 square acre area (represented as one square per acre below) has a corner of habitat and subsequently has the following habitat percent:

0	10	12	15	25
0	10	12	15	15
0	10	12	12	12
0	0	10	12	12
0	0	0	10	10

The following habitat core percent:

0	0	10	12	12
0	0	10	12	12
0	0	10	10	10
0	0	0	10	10
0	0	0	0	0

The following contiguity values (as it is within reach of a fairly large amount of habitat)

0	0	80	80	80
0	0	80	80	80
0	0	80	80	80
0	0	0	80	80
0	0	0	0	80

These values average together to give the following table of Habitat Values:

0	3	34	36	39
0	3	34	36	36
0	3	34	34	34
0	0	3	34	34
0	0	0	3	30

The sum of the values is the total Species A debit for the parcel and equals 430. Assuming that the development footprint removes all of the habitat on the parcel, the developer of the parcel will offset 430 debits. The number of offsetting credits depends on the required Credit:Debit ratios required to reach Non Net Loss of Habitat Value. For example, at a 2:1 Credit:Debit ratio 860 credits would be needed to offset the 430 debits.

The following portion of the example shows how credits might be created by a conservation bank or by a mitigation procedure.

In example A, assume there is another piece of private property also 25 acres within the designated service area. This property has been preserved as a conservation bank for the target species, but that no special management will be undertaken to increase the carrying capacity for the species (i.e., Habitat Enhancement weighting factor = 0.0 or 0%). As an approved conservation bank, the full value of the Habitat Value credits is available for sale (i.e., the Habitat Preservation + Habitat Enhancement weighting factor = 1.0 or 100%), which adds up to 1200 credits.

40	50	50	60	40
40	50	50	60	40
40	50	50	60	40
40	50	50	60	40
40	50	50	60	40

In Example B, there is a 50-acre conservation bank within the service area. This area has a lower initial habitat value of 690.

5	5	10	10	20	20	10	10	15	15
5	5	10	10	20	20	15	15	20	20
5	5	10	10	20	20	15	15	20	20
5	5	10	10	20	20	15	15	20	20
15	15	10	10	10	10	20	20	20	20

If the property was enrolled in a conservation bank and the habitat is proactively managed to increase the Habitat Enhancement Value by 0.25 or 25% (i.e., the Habitat Preservation + Habitat Enhancement weighting factor = 1.25 or 125%), then the overall weighting factors values = 125% (preservation + enhancement) for a total number of credits of 862.5.

6.25	6.25	12.5	12.5	25	25	12.5	12.5	18.75	18.75
6.25	6.25	12.5	12.5	25	25	18.75	18.75	25	25
6.25	6.25	12.5	12.5	25	25	18.75	18.75	25	25
6.25	6.25	12.5	12.5	25	25	18.75	18.75	25	25
18.75	18.75	12.5	12.5	12.5	12.5	25	25	25	25

In Example C, there is an existing 125-acre property that is already preserved as public conservation land but that receives no special species-oriented management. The sum total of initial Habitat Value for the entire property is 1725 (i.e., the property is similar in character to Example B above but 2.5x as large). This property is then enrolled into a conservation bank and actively managed for the target species. In this case the Habitat Preservation weighting factor = 0 (already preserved, so no credit given) but the Habitat Enhancement factor is 0.25 or 25%, giving an overall weighting factor of 0.25 or 25%. The sum total of credits is 25% of 1725 = 431.5.

Options to Achieve No Net Loss of Habitat Value at Regional Scales

The following mock "thought experiment" examines different options for achieving the goal of No Net Loss of Habitat Value at the scale of a service area or other geographic region. In this example an area of 100 units with varying habitat value is progressively developed over several time steps until buildout. As area is progressively developed and debits generated, these are balanced by credits generated by land being enrolled in a conservation bank. In the first scenario both the debit value and the credit values of the developed and conserved land respectively equal 100% of their habitat values. Two different Credit:Debit ratio options are evaluated (1:1 and 2:1 Credit:Debit ratio). [Noted on the chart as "Hab 100%".] In the second scenario, it is assumed that the habitat value of the conservation bank credits are boosted by a factor of 1.5 (i.e., the habitat value of the conservation bank achieved through proactive species

management/habitat enhancement actions is 1.5 times the value of the land if strictly preserved; Habitat Preservation weighting factor of 1.0 + the Habitat Enhancement weighting factor of 0.5 = total weight of 1.5 or 150%) and this increased value is given as a credit; the debit value = 100% of the habitat value of the property developed, but the credit value = 150% of the land conserved. [Noted on the charts as "Hab 150% credit given".] In the third scenario it is also assumed that the habitat value of the conservation bank credits are boosted by a factor of 150%, but that the boosting is subsequent to the credit evaluation; , this extra 50% boost in value is not made available for sale as a credit. [Noted on the charts as Hab 150% after credit.]

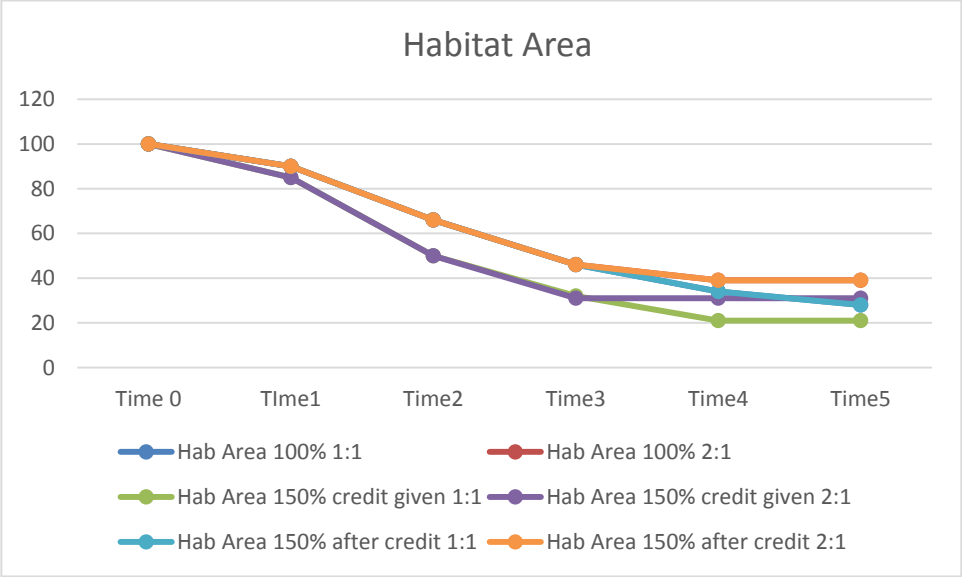

Figure 8. Habitat Area under the different scenarios.

From Figure 8, one can see that Habitat Area is not preserved at the regional scale under any of the scenarios. The loss of habitat area will depend on the variation in habitat values across the landscape. Habitat Value decreases as well except for under one set of conditions: where the 2:1 Credit:Debit ratio and a 1.5x increase in Habitat Enhancement Value (Figure 9). Thus to achieve Non Net Loss of Habitat Value, a 2:1 Credit:Debit ratio is needed at a minimum and assuming that a 1.5x increase of habitat value is feasible through habitat preservation and enhancement actions, but not made available for trading (i.e., to offset debits). Achieving a 1.5x increase for all the listed T&E species is potentially feasible but is not directly supported by the existing body of scientific research at this time. Additional research is needed to evaluate the feasibility of best management options in increasing T&E species populations (i.e., what is the maximum value one can expect for the Habitat Enhancement weighting factor).

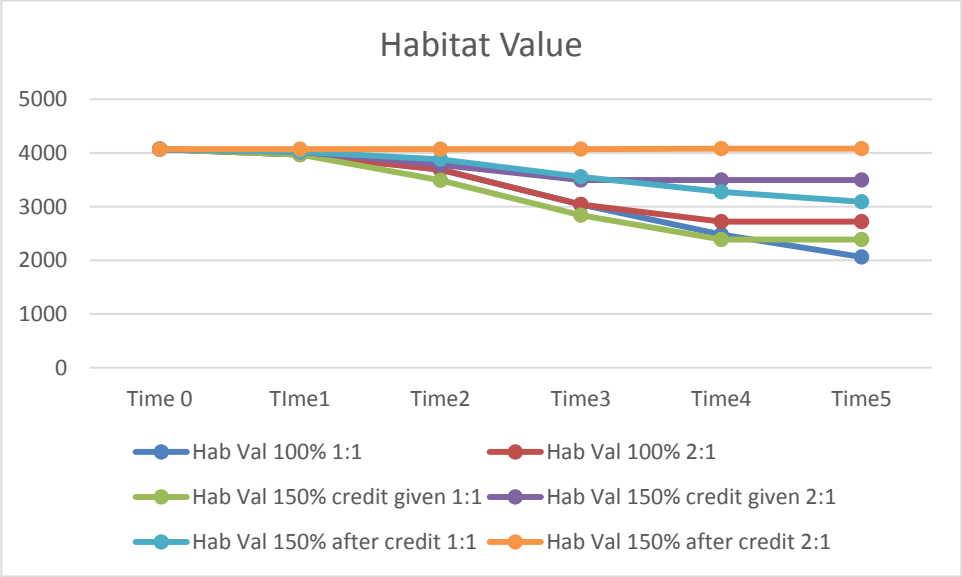

Figure 9. Habitat Value under the different scenarios.

In conclusion, due to the inherent risk and uncertainty in offsetting development debits with conservation bank credits, we recommend a precautionary approach through the adoption of a 2:1 Credit:Debit ratio at a minimum to achieve a no net loss of habitat value. One could argue that even a higher 3:1 Credit:Debit ratio is warranted. While extant species recovery plans could help inform this decision, we suggest that the proposed system can move forward separate from or in tandem with the development of species recovery plans. By implementing the proposed approach under an adaptive management framework, decisions concerning the adequacy of a 2;1 Credit:Debit ratio and/or whether habitat enhancement/restoration actions are sufficient in achieving the envisioned gains can be re-evaluated on a regular basis and revised accordingly.

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Appendix A: Conservation Banking Roles and Responsibilities

The following is proposed as a more detailed outline of the roles and responsibilities of state, county and municipal agencies, and non-profit organizations in the New Jersey species conservation banking program. The New Jersey state government will regulate the no net loss approach to wildlife habitat valuation and develop incentives and regulations to encourage and enforce participation.

State Level

1. The state will develop regulations to establish the species conservation banking program. Participation will be enforced by regulation rather than voluntary in nature.
2. The state will set up a Conservation Bank Trust to oversee and coordinate the species conservation banking program.
3. The state will designate some entity as responsible for the wildlife habitat value (WHV) modeling/mapping process. This could be ENSP, or some third party under contract. As part of the mapping process, we propose the following steps.
    a. Allow every county to review NJDEP land use/land cover (LU/LC) mapping and to coordinate municipal and public input that will update LU/LC data. Use 2012 LU/LC data as baseline.
    b. The New Jersey Office of GIS to compile and quality control LU/LC updates and modify as appropriate.
    c. The designated WHV mapping entity will undertake the habitat value modeling and mapping and release draft WHV mapping. Overall values and weights in the model will be set by the WHV entity with input from an outside academic review committee and approved by the NJDEP Endangered & Nongame Species Program (ENSP). These will be periodically reviewed and updated.
    d. Allow every county to review and coordinate municipal and public input on the resulting WHV mapping and forward recommended changes to the WHV mapping entity.
    e. The Statewide WHV mapping entity will compile, QC, modify as appropriate, and release draft final WHV maps. Disputes will be settled by ENSP. The final maps will be certified and then released by ENSP.
    f. The State shall create an online resource that allows county and municipalities and the development community access to WHV maps.

County and Municipal Level

1. The statewide WHV mapping entity will create mapping that identifies conflicts between existing county/municipal planning and zoning maps and WHV mapping. Maps will provide planners with guidance on degree of conflict:

    Green – no conflict

    Yellow – resolvable conflict/replaceable habitat

Red – irresolvable conflict/ irreplaceable habitat

2. Municipalities and counties will update their master planning as they deem appropriate.

Permitting Process

1. The state will create a process for training or certifying consultants and create a list of qualified consultants to work with the WHV mapping and debit/credit calculation protocol.
2. Qualified consultants and planners will use the WHV mapping to identify the potentially impacted T&E species and to calculate the debits incurred by a proposed development plan.
3. The developer will submit the WHV debits calculation to the NJDEP Land Use Regulatory Program for certification as part of the permitting process, who will approve or disapprove the calculation of lost value.
4. The developer will (a) apply to a conservation bank to purchase the required number of WHV credits for the identified T&E species, or (b) undertake a permittee-responsible habitat mitigation either on- or off-site. This alternative habitat mitigation must follow the rules of a normal conservation bank and be enrolled and approved as such.
5. The developer will submit evidence of meeting the WHV mitigation debit obligation to the NJDEP Land Use for final certification of meeting the no-net-loss of WHV requirements.
6. Counties (or NJDEP Land Use) will maintain a GIS database of each WHV transaction and will provide the GIS database and a yearly summary of the values gained and lost for each municipality to the NJDEP.

Mitigation Banking System

1. A statewide entity called the Conservation Bank Trust (CBT) will be responsible for oversight of species conservation/habitat mitigation banking.
    a. Create a registry of certified conservation banks
        i. Develop standards for the development of mitigation banks
        ii. Certify individual banks for specific species
        iii. Solicit new projects that could serve as the basis for new banks
    b. Create two alternative methods of purchasing credits
        i. Establishing and operating a trading platform for the orderly exchange of credits between developers and conservation banks
        ii. Receiving and holding in lieu payment that would then fund conservation banks/projects submitted by conservation banks
2. The CBT will work with ENSP to determine best management practices for all T&E species for use by conservation banks and will provide technical guidance and training to conservation banks and consultants to implement recovery management techniques.
3. Conservation banks must follow established best management practices in proposing active management projects.
    a. WHV suitability and management plans will be evaluated and approved by the CBT before initiation of a selected mitigation project.
    b. The CBT will certify the number of credits gained/earned.

   c. The conservation banks will be responsible for ensuring that management plans are implemented.

4. The NJDEP ENSP and CBT will review the conservation banks' projects every three years to ensure that the projects are following BMPs for the target T&E species.
   a. This review would provide the basis for adaptive management of individual species' habitats and best management practices.
   b. The CBT will notify conservation banks that are out of compliance. Noncompliance will threaten the conservation bank's certification.

Funding Mechanism

1. The conservation credit costs shall incorporate stewardship endowment monies to support long-term management. The CBT will be responsible for managing the stewardship endowment.
2. Fee assessed on each transaction to fund:
   a. The CBT will be funded by a fee assessed for each mitigation banking transaction.
   b. The State (e.g., NJDEP Land Use, ENSP, NJDEP OIG, the Habitat Value Mapping Entity) will be funded by fees associated with the permitting process.

Appendix B: Wildlife Habitat Value Debit/Credit Quantification Model for Use in Conservation Banking

Introduction

The Rutgers University Center for Remote Sensing & Spatial Analysis (CRSSA) and the Conserve Wildlife Foundation of New Jersey, at the behest of the New Jersey Department of Environmental Protection, have developed a Wildlife Habitat Value Debit/Credit Quantification Model for use in the conservation banking system. This document serves as the technical documentation of the methodology employed.

One problem of current conservation banking systems is that there is a lack of consistency and a difficulty reaching agreement on the number of credits warranted by the wildlife values at the conservation banking site (Bunn et al. 2013). This method attempts to pre-emptively solve this problem by valuing wildlife habitat across the state in a consistent, scientifically-based way. The Wildlife Habitat Value of any tract of land is a function of the landscape scale characteristics of the habitat. The model gives higher value to areas that have a high proportion of potential habitat (i.e., land cover types known to be used by the target species as part of its life cycle), that are comparatively un-fragmented (referred to as a core or interior habitat) and that are contiguous with other documented habitat areas for the target species. Land is categorized as Threatened & Endangered (T&E) Species habitat only if it fits the New Jersey Landscape 3 Project definition of habitat (there is a documented sighting within the landscape habitat patch).

This appendix lays out the method to develop a scientifically defensible estimate of wildlife habitat value for rare and endangered species. Building on New Jersey's Landscape Project, this geographic information system (GIS) modeling methodology was developed to be able to map habitat value at a fine enough scale for site-based planning and decision-making (i.e., at the scale of a typical ownership parcel). Users can use the model to estimate existing habitat value in a single tract or across a municipality or region. They can then apply changes, either negative such as development, or positive such as land management or protection, and recalculate the loss or gain in wildlife habitat value.

The model has been completed statewide using 2007 land use/land cover mapped data; however, a new version of the land use/land cover maps (2012), in addition to scheduled updates made by the municipalities and through public comment periods, indicate that a new set of map layers will need to be completed. This document details the procedures used. In addition, there was a previous pilot project completed for the Highlands during which additional testing of the methods was completed. This will be discussed where relevant.

Background: Wildlife Habitat and the Impact of Fragmentation

Large contiguous tracts of forest, wetland and grasslands (i.e., natural habitat) that are not fragmented by human development are especially valuable as wildlife habitat. Human development has the direct impact of removing existing natural habitat as well as fragmenting the habitat that remains into smaller remnants. Empirical studies suggest that habitat loss has large and consistently negative effects on biodiversity, while habitat fragmentation has much weaker effects that are often highly species specific (Fahrig 2003). When considered from a

landscape perspective, the spatial pattern of the forest remnants may play an important role in maintaining connectivity across a watershed and thereby facilitating such important ecological processes as dispersal for forest-dependent wildlife species (Gardner et al. 1987; With and Crist 1995). In highly fragmented landscapes, the habitat quality of the intervening matrix (i.e., developed or agricultural lands) can also be important in determining how well species can disperse across a landscape as they try to traverse between forest remnants or other habitat patches (Franklin 1993; Malanson 2003). In assessing landscape integrity in the New Jersey Pinelands, Zampella et al. (2008) were guided by the principle that the conservation of characteristic Pinelands animal species, including wide-ranging species, requires the protection of relatively large tracts of Pinelands habitat, including upland forests, wetlands and water bodies.

Paved roads, residential and commercial development often serve as a hazard or barrier to wildlife movement and native plant dispersal, as well as altering "natural" disturbance regimes. Roads of all kinds are associated with negative effects on the biotic integrity of both terrestrial and aquatic habitats (Trombulak and Frissell 2000). Human development also has "indirect" impact by creating a number of different kinds of intrusions with varying depths of impact into adjacent natural habitat and recreational open spaces. These intrusions include increased air, water, noise and light pollution; changes in microclimatic conditions due to higher sunlight and wind levels; increased populations of invasive "weed" species; and increased frequency of disturbance due to direct contact with humans, human pets, and associated "rural/suburban pest" species. The border area affected by these disturbances is labeled edge, as compared to the undisturbed core or interior forest habitat (Zipperer 1993).

One reason for the decline of New Jersey's threatened and endangered species is the loss of habitat through forest fragmentation and development pressure (Niles et al. 1999). There are a number of other so-called area-sensitive species that depend on large tracts of undisturbed interior habitat to maintain viable populations. Large raptors such as red-shouldered hawks (*Buteo lineatus*) and barred owls (*Strix varia*) are area-sensitive species that require large blocks of mature forested wetlands and adjacent upland forest (Niles et al. 1999). In addition, there are a number of wide-ranging, area-sensitive mammal species such as bobcats (a state threatened species in New Jersey) that rely on large areas of relatively intact forest (Niles et al. 1999). Many characteristic Highlands amphibians and reptiles are sensitive to habitat fragmentation and human disturbance through a variety of mechanisms. Slow moving amphibians and reptiles are especially susceptible to road-kill and are therefore impacted by increasing densities of roads and traffic volumes (Mitchell 1992). Timber rattlesnakes (*Crotalus horridus*), a New Jersey endangered species of particular concern in the Highlands, are especially susceptible to roads and other human disturbance (Brown 1993; Clark et al. 2010). The federally threatened bog turtle (*Clemmys muhlenbergii*) and state threatened wood turtle (*Clemmys insculpta*) need contiguous blocks of wetland buffered by upland forest.

Methods

The numerical GIS modeling protocol used to determine the value of existing habitat areas for individual T&E species has two components: 1) determination of intrinsic habitat value; 2) determination of potential mitigation value that could be realized for prospective conservation bank properties by determining the increase in preservation value along with landscape enhancement value. Figure 10 outlines a general work-flow diagram of the approach.

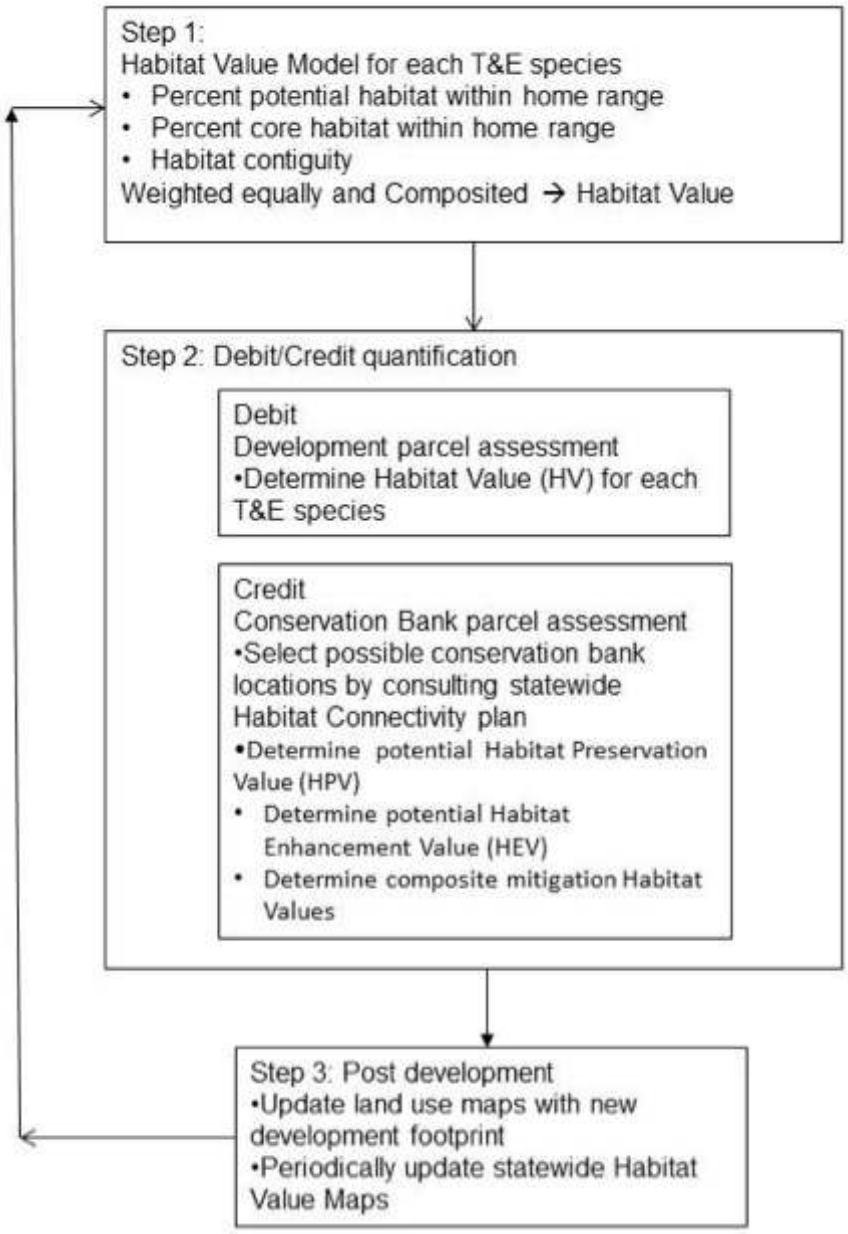


Figure 10. Flowchart of Habitat Valuation modeling protocol and Debit/Credit Quantification.

I. Habitat Value

The determination of Habitat Value is based on the species-specific information documented in the NJ Endangered & Nongame Species Program (ENSP) Landscape Project Version 3 (LP3). This information includes the land use/land cover types that constitute each species' known habitat, what constitutes core area vs. edge area, and the species' home range or siting diameter size. Additional information on the spatial contiguity of the existing habitat patch to nearby habitat was computed. A composite Habitat Value was determined for each individual threatened and endangered species by taking a straight average of three factors (percent of the surrounding circular home range that is habitat, percent of the

surrounding circular home range that is core habitat, and contiguity factor) and rescaling this result to a value from 0 to 1.00.

A grid-based modeling approach was employed using the following model steps for each species.

A. The NJ Land Use Land cover map was rasterized into 50ft. pixels using NJ State Plane projection. A 10 km buffer around the state was created using the national land use land cover data. The buffer was included in order to get more correct values habitat values near the borders of NJ where habitat patches might extend into neighboring states. The original national data was 30 meters by 30 meters and was first re-projected to state plane coordinates and recoded into as close to the NJ LU/LC categories as possible (Table of changes is listed in the HCP folder under HCP\DataModified\RecodeTableBuf_to_NJ) then changed to 50 feet by 50 feet pixel size. The NJ and buffer were merged together in a union with maximum value. Information on what land use/land cover types constitute habitat for each species and home range size comes from the Landscape 3 data available on the DEP landscape project website.
B. Using LP3 rules on *Species A* habitat Land use/land cover (LU/LC) designations, potential suitable LU/LC map is developed for NJ and the surrounding 10 km buffer. The land is categorized into three categories: habitat (5), neutral non-habitat (10), and altered non-habitat (1) with a thematic output. Figure 11 shows potential habitat for barred owl.
C. A buffer of 300 feet around altered non-habitat was created. Core habitat area was calculated as habitat – buffer (Figure 12).
D. Using the LP3 home range/siting diameter size, the percentage of potential suitable habitat (Figure 13) was each calculated using a GIS moving window approach. This approach is similar to that employed to characterize landscape integrity in the New Jersey Pinelands (Zampella et al. 2008). The value of a pixel is calculated using on a circular area centered at the pixel with area equal to the average home range of the species as indicated by the LP3. The percentage of the pixels within the circular area that are designated habitat multiplied by 100 is the value of the central pixel. This represents the amount of the home range centered at the pixel that is habitat. The percentage of core habitat in a circular home range surrounding the center was calculated analogously (Figure 14).

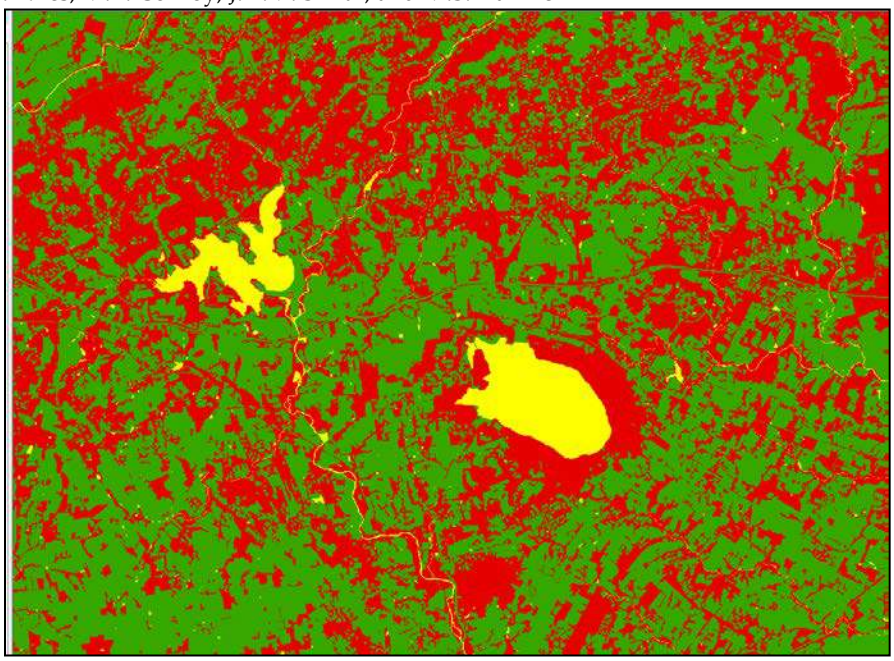


Figure 11. Potential Habitat for Barred Owl (colored in red).

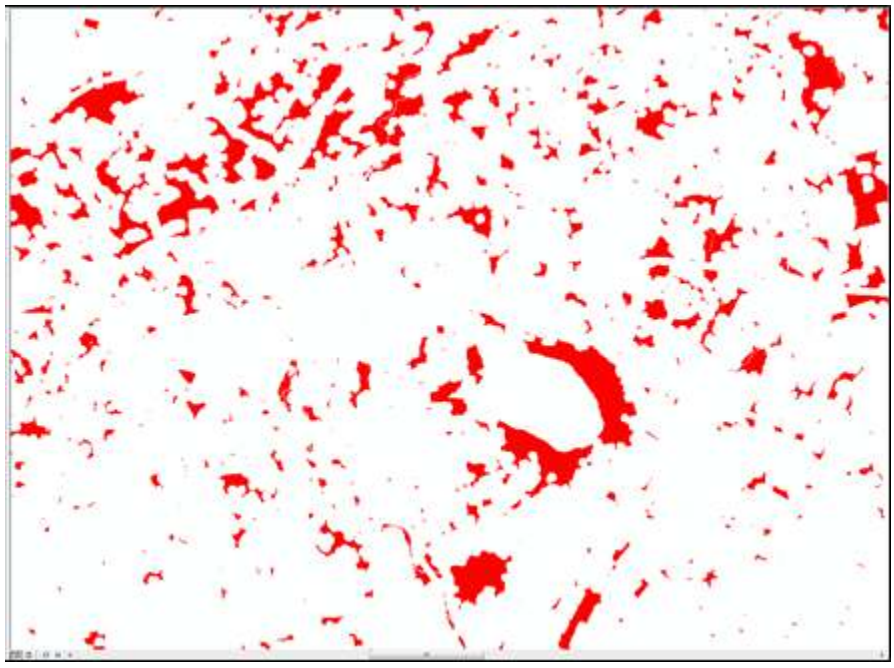


Figure 12. Potential Core Habitat for Barred Owl (colored in red).

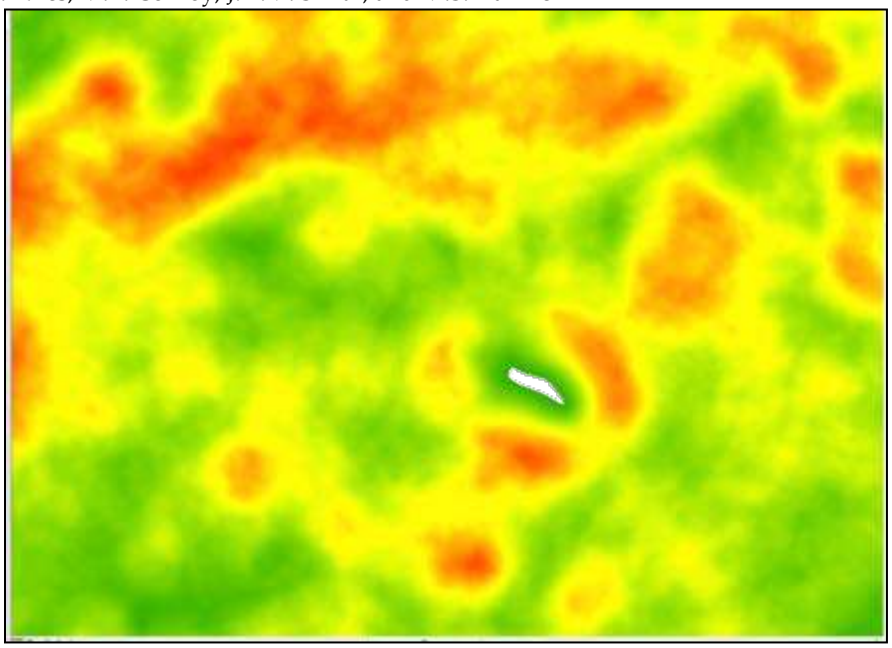


Figure 13. Percent Potential Habitat for Barred Owl.

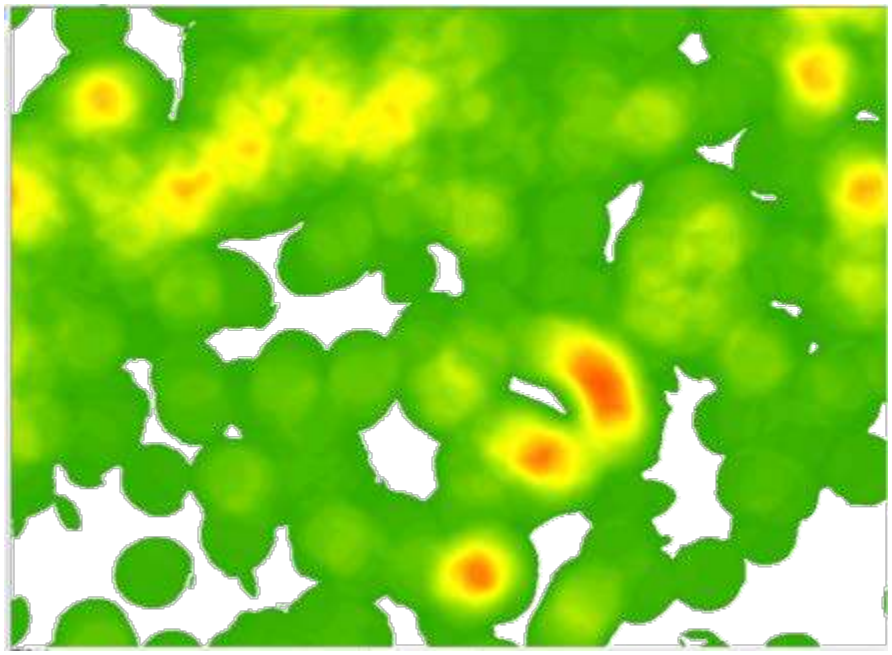


Figure 14. Percentage of Potential Core Suitable Habitat for Barred Owl.

E. The third measure in the habitat value calculation is a measure of the contiguity of the habitat. Theoretically, we would like to give habitat areas higher scores if they are within reach of large amounts of other habitat areas. This will take into account the size of the current patch as well as the ease of connecting to other habitat patches and the size of the connected patches. This is a measure solely the potential habitat

(as are the habitat percent and core habitat percent measures). This was completed in several steps.

1. The first step in this is to take the habitat and add to it the neutral landscape under the assumption that each species can easily move through habitat that is classified as neutral for that species. This may include streams, right-of-ways and other types of habitat depending on the species.
2. Next, certain categories of roads are subtracted out of the layer in order to cut areas if they are divided by a road that is deemed difficult to cross (Table 1).

Table 1. Roads viewed as barriers to movement of endangered and threatened species.

Species	Interstate Highway	US Highway	State Highway	Toll Road	County 599 Series Route	Other County Series Route	Local Road	Ramp	Unimproved Roads
Barred Owl	X	X	X	X				X	
Timber Rattlesnake	X	X	X	X	X	X	X	X	
Blue-spotted Salamander	X	X	X	X	X	X	X	X	X
Bobcat	X	X	X	X				X	
Indiana Bat (roost/breeding)	X	X	X	X				X	
Indiana Bat (hibernaculum)	X	X	X	X				X	
Bobolink	X	X	X	X				X	
Grasshopper Sparrow	X	X	X	X				X	
Long-eared Owl	X	X	X	X				X	
Long-tailed Salamander	X	X	X	X	X	X	X	X	X
Northern Goshawk	X	X	X	X				X	
Red-headed Woodpecker	X	X	X	X				X	
Red-shouldered Hawk	X	X	X	X				X	
Savannah Sparrow	X	X	X	X				X	
Vesper Sparrow	X	X	X	X				X	
Wood Turtle	X	X	X	X	X	X	X	X	X
Bog Turtle	X	X	X	X	X	X	X	X	X
Black-crowned Night-Heron (foraging)	X	X	X	X				X	
Black-crowned Night-Heron (nesting)	X	X	X	X				X	
Great Blue Heron	X	X	X	X				X	
Northern Pine Snake	X	X	X	X	X	X	X	X	
Xs indicate which roads are viewed as barriers and used to cut the contiguous clumps.									

3. The next step is to clump the habitat plus neutral minus roads. The object here is to make "superclumps" of patches of habitat that are within travelling distance of each other (Figure 15). Then the patches of habitat within these superclumps will be given a value based on the amount of total habitat within the superclump. A superclump containing more habitat will get a higher value.

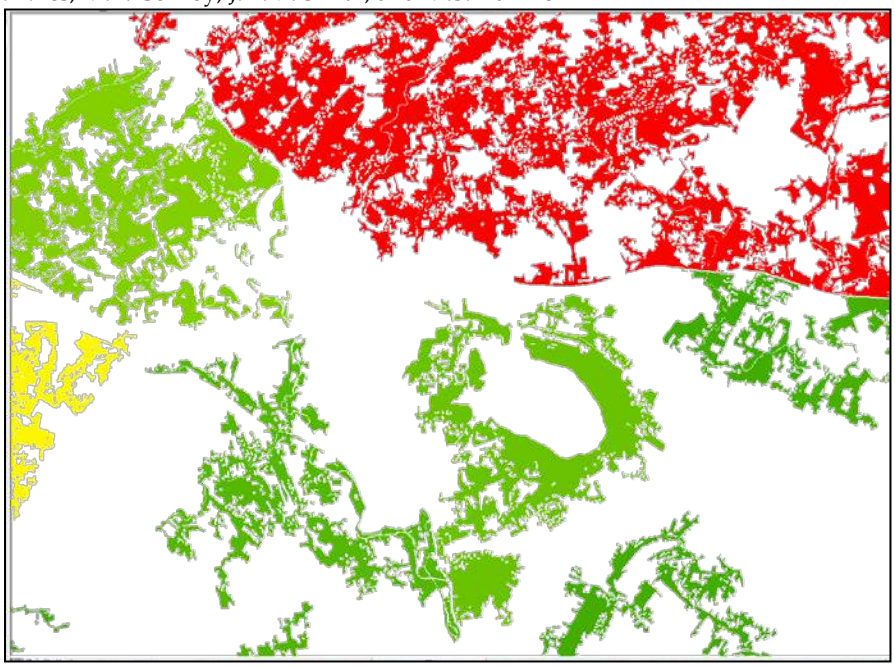


Figure 15. Habitat plus neutral minus roads for Barred Owl.

4. Superclumps were sieved so that areas less than one home range are not included. Remaining value is normalized by dividing by the area in a number of home ranges that represent a large "sustainable" population (Table 2). The numbers used are draft and need further vetting by the Science/Technical Advisory workgroup. Any clumps larger than or equal to that number of home ranges get the highest value of 100. Other values range down to 0.

F. A composite Habitat Value (HV) map for *Species A* was developed that equally weights the three above components: suitable LU/LC, core area, and habitat contiguity (Figure 16).
G. Non-LP3 patches were then masked out. The only habitat given a non-zero value is the habitat recognized in LP3.
H. Steps B-G above were undertaken for each selected T&E species.

Table 2. Number of Home Ranges Required for Full Contiguity Value.

Species	Number of Home Ranges for Full Contiguity Value
Blue-spotted Salamander	100
Long-tailed Salamander	100
Southern (Cope's) Gray Treefrog	100
Barred Owl	45
Black-crowned Night-Heron (foraging)	1
Black-crowned Night-Heron (nesting)	45
Bobolink	200
Golden-winged Warbler	200
Grasshopper Sparrow	200
Great Blue Heron	45
Long-eared Owl	45
Northern Goshawk	45
Northern Harrier	45
Red-shouldered Hawk	45
Red-headed Woodpecker	45
Savannah Sparrow	200
Vesper Sparrow	200
Bobcat	2
Indiana Bat (hibernaculum)	45
Indiana Bat (roost/breeding)	45
Bog Turtle	200
Corn Snake	100
Northern Pine Snake	100
Timber Rattlesnake	100
Queen Snake	100
Wood Turtle	100

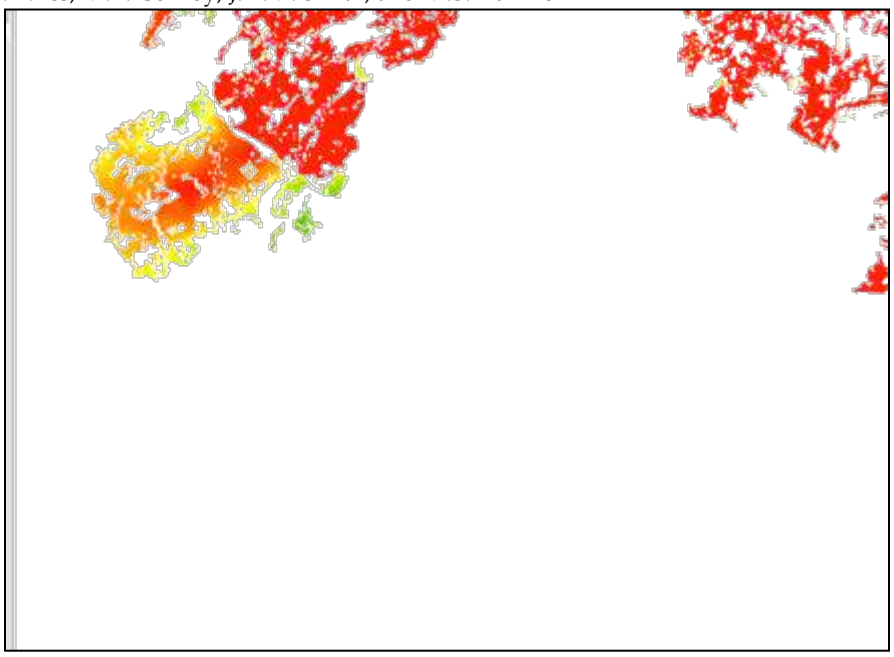


Figure 16. Composite Habitat Value Map for Barred Owl.

II. Assessment of Results

We have completed an assessment of results by comparing the estimated habitat quality maps with the ENSP's Natural Heritage sightings locations data for the individually modeled species. The results are discussed at the end of this section.

III. **Calculations of Conservation Debits and Credits**

The second part of the protocol requires the extraction for a parcel area and summary calculation using straight-forward GIS processing (i.e., in ESRI ArcGIS, a *select* and *calc* commands). Further examples are provided in the main body of this document.

Habitat Value Modeling Results

Habitat value models were developed for species that have wider distribution and might be considered area-dependent. Species with very restricted distribution or dependent on very specific habitats were not modeled and the Landscape Project 3 maps should be used to determine habitat value. See Table 3 for a list of the species that were modeled.

Table 3. Species for which Habitat Value Models were developed.

Barred Owl	Black-crowned Night-Heron	Blue-spotted Salamander
Bobcat	Bobolink	Bog Turtle
Grasshopper Sparrow	Indiana Bat	Long-eared Owl
Long-tailed Salamander	Northern Goshawk	Red-headed Woodpecker
Red-shouldered Hawk	Savannah Sparrow	Timber Rattlesnake
Vesper Sparrow	Wood Turtle	

Assessment of Wildlife Habitat Values using ENSP Sightings

To assess the validity of the resulting models, the estimated habitat quality maps were compared with the ENSP's Natural Heritage sightings locations data for the individual modeled species. If the model does not have utility in estimating habitat value then we might assume that the distribution of sightings across the area would be uniform or random. Thus across Wildlife Habitat Value (WHV) classes the sightings would be more likely in classes with higher areas and less likely in classes with lower areas, and the number of sightings per area would be uniform (with random variation) across WHVs. If sightings are more concentrated in areas of higher value it may indicate that the model is correctly identifying higher value habitat. We are attempting to determine whether the composite WHV for a grid cell location is a better indicator of species presence than random chance alone.

There are naturally, several complications to this simplistic evaluation. One is observation bias. Some observations are road-based which would bias observations towards roads and hence is away from core habitats. Other observations (those not from a random sampling or a transect) may be biased toward areas more frequented by humans which, for many species, would be non-core areas. This observation bias is a bias toward sightings in lower WHV than an unbiased observation method.

Given the composite WHV maps, the ENSP cross-tabulated with the Natural Heritage database to calculate the number of sightings for an individual species within each WHV class (i.e., between 1-100). This was done for sightings within the Landscape 3.1 habitat boundaries. For areas outside the Landscape 3.1 designated habitat areas the ENSP also provided the number of sightings for an individual species within each potential WHV class using potential WHV maps which included the appropriate areas. For the Landscape 3.1 designated habitat area and for the species range, we have been able to calculate the area for each HV class (between 0 and 100). In this document "within landscape 3" means within the Landscape 3.1 designated habitat area, "entire range" designates the union of the ENSP designated species range (as provided to us as a shape file for each species in question) and the Landscape 3.1 designated habitat area. The charts and results in this document refer to the entire range of each species.

Graphically

We have graphically presented the findings in three ways.

1. We show the percent of all the sightings in each decade of the Wildlife Habitat Value (WHV) range (in blue). On the same graph we show the % of land area in those same ranges (in red). If our model is useful for the species we would expect (before taking into account the biases listed above) that the sightings bars would be higher than the WHV bars on the higher WHV and lower on the lower WHV.

2. The second chart for each species shows, on the independent axis (horizontal) the cumulative share of the area at any given WHV and on the dependent (vertical axis) the cumulative share of sightings at a given WHV. If the sightings were random, we would expect these to fall exactly on the 1:1 line (shown in red). If the WHV model has predictive value we would expect the curve to have a low slope at the lower x values and a steepening slope at the higher x values.

   This graph is based on a modified Lorenz curve. A Lorenz curve is used in the calculation of a Gini coefficient. The Gini coefficient is a measure of statistical dispersion used most often to determine income inequality. Please see the quantitative measures section for more details on the Gini coefficient and Lorenz curve.

3. The third chart for each species is a graph of smoothed sightings per area (9 habitat values included in each point; the point itself and four lower, four higher) graph for each WHV. If the WHV indeed indicates areas with a higher probability of sightings, we would assume a positive slope of a line fitted to the points graphed.

The charts are shown at the end of the section.

Quantitative Measures

The two main quantitative measures we are using are the slope of the fitted line to the smoothed sightings per area and the area under the curve of the graph of the cumulative share of the sightings compared to cumulative share of area for each habitat value.

We fit a line to the point graph of the smoothed sightings per area. The independent variable is the WHV and the dependent variable is sightings per unit of area in each Wildlife Habitat Value smoothed to minimize the discrepancies between adjacent Wildlife Habitat Values. Nine Wildlife Habitat Values are combined to create the smoothing. With this measure a negative or zero slope would mean that higher WHV do not indicate higher number of sightings whereas positive slope would mean that higher WHV incur a higher number of sightings, with a higher positive slope

For the second measure, we have used a variant of the Gini coefficient in order to measure the equality of values. Generally the Gini coefficient is used as a measure of

inequality of income or wealth. The Gini coefficient is based on the Lorenz curve. For the Lorenz curve the cumulative share of people from lowest to highest income are the independent variable and the cumulative share of income earned by those people is the dependent variable. The Gini coefficient is [1-2(area under the curve)]. A value of 0 is complete equality and 1 is complete inequality. The variant that we have used is plotting the cumulative share of sightings as the dependent variable on the cumulative share of area at a given Wildlife Habitat Value, the independent variable. If there are more sightings per area at the higher habitat values, then the curve will be analogous to the Gini coefficient curve. In our case the curve can be above the line of equality if, for example, the lower habitat values have more sightings per area than the higher ones. A curve with a very low area under the curve implies that there are more sightings per area at the higher habitat values and hence the WHVs are very instructive in where we are likely to find members of the species. Extreme inequality in our case is the desired state.

Results

Below is a chart of our quantitative findings over the entire range of the species.

	Gini Coefficient Variant	Smoothed Sightings per Area	
Species	Area Under the Curve entire Range	Slope Entire Range	Number of Sightings
Bobcat	0.38	0.02	547
Indiana Bat	0.51	-0.01	232
Bog Turtle	0.28	-0.02	222
Wood Turtle	0.39	0.01	949
Timber Rattlesnake	0.38	0.02	840
Long-tailed Salamander	0.06	0.23	53
Black-Crowned Night	0.59	-0.09	144
Northern Goshawk	0.45	0.03	24
Red-Shouldered Hawk	0.25	0.03	348
BarredOwl	0.22	0.03	1057
Long-eared Owl	0.40	-0.01	21
Red-headed Woodpecker	0.46	0.01	274
Bobolink	0.12	0.05	1137
Grasshopper Sparrow	0.14	0.07	977
Vesper Sparrow	0.17	0.02	88

We can compare these quantitative measures to the charts at the end of the section.

What we find is that there are more sightings per area in high Wildlife Habitat Value areas than in low WHV areas for the vast majority of the species. The only species for which higher WHV does not seem to correlate with higher sightings frequency is Black-crowned Night Heron which we will discuss below. For the other species, there are some exceptions, but sightings are more common at the higher habitat values.

There are two mammals in our group of selected species: Bobcat and Indiana Bat. For both of these with there are few or no sightings in the highest habitat value areas: only 2 sightings over WHV 85 for Bobcat and no sightings over WHV 73 for Indiana Bat. However, in those WHVs for which there are sightings, there are more in the higher habitat value areas. Looking at our modified Lorenz curves for these two species the Bobcat looks good up until the point of few to no sightings, the Indiana Bat has a curve close to the one to one line.

The amphibian example in our group of species has a modified Lorenz curves approaching ideal. The Long-tailed Salamander has an extreme modified Lorenz curve with a very gradual slope at low shares of HV increasing to a very steep slope at the highest share of HV leading to the lowest area under the curve of all the species: 0.06.

The reptiles have reasonably good modified Lorenz curves as well, though the slopes decrease in the highest share of area at a given HV. Bog Turtle, Wood Turtle, and Timber Rattlesnake have low slopes at the lower share of Habitat Value increasing gradually to much higher slopes at the higher share of area at a given HV, but then level off to some extent at the highest HVs. Areas under the curve run from 0.28 to 0.39 for the reptiles. For the Bog Turtle, NJ endangered and Non-game Species Program has a fairly detailed model, based on ground surveys which will likely be more accurate in terms of highlighting the best and most-used habitat for Bog Turtle. We recommend that in an instance where there are extensive, detailed models or maps consistent across the habitat of a species within NJ that those models be used. The timber Rattlesnake model would be improved greatly if the habitat value would be increased for known hibernacula and areas contiguous to them.

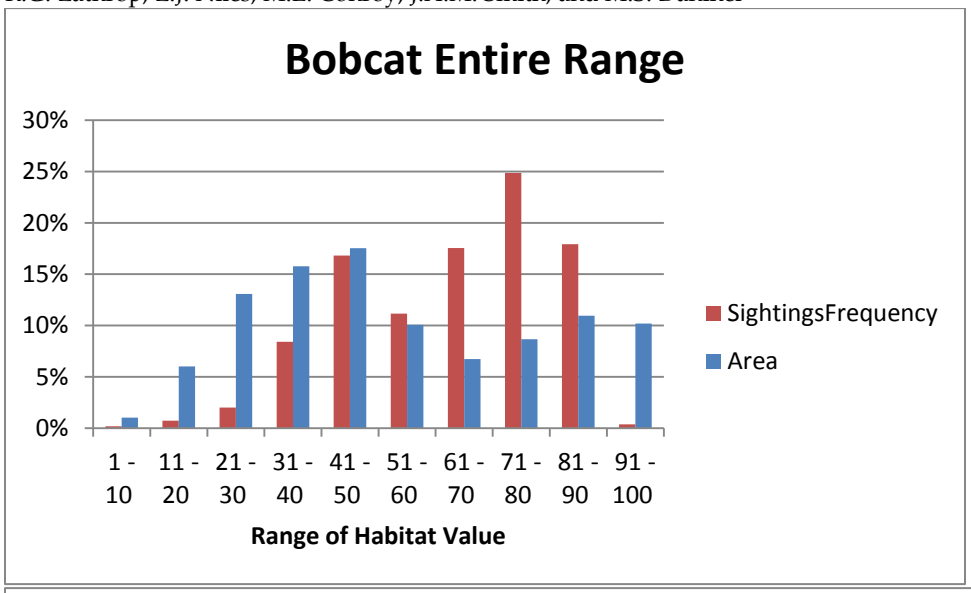
We have found that the methodology producing the WHV we have used does not show a good outcome for species that are not wide-ranging (i.e. do not have comparatively large home range sizes) or those that use habitats stretching along riparian/stream corridors. We hypothesize for those wide-ranging species using riparian/stream corridors that this is because the moving window part of the habitat valuation does not accurately portray the pattern of use. For example, Black-crowned Night Heron has a very large home range. It uses forests, scrub/shrub, marshes, and ponds as nesting, roosting, and foraging habitats. Since wooded swamps, coastal dune forests, vegetated dredge spoil islands, scrub thickets, and mixed phragmites marshes which are in close

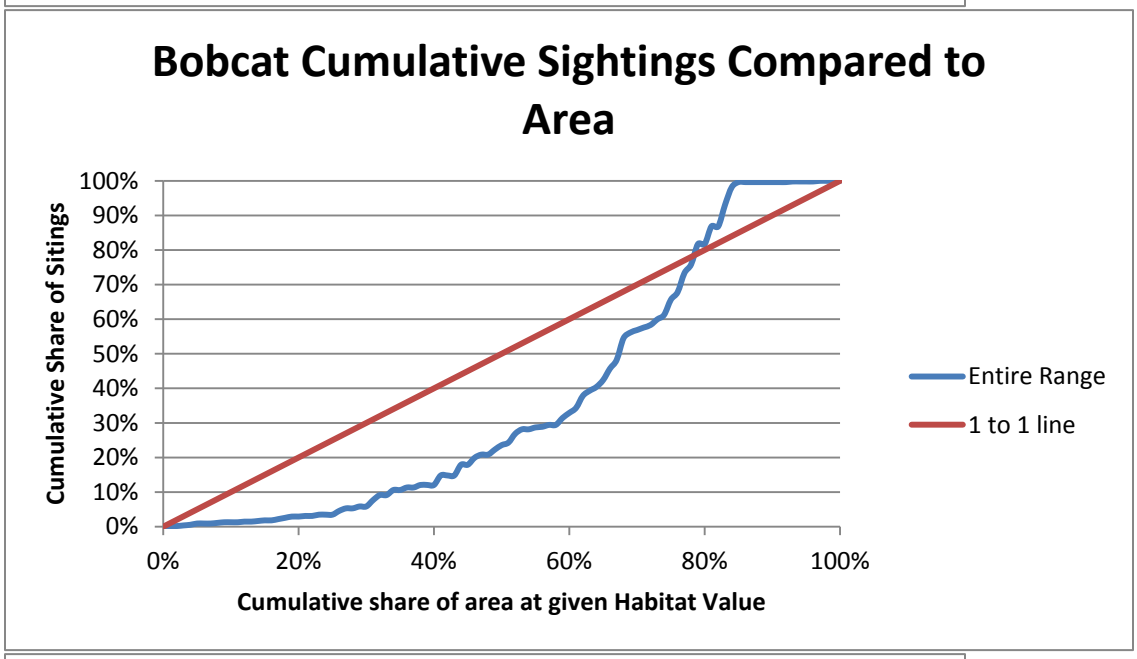
proximity to water is the habitat that is heavily used and which happens to be along waterways and thus not circular, we postulate that the circular moving window approach to valuing habitat is not ideal for this species. The values found using the extremely large circular moving window are all very low (a low percentage of the circle is habitat or core habitat). We suggest that this method not be used for species using narrow (with respect to home range size) bands of habitat such as along waterways.

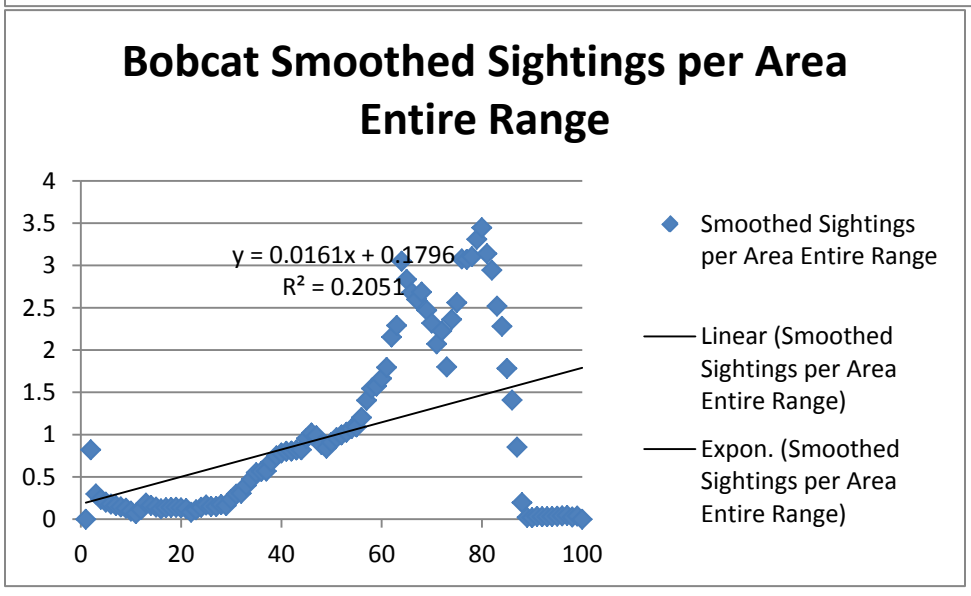
For the other bird species modelled we see variation, but on the whole we do see more sightings per area in areas of higher WHV, indicating that the model is useful. For the rarest birds and the ones with the fewest sightings (Northern Goshawk (24 sightings), Long-eared owl (21 sightings), Vesper Sparrow (88 sightings)) it is more difficult to determine the usefulness and accuracy of the models since the absence of sightings at certain WHV may not indicate an absence or lower abundance of the species at these values. All of the birds outside of the Black-crowned Night Heron and the Long-eared Owl have positive slopes on the lines fit to their smoothed sightings per area. The modified Gini coefficients for these birds (excluding black-crowned night heron) vary from 0.12 to 0.46. The grassland species have the best values varying from 0.12 to 0.17.

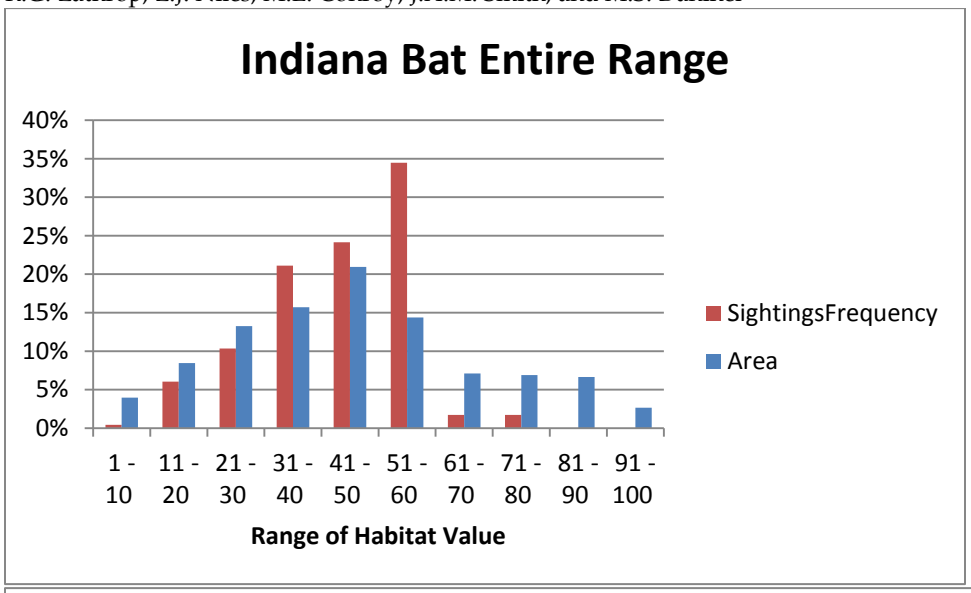
In conclusion, we find that this methodology works best for wide-ranging species that do not have specialized microhabitat requirements. To better understand the influence of and correct for sampling bias, we suggest that this analysis could be refined if access was granted to work directly with the sightings data.

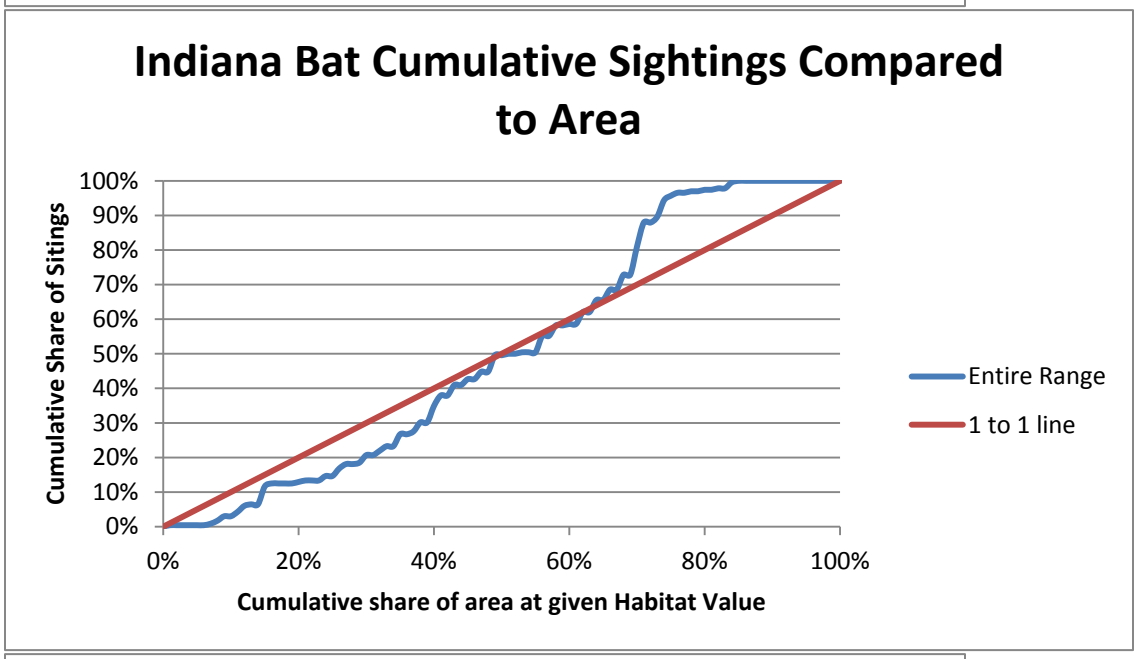
The chart above gives the actual values as well as showing the number of sightings for each species. Below are the details on each species.

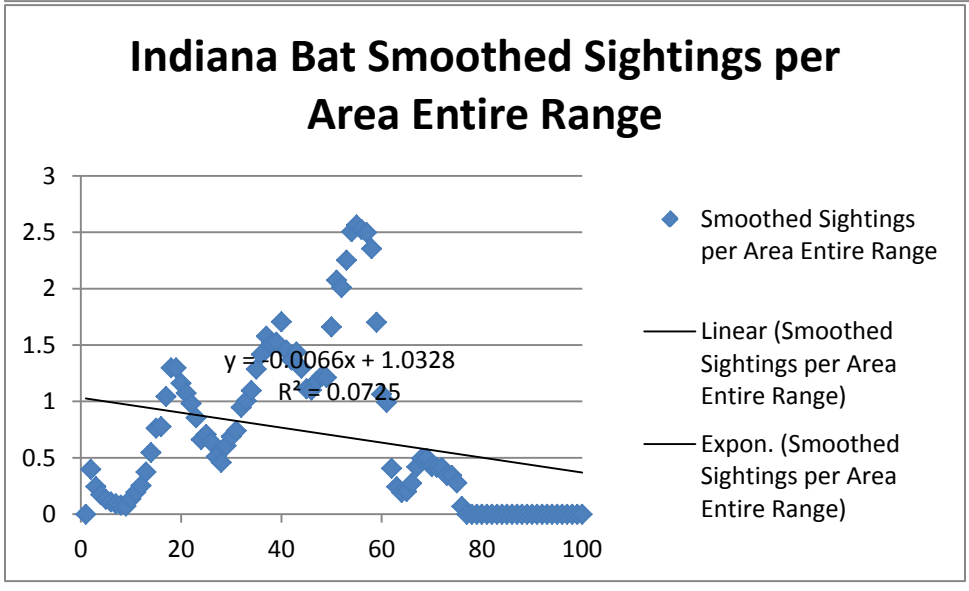

Bobcat Entire Range
30%
25%
20%
15%
10%
5%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

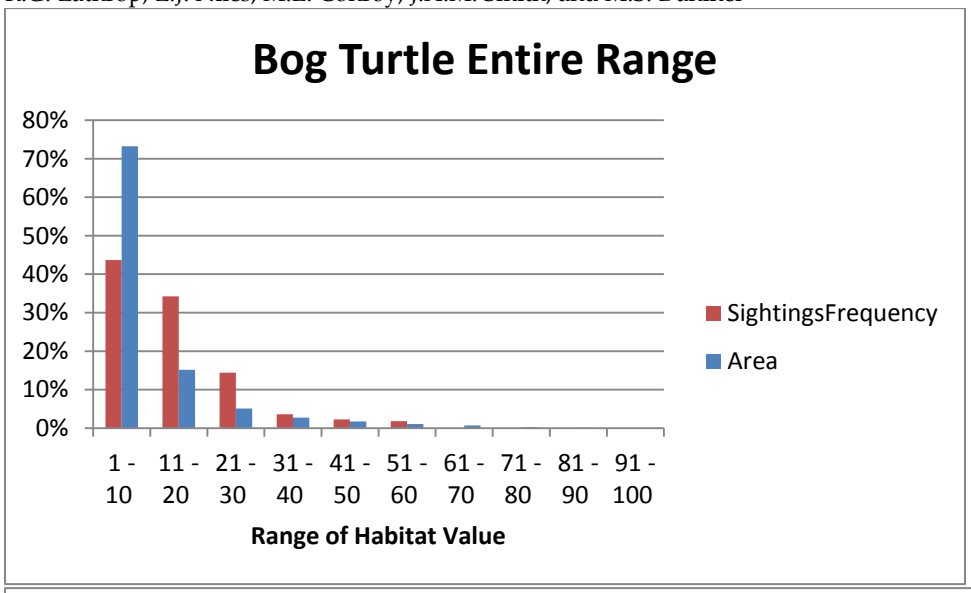

Bobcat Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

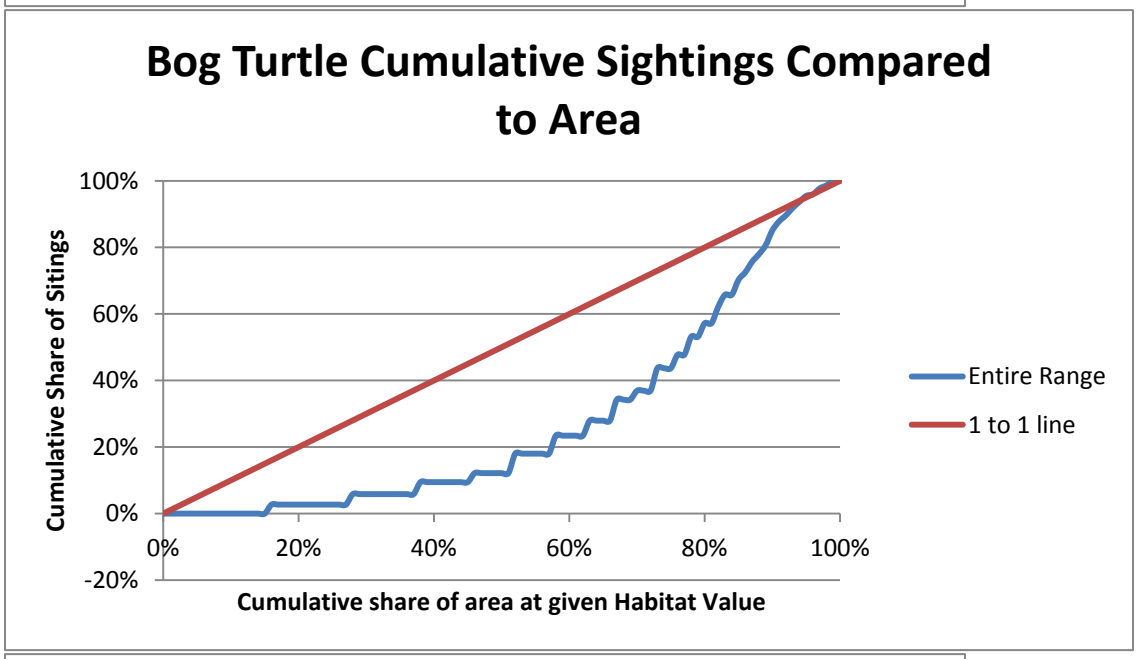

Bobcat Smoothed Sightings per Area Entire Range
y = 0.0161x + 0.1796
R² = 0.2051
4
3.5
3
2.5
2
1.5
1
0.5
0
0
20
40
60
80
100
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

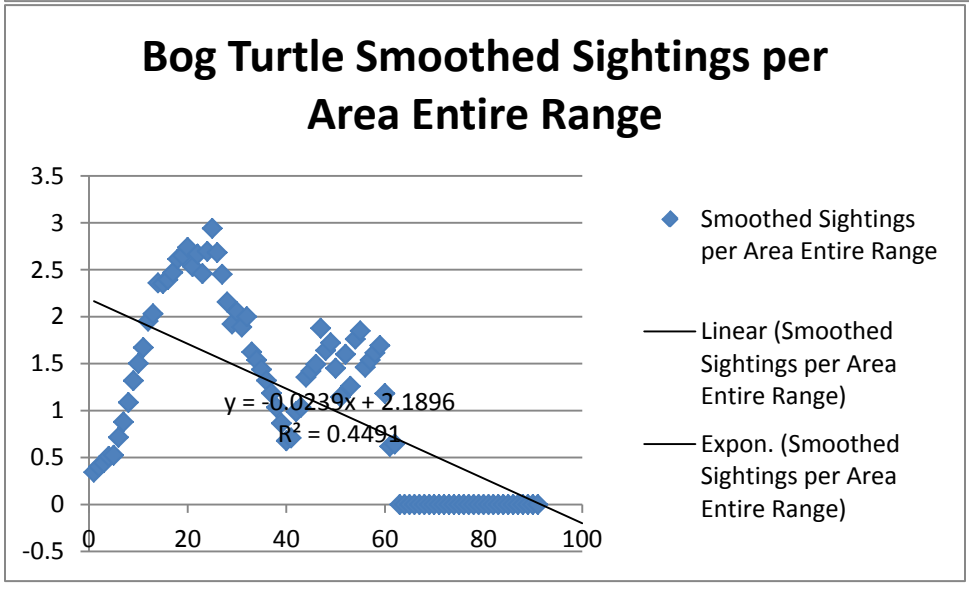

Indiana Bat Entire Range
40%
35%
30%
25%
20%
15%
10%
5%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

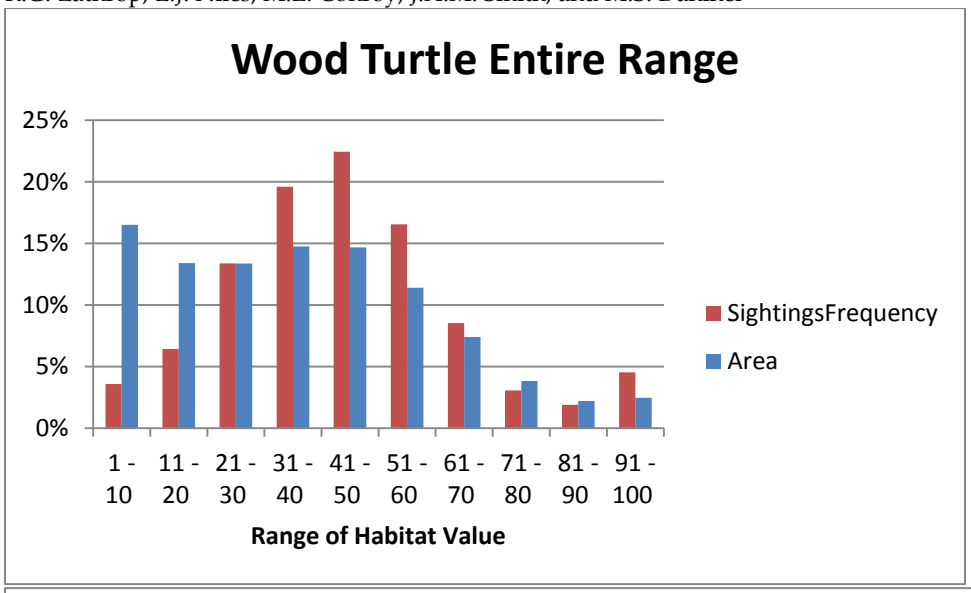

Indiana Bat Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

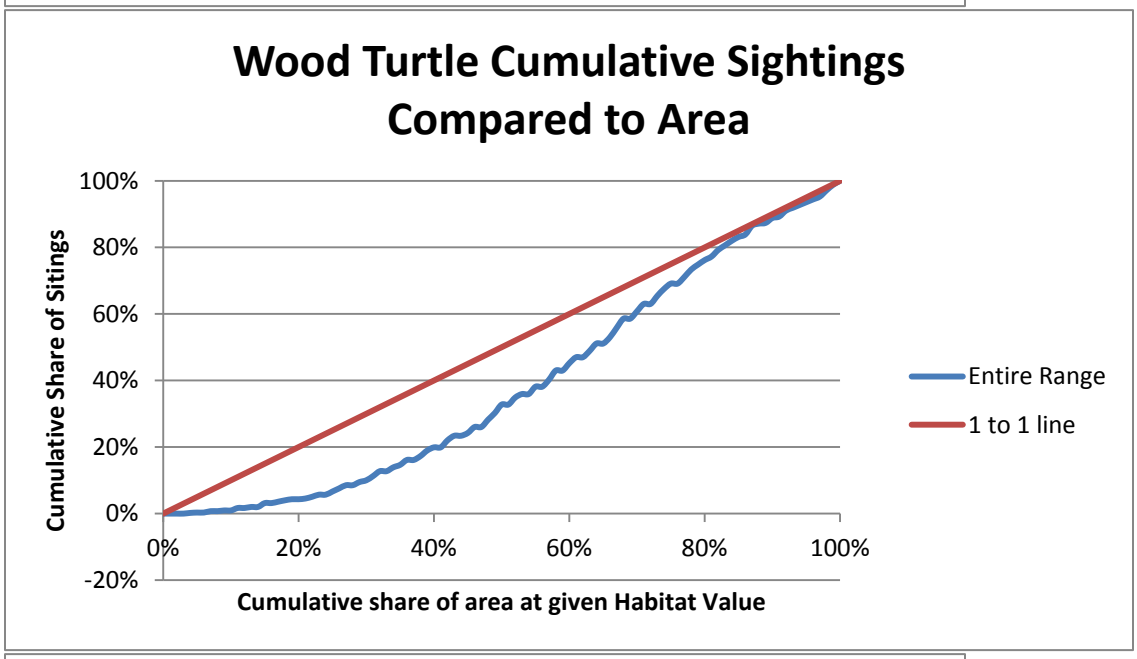

Indiana Bat Smoothed Sightings per Area Entire Range
3
2.5
2
1.5
1
0.5
0
0
20
40
60
80
100
y = -0.0066x + 1.0328
R² = 0.0725
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

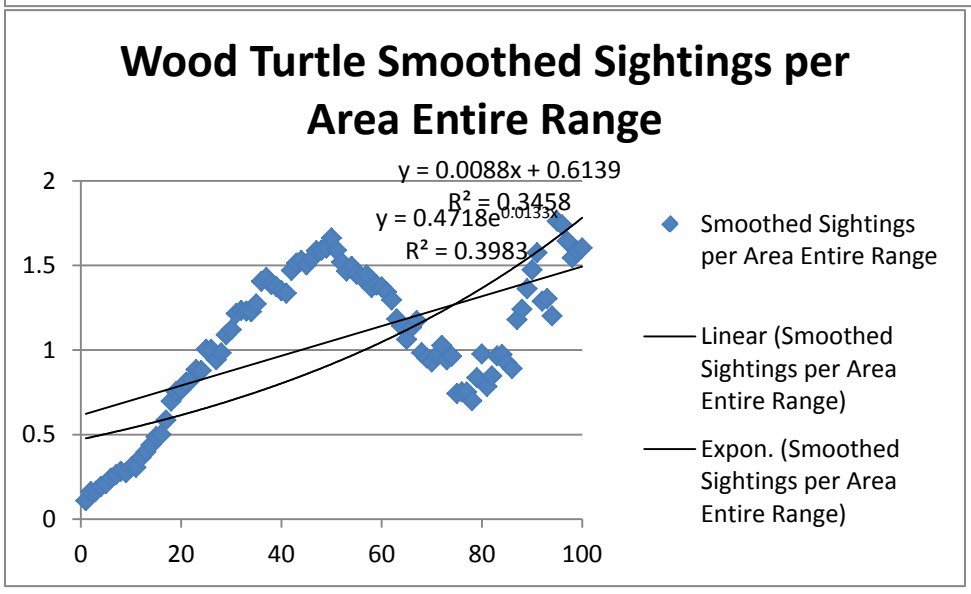

Bog Turtle Entire Range
80%
70%
60%
50%
40%
30%
20%
10%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

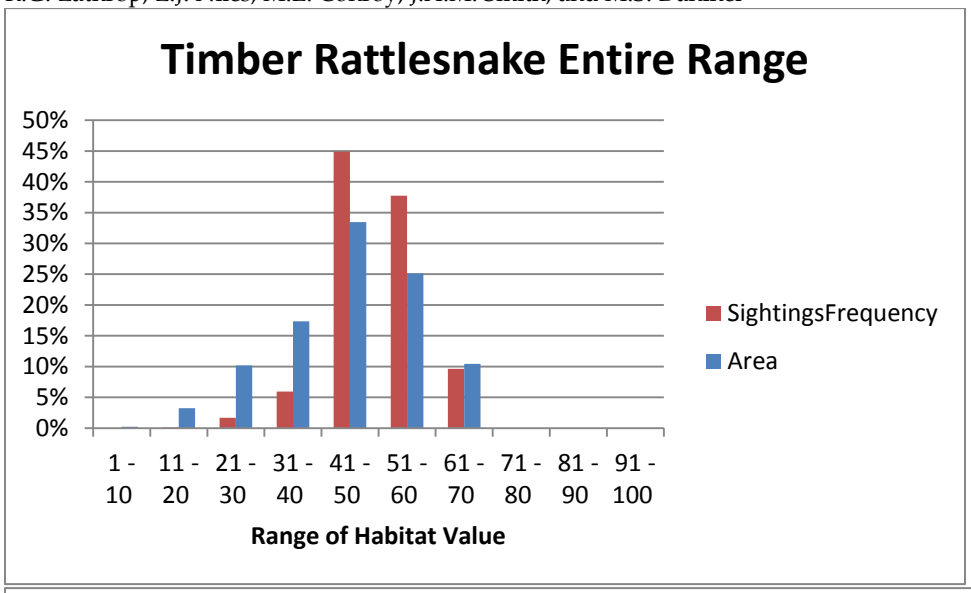

Bog Turtle Cumulative Sightings Compared to Area
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative Share of Sitings
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

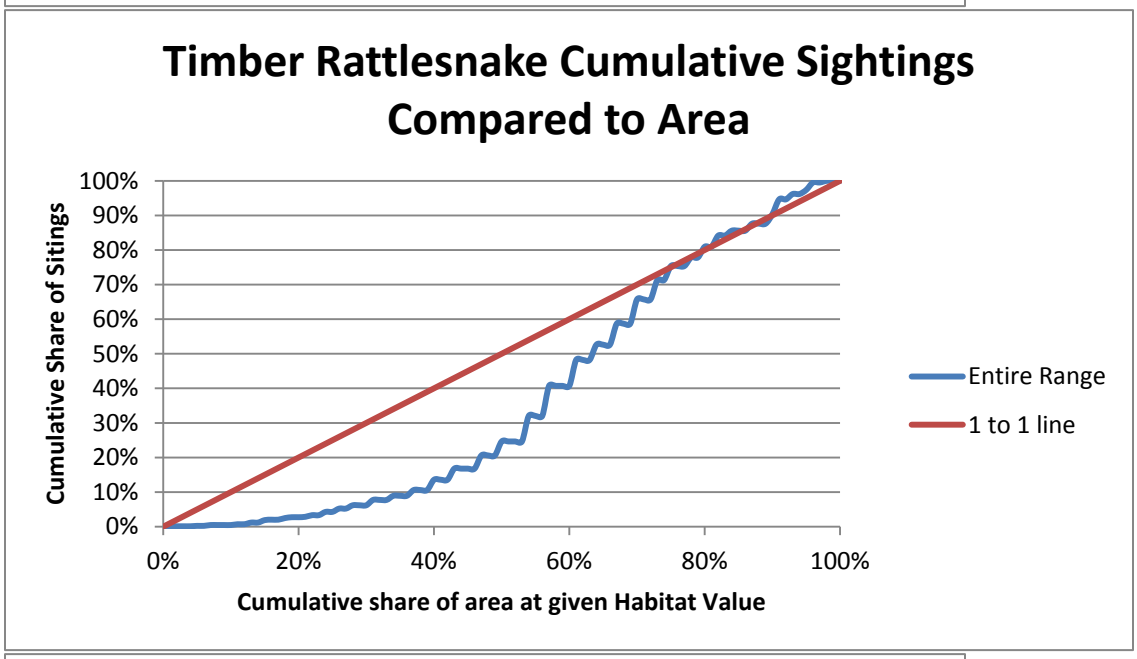

Bog Turtle Smoothed Sightings per Area Entire Range
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
0
20
40
60
80
100
y = -0.0239x + 2.1896
R² = 0.4491
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

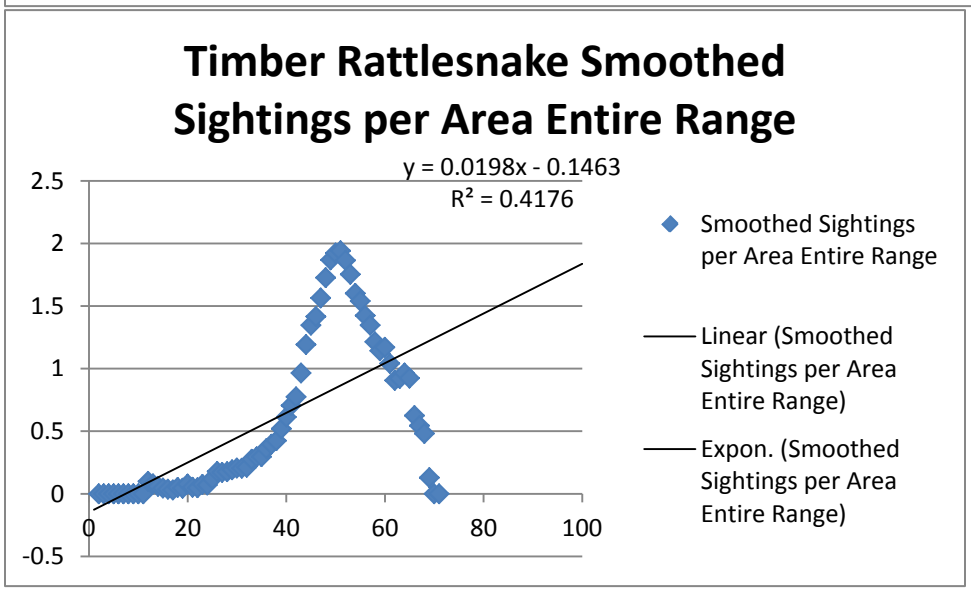

Wood Turtle Entire Range
25%
20%
15%
10%
5%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

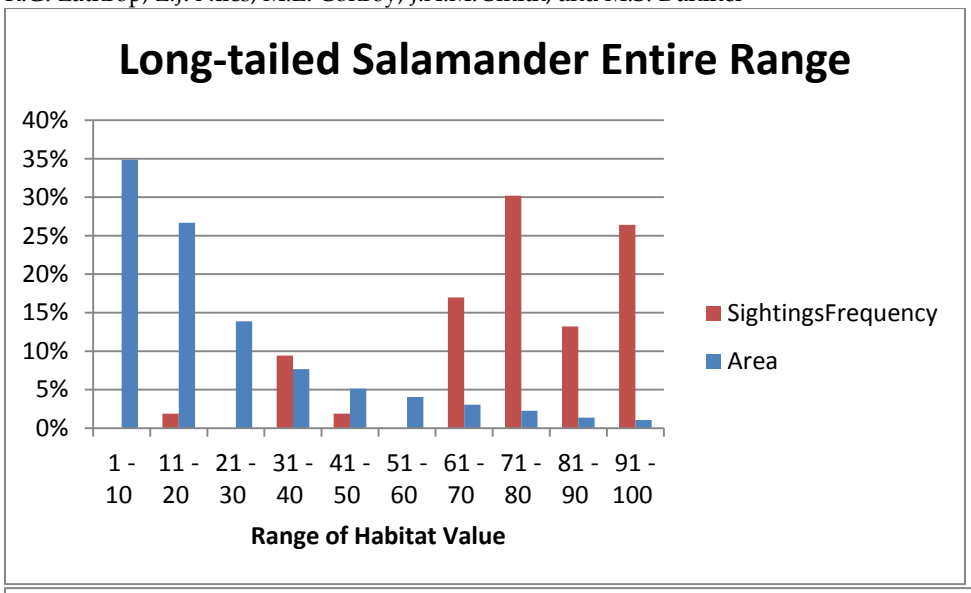

Wood Turtle Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

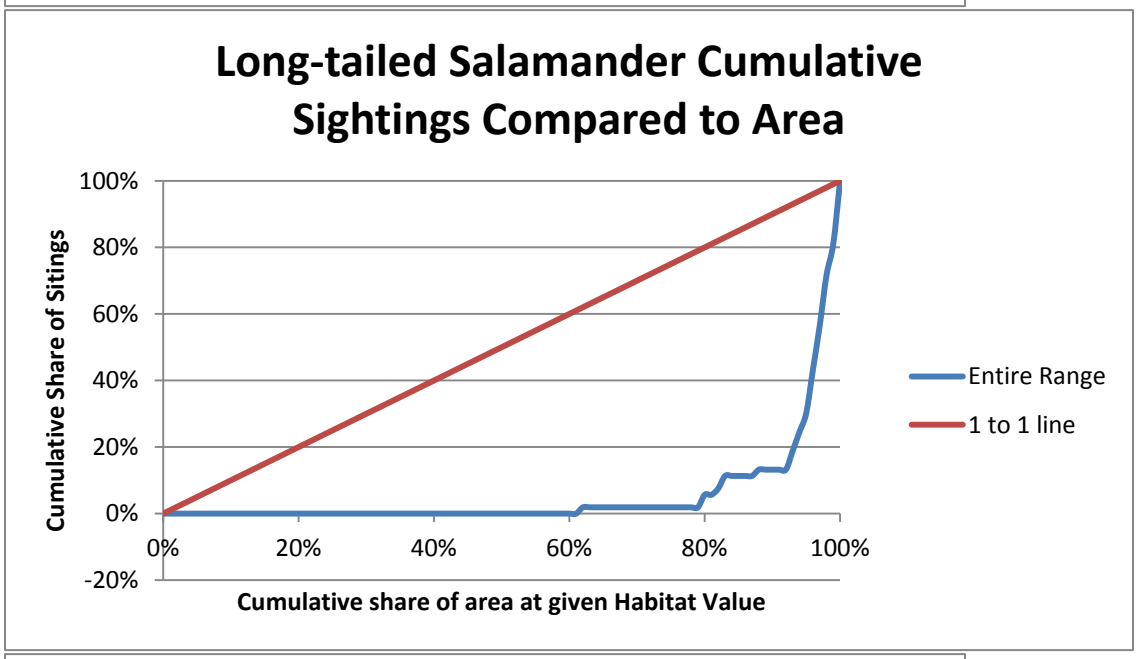

Wood Turtle Smoothed Sightings per Area Entire Range
y = 0.0088x + 0.6139
R² = 0.3458
y = 0.4718e^0.0133x
R² = 0.3983
2
1.5
1
0.5
0
0
20
40
60
80
100
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

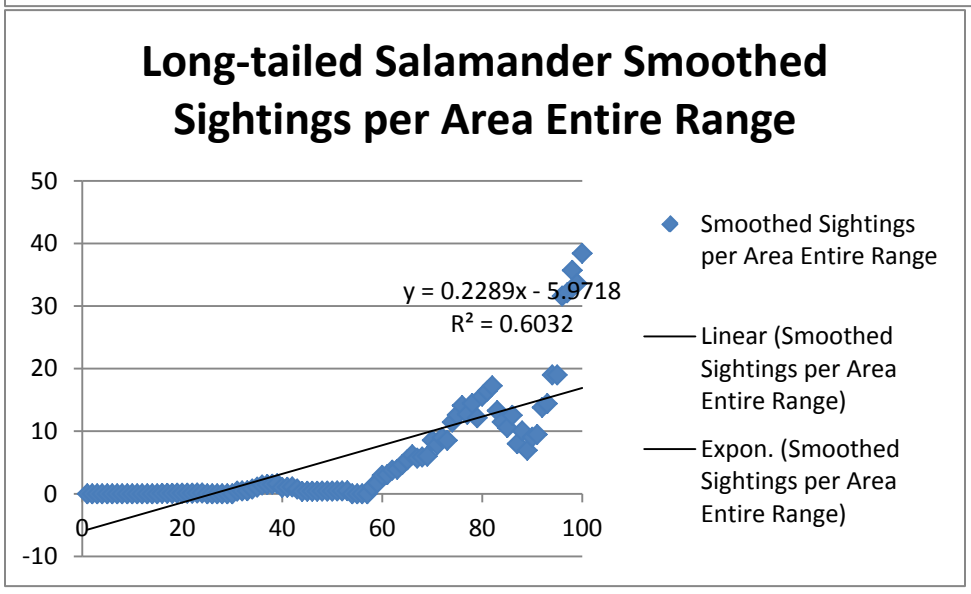

Timber Rattlesnake Entire Range
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

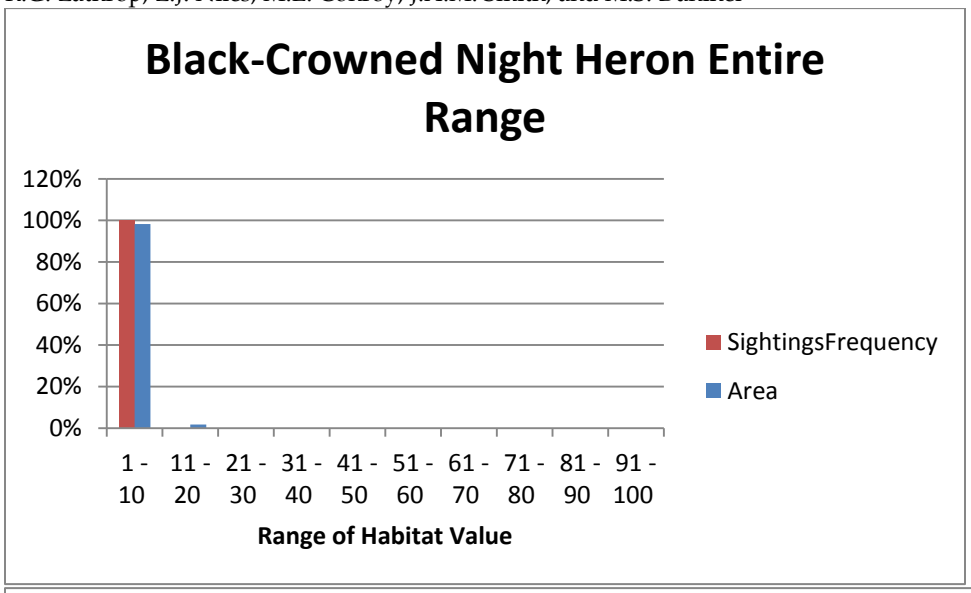

Timber Rattlesnake Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

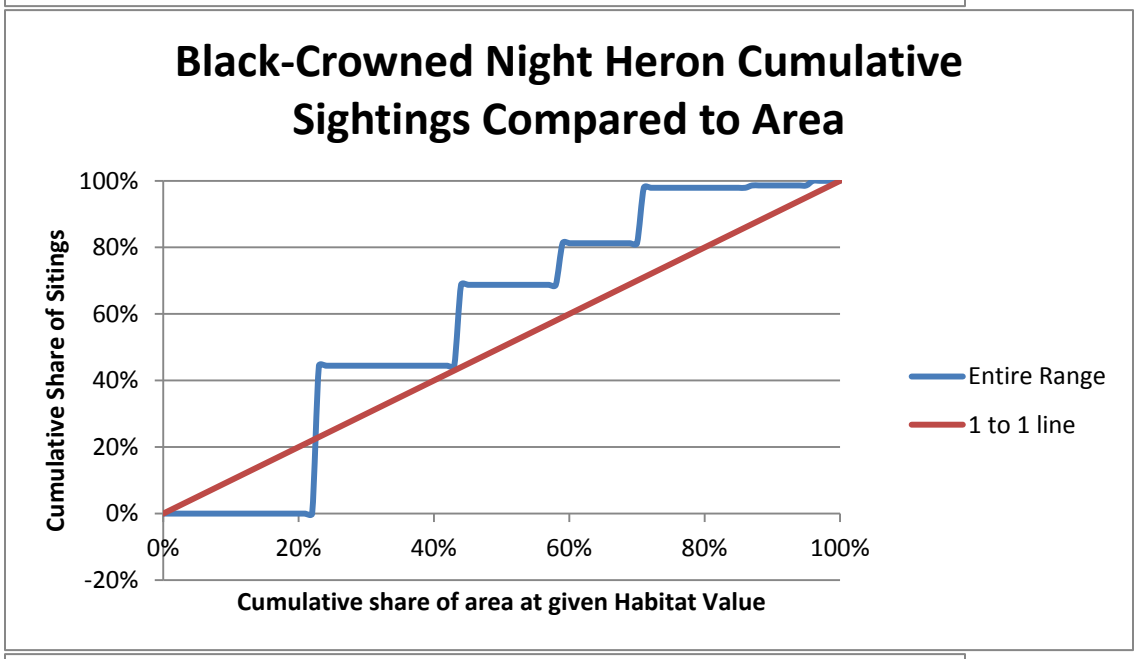

Timber Rattlesnake Smoothed Sightings per Area Entire Range
y = 0.0198x - 0.1463
R² = 0.4176
2.5
2
1.5
1
0.5
0
-0.5
0
20
40
60
80
100
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

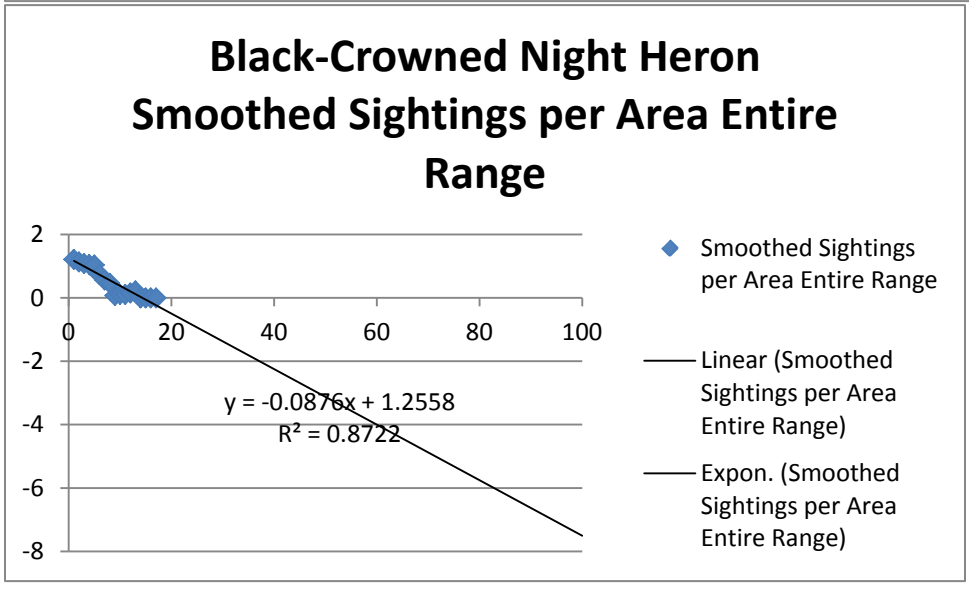

Long-tailed Salamander Entire Range
40%
35%
30%
25%
20%
15%
10%
5%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

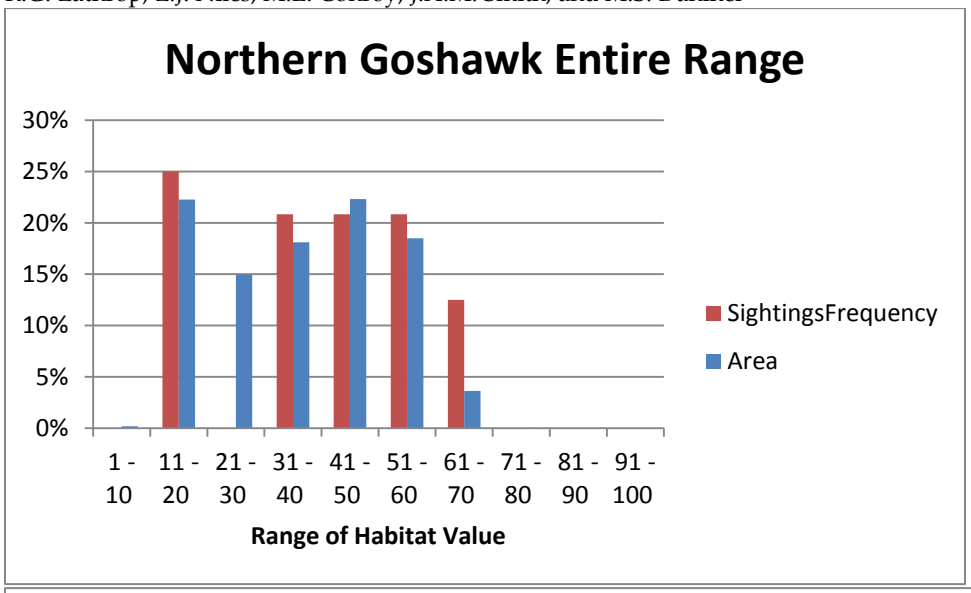

Long-tailed Salamander Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

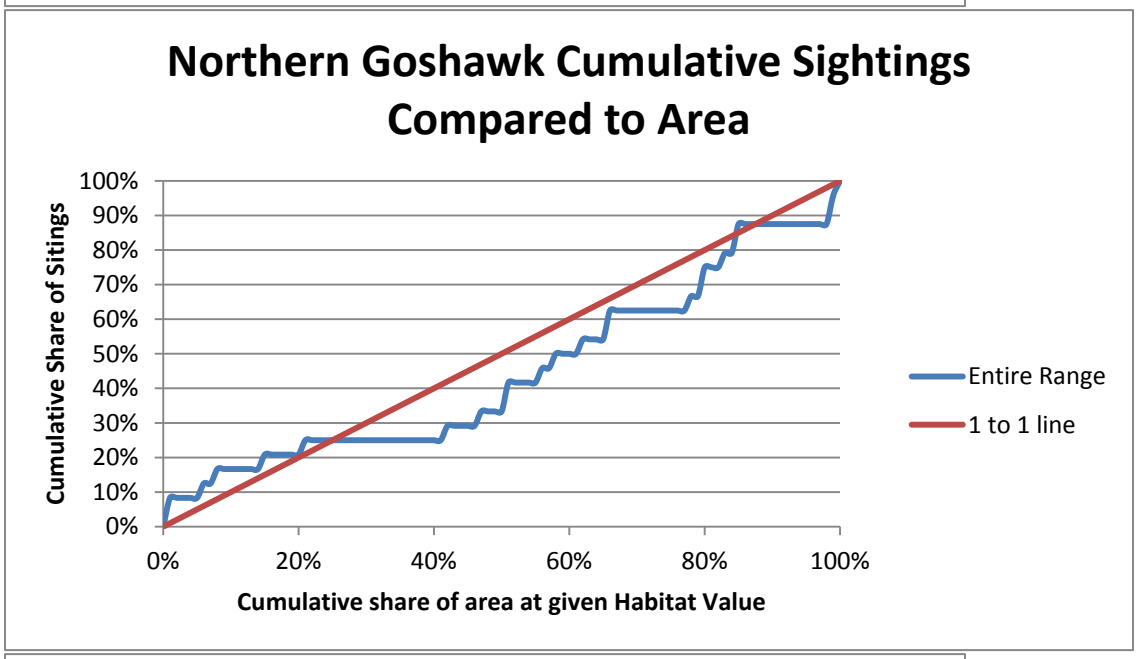

Long-tailed Salamander Smoothed Sightings per Area Entire Range
50
40
30
20
10
0
-10
0
20
40
60
80
100
y = 0.2289x - 5.9718
R² = 0.6032
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

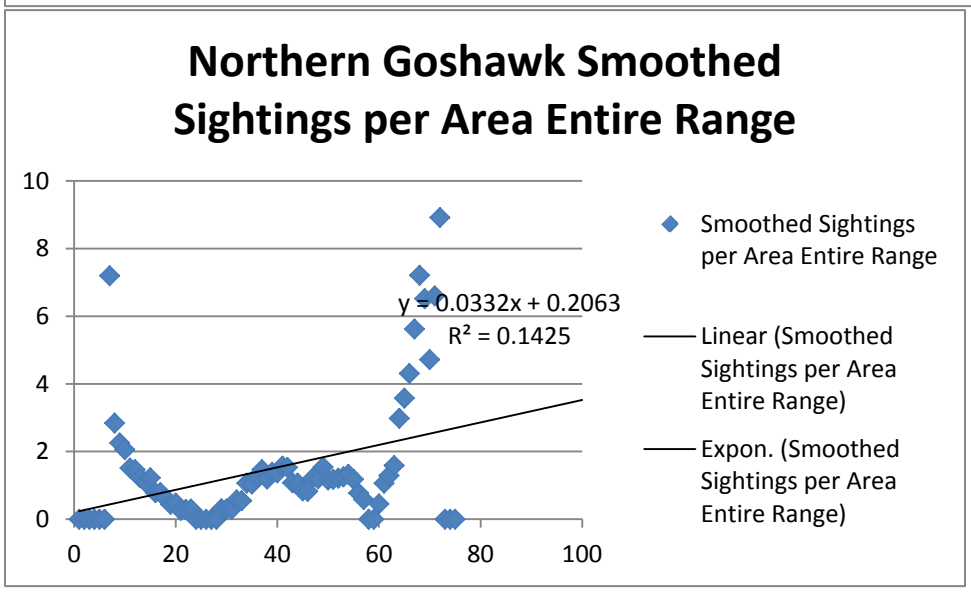

Black-Crowned Night Heron Entire Range
120%
100%
80%
60%
40%
20%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

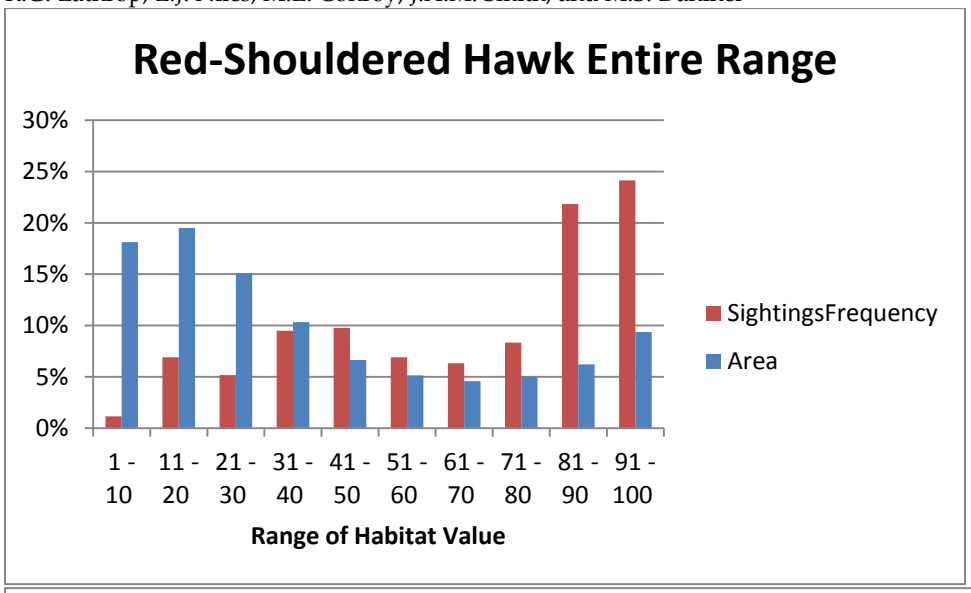

Black-Crowned Night Heron Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

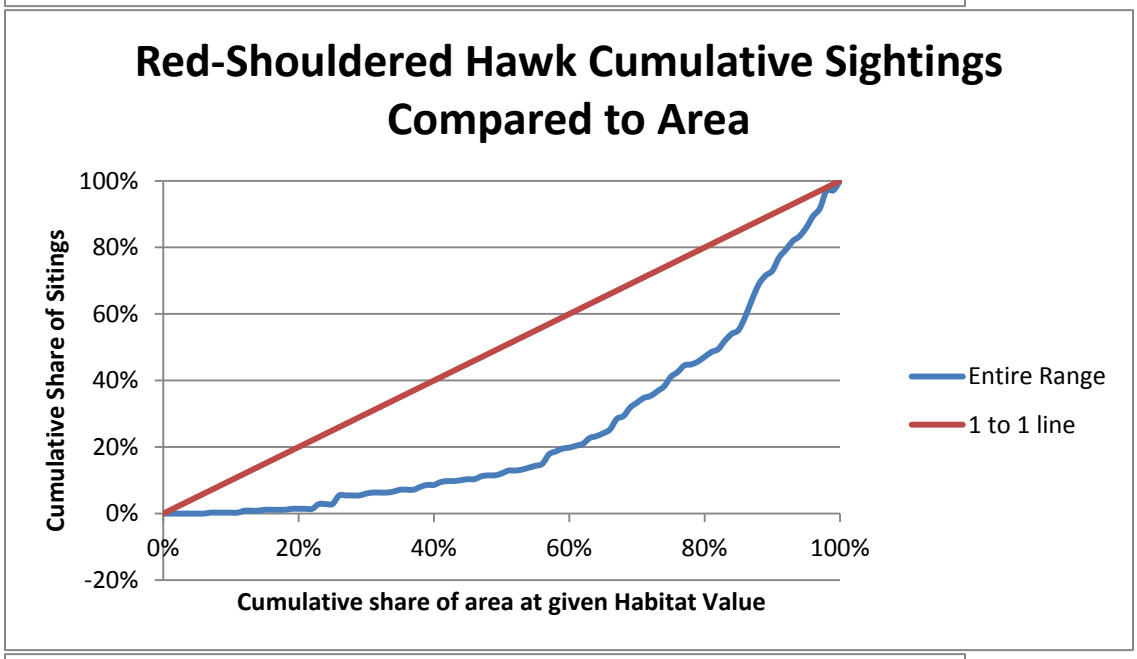

Black-Crowned Night Heron Smoothed Sightings per Area Entire Range
2
0
-2
-4
-6
-8
0
20
40
60
80
100
y = -0.0876x + 1.2558
R² = 0.8722
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

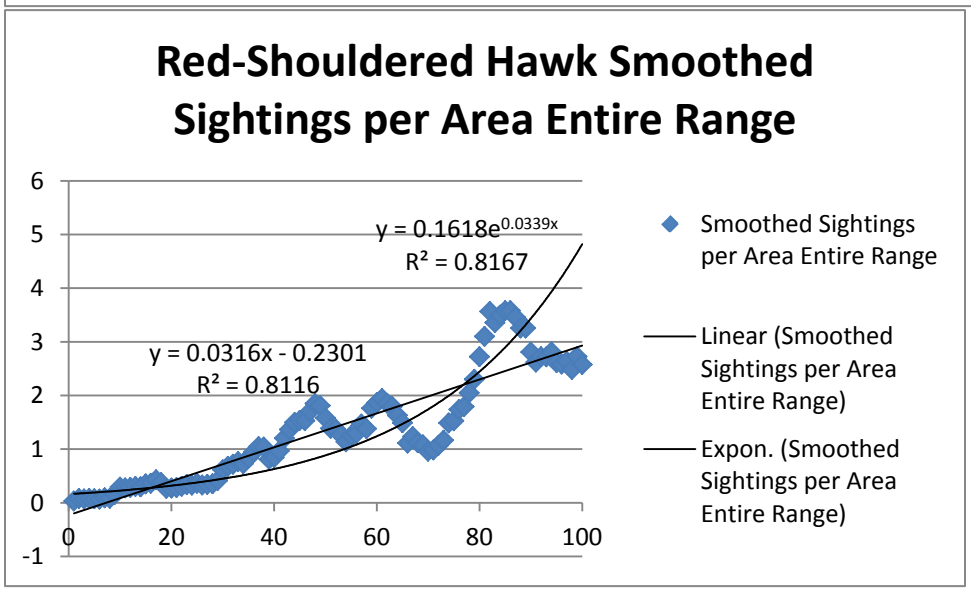

Northern Goshawk Entire Range
30%
25%
20%
15%
10%
5%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

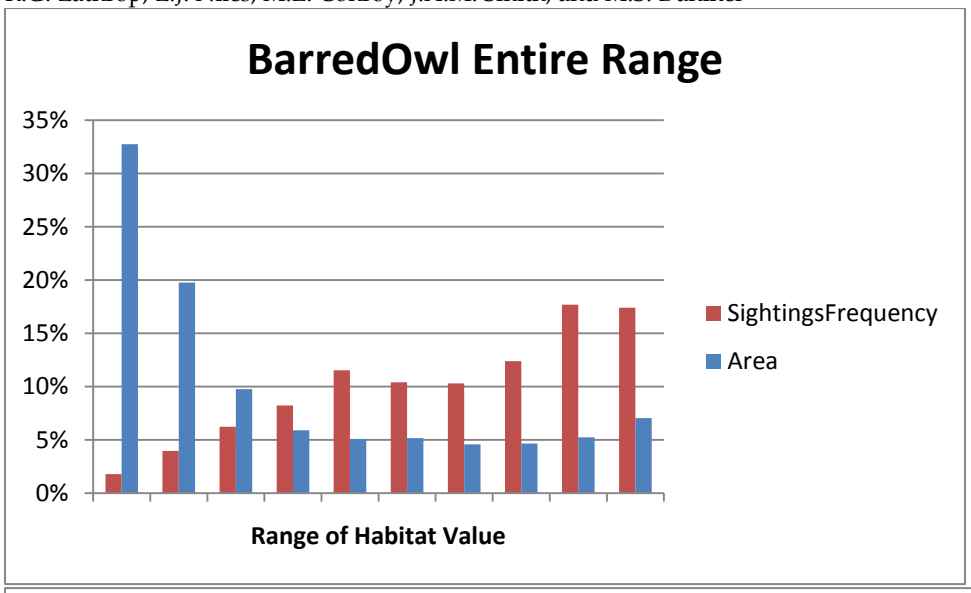

Northern Goshawk Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

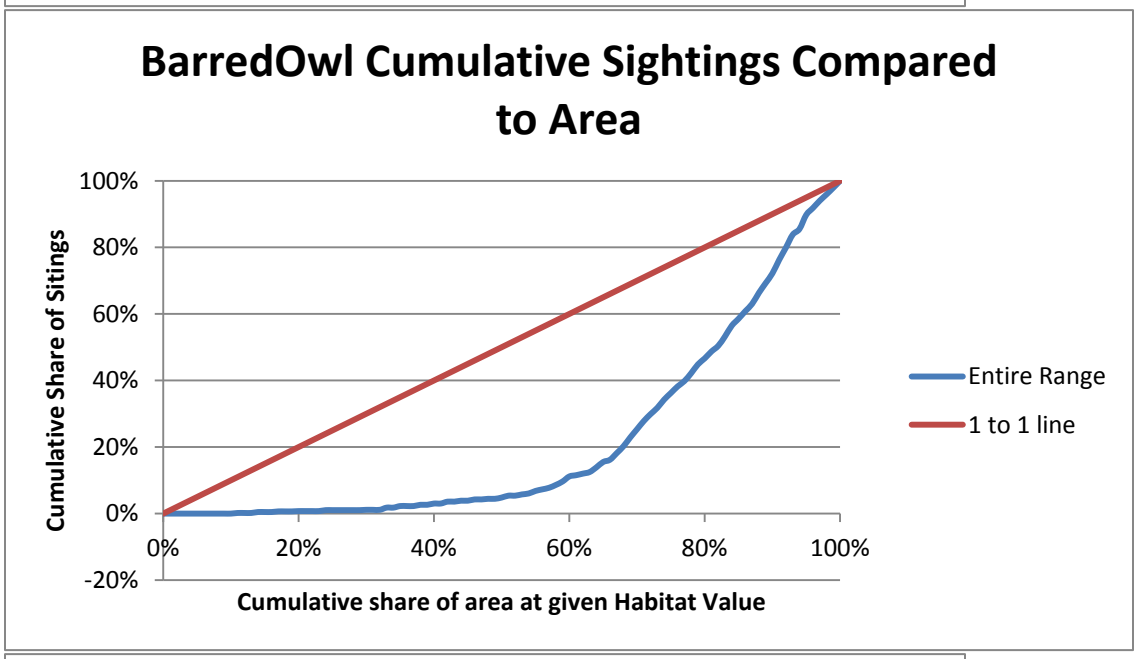

Northern Goshawk Smoothed Sightings per Area Entire Range
10
8
6
4
2
0
0
20
40
60
80
100
y = 0.0332x + 0.2063
R² = 0.1425
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

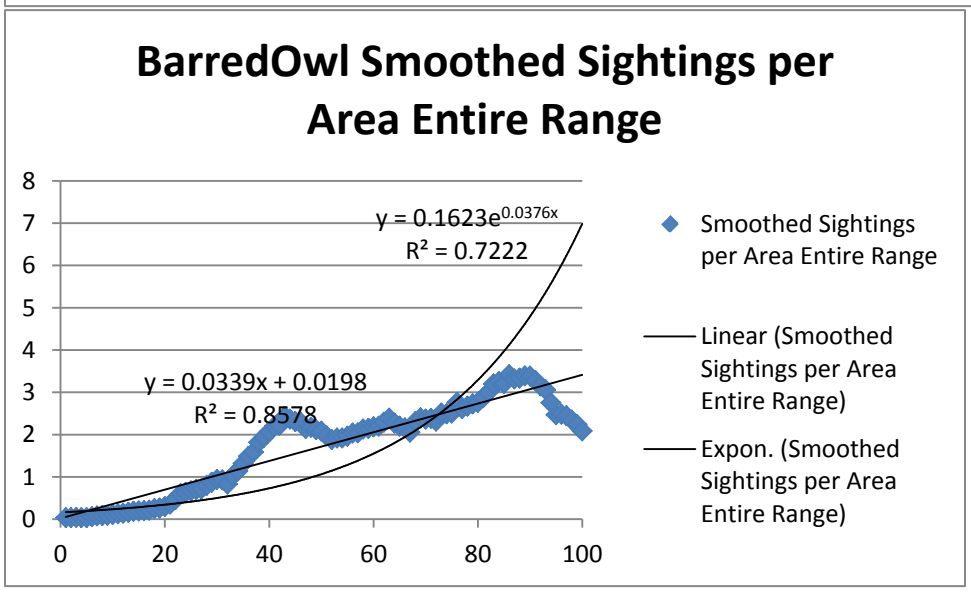

Red-Shouldered Hawk Entire Range
30%
25%
20%
15%
10%
5%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

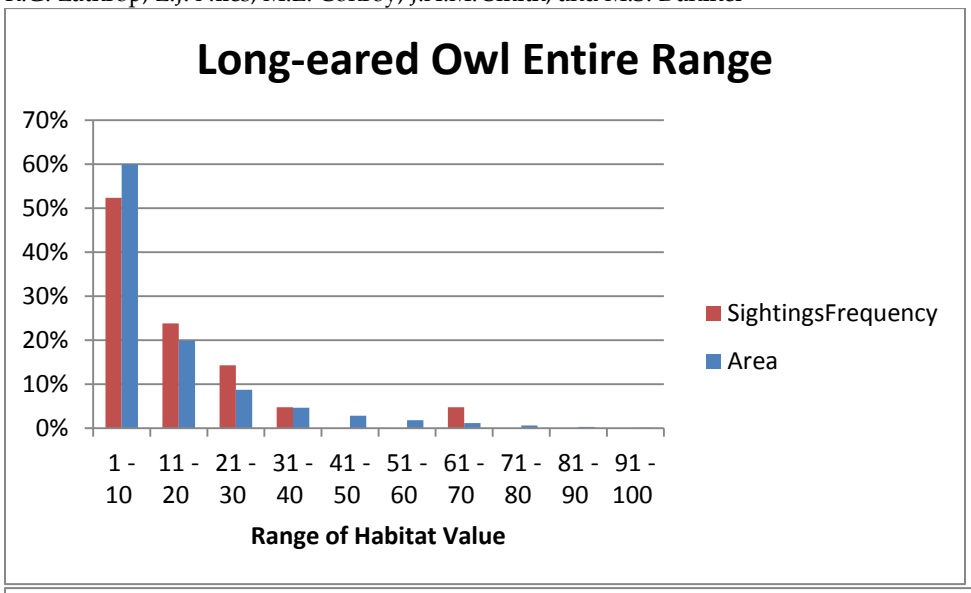

Red-Shouldered Hawk Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

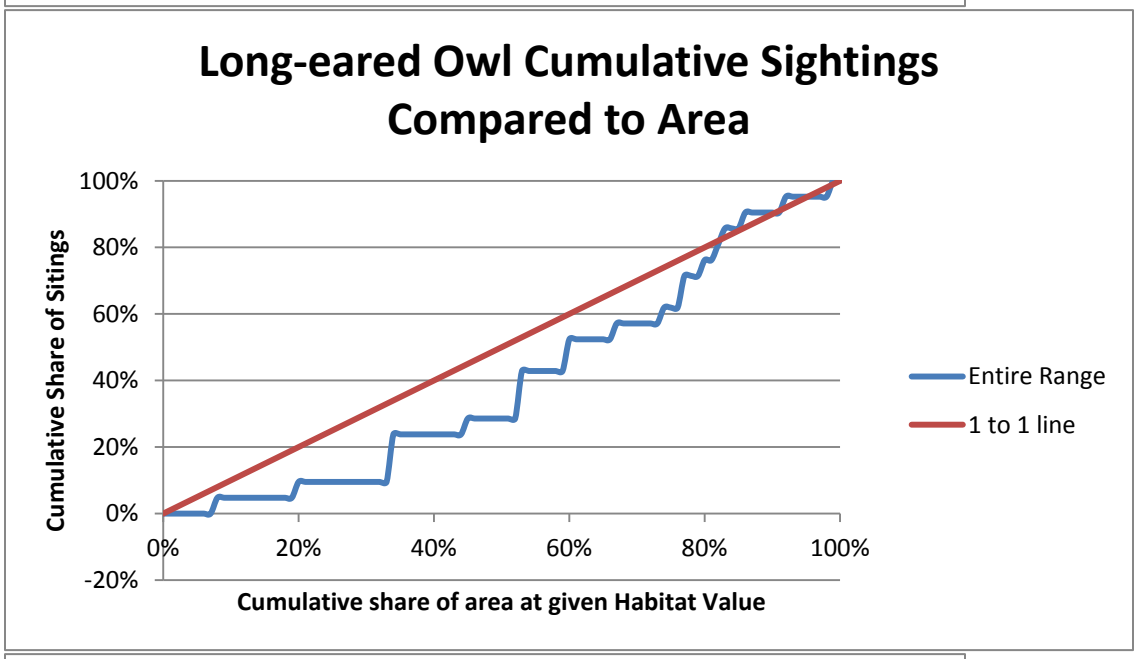

Red-Shouldered Hawk Smoothed Sightings per Area Entire Range
y = 0.1618e0.0339x
R² = 0.8167
y = 0.0316x - 0.2301
R² = 0.8116
6
5
4
3
2
1
0
-1
0
20
40
60
80
100
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

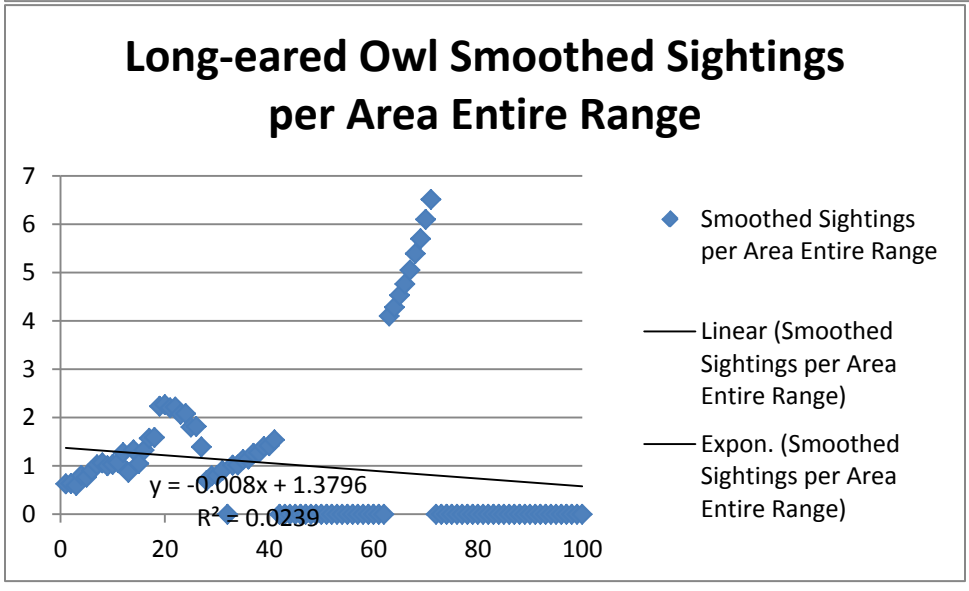

BarredOwl Entire Range
35%
30%
25%
20%
15%
10%
5%
0%
Range of Habitat Value
SightingsFrequency
Area

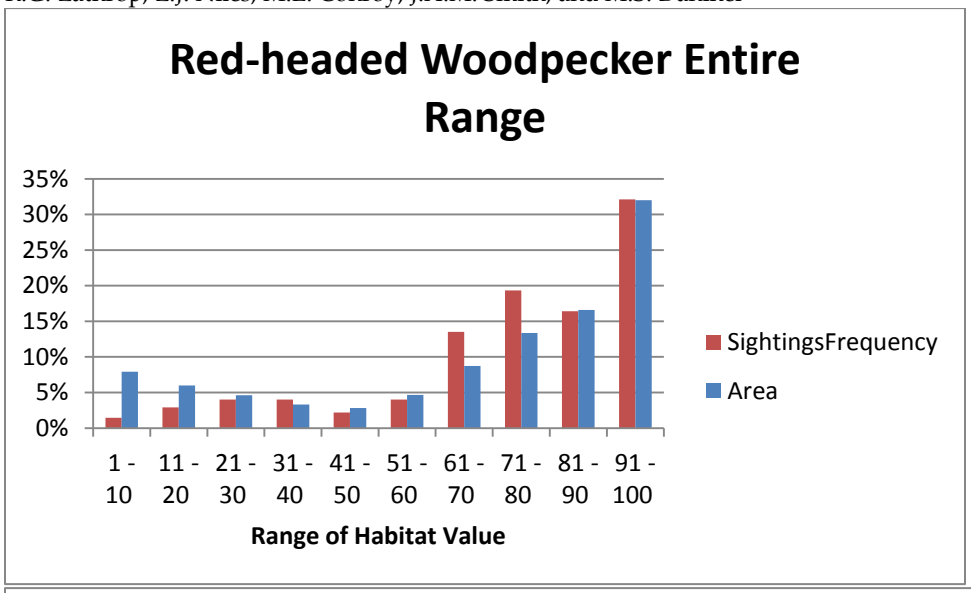

BarredOwl Cumulative Sightings Compared to Area
100%
80%
60%
40%
20%
0%
-20%
Cumulative Share of Sitings
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

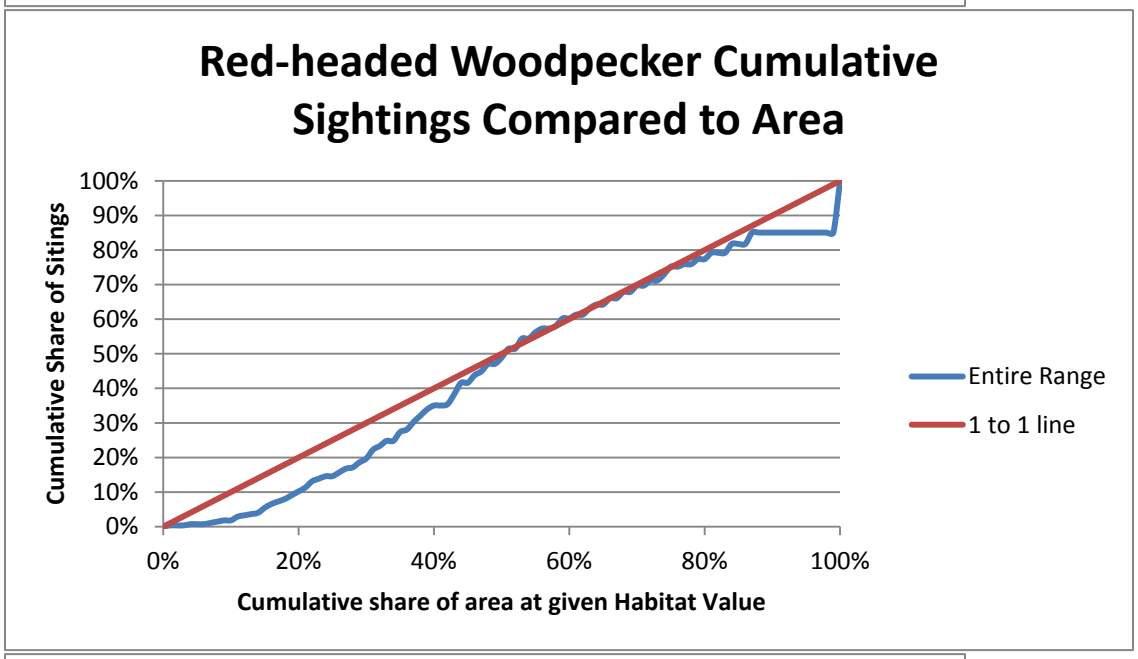

BarredOwl Smoothed Sightings per Area Entire Range
8
7
6
5
4
3
2
1
0
0
20
40
60
80
100
y = 0.1623e0.0376x
R² = 0.7222
y = 0.0339x + 0.0198
R² = 0.8578
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

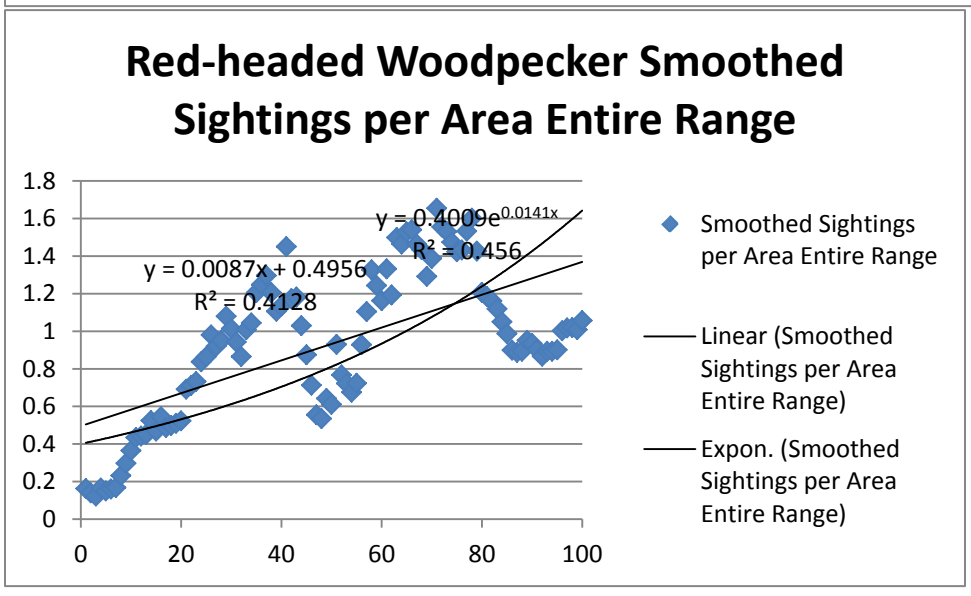

Long-eared Owl Entire Range
70%
60%
50%
40%
30%
20%
10%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

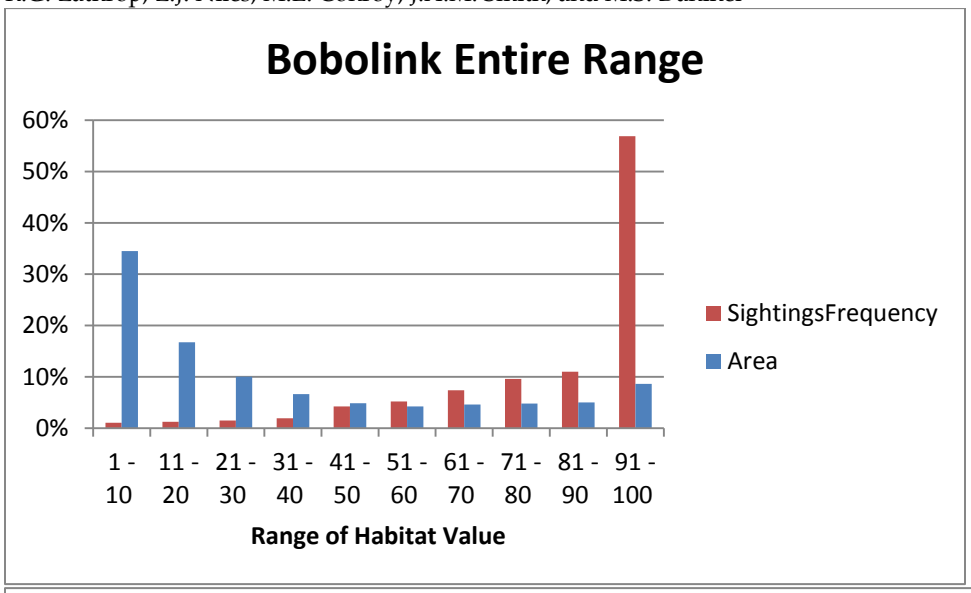

Long-eared Owl Cumulative Sightings Compared to Area
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative Share of Sitings
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

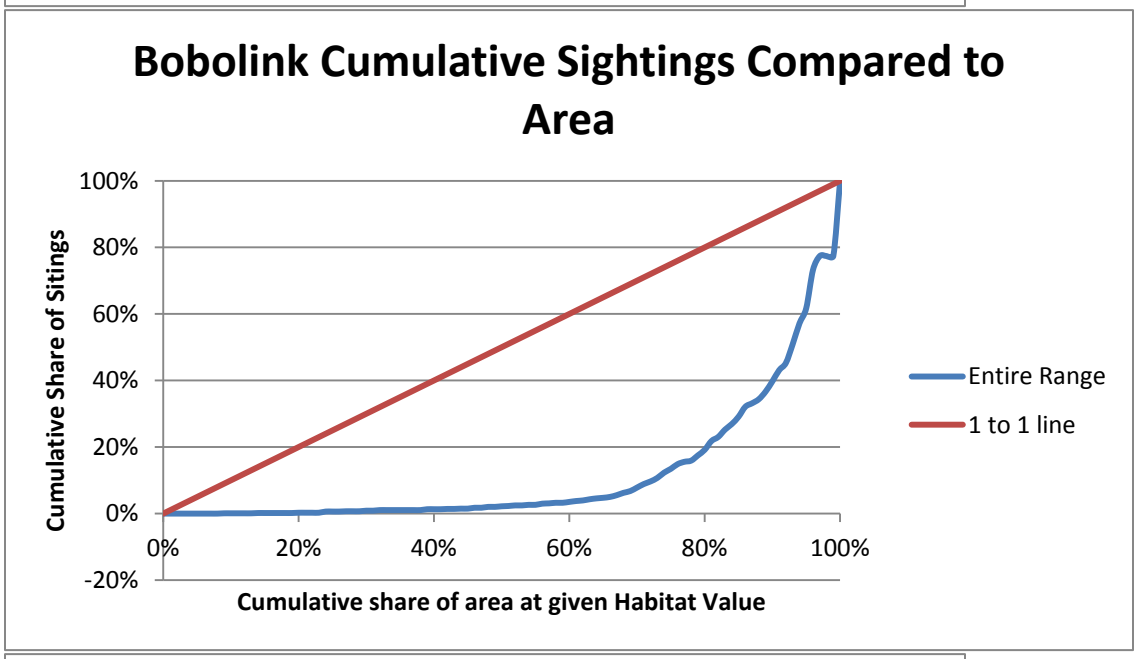

Long-eared Owl Smoothed Sightings per Area Entire Range
7
6
5
4
3
2
1
0
0
20
40
60
80
100
y = -0.008x + 1.3796
R² = 0.0239
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

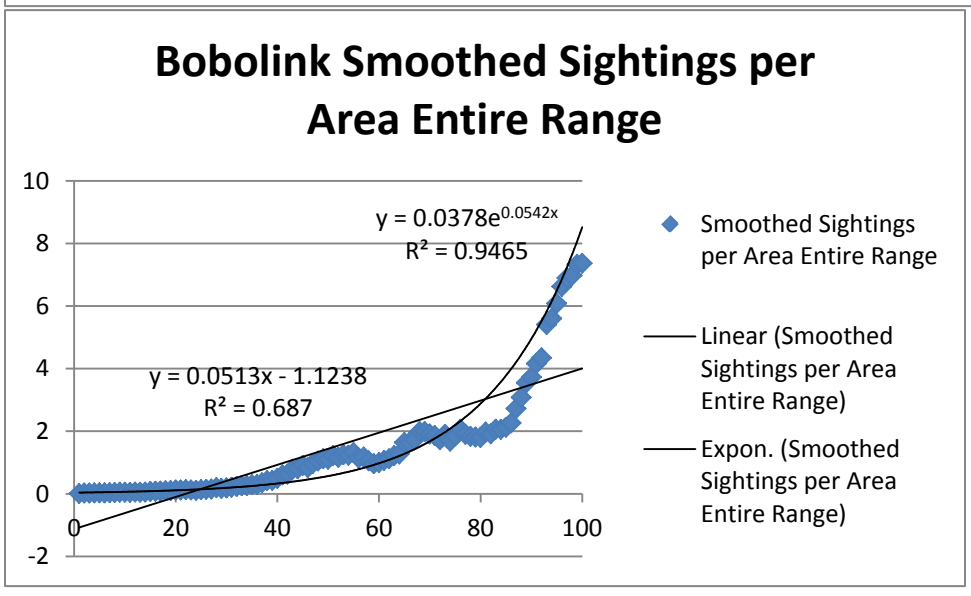

Red-headed Woodpecker Entire Range
35%
30%
25%
20%
15%
10%
5%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

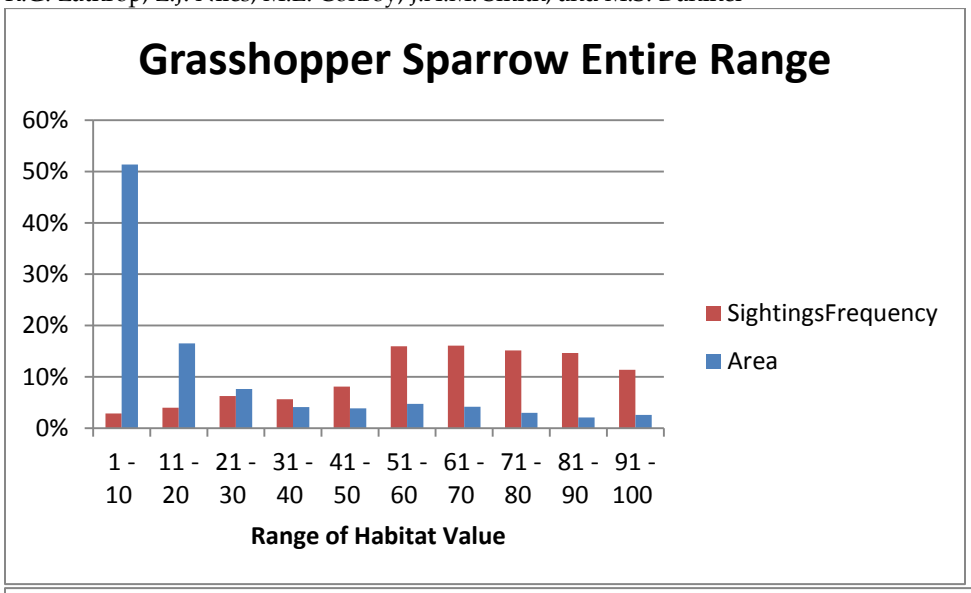

Red-headed Woodpecker Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

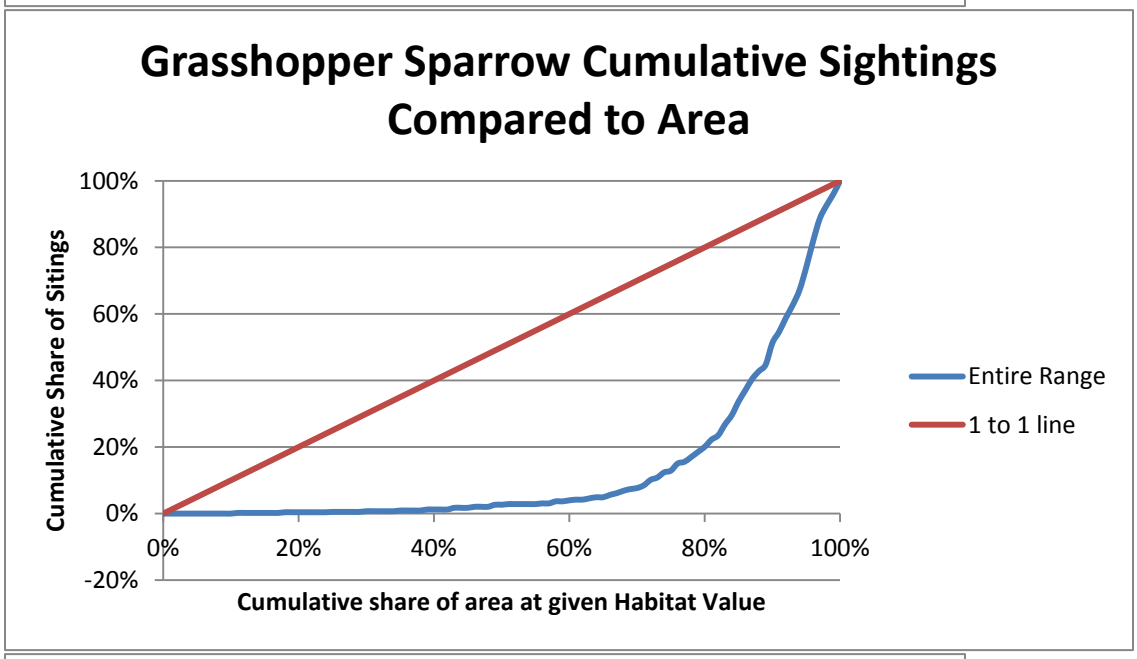

Red-headed Woodpecker Smoothed Sightings per Area Entire Range
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
y = 0.4009e0.0141x
R² = 0.456
y = 0.0087x + 0.4956
R² = 0.4128
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

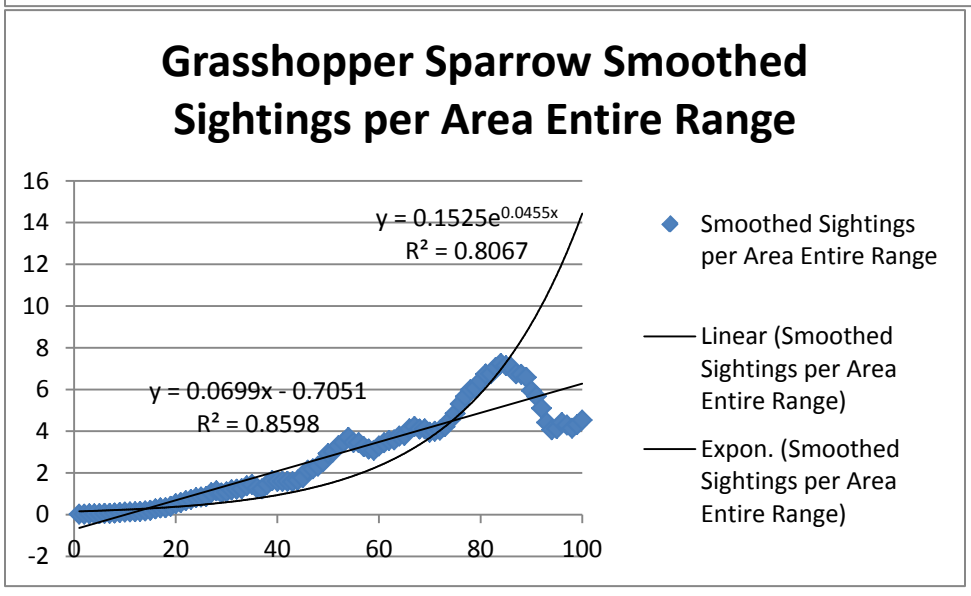

Bobolink Entire Range
60%
50%
40%
30%
20%
10%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area

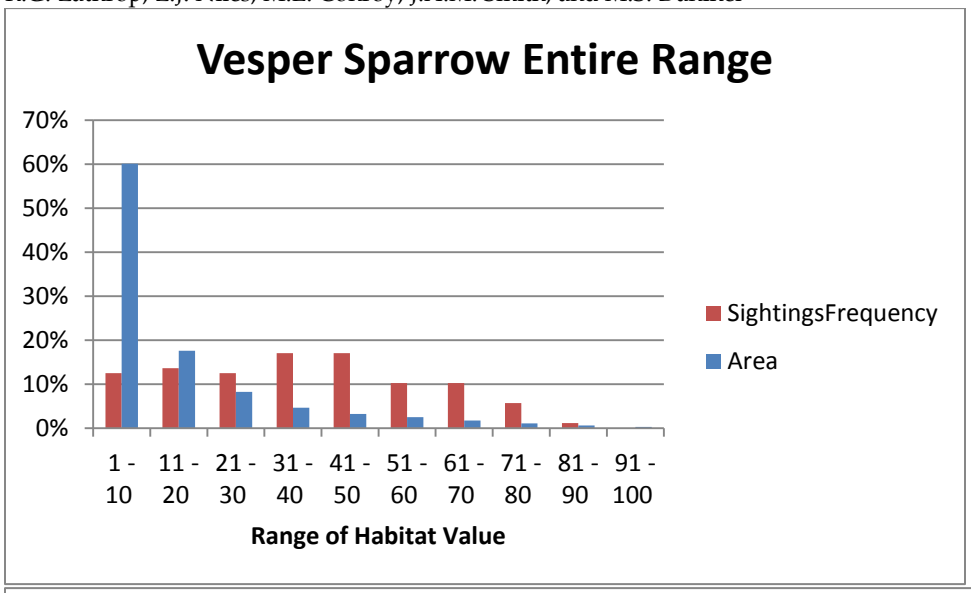

Bobolink Cumulative Sightings Compared to Area
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative Share of Sitings
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line

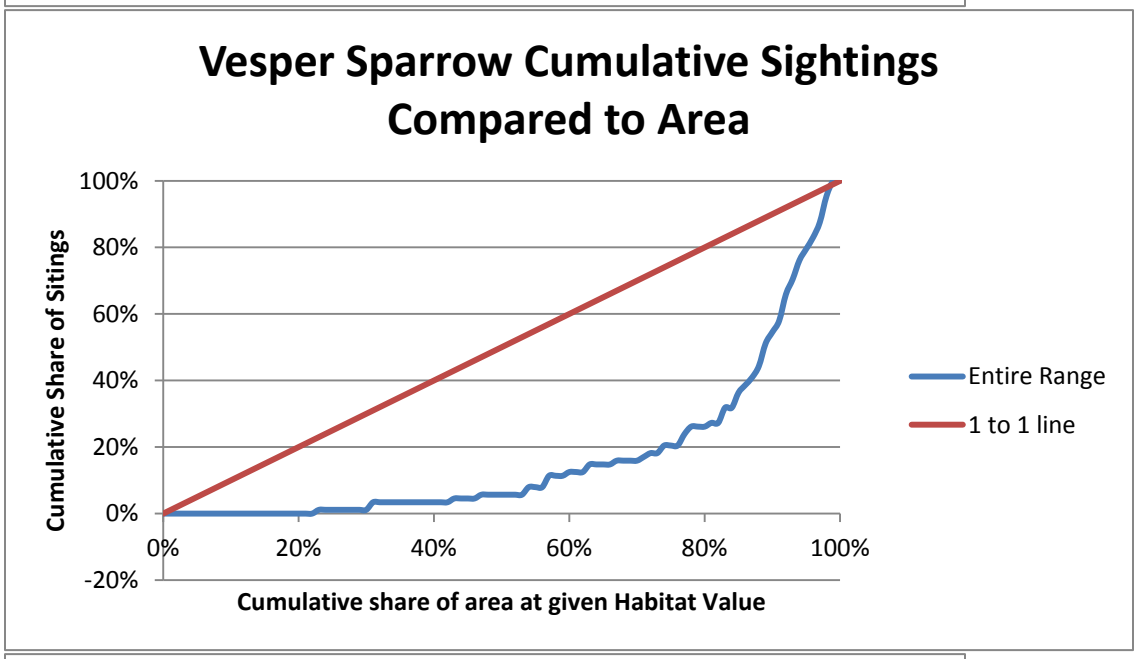

Bobolink Smoothed Sightings per Area Entire Range
10
8
6
4
2
0
-2
0
20
40
60
80
100
y = 0.0378e0.0542x
R² = 0.9465
y = 0.0513x - 1.1238
R² = 0.687
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

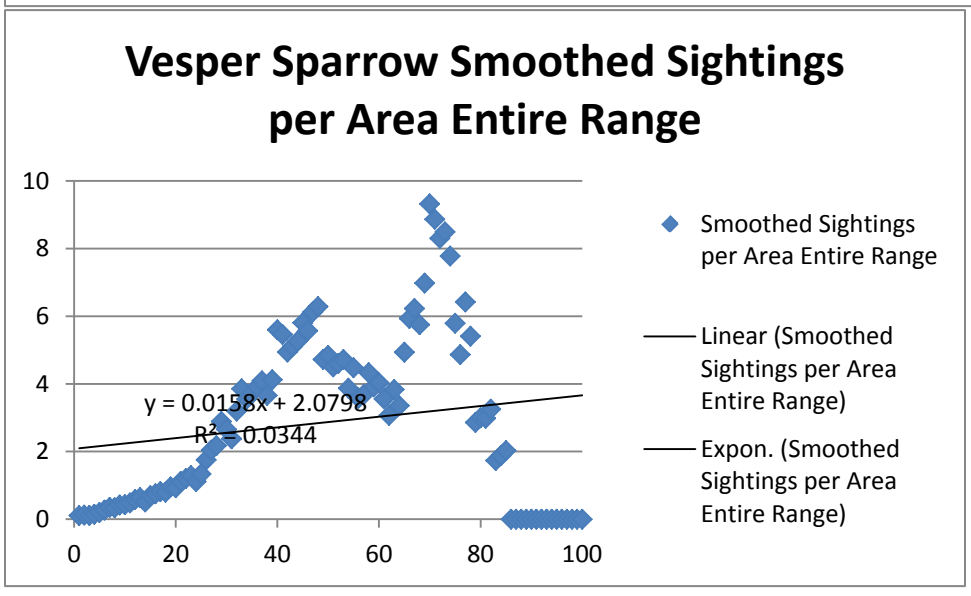

Grasshopper Sparrow Entire Range
60%
50%
40%
30%
20%
10%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area


Grasshopper Sparrow Cumulative Sightings Compared to Area
Cumulative Share of Sitings
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line


Grasshopper Sparrow Smoothed Sightings per Area Entire Range
16
14
12
10
8
6
4
2
0
-2
0
20
40
60
80
100
y = 0.1525e0.0455x
R² = 0.8067
y = 0.0699x - 0.7051
R² = 0.8598
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)


Vesper Sparrow Entire Range
70%
60%
50%
40%
30%
20%
10%
0%
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Range of Habitat Value
SightingsFrequency
Area


Vesper Sparrow Cumulative Sightings Compared to Area
100%
80%
60%
40%
20%
0%
-20%
0%
20%
40%
60%
80%
100%
Cumulative Share of Sitings
Cumulative share of area at given Habitat Value
Entire Range
1 to 1 line


Vesper Sparrow Smoothed Sightings per Area Entire Range
10
8
6
4
2
0
0
20
40
60
80
100
y = 0.0158x + 2.0798
R² = 0.0344
Smoothed Sightings per Area Entire Range
Linear (Smoothed Sightings per Area Entire Range)
Expon. (Smoothed Sightings per Area Entire Range)

Summary and Conclusions

The habitat value model described in this report estimates the value of habitat for listed threatened and endangered animal species based on each species' needs and the intrinsic characteristics of the landscape. Based on a comparison with empirical data, we suggest that this model works well for wide-ranging area-sensitive species (e.g., species such as the bobcat, Indiana bat, northern goshawk, red-headed woodpecker, red-shouldered hawk, timber rattlesnake, wood turtle) and provides a complement to existing ENSP Landscape project maps. Rather than a simple binary map of documented potential habitat vs. not documented, our maps provide more nuanced information as to the potential habitat value or importance for the species in question. We suggest that the existing ENSP Landscape maps and/or other information (i.e. site specific surveys) be used for species with restricted geographic distributions or more specific habitat requirements. Where "better" habitat models are available, these can be substituted in for the models described above, for application in subsequent non-net-loss habitat value mitigation evaluations.

Appendix C. Questions to Stakeholders

Answers to the following questions by stakeholders will provide the basis for the recommendations made in the final white paper. The following survey was administered through SurveyMonkey starting on January 21, 2014 and all the stakeholders were requested to respond. Ten responses were received.

1. Conversion and loss of T&E wildlife species habitat should be avoided where possible. But if is unavoidable, then it should be mitigated for in some fashion.

   Agree **(7)** Agree with Reservation **(3)** Disagree **(0)**

2. The Wildlife Habitat Value (WHV) model is a fair representation of value to serve as the basis for determining wildlife habitat mitigation obligations.

   Agree **(3)** Agree with Reservation **(4)** Disagree **(3)**

3. In conducting mitigation for loss of WHV due to development, we want to ensure that actions to offset loss in value result in no net loss of WHV at the scale of the landscape.

   Agree **(4)** Agree with Reservation **(4)** Disagree **(2)**

4. A conservation market should be used as a trading platform for offsetting WHV debits with credits.

   Agree **(3)** Agree with Reservation **(4)** Disagree **(3)**

5. A non-wasting stewardship endowment should be used to support increased WHV via habitat management/enhancement and funded as part of the price of a WHV credit.

   Agree **(3)** Agree with Reservation **(6)** Disagree **(1)**

6. The Conservation Bank Trust should be responsible for overseeing conservation banks/sponsors, stewardship endowments and operating the trading platform.

   Agree **(5)** Agree with Reservation **(4)** Disagree **(1)**

7. Certified consultants will play the role of helping landowners and developers calculate debits, acquire offsetting credits through the conservation market, develop mitigation plans, and work with bank sponsors in creating conservation banks.

   Agree **(3)** Agree with Reservation **(4)** Disagree **(3)**

8. The ENSP working with the Trust will be responsible for reviewing management plans, helping the Trust assess management credits, developing best management practices, monitoring consultants and overseeing the progress of the system every three years.

   Agree **(3)** Agree with Reservation **(5)** Disagree **(2)**

9. Municipal, county and state agencies should be allowed to generate WHV credits with newly preserved land by enrolling these lands in an approved conservation bank.

   Agree **(4)** Agree with Reservation **(6)** Disagree **(0)**

10. There should be a minimum threshold for involvement in the program (minimum acreage).

    Agree **(3)** Agree with Reservation **(5)** Disagree **(2)**

Appendix D: Additional Information

The following papers provide additional information on the conservation banking concept.

USFWS 2003. Guidance for the establishment, use, and operation of conservation banks.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

MAY 2 2003

Memorandum

To: Regional Directors, Regions 1-7
Manager, California Nevada Operations

From: Director

Subject: Guidance for the Establishment, Use, and Operation of Conservation Banks

This memorandum transmits guidance that will help Service personnel evaluate proposals to establish conservation banks (attached). This guidance provides a collaborative incentive-based approach to endangered species conservation, which if used in coordination with other tools available to the Service, can aid in the recovery of the species. Due to the beneficial aspects derived from this guidance we are establishing it effective immediately. As with any program, however, the Service will review and monitor use of this guidance for the establishment of conservation banks, and may choose to revise, update, and improve this guidance in the future. Consequently, when implementing this guidance, Service personnel should encourage discussion and obtain feedback from landowners, applicants, owners of conservation banks, or other members of the public.

This memorandum is intended to be applied to conservation bank proposals submitted for approval on or after the date of this guidance and to those in early stages of planning or development. It is not intended for the guidance to be retroactive for banks that have already received agency approval. While it is recognized that individual conservation banking proposals may vary, it is the intent of this guidance that the fundamental concepts be applicable to future conservation banks.

Attachment

Guidance for the Establishment, Use, and Operation of Conservation Banks

I. Introduction

A. Purpose and Scope of Guidance

This document provides guidance on the establishment, use, and operation of conservation banks for the purpose of providing a tool for offset mitigating adverse impacts to species listed as threatened or endangered under the Endangered Species Act of 1973, as amended. This guidance can also be used to aid in the establishment of banks for candidate species. The Service envisions that banks will mainly be used for candidates in conjunction with Candidate Conservation Agreements with Assurances or as a precursor to a multiple species Habitat Conservation Plan effort that covers listed and non-listed species.

The policies and procedures discussed herein are applicable to the establishment, use, and operation of public conservation banks, privately sponsored conservation banks, and third party banks (i.e., entrepreneurial banks). The guidance they provide is intended to help Service personnel; (1) evaluate the use of conservation banks to meet the conservation needs of listed species; (2) fulfill the purposes of the ESA; and (3) provide consistency and predictability in the establishment, use, and operation of conservation banks. In this regard, it is important to apply consistent standards and principles of mitigation whether mitigating through conservation banks or through other means. The purpose of this policy is not to set the bar higher for conservation banks than for other forms of mitigation, but articulate generally applicable mitigation standards and principles and to explain how they are to be accomplished in the special context of conservation banks.

Conservation banks are a flexible means of meeting a variety of conservation needs of listed species. The use of conservation banks should be evaluated in the context of unavoidable impacts of proposed projects to listed species. In addition some cases, the use of off-site banks may be the only be appropriate mitigation option when on-site conservation measures are not practicable for a project or when the use of the bank is environmentally preferable to on-site measures. In general, no two conservation banks will be used or developed in an identical fashion. However, as demand for conservation banking increases, it is important that the essential components and operational criteria of conservation banks are standardized to ensure national consistency.

B. Background

Conservation banking is attractive to landowners and land managers because it allows conservation to be implemented within a market framework, where habitat for listed species is treated as a benefit rather than a liability. From the Service's perspective, conservation banking reduces the piecemeal approach to conservation efforts that can result from individual projects by establishing larger reserves and enhancing habitat connectivity. From a project applicant's perspective, it saves time and money by identifying pre-approved conservation areas, identifying "willing sellers," increasing flexibility in meeting their conservation needs, and simplifying the regulatory compliance process and associated paperwork. From the landowner's perspective, it provides a benefit an opportunity to generate income from what may have previously been considered a liability.

Directing smaller individual mitigation actions into a bank streamlines compliance for the individual permit applicants or project proponents while providing a higher benefit to the natural resources. Banking allows a collaboration of private/public partnerships to maintain lands as open space, providing for the

conservation of endangered species. Local communities as a whole benefit by being assured that their natural resources will be protected and open space maintained.

Conservation banking can bring together financial resources, planning, and scientific expertise not practicable for smaller conservation actions. By encouraging collaborative efforts, it becomes possible to take advantage of economies of scale (both financial and biological), funding sources, and management, scientific, and planning resources that are not typically available at the individual project level.

1. What Is a Conservation Bank?

A conservation bank is a parcel of land containing natural resource values that are conserved and managed in perpetuity, through a conservation easement held by an entity responsible for enforcing the terms of the easement, for specified listed species and used to offset impacts occurring elsewhere to the same resource values on non-bank lands. Bank parcels are typically large enough to accommodate the mitigation of multiple projects. A project proponent will secure a certain amount of natural resource values within the bank to offset the impacts to those same values offsite. The bank is specifically managed and protected by the banker or designee for the natural resource values. The values of the natural resources are translated into quantified "credits." Typically, the credit price will include funding for the long-term natural resource management and protection of those values. Project proponents are, therefore, able to complete their conservation needs through a one time purchase of credits from the conservation bank. This allows "one-stop-shopping" for the project proponent, providing conservation and management for listed species in one simplified transaction.

A bank can be created in a number of different ways: (1) acquisition of existing habitat; (2) protection of existing habitat through conservation easements; (3) restoration or enhancements of disturbed habitat; (4) creation of new habitat in some situations; and (5) prescriptive management of habitats for specified biological characteristics. Banks can be created in association with specific projects, or can proceed from a circumstance where the a project proponent sets aside more area than is needed for the immediate project, or where the specific project and is willing to protect the remaining area and thus generate credits, or where the specific project is implemented over a longer period of time. A conservation bank also can also be created as an entrepreneurial effort in anticipation of an independent customer base with a number of different potential projects.

Once conservation banks are established, conservation banks each credit they sell are is considered to be part of the environmental baseline. As a result, future project evaluations and listing or delisting decisions can be made in a more stable ecological context. This stability is one of conservation banking's greatest assets, both from the an ecological and economic standpoint. For this reason, it is particularly important that conservation banks be established in perpetuity, regardless of the future status of the species for which the bank was initially established.

2. Wetland Mitigation Banking vs. Conservation Banking

The wetland mitigation banking policy was finalized in November of 1995*(60* FR *58605)*. The main concept behind wetland mitigation banking is similar to that of conservation banking; to provide compensation for adverse impacts to wetlands and other aquatic resources in advance of the impact. Under the guidelines established for section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act, impacts to wetlands are mitigated sequentially by avoiding impacts, minimizing impacts, and then, as a last resort, compensating for those impacts. Compensatory mitigation involves creating, restoring, or enhancing lost function and values of the wetlands. In the absence of mitigation

banking, this often led to small, isolated wetlands being restored without long-term value. Wetland mitigation banking was used to consolidate smaller mitigation requirements for wetland impacts. Typically, the mitigation bank policy focused on establishing credits based on the restored or enhanced value of the area, and discouraged the establishment of "preservation" banks. This makes sense when the functions of wetlands on the landscape are considered in the context of a no net loss policy.

Conservation banking transferred the concept of wetland mitigation banking into endangered and threatened species conservation with a few slight differences. While in wetland mitigation banking the goal is to replace the exact function and values of the specific wetland habitats that will be adversely affected by a proposed project, in conservation banking the goal is to offset adverse impacts to a species. These different goals account for differences in the policies guiding operations of the two banks. In contrast to mitigation banks, an appropriate function of conservation banks is the preservation of existing habitat with long-term conservation value to mitigate loss of other isolated and fragmented habitat that has no long-term value to the species. It forces the Service to evaluate all issues surrounding banking in the context of the benefit to the species a sharply contrasting standard to that of wetland banking, where the focus of mitigation is on maintaining function and values present in a particular watershed.

Endangered species conservation banking has been implemented in California since 1995, where the Service has worked with the State of California Department of Fish and Game (CDFG). The CDFG policy on conservation banking describes conservation banks as:

> A conservation bank is privately or publicly owned land managed for its natural resource values. For example, in order to satisfy the legal requirement for mitigation of environmental impacts from a development, a landowner can buy credits from a conservation bank, or in the case of wetlands, a mitigation bank. Conservation banking legally links the owner of the bank and resource agencies, such as the Department of Fish and Game or the U.S. Fish and Wildlife Service.

II. Policy Considerations

The Services intent is that this guidance be applied to conservation bank proposals submitted for approval on or after the effective date of this guidance and to those in early stages of planning or development. We do not intend for the policy to be retroactive for banks that have already received agency approval. While we recognize that individual conservation banking proposals may vary, our intent for this guidance is that the fundamental concepts be applicable to future conservation banks.

Conservation banking can assist both the section 7 and section 10 processes in reaching their goals. Many activities authorized under these processes result in adverse effects to listed species, including habitat loss or modification. One way to offset these types of impacts is to include in the project design a plan that involves the restoration and/or protection of similar habitat on- and/or off-site. Purchasing credits in conservation banks is one method of protecting habitat off-site or on-site.

A. Authorities

1. Section 7

Section 7(a)(1) of the ESA requires that all Federal agencies ...in consultation with and with the assistance of the [Service], utilize their authorities in furtherance of the purposes of [the ESA] by carrying out programs for the conservation of [listed species]. Section 7(a)(2) of the ESA also requires each Federal agency to consult with the Service regarding effects of their actions to insure that the continued existence

of listed species will not be jeopardized and that designated critical habitat will not be destroyed or adversely modified. Impacts to listed species are minimized by including conservation measures for the listed species in the Federal agency's project description. These conservation measures could include, if appropriate, protection of off-site listed species habitat through purchase of credits in a conservation bank.

2. Section 10

Section 10(a)(1)(B) of the ESA authorizes the Service to issue to non-Federal entities a permit for the incidental take of endangered and threatened species. This permit allows a non-Federal landowner to proceed with an activity that is legal in all other respects, but that results in the incidental taking of a listed species. A habitat conservation plan, or HCP, must accompany an application for an incidental take permit. The purpose of the HCP is to ensure that the effects of the permitted action on covered species are adequately minimized and mitigated and that the action does not appreciably reduce the survival and recovery of the species. Mitigation may include off-site protection of the listed species and its habitat and may take the form of purchasing credits in an approved conservation bank. Credits must be acquired by the permittee prior to commencement of actions authorized by an incidental take permit and intended to be mitigated by those credits.

B. Planning Considerations

1. Goals and Objectives

The overall goal of any conservation bank should be to provide an economically effective process that provides options to landowners to offset the adverse effects of proposed projects to listed species. The goal of a bank should be focused on producing conservation benefits for the species for which the bank is being established. For instance, many species are facing the threat of habitat loss and fragmentation. By consolidating and managing the high-priority areas in a reserve network, the threat of fragmentation may be reduced and the species can be stabilized. The species recovery plan and conservation strategy can help provide are among the tools available to develop the goals and objectives for establishing conservation banks. The important point in establishing a bank is to site banks in appropriate areas that can reduce the threat of fragmentation and provide management measures that address other threats that a species might encounter, such as cowbird parasitism, non-native invasion, or disruption of natural disturbance regimes.

2. Conservation Strategy

Any conservation strategy that the Service develops should identify threats, conservation needs and actions that address those threats and needs in the Service area. This information can then help the Service evaluate whether the banking concept, the geographic location, the size, and management for the species is appropriate. The recovery plan can help guide the Service in evaluating whether creation of a bank will contribute to the conservation needs of the species. However, in instances where the recovery plan is not specific, is not available or is outdated, the Service may consider options to assess bank effectiveness. One option is to develop a local step down approach or strategy to addressing the needs of the species.

The conservation strategy or species conservation needs should address the factors which caused the species to be listed and must be based on sound scientific principles. The main threat to a majority of the listed species is habitat loss and fragmentation of the remaining habitat. To reduce this threat,

conservation biology principles have often been used to conserve populations of species in a reserve network, consisting of core populations that are interconnected by dispersal corridors. Conservation banking can aid in such a strategy by adding conservation areas that are permanently managed to the reserve network.

3. Principles of Conservation Bank Evaluation

Both section 7 and section 10 require the evaluation of a project's adverse effects to a species and determine whether proposed project, together with any offsetting measures, will jeopardize the continued existence of the species. The adverse effects and offsetting measures are evaluated in the context of the current status of the species and the threats to the species. Implicit in the approval of a conservation bank, is the recognition that adverse effects to a species may be offset by the conservation improvements offered by the bank, That is, the Service is agreeing that projects which include adequate mitigation of impacts through the purchase of bank credits are consistent with the conservation needs of the species covered by the bank.

For the Service to determine whether to approve a proposed bank, the Service should determine whether the bank will provide adequate mitigation for the species. When the Service evaluates a proposed mitigation package that is intended to offset adverse effects to listed species, the Service evaluates whether the mitigation will fit within the conservation needs of the species.

For instance, if a proposed project involved habitat loss, the offsetting measure may be to conserve habitat in a location that contributes to the overall conservation strategy of the species, which may be located in a corridor or core area that supports essential breeding habitat. The conservation bank will provide mitigation to offset impacts and therefore should be evaluated in the same fashion. The best way to justify approving a bank is to evaluate whether the bank fits into the overall conservation needs of the listed species the bank intends to cover.

Two issues of paramount importance in evaluating any conservation bank are the siting of the bank and its management program. Although recovery plans for individual species will rarely, if ever, identify particular parcels as desirable sites for conservation banks or other conservation actions, they often identify broader areas within which recovery efforts will be focused. Conservation banks sited in these areas can create mitigation opportunities that both increase the options available to regulated interests and contribute to the conservation of the species. For species without recovery plans, or with plans that do not clearly identify those areas where recovery efforts will be primarily focused, conferral with the Service is especially important, to identify those areas it regards as of particular value in conserving the species.

For many species, individual conservation banks are seldom large enough, by themselves, to support a viable population of a threatened or endangered species over the long term. But if the bank is located next to an existing area managed for the conservation of that species, even a small conservation bank may increase the likelihood that a viable population can be maintained there. Similarly, if a bank is sited to encourage dispersal between two areas managed for the conservation of the species, the bank may increase the likelihood of the species surviving at both locations and thus provide a benefit proportionally larger than its actual area. In some instances, banks may be able to provide replacement habitat for species currently occupying nearby unmanaged habitats at risk of becoming unsuitable because of succession. Sites that otherwise appear to be good locations for conservation banks may turn out, on closer examination, to be inappropriate because of anticipated land-use changes in the surrounding area. These and other considerations relevant to the siting of a conservation bank should be taken into account at the outset and discussed with the would-be banker's to ensure that needs for species conservation is

compatible with the banker's objectives.

No less important than siting is the bank's management program. Seldom will the needs of a threatened or endangered species be met on a completely unmanaged piece of property. More commonly, an active management program--to control invasive exotic species, replicate natural disturbance regimes; prevent an area's use by off-road vehicles, illegal garbage dumpers or others; and address myriad other threats--is essential to ensure that the potential conservation value of a particular property is realized and maintained. These management needs should be anticipated and provided.

4. Eligible Lands

Conservation banks may be established on Tribal, local, private, or State lands where managing agencies maintain or will maintain habitat in the future. Use of conservation banks on Federal lands is not precluded under this guidance, although there may be special considerations concerning applicability of conservation banks on Federal lands. Therefore, future guidance will be forthcoming on this point. Until such time, use of conservation banks on Federal lands would occur only on a case-by-case basis after review and approval by the Director.

Land used to establish conservation banks must not be previously designated for conservation purposes (e.g., parks, green spaces, municipal watershed lands), unless the proposed designation as a bank would add additional conservation benefit. For instance, it may be advantageous to place in a conservation bank the biological and habitat benefits that a species has gained under a Safe Harbor Agreement, where the landowner would agree to maintain those resource values in perpetuity.

Where conservation values have already been permanently protected or restored under other Federal, State, Tribal, or local programs benefitting federally listed species, the Service will not recommend, support, or advocate the use of such lands as conservation banks for mitigating impacts to species listed under the ESA. This includes programs that compensate landowners who permanently protect or restore habitat for federally listed species on private agricultural lands, as well as easement areas associated with inventory and debt restructure properties, lands protected or restored for conservation purposes under fee title transfers, lands protected by a habitat management agreement (unless the agreement is extended in perpetuity by a bank agreement), or habitats protected by similar programs. For example, lands conserved under the section 6 habitat conservation plan land acquisition grant program would not be available for conservation bank establishment. Where Federal funds have been used in the establishment of a bank, the allocation of credits to the bank will be proportionate to the non-Federal contribution. A bank capable of sustaining 10 credits, but with a 50 percent Federal contribution, will be allocated 5 credits.

5. Site Selection

The Service will give careful consideration to the ecological suitability of a site for achieving mitigation. The Service will evaluate the location, size, and configuration of the proposed bank. Additional items to consider when determining the suitability of an area as a conservation bank might be topographic features, habitat quality, compatibility of existing and future land use activities surrounding the bank, and species use of the area.

Conservation biology principles suggest that conserving large, unfragmented habitat blocks, to reduce the edge effect, in a reserve network will help to maintain viable populations. A conservation bank could be large enough to maintain a viable population within its boundaries or be situated in a strategic location

that would add to an already established conserved area. The conserved area might be a privately owned mitigation site established under an habitat conservation plan, or a State park . Banks could also be sited between two larger areas in a corridor that will maintain connectivity for dispersing individuals.

Bank boundaries should ordinarily be drawn so as to exclude developed areas or other areas that cannot reasonably be restored. Potential banks that encompass such areas should only be approved if the activities that will occur on these areas will not impact the value of the bank for conservation or if the resulting value will be sufficient to warrant conservation in spite of the developed areas. However, if the latter is the case, we must have the assurance that the impacts will not change over time in a manner that will decrease the value of the bank. Factors to consider include, but are not limited to, activities that may result in incidental take, habitat degradation, and contamination.

It is also possible to establish conservation banks within the boundaries of a proposed project, such as an HCP planning area, if it is both feasible and appropriate given the habitat type and species needs. If the project plan area contains sufficient land and the project impacts are fairly localized, it may be possible, or even desirable, to designate a conservation bank within its boundaries. Ultimately, the habitat credits purchased within from a conservation bank must provide biologically comparable habitat values to the area affected by the activity to be covered mitigated.

6. Inclusion of Buffer Area

In general, it is important that banks be of sufficient size to ensure the maintenance of ecological integrity in perpetuity. However, the minimum or maximum sizes of parcels of land designated as a conservation bank will be determined on a case-by-case basis depending on the needs of the species proposed to be covered in the bank, the location of the bank, and the habitat values that are provided. Bank boundaries must encompass all areas that are necessary to maintain the habitat function specific to the species covered by the bank, which may include the appropriate buffer against edge effects from adjacent land use.

These buffer areas may not always consist of habitat that is necessary for the species included in the bank. However, limited credits may be given for the inclusion of these buffer areas only to the degree that such features increase the overall ecological functioning of the bank.

7. Role of Restoration, Enhancement, and Creation of Habitat

Conservation banks will rely on a range of strategies to achieve and maintain mitigation in perpetuity on existing functioning and occupied habitat for a majority of those species facing threats of habitat loss and fragmentation. Such strategies include preservation, management, restoration of degraded habitat, connecting of separated habitats, buffering of already protected areas, creation of habitat, and other appropriate actions. The preservation strategy will be employed for those species in which the habitat is not easily restored or created, or the information on how to accomplish the restoration or creation of habitat is either not known or unreliable. Other species may rely heavily on creation or restoration of habitat as part of a conservation bank. The reliance on restoration, enhancement, or creation of habitat as part of a bank strategy will be species specific. All conservation banks will must have an element of management that will maintain the habitat for the species in the bank.
Conservation banks can be used in instances where significant restoration, enhancement, or creation of habitat are necessary. However, an appropriate credit system will need to must be developed to address these situations. If restoration is proposed as part of the conservation bank, appropriate measures should

be implemented to increase the likelihood of success. One way to increase the likelihood of success is to require some method of ensuring performance, such as authorizing sale of credits only upon completion and verification of restoration outcomes.

One strategy is to designate preservation credits for the protection of existing habitat and restoration credits for the restoration, enhancement, and preservation of areas not currently providing suitable habitat. The need for this type of distinction will vary depending on the specific ecological situation and the conservation strategy being employed. For example, we may determine that a species cannot afford any reduction of its total available habitat. For this reason, we may require the development of a process that provides for one acre to be protected and one acre to be restored for every acre of habitat destroyed. Taken to its full extent, this conservation strategy would result in half of the existing habitat being protected with the remaining habitat being replaced through habitat restoration.

C. Criteria for Use of a Conservation Bank

1. Project Applicability

Activities regulated under section 7 or section 10 of the ESA may be eligible to use a conservation bank, if the adverse impacts to the species from the particular project are offset by buying credits created and sold by the bank. Credits from a conservation bank may also be used to compensate for environmental impacts authorized under other programs (e.g., State or local regulatory programs, transportation projects, NEPA or State equivalent). In no case may the same credits be used to compensate for more than one activity; however, the same credits may be used to compensate for an activity that requires authorization under more than one program. In other words, once a credit is sold to offset an adverse impact, that same credit cannot be sold again.

2. Service Area

In general, the Service Area of a conservation bank is identified in the bank agreement and defines the area (e.g., recovery unit, watershed, county) in which the bank's credits may be used to offset project impacts. In other words, if proposed projects fall within a specific conservation bank's Service Area, then the proponents of those projects may offset their impacts, with the Services approval, by purchasing the appropriate number of conservation credits from that bank. In the event that the proposed projects fall within the Service Area of more than one conservation bank, then the project proponents would have the option of using any of the banks or perhaps even more that one bank.

Designation of the Service Area should be based on the conservation needs of the species being conserved. For this reason, banks generally should be located within areas designated in recovery plans as recovery units or other applicable recovery focal area, and their Service Areas should correspond to the recovery areas in which they are located. If there is no applicable recovery plan, banks should be sited, and Service Areas should be designated, to serve a comparable purpose.

Two exceptions to the preceding general guidance should be noted. First, some projects may be located outside a recovery unit. Banks located within recovery units should be able to provide credits for such projects. In such situations, the project to be mitigated will have little or no detrimental impact on recovery prospects, and the mitigation bank will aid those prospects.

A second exception to the general guidance regarding Service Areas concerns projects located in recovery units and undertaken *after* the recovery objectives for those areas have been achieved. Such projects should be able to buy mitigation credits from banks located in other recovery units. Allowing such

projects to do so will help achieve the recovery objectives in the recovery unit where the bank is located, without hurting these objectives in the area of the project requiring mitigation.

The Service Area is an important component for the bank owner who will need to evaluate the marketability of their banks, i.e., the potential demand for their conservation credits. The individual bank owner has the responsibility to determine if a bank will be profitable. The bank agreement should clearly define any constraints that are found within the Service Area. These might include exclusion of areas that are key to a regional reserve system, such as projects that occur within corridors or core reserve areas. Or, a particular bank in a county could have a Service Area corresponding to the regional plan boundary, yet limit projects using the bank to those that are in fragmented, isolated, highly urbanized areas not contributing to the regional reserve system.

3. Credit System

Credits are the quantification of a species' or habitat's conservation values within a bank. The conservation values secured by a bank are converted into a fixed number of credits that may be bought, sold, or traded for the purposes of offsetting the impacts of private, State, local, or Federal activities. In its simplest form, one credit will equal one acre of habitat or the area supporting one nest site or family group. Credit values are based upon a number of biological criteria and may vary by habitat types or management activities. When determining credit values, some of the biological criterion that may be considered include habitat quality, habitat quantity, species covered, conservation benefits, including contribution to regional conservation efforts, property location and configuration, and available or prospective resource values.

In general, the credit system for a conservation bank should must be expressed and measured in the same manner as the impacts of the development projects that will utilize the bank. For instance, if a development project will permanently remove some amount of habitat acreage and a number of pairs of a species, then the bank's credits should be expressed in terms of acreage and pairs. If effects are evaluated in terms of losses of family groups due to timber activities, then the bank credits should be established in terms of the number of family groups being conserved. The method of calculating bank credits should be the same as calculating match project impact debits.

In some instances a bank may contain habitat that is suitable for multiple listed species. When this occurs, it is important to establish how the credits will be divided. For instance, once a project buys a credit for one species, that credit cannot be sold again for another species. If the proposed project impacts multiple species and the bank contains the same multiple species, then the credits can be sold for in-kind replacement. As a general rule, overlapping multiple species credits can overlap for a single project, but not multiple projects.

If the bank is a preservation bank, the credits should be based on the biological values of the bank at the time the bank agreement is established. Because some populations may vary in size due to natural dynamics, an agreement should be made, before the bank agreement is finalized, as to the number of credits in the bank, especially if the credits are based on the number of individuals or nesting pairs. This is a risk both for the Service and the banker. The risk to the Service is that the credit overestimates the average populations of the bank. The risk for the banker is that the agreement could be made in a low population year, depressing the amount of credits that the bank could have received. A study might be undertaken to determine the average populations occupying the bank, but this would be time consuming and expensive for the banker and the Service.

USFWS 2012. Conservation banking: incentives for stewardship.

U.S. Fish & Wildlife Service

Conservation Banking

Incentives for Stewardship

Conservation banks are permanently protected lands that contain natural resource values. These lands are conserved and permanently managed for species that are endangered, threatened, candidates for listing, or are otherwise species-at-risk. Conservation banks function to offset adverse impacts to these species that occurred elsewhere, sometimes referred to as off-site mitigation. In exchange for permanently protecting the land and managing it for these species, the U.S. Fish and Wildlife Service (FWS) approves a specified number of habitat or species credits that bank owners may sell. Developers or other project proponents who need to compensate for the unavoidable adverse impacts their projects have on species may purchase the credits from conservation bank owners to mitigate their impacts.

A biologist monitors the vernal pool vegetation in spring at the Orchard Creek Conservation Bank, Placer County, California.

Conservation banking offers opportunities for a variety of landowners through preservation, enhancement, restoration and/or establishment of habitat for species. Lands used for ranching, farming, and timber operations or similar agricultural purposes can function as conservation banks if they are managed as habitat for species. Degraded habitat, such as retired croplands or orchards, may be restored. Linear areas or corridors, such as stretches of streams and their associated riparian habitat that link populations of species, may also qualify as conservation banks.

Who benefits?

A conservation bank is a market enterprise that offers landowners incentives to protect species and their habitat. Landowners can profit from selling habitat or species credits to parties who need to compensate for adverse impacts to these species. Landowners can generate income, keep large parcels of land intact, and possibly reduce their taxes.

Developers and others whose activities result in adverse environmental impacts typically are required to compensate for such impacts. Providing compensatory habitat off-site is often the best solution. However, it can be difficult for individual project proponents to locate appropriate lands and costly to restore, protect, and provide for the long-term management of these lands. Conservation banks provide a simple, economical alternative for developers and other project proponents. A one-time purchase of credits saves developers time and money and provides regulatory certainty.

Conservation banking benefits species by establishing large reserves that function as compensatory mitigation areas for multiple projects. It costs less per acre to manage a conservation bank than the equivalent acreage divided among many small isolated mitigation sites. Larger reserves are more likely to ensure ecosystem functions, foster biodiversity, and provide opportunities for linking existing habitat. In coordination with other tools, this collaborative, incentive-based approach to conservation may aid in the recovery of listed species.

Conservation banking also benefits the public by protecting open space and contributing environmental services such as nutrient recycling, pollination services, and climate regulation. Conservation banking works best in concert with regional conservation planning where the community is involved in determining which areas are conserved and which are developed to achieve a healthy environment and economy. It is particularly useful when used in conjunction with regional or county-wide Habitat Conservation Plans (HCPs) or green infrastructure plans.

Background

Conservation banking for federally-listed species has its roots in wetland mitigation banking. In the early 1990s, the FWS began working with other Federal agencies to establish wetland mitigation banks. In 1995, the final policy on wetland banking, *Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks*, was published (60 FR 58605-58614). In that same year, the State of California established a policy to promote regional conservation by encouraging a second generation of mitigation banks, called conservation banks, to preserve existing habitats. In the early 1990s, the FWS began approving conservation banks for a variety of federally-listed species, often in cooperation with other Federal agencies and the State of California. As of October 2011, 105 conservation banks have been approved by the FWS. Information on these banks can be found at RIBITS, the Regulatory In-lieu Fee and Bank

Tracking System, at http://geo.usace.army.mil/ribits/index.html.

In May 2003, in what has been termed "a hallmark event in the 36-year history of the Endangered Species Act," the FWS issued the first comprehensive Federal guidelines designed to promote conservation banks as a tool for mitigating adverse impacts to species. Although no two banks will be developed or used in an identical fashion, the guidelines foster national consistency by standardizing establishment and operational criteria. A copy of the guidance is available at http://www.fws.gov/endangered/landowners/conservation-banking.html

What lands are eligible?

Private, Tribal, State and local government lands are eligible to become conservation banks. Federal lands may require special consideration concerning applicability of the lands for mitigation purposes and review and approval by the FWS for consistency with other regulations and policies. Generally, lands previously designated for conservation purposes through another program are not eligible unless designation as a bank provides an additional conservation benefit to the species. Before the FWS can approve a conservation bank, landowners are required to:

- enter into a Conservation Banking Agreement with the FWS;
- grant a conservation easement to an eligible third party, precluding future development of the property and restricting certain land uses;
- develop a long-term management plan for the conservation bank; and
- provide funding for monitoring and long-term management of the conservation bank through establishment of a non-wasting endowment.

In return, the FWS approves landowners to sell a specified number of credits to project proponents seeking mitigation for listed species or other species-at-risk. The FWS designates a service area for the bank within which the landowner/bank sponsor may sell credits.

What is a conservation easement?

A conservation easement is a legal contract between the landowner (grantor) and the easement holder (grantee) in which the landowner gives up certain development rights and agrees to certain restrictions on the property. Public agencies, land trusts, and other nonprofit conservation organizations are typical groups that States authorize to hold conservation easements. Restrictions on the property may include a reduction in the number of livestock that may be grazed, prohibition of recreational off-road vehicle use, or prohibition of construction of new roads and buildings. Any activities inconsistent with the purposes of the conservation bank are restricted under the easement. Because perpetual conservation easements are binding on future owners, the resource values of these properties are protected in perpetuity. Many States and local governments offer tax benefits associated with this type of property encumbrance.

What is a management plan?

A management plan identifies tasks for operating and maintaining a bank site as well as methods for monitoring and maintaining desired habitats for species. A management plan may include removing trash on a regular basis, mending and replacing fencing, monitoring the listed species or habitat conditions, controlling invasive species that interfere with the naturally functioning ecosystem, conducting prescribed burns, and other activities to maintain the habitat. A management plan is long-term, requires careful development, and should take into account any foreseeable changes that may affect property management. A management plan should be as specific as possible, but flexible enough to allow changes in management practices in response to monitoring results.

How is management funded?

Most often an endowment is established to fund the long-term management of the conservation bank. The endowment is an interest-bearing account in an amount sufficient to generate enough yearly income to fund the annual management of the conservation bank. Since only the interest is available for use and the principal is not withdrawn, the endowment is "non-wasting," providing a perpetual source of funding for management of the conservation bank. The endowment may be funded in full at the time of conservation bank approval or in increments, but should be fully funded within five years.

What are credits?

A credit is a defined unit of trade related to habitat or species of interest at the bank site. A credit may be equivalent to:

(1) an acre of habitat for a particular species;
(2) the amount of habitat required to support a breeding pair;
(3) a wetland unit along with its supporting uplands; or
(4) some other measure of habitat or its value to the listed species.

Methods of determining available credits may rely on ranking or weighting of habitats based on habitat condition and/or function, size of the parcel, or other factors.

What is a service area?

The service area for a conservation bank is the area outside the bank property within which the bank owner may sell credits. The FWS determines service areas for conservation banks based on physical and ecological attributes such as watersheds, soil types, species recovery units, and/or species and population distributions. Banks with more than one type of credit may have different service areas designated for different credit types.

What projects are eligible?

Only projects that would otherwise be permitted and are suitable for off-site mitigation may use conservation banks. The species and habitats for which the project proponent seeks mitigation must be present at the conservation bank. Conservation banking is not a substitute for avoiding and minimizing effects on listed species on-site. The purpose of conservation banking is not to encourage development of listed species' habitats, but rather to provide an ecologically effective alternative to small on-site preserves which are not defensible or sustainable.

Contact Us

If you would like more information on conservation banking, please contact the FWS Regional Office with responsibility for the State or Territory in which the project is being proposed. A map of our Regional Offices can be found at http://offices.fws.gov/directory/listofficeregion.cfm

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Gardner et al. 2013. Biodiversity offsets and the challenge of achieving no net loss

Review

Biodiversity Offsets and the Challenge of Achieving No Net Loss

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Abstract: *Businesses, governments, and financial institutions are increasingly adopting a policy of no net loss of biodiversity for development activities. The goal of no net loss is intended to help relieve tension between conservation and development by enabling economic gains to be achieved without concomitant biodiversity losses. biodiversity offsets represent a necessary component of a much broader mitigation strategy for achieving no net loss following prior application of avoidance, minimization, and remediation measures. However, doubts have been raised about the appropriate use of biodiversity offsets. We examined what no net loss means as a desirable conservation outcome and reviewed the conditions that determine whether, and under what circumstances, biodiversity offsets can help achieve such a goal. We propose a conceptual framework to substitute the often ad hoc approaches evident in many biodiversity offset initiatives. The relevance of biodiversity offsets to no net loss rests on 2 fundamental premises. First, offsets are rarely adequate for achieving no net loss of biodiversity alone. Second, some development effects may be too difficult or risky, or even impossible, to offset. To help to deliver no net loss through biodiversity offsets, biodiversity gains must be comparable to losses, be in addition to conservation gains that may have occurred in absence of the offset, and be lasting and protected from risk of failure. Adherence to these conditions requires consideration of the wider landscape context of development and offset activities, timing of offset delivery, measurement of biodiversity, accounting procedures and rule sets used to calculate biodiversity losses and gains and guide offset design, and approaches to managing risk. Adoption of this framework will strengthen the potential for offsets to provide an ecologically defensible mechanism that can help reconcile conservation and development.*

Keywords: impact assessment, mitigation, risk

Balances de Biodiversidad y el Reto de No Obtener Pérdida Neta

Resumen: *Los negocios, gobiernos e instituciones financieras adoptan cada vez más una política de no pérdida neta de biodiversidad para el desarrollo de actividades. La meta de la no pérdida neta está enfocada en ayudar a aliviar la tensión entre la conservación y el desarrollo al permitir que se obtengan ganancias económicas sin pérdidas de biodiversidad acompañantes. Los balances de biodiversidad representan un componente necesario de una estrategia de mitigación mucho más amplia para obtener una no pérdida*

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neta siguiendo la aplicación previa de evitación, minimización y medidas de remediación. Sin embargo, han surgido dudas sobre el uso apropiado de los balances de biodiversidad. Examinamos lo que implica una no pérdida neta como un resultado de conservación deseable y revisamos las condiciones que determinan si, y bajo cuales circunstancias, los balances de biodiversidad pueden ayudar a obtener dicha meta. Propusimos un marco de trabajo conceptual para sustituir las aproximaciones seguidas y ad hoc en muchas iniciativas de balances de biodiversidad. La relevancia de los balances de biodiversidad hacia la no pérdida neta yace sobre dos premisas fundamentales. Primero, los balances rara vez son adecuados para obtener la no pérdida neta por sí sola. Segundo, algunos efectos de desarrollo pueden ser muy difíciles o riesgosos, o incluso imposibles, para el balance. Para ayudar a obtener no pérdida neta a través de los balances de biodiversidad, las ganancias de biodiversidad deben ser comparables con las pérdidas, estar sumadas a las ganancias de conservación que pueden haber ocurrido en la ausencia de los balances y ser duraderas y estar protegidas del riesgo de fracaso. La adhesión a estas condiciones requiere una consideración del contexto de paisaje más amplio de desarrollo y de las actividades del balance, la sincronización de la obtención del balance, medida de la biodiversidad, procedimientos de aseguramiento y juegos de reglas usados para calcular las pérdidas y ganancias de biodiversidad y guías en el diseño de balances, y aproximaciones al manejo de riesgo. La adopción de este marco de trabajo hará más fuerte el potencial para que los balances proporcionen un mecanismo defendible ecológicamente que pueda ayudar a reconciliar a la conservación con el desarrollo.

Palabras Clave: evaluación de impacto, mitigación, riesgo

Introduction

Global losses in biodiversity and ongoing development pressures on the environment have led an increasing number of government agencies, businesses, and financial institutions to introduce policies or voluntary commitments aimed at achieving no net loss or preferably a net gain of biodiversity across areas for which these organizations are responsible (Madsen et al. 2010; McKenney & Kiesecker 2010; BBOP 2012; IFC 2012). The goal of no net loss is intended to go beyond traditional environmental-impact mitigation measures and help relieve tension between conservation and development by enabling economic gains to be achieved without concomitant biodiversity losses.

Biodiversity offsets, also known as compensatory mitigation (e.g., in the United States, where no net loss has its origins as a project level policy goal under the 1977 Clean Water Act), have emerged as an important mechanism in efforts to achieve no net loss of biodiversity as part of implementing specific development projects. Offsets are intended to ensure compensation for residual negative effects following the rigorous, prior application of the mitigation hierarchy (i.e., avoidance measures, minimization of onsite effects, and restoration measures) (BBOP 2012; IFC 2012). Substantial concerns have, however, been raised about the use of biodiversity offsets and hence the achievability of no net loss as a practical conservation goal (Bull et al. 2013). These concerns include the absence of clear definitions and adequate biodiversity accounting frameworks (Gardner 2007), lack of evidence of actual effectiveness (Gibbons & Lindenmayer 2007), potential for offsets to undermine crucial prior steps in the mitigation hierarchy (Clare et al. 2011), and risk of biodiversity offset policies serving a largely symbolic purpose by neutralizing environmental concerns regarding development effects while providing little real protection for biodiversity (Salzman & Ruhl 2000; Walker et al. 2009).

We assessed what is necessary to achieve no net loss of biodiversity from an ecological perspective. We considered what no net loss means as a desirable conservation outcome and the ways in which the goal of no net loss is operationalized in practice. We reviewed the set of conditions and considerations that determine whether, and under what circumstances, biodiversity offsets could help to achieve the goals of no net loss or net gain of biodiversity. A critical first step in this process is the identification of situations where, a priori, offsets are likely to be inappropriate or unfeasible (Pilgrim et al. 2013). For situations where offsets may be appropriate and feasible, we propose a formal conceptual framework and decision making process (Fig. 1) as a substitute for the often ad hoc approaches in many biodiversity offset initiatives. We focused primarily on what constitutes best practice in planning for no net loss of biodiversity in the context of individual development projects, but we also considered the crucial importance of setting offset policy in an appropriate landscape and regional context. Although we acknowledge the importance of legal, financial, institutional, and political considerations in determining the success of a biodiversity offset (e.g., BBOP 2009*a*) and hence in achieving no net loss (Robertson 2004; Walker et al. 2009; Clare et al. 2011), we focused on ecological factors. biodiversity offsets are still in their infancy and until more evidence becomes available from actual field projects, controversy on whether, and under what circumstances, no net loss can be achieved will persist. Nevertheless, interest in biodiversity offsets and the concept of no net loss in both private and public sectors has increased rapidly in recent years. Our overarching aim was to inform a more robust, science-based

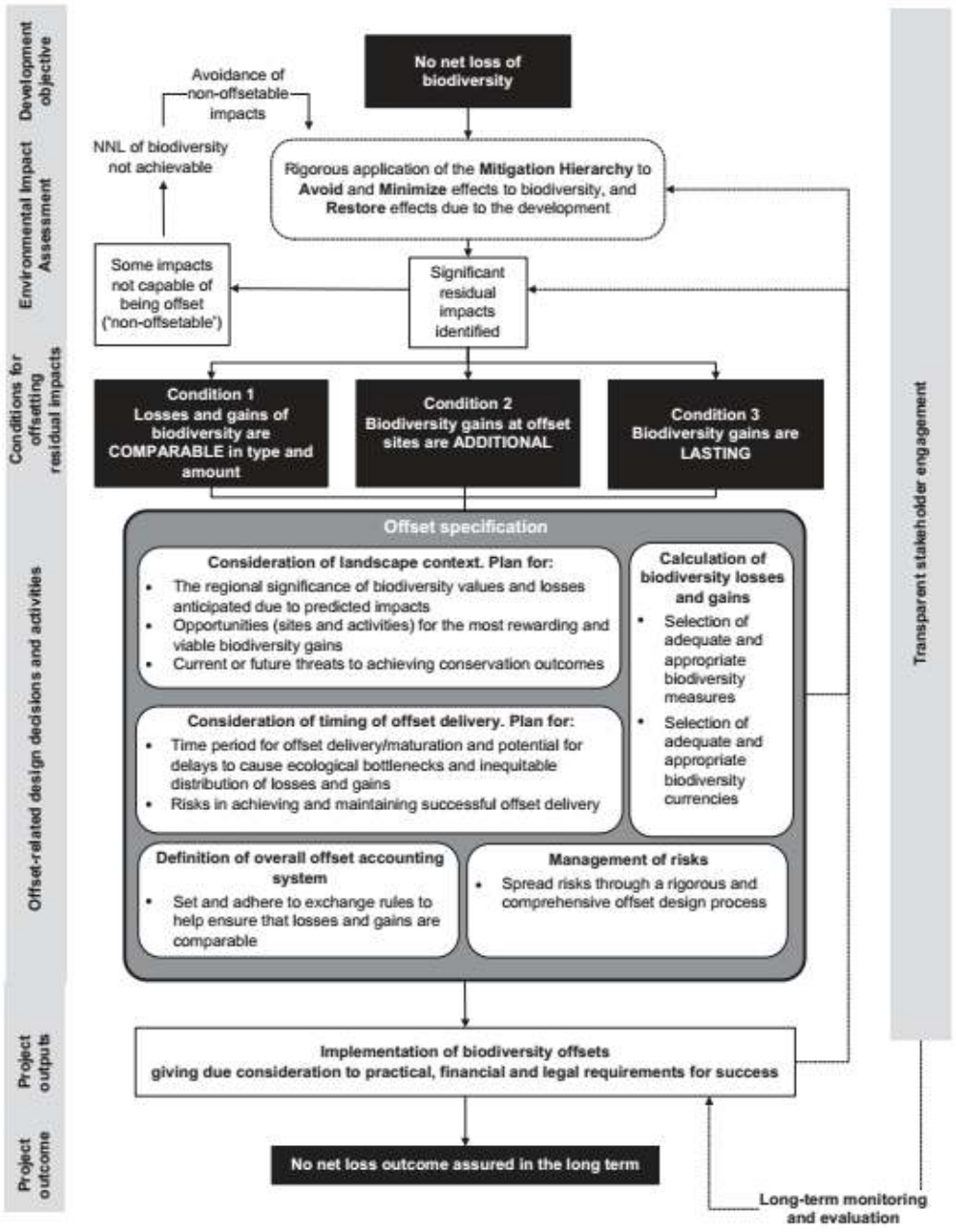

Figure 1. A generalized conceptual framework of the offset-related conditions and design activities necessary to evaluate efforts to achieve a no net loss (NNL) conservation outcome.

understanding of the conditions and precautionary standards of practice that are necessary for offsets to provide an ecologically defensible mechanism to help reconcile conservation and development.

Meaning of No Net Loss as a Desired Conservation Outcome

Concerns regarding the potential and limitations of biodiversity offsets can be partly understood in light of differing interpretations of what no net loss means. Interpretations of no net loss often vary according to the perspective and values of different stakeholders; hence, different components of biodiversity are emphasized. The interpretation of no net loss is then further affected by decisions regarding how one measures and interprets biodiversity and biodiversity changes, the scope of development effects considered, and the temporal and spatial scale at which the goal of no net loss is applied.

Defining Biodiversity

From a conservation perspective that affords intrinsic value to all components of biodiversity as defined by the Convention on Biodiversity, the goal of achieving a no net loss biodiversity outcome for a given set of development effects means no net reduction in the diversity within and among species and vegetation types; long-term viability of species and vegetation types (i.e., ensuring minimum population sizes and areas of occupation); and functioning of species assemblages and ecosystems (including ecological and evolutionary processes). Operationally, this high standard is almost impossible to guarantee because the interpretation and measurement of biodiversity are always limited by the amount of information available on the populations, species, and ecosystems involved and practical difficulties in collecting new data (Caro 2010; Gardner 2010).

A critical task, therefore, is to determine how biodiversity can best be described and measured to adequately assess effects and gauge the extent to which they can be offset. This knowledge can then guide appropriate application of the mitigation hierarchy and overall offset design, including the calculation of biodiversity losses and gains.

Best practice guidelines for achieving no net loss require developers to account for effects in at least 2 ways when designing and implementing an offset (BBOP 2012). Developers should preserve biodiversity components that are particularly valued by people (locally or elsewhere) or are of particular functional importance, which may include culturally important sites, species of high economic value, rare or threatened ecosystems, species and their habitats, and associated ecological processes and should, through the use of surrogate metrics (e.g., measures of landscape structure, condition, and fragmentation), attempt to represent and thus account for the loss of unmeasured biodiversity.

One way of ensuring the rigorous selection of particularly valued and ecologically important biodiversity components is to explicitly identify a set of affected key biodiversity components on the basis of a comprehensive assessment of potential effects and dialogue with stakeholders (BBOP 2012). Apart from helping to inform what should be the basis of loss–gain calculations, this subset of key components helps in understanding the kinds of effects a development project will have; whether effects can be offset; equivalence of affected and offset areas; and kinds of activities needed to deliver gains to offset substantial residual effects. In selecting key biodiversity components for a specific project, careful attention should be placed on biodiversity patterns (i.e., compositional and structural elements such as populations, species, and vegetation types) and ecological and evolutionary processes (e.g., plant–animal interactions and ecological connectivity). The complexity and limited understanding of biodiversity means it is always necessary to spread risk and use a diverse set of biodiversity measures that represent different levels and scales of biological organization (including species, communities, and ecosystems) and goes beyond the limited set of species and vegetation types that may have some form of legal protection in a given country or region (Lindenmayer et al. 2007; Gardner 2010). It is the selection of such key biodiversity components and associated surrogate metrics that together comprise the operational definition of biodiversity that underpins the assessment of no net loss.

Interpreting Losses and Gains in Biodiversity

The *net* in *no net loss* is indicative of the fact that some losses at the development site are inevitable and that exchanges may not be perfectly balanced—whether in time (e.g., where losses precede gains), space (no place is exactly the same as another), or type of biodiversity involved. Thus, in addition to the choices made in selecting the biodiversity components deemed at risk, subjective and legal judgments are also made regarding the acceptability of different kinds of exchanges, depending on the societal values of the stakeholders. It may, for example, be argued that it is defensible to accept the loss of a type of common biodiversity component in exchange for enhanced protection of another component that is severely threatened and rare (often called trading-up offsets).

Defining the Scope of Effects on Biodiversity

Beyond limitations in how one interprets and measures changes in biodiversity, the meaning of no net loss as a conservation outcome also depends critically

on defining the scope of effects for which a given project should be held accountable. Current best practice focuses on substantial direct, indirect, and cumulative (where feasible and appropriate) project effects by the project proponent and contractors or subcontractors. These effects include those associated with access and delivery infrastructure but do not include effects on biodiversity from third-party suppliers or delivery to end users (BBOP 2012; IFC 2012). We focused on these development site-level effects, rather than on the much more challenging goal of achieving no net loss for a given end product at point of use. We also recognize the importance of wider concerns for regional biodiversity losses due to cumulative effects on biodiversity from multiple developments and the need to take such changes into account when designing offsets for individual projects (Brownlie & Botha 2009). Achieving no net loss at wider landscape or regional scales fundamentally requires governing authorities to provide enabling conditions such as imposing limits on other development effects and offset activity (Pilgrim et al. 2013) or establishing minimum targets for the protection of key areas and species, which can be used to guide offset objectives in situations where such key biodiversity components are under increasing threat (e.g., Brownlie & Botha 2009).

Balancing Aspirations and Practical Constraints

Minimizing the discrepancy between the aspirations and practical constraints of attaining no net loss of biodiversity requires acceptance of a high-level conservation goal as the basis for selecting measured biodiversity components and strict adherence to a set of necessary conditions and transparent accounting procedures. The no-net-loss concept then legitimizes the exchange of biodiversity across types of biodiversity, locations, and time, subject to this set of constraining conditions and design procedures.

Conditions under Which Offsets Help to Achieve No Net Loss of Biodiversity

Biodiversity offsets are limited in their ability to mitigate against development effects. Perhaps most importantly, offsets are rarely, if ever, adequate for achieving no net loss of biodiversity alone. Rather, the appropriateness and potential success of an offset depend on the extent to which prior steps in the mitigation hierarchy (avoidance, minimization, and remediation of effects) are applied. Some effects (e.g., on highly threatened biodiversity) may be too difficult or impossible to offset and have to be avoided. Other residual effects need to be limited (e.g., through onsite mitigation and restoration measures) to increase the chance that they could be offset entirely (BBOP 2012) (Fig. 1). Although some effects, such as species extinction, are obviously irreversible, clearly defining a comprehensive and regionally appropriate set of limits to the kinds of effects on biodiversity that are possible to offset is difficult. To help overcome this difficulty, Pilgrim et al. (2013) devised a generic burden-of-proof framework that can be used as a starting point to assess the appropriateness and achievability of offsets, given differing levels of concern for affected biodiversity, magnitude of residual effects, opportunity for suitable offsets, and feasibility of offset implementation in practice.

The combination of these limitations demonstrates that offsets cannot be seen as the only solution to balancing all forms of development effects on biodiversity. The types of effects for which offsets, as part of the broader mitigation hierarchy, can make an appropriate contribution toward the delivery of a no-net-loss outcome is challenging to define on the basis of the limited evidence available. Although the conditions and considerations we outline can be applied generally, successful outcomes are more likely for localized, spatially limited projects such as mining, building, and infrastructure development (which comprise the majority of offset initiatives to date) that do not affect more vulnerable and spatially restricted (and hence irreplaceable) components of biodiversity. As currently conceived offsets are unlikely to be appropriate for mitigating the effects of large-scale clearing of land for agriculture.

In situations where offsets are being appropriately applied in the context of the mitigation hierarchy, and there is no clear evidence that an offset would be inappropriate due to unacceptable effects on biodiversity of high conservation concern or a lack of opportunity for concomitant biodiversity gains (e.g., as outlined by Pilgrim et al. 2013), no net loss can be achieved theoretically by satisfying 3 main conditions: biodiversity gains are comparable to losses from residual effects insofar as they are both appropriate (similar in kind or type) and adequate (of an amount greater than or equal to the losses); biodiversity gains are additional to outcomes that would have resulted in the absence of an offset; and biodiversity gains are lasting and protected from risk of failure (Fig. 1). Demonstrating that these 3 conditions have been met and a no net loss outcome achieved is only possible if sufficient ecological data exist to account for biodiversity changes that result from the development and mitigation efforts.

Condition 1: Biodiversity Losses and Gains are Comparable in Type and Amount

An explicit biodiversity loss and gain calculation is required to ensure that, with a reasonable degree of confidence, gains are comparable to losses (and hence ensure that biodiversity is not lost) and to track

delivery of gains due to the offset activities. Calculation of biodiversity losses and gains requires selection of appropriate and representative biodiversity components and metrics to measure changes and definition of biodiversity currencies and an associated offset accounting system to help ensure equity in the type, distribution, and temporal delivery of biodiversity gains compared with losses and to adjust offsets to guard against underperformance or failure (Salzman & Ruhl 2000; BBOP 2009*b*; Quétier & Lavorel 2011; Overton et al. 2012).

Condition 2: Biodiversity Gains are Additional

Biodiversity gains from conservation activities undertaken as part of an offset project need to be additional to those that would have occurred in the absence of the project (thereby ensuring that an offset has actually occurred due to conservation activities of the developer). It is also necessary to ensure that offset activities do not lead to the displacement or leakage of harmful activities and damage elsewhere and that offset activities do not result in negative effects on biodiversity that is not the focus of the offset. biodiversity offset gains can be achieved through 2 broad kinds of intervention.

First, gains can be achieved by averting the loss and degradation of biodiversity by removing or reducing threats. Offset activities could include promoting more responsible natural resource management and alternative livelihoods for people who undertake unsustainable levels of resource extraction (e.g., providing alternative protein sources to substitute for wild game) and creating, expanding, or strengthening protected areas to guard against current or future risks to affected biodiversity (e.g., through mechanisms such as land purchase, contractual agreements, and conservation easements that limit legal rights to clear vegetation or to mine). For averted-loss offsets to be defensible, it must be shown that ongoing or impending threats are both imminent and will have substantial effects on biodiversity. It is also essential that an offset results in measurable conservation outcomes. General structural investments in local capacity building, research, and environmental education may be important, particularly in establishing enabling conditions for offset success. Yet to qualify as part of an offset they need to produce relevant and measurable biodiversity gains that are comparable to the residual effects of development.

Second, biodiversity gains can be achieved through positive management actions to improve biodiversity condition through habitat restoration. Restoration refers to activities that endeavor to return some features and processes in an area to their ecological condition prior to some anthropogenic effect, for example by stabilizing soil erosion, reintroducing native species, removing and controlling invasive species, or accelerating natural regeneration processes (e.g., inclusion of bird perches to encourage seed dispersal) (Harper & Quigley 2005; Gibbons & Lindenmayer 2007). There is considerable skepticism in the scientific community that the current science and practice of restoration ecology is, for the majority of ecosystems, capable of delivering biodiversity gains that are sufficient to achieve no net loss (e.g., Palmer & Filoso 2009; Maron et al. 2012).

Condition 3: Biodiversity Gains Are Lasting

Biodiversity gains from an offset need to last at least as long as the residual effects, which may well be permanent for many development projects. This requirement to assume long-term responsibility for residual effects is a key aspect that differentiates no-net-loss offsets from other weaker and less rigorous forms of compensatory conservation. In ensuring that gains are lasting, 2 sources of uncertainty and risk need to be considered (Fig. 1). First, offset activities may underperform or fail, either because of management failure or due to an external threat (e.g., other development or climate change) that jeopardizes the long-term integrity of the offset. Second, unless offset gains are fully secured prior to effects, time lags in achieving an offset may lead to ecological bottlenecks that threaten long-term biodiversity persistence (Bendor 2009; Bekessy et al. 2010). [Correction added after publication 24 September 2013: The subheading for this paragraph was changed for clarity.]

Offset-Related Design Decisions and Activities for Achieving No Net Loss

Designing a biodiversity offset to help ensure no net loss—and therefore meet the 3 conditions outlined earlier—requires consideration of the wider landscape context of development effects and associated offset activities, the timing of offset delivery, the approach taken for calculating biodiversity losses and gains, and the definition of the overall offset accounting system and approaches to managing risk.

Importance of Considering Landscape Context

It is essential that the design and implementation of project-level offsets account for the wider landscape context (Fig. 1) for at least 3 reasons. First, estimates of biodiversity losses and gains need to ensure comparability in the regional significance of biodiversity on the basis of patterns of irreplaceability and vulnerability and socioeconomic and cultural biodiversity values (Walker et al. 2008, 2009; Gibbons et al. 2009; Underwood 2011). Second, a landscape understanding of the distribution of biodiversity and

development activities is needed to identify opportunities for securing additional and ecologically viable biodiversity gains and hence to determine the most appropriate set of offset activities and locations (Kiesecker et al. 2009; Pouzols et al. 2012) and identify areas where effects should be avoided altogether because they cannot be offset (Kiesecker et al. 2009). Third, a landscape perspective is necessary to identify and address risks to the long-term maintenance of biodiversity gains (e.g., due to other development projects, encroachment by invasive species, and informal settlements) in offset design and implementation.

Importance of Considering Timing of Offset Delivery

The timing of offset delivery affects the temporal distribution of biodiversity losses and gains, the durability of conservation outcomes, and the size of the offset (Fig. 1). Unless all the biodiversity gains from an offset are delivered before development occurs, losses due to project effects will exceed, at least temporarily, any biodiversity gains from the offset (Bendor 2009; Bekessy et al. 2010). Such delays in compensating for losses can result in bottlenecks in ecological resources and time-delayed cascade effects, such as the delayed recovery of key species' resources (e.g., tree hollows, large tree boughs, and fallen timber that characterize mature forest habitats [Vesk et al. 2008; Bedward et al. 2009]), that may threaten the persistence of certain species, especially those vulnerable to extinction (Maron et al. 2010). In such cases, it is not possible to achieve offset gains comparable to residual losses.

Two approaches have been proposed for addressing the potential problem of time lags in biodiversity offsets. One approach is to demonstrate that the requisite biodiversity gains have been secured before development begins. For example, gains can be demonstrated through the use of a biodiversity banking system in which a developer can buy credits in the form of mature offsets to license planned operations (Bekessy et al. 2010). Although this approach unquestionably improves the probability that no net loss is achieved, its success depends on a wide range of biodiversity credits being available to ensure ecological comparability between gains and losses (Bekessy et al. 2010). In addition, most existing conservation-banking schemes allow credits to be released over a limited period (often <20 years) prior to full maturation of target biodiversity to incentivize landowners to create conservation credits as opposed to pursuing other potential land uses.

An alternative approach to compensate for delays in offset maturity is to increase the size of the offset through a so-called multiplier or mitigation ratio (Bendor 2009). This ratio may be calculated in proportion to the expected delay (e.g., Hruby 2012) or by applying a discount rate over a specific time interval that relates to the project life span, human lifetimes, and expected biodiversity recovery rates (e.g., Moilanen et al. 2009). Overton et al. (2012) extend the use of discounting to develop the concept of net present biodiversity value (NPBV) as a measure of equity in biodiversity transactions across type of biodiversity, space, and time. The use of time discounting is advocated on the grounds that it is inherently unfair to compensate for a guaranteed immediate loss with a hypothetical and much less certain future gain (Bruggeman et al. 2005; Moilanen et al. 2009; Overton et al. 2012). Although this makes sense in terms of equity, the use of multipliers that are based on time discounting may do nothing to address the underlying problem that temporal delays can lead to critical shortages in ecological resources over time (no matter how large the offset) that then make it impossible to achieve offset gains comparable to losses from development.

Importance of Approach for Calculating Biodiversity Losses and Gains

Confidence in the integrity of a proposed offset depends foremost on a transparent process for selecting the subset of measured biodiversity components and metrics, the biodiversity currencies used to quantify residual losses and potential gains and guide offset design processes, and an appropriate offset accounting system.

The selection of biodiversity components and surrogate metrics is central to our interpretation of what no net loss of biodiversity means as a conservation outcome. They should include components of biodiversity that are of particular importance to people (which should include those already afforded legal protection in the country in question), ecosystem functions, and surrogate components that represent unmeasured biodiversity (e.g., measures of habitat structure). biodiversity metrics are the specific parameters used to measure changes in biodiversity components (e.g., area, number of individuals and species, vegetation height, and canopy cover). biodiversity components can only contribute to the assessment of biodiversity losses and gains if they are measurable.

Biodiversity currencies are used to calculate losses and gains in biodiversity and to quantify residual effects of development on biodiversity and the nature and size of the offset required to achieve no net loss (BBOP 2009*b*; Norton 2009). Currencies can include direct measures of biodiversity or comprise multiple or surrogate measures, such as metrics of habitat extent and condition. No single currency can adequately account for all biodiversity affected by development (Salzman & Ruhl 2000; Gardner 2010), meaning that complementary currencies are needed to reasonably account for different components of biodiversity.

In simple offset schemes, such as early U.S. wetland mitigation efforts, offsets are determined only on the basis of area (Salzman & Ruhl 2005; Madsen et al. 2010).

More tailored currencies that incorporate information on type, amount, or condition of multiple biodiversity components have accompanied the rise in popularity of biodiversity offsets. Some of these newer currencies are already well developed and established in law, such as the habitat hectares index used in the Bushbroker program in Victoria, Australia (Parkes et al. 2003) and the environmental benefits index applied in Western Australia (Hajkowicz et al. 2009). There are also a growing number of proposals in the literature, including integration of data on habitat area with data on abundance of key indicator species (e.g., biodiversity change index [Normander et al. 2012]); modeling frameworks to estimate trade-offs between changes in habitat area and population size (Tanentzap et al. 2013); intervention-specific metrics (e.g., plantation biodiversity benefits score for restoration plantings [Cawsey & Freudenberger 2008]); spatially nested metrics to assess changes in site-, landscape- and regional-level biodiversity values (e.g., Gibbons et al. 2009); economic habitat-value metrics that measure incremental progress toward landscape-scale conservation targets (Dymond et al. 2008); and multidimensional metrics that incorporate stakeholder preferences and management indicators together with information on different components of biodiversity (e.g., Hajkowicz & Collins 2009).

Preference should ideally be given to currencies that are based on direct, disaggregated, and context-dependent measures of biodiversity that provide the most unambiguous and locally relevant data (e.g., persistence probabilities of a regionally threatened species). However, in practice, a lack of relevant data (e.g., good, up-to-date, and context-dependent biodiversity data) or of adequate resources, capacity, or time to collect such data means that aggregated surrogate measures that combine the affected area of vegetation or habitat with some measure of condition (e.g., habitat hectares index) are most commonly employed. Aside from pragmatic reasons, such surrogate measures aid communication to the general public (BBOP 2009*b*). Despite the advantages of surrogate-based currencies, direct measures of specific components of high-value biodiversity (e.g., threatened and economically important species) and of components for which surrogates cannot be used (e.g., individual species targeted by hunting or disease) are invariably necessary to prevent important losses being masked in the exchange of biodiversity losses and gains.

Estimates of biodiversity condition are an important component of most biodiversity currencies. Measurements of ecological condition or quality can only be made with reference to some independently assessed benchmark state(s) (whether theoretical or measured) that provides a common reference point for evaluating biodiversity losses and gains across development and offset sites (Gibbons & Freudenberger 2006; Gardner 2010). Despite its intuitive appeal, estimating changes in ecological condition is not easy and requires local and regional ecological knowledge and expert experience.

Defining an Overall Offset Accounting System

A number of generalized offset accounting systems or decision frameworks have been proposed to integrate considerations of landscape context, timing of offset delivery, selection of biodiversity measures and currencies, and integration of regional conservation planning considerations in offset design (Kiesecker et al. 2009, 2010; Underwood 2011); integrated assessment methods to improve or maintain environmental outcomes following land clearing (Gibbons et al. 2009); landscape equivalency analyses that account for metapopulation persistence across entire landscapes and incorporate societal time preferences (Bruggeman et al. 2005); and the offset design process in Business and Biodiversity Offset Program Standard (BBOP 2012). Pouzols et al. (2012) propose an integrated offsets calculator (with accompanying software, RobOff) that allows a systematic comparison of the biodiversity benefits of alternative conservation actions and their uncertain effects on biodiversity components in different environments through consideration of time, costs, and feasibility of actions. The calculator does not, however, explicitly account for landscape context due to computational limitations.

Accounting procedures are used to estimate the net balance, or equity, of exchanges. Limits in the fungibility of biodiversity across space, time, and type of biodiversity mean that in addition to the careful selection of appropriate and adequate biodiversity currencies, the specification of offsets to achieve no net loss of biodiversity also requires a set of restrictions or exchange rules.

The most important restriction to recognize prior to considering the application of a biodiversity offset is the existence of limits to the application of offsets. These limits are based on the irreplaceability and vulnerability of the biodiversity in question and on the feasibility of possible offsets (Pilgrim et al. 2013). In situations where development may affect highly vulnerable or irreplaceable biodiversity, or where offset options are extremely limited, achieving no net loss may only be possible through avoidance of effects (e.g., by redesigning parts of the development project itself). Where an offset is deemed possible, a number of exchange rules are necessary to help ensure biodiversity losses and gains are comparable: limits on biodiversity components that are substitutable, guidelines on the acceptability and desirability of trading up, limits on declines in area or ecological condition between development and offset sites, and integration of project-level offsets into a wider conservation planning framework.

Limits need to be established regarding the biodiversity metrics that can be considered substitutable within

aggregated, surrogate currencies. McCarthy et al. (2004) highlight the importance of this rule by identifying possible weaknesses in the habitat hectares method (Parkes et al. 2003). For example, in some situations increases in a biodiversity component (e.g., volume of dead wood) can mask negative changes in other biodiversity components (e.g., loss of live trees). This kind of problem can be solved through use of disaggregated currencies or, at least in part, by establishing exchange rules that set minimum values (and possibly upper limits) to which the individual components that make up an aggregated currency can be substituted.

Clear guidelines are needed on the acceptability and desirability of trading up. Although like-for-like exchanges (i.e., adherence to condition 1 in Figure 1, that losses and gains are comparable in type and amount) should be the default approach to all offsets, there are occasions where trading-up (or out-of-kind) offsets may be desirable. Trading up is the process by which loss of more common and widespread biodiversity is offset with enhanced protection or restoration of rarer or more threatened biodiversity. Although such exchanges can represent valuable conservation opportunities, clear guidelines are needed to prevent the exchange (possibly inadvertent) of highly irreplaceable or threatened biodiversity for components of lower irreplaceability or threat status (e.g., Walker et al. 2008; Pilgrim et al. 2013).

Limits need to be established regarding acceptable declines in area or ecological condition between development and offset sites. A fundamental problem with simple area × condition currencies is that increases in the spatial extent of an offset may be allowed to compensate for decreases in its condition or similarly that improvements in condition are allowed to compensate for decreases in extent. Such risks may be limited by applying an exchange rule that requires estimates of habitat extent and ecological condition either do not change substantially or can only increase between development and offset sites (e.g., Kiesecker et al. 2009).

The design of project-level offsets must be integrated into a wider conservation planning framework to ensure compositional similarity between losses and gains. Intrinsic human use and cultural values of biodiversity are by definition context dependent (e.g., species composition, rarity, endemism, human use), and this makes it essential that offset designers carefully assess the compositional similarity and regional significance of both expected losses and potential gains of biodiversity. Efforts to ensure compositional similarity between losses and gains for unmeasured components of biodiversity can be assisted by rule-of-thumb spatial restrictions such as the maximum distance between development and offset sites or by restricting exchanges to within the same watershed, center of endemism, environment and vegetation type, or area in which people who may be affected by the effects of development on biodiversity live (Salzman & Ruhl 2000). In addition, a number of simple index-based frameworks incorporate landscape and regional biodiversity values alongside site-based estimates derived from information on percent cover, condition of vegetation types, and rates of change in habitat area and condition (e.g., Oliver et al. 2005; Gibbons et al. 2009). More elaborate frameworks exist that incorporate spatially explicit information and modeling of biodiversity patterns and processes in landscape-scale assessments of conservation options (e.g., Ferrier & Drielsma 2010). Such frameworks have been applied recently to the specific problem of offsets (Kiesecker et al. 2010; Underwood 2011) and integration of conservation prioritization, development effects, and offset evaluation (Overton et al. 2012).

Managing Risks

In addition to the exchange rules, other safeguards are needed to maximize the probability that offsets can deliver comparable and lasting biodiversity outcomes. These safeguards include a rigorous adherence to the mitigation hierarchy, assurance that offset activities are in addition to interventions that would occur in the absence of development, selection of offset activities that are based on existing evidence of effectiveness, and a rigorous approach to selecting biodiversity measures, currencies, and accounting frameworks.

Particular emphasis needs to be placed on a precautionary approach to offset design and implementation in situations where risk and uncertainty in offset delivery are high, as is invariably the case for all but the simplest ecosystems (Maron et al. 2012). Uncertainty in the performance of offset interventions is best minimized by producing offset gains prior to losses due to development through biodiversity savings banks (Bekessy et al. 2010). Many existing offset schemes employ risk-aversion multipliers to increase the size of an offset and safeguard against uncertain outcomes (BBOP 2009*b*; Quétier & Lavorel 2011). Although intuitive, a lack of data and technical understanding means that such multipliers are often generic and determined by the conservation significance of affected biodiversity (e.g., Parkes et al. 2003) rather than being linked to specific risks and mitigation measures (e.g., probability of seedling survival in a restoration planting). As in the case of time delays and resource bottlenecks, multipliers are inappropriate for situations where there is a risk that the offset intervention may fail entirely. For restoration offsets, Moilanen et al. (2009) concluded that when multipliers are calculated appropriately (i.e., probability of failing to achieve no net loss is minimized) very high multiplier ratios may be required (e.g., >1:100). Yet in practice, offset ratios are often even lower than levels required by law (e.g., Quigley & Harper 2006).

To account for these difficulties a bet-hedging strategy (Moilanen et al. 2009) is advisable that spreads

risks by combining a rigorous offset design framework with multiple offset sites and activities that seek to account for a wide range of biodiversity components. Multipliers should not be relied on to minimize probabilities of failure, especially when there are risks of ecological bottlenecks from time delays in offset maturation, but they may be useful in compensating for discounted time preferences for low-risk (i.e., not vulnerable or threatened) biodiversity.

Future of Biodiversity Offsets and No Net Loss

Biodiversity offsets are receiving increasing interest from business, government, finance, and conservation sectors across the world, and we expect the opportunities and challenges we discussed here to become increasingly prevalent. Ambitious policy goals relating to no net loss of biodiversity and the contribution that offsets may, in some cases, make in achieving this need to be interpreted and operationalized in a defensible and transparent way.

Considerable concern about biodiversity offsets remains due to differing interpretations of no net loss and the potential for misuse of offsets (Walker et al. 2009; Clare et al. 2011). There is a lack of clear examples where best practice has, beyond reasonable doubt, delivered no-net-loss outcomes. There is also need for a greater recognition that in some situations, and despite every attempt at mitigation, no net loss of biodiversity cannot be achieved; that is, development will result in irreplaceable loss of biodiversity. Such development projects may be approved by governments because there is a clear and overriding public interest in the project. In such situations, it may be possible to achieve partial compensation for loss of biodiversity, but a claim of no net loss of biodiversity should not be made (Pilgrim et al. 2013).

Conservation outcomes from biodiversity offsets only partly depend on the scientific rigor underpinning the choices of biodiversity currencies and exchange restrictions we have discussed. Positive outcomes are also to a large extent determined by other factors that affect the appropriate application of the mitigation hierarchy and adoption of a rigorous offset design and implementation framework (Gibbons et al. 2009; Walker et al. 2009; Quétier & Lavorel 2011), such as access to adequate data and technical expertise, economic and financial safeguards and incentives, and the strength of monitoring and enforcement.

We hope our article will help to reduce confusion and improve the accountability and rigor of future projects by laying out a clear framework of the basic conditions and issues that need to considered and accounted for in any offset design process. Although considerable progress has been made in developing good practice for biodiversity offsets (e.g., BBOP 2012), more research is urgently needed to strengthen the evidence base on ways to achieve no net loss. Developers, regulators, civic groups, and scientists all have a responsibility to engage critically and constructively in this process to ensure that offset projects are given adequate scrutiny and that the promise of no net loss moves from a largely symbolic policy to an ecologically defensible mechanism for helping to reconcile conservation and development.

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Reforms could boost conservation banking by landowners

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Abstract

California pioneered the first conservation banking program in the nation in 1995. In contrast to the regulatory approach that penalizes landowners for harming protected species, conservation banking creates a market incentive for landowners to conserve wildlife. We investigated the implementation of the California Conservation Banking Program including a preliminary assessment of factors that limit the program's potential, both as an effective approach to conserving wildlife and as an economically rational option for ranchers and other landowners. We then surveyed the majority of wildlife agency conservation bank staff and conservation banking practitioners, and analyzed monitoring programs and ecological parameters of all approved banks. Most of the major challenges facing the Conservation Banking Program are linked to three fundamental problems: (1) the lack of clear standards and regulations, (2) the lack of adequate funding for dedicated wildlife agency coordinators and (3) the inefficiency and ecological constraints of managing stand-alone banks. Many of the challenges inhibiting conservation banking could be eliminated or reduced by enacting standards in statutes as well as by implementing a regional approach to planning for future sites.

Full Text

Conservation banking provides a mechanism for ranchers and other landowners to receive income for managing their lands to benefit wildlife. California established the first conservation bank program in the nation and is recognized as a world leader in implementing biodiversity offsets as a means to conserve species (Mead 2008). Modeled on the federal wetlands mitigation bank program, conservation bank programs are applied to mitigating impacts of development projects on endangered species and species of concern. Conservation banks are publicly or privately owned lands that are protected in perpetuity by fee title or easement and managed to provide habitat for at-risk species. The owner, or management firm owning the bank, is authorized by wildlife agencies to sell credits to developers to mitigate impacts of their proposed development projects on wildlife.

The 18-year-old California Conservation Banking Program, the largest such state program, was launched by a state executive policy rather than by legislation (Wheeler and Strock 1995). The purposes of the program are to (1) conserve important habitats and habitat linkages, (2) provide a better alternative to the piecemeal project-by-project mitigation approach, (3) take advantage of economies of scale not available to individual mitigation projects, (4) provide incentives for private landowners to protect species and (5) provide an additional funding mechanism for ecosystem reserves within regional conservation plans (Wheeler and Strock 1995). In 2003 the U.S. Fish and Wildlife Service released a guidance document for establishment and operation of conservation banks across the nation. In California, mitigation for development projects that harm wildlife is implemented through one of four mechanisms: (1) mitigation on a project-by-project basis, (2) mitigation within a multispecies regional plan (under the state Natural Community

Conservation Planning Program, coupled with a Habitat Conservation Plan for federally listed species), (3) purchasing offset credits in a conservation bank (Mead 2008; Wheeler and Strock 1995) or (4) payment of in-lieu mitigation fees.

Regional Conservation Planning

Regional conservation planning is the most comprehensive approach to conserving species and natural communities. Large-scale regional conservation plans, as developed under the state Natural Community Conservation Planning Program, are designed to conserve habitat and ecosystem functions that are critical to sustain at-risk species covered by the plan over a large landscape (Calif. Fish & Wildlife Code § 2800 et. seq.; Pollack 2001). A broad range of ecological considerations is incorporated into the design of regional conservation plans and the protected reserve sites within them. These considerations include the distribution of plant communities, size of habitat patches required by various species, vital corridors, heterogeneity of the landscape, water resource commitments and management, appropriate recreational uses of the lands, the network design of protected areas and reliable long-term management funding (Calif. Fish & Wildlife Code § 2800 et. seq.; Noss et al. 1997). In addition, Natural Community Conservation Plans (NCCPs) require a monitoring program capable of assessing the biological status of covered species and habitats, and the ecological performance of the conservation plan. Monitoring is also necessary to inform adaptive management (Atkinson et al. 2004; Calif. Fish & Wildlife Code § 2800 et. seq.).

However, development of a Natural Community Conservation Plan usually requires 5 to 10 years of analyses and dozens of meetings for scientific and public review. Due to limited state resources, the vast majority of development over the next couple of decades will occur without the Natural Community Conservation Plan level of regional planning (Bunn et al. 2007).

[View Enlargement]

Conservation banks protect vernal pools on the Santa Rosa Plain and in the Central Valley. The California program mitigates impacts of development projects on endangered species and is modeled on the federal wetlands mitigation bank program.

Conservation Banking Glossary

Fee Title Or Easement:

Conservation banks may be protected in perpetuity either by purchase of fee title or by easements on the land to ensure it is managed for conservation values. A key decision is who will own the land or hold the easement. A conservation banker may initially own a bank but later transfer ownership to the California Department of Fish and Wildlife (CDFW) or to a nonprofit land management firm.

Credit And Debit Values:

A credit is a unit used to quantify the species or habitat conservation values within a conservation bank. For example, 1 acre of habitat is often worth one credit. A debit is a unit used to quantify adverse impact to species or habitats of concern on lands being developed. The wildlife agencies decide how many credits must be purchased to offset the impact of a development project, and these terms are a requirement for mitigation and permit approvals.

Service Area:

The service area is a geographic region where the adverse impacts of development projects can be covered by a particular conservation bank. The service area should be justified based on ecological considerations, including watershed boundaries as well as the population structure and distribution of covered species, and must be approved by the wildlife agencies. In addition, conservation banks that offer credits for multiple species may have more than one service area. Bankers are critically interested in the service area because it determines the potential market for credits. Wildlife agencies want to be sure of the ecological justifications for using the conservation bank to offset development impacts anywhere in the service area. Local governments may be concerned about the service area because they usually want the benefits of mitigation for local projects to occur within the county.

Endowment And Financial Commitments:

To cover the costs of management and monitoring in perpetuity, conservation banks must use a portion of the income from credit sales to set up a non-wasting endowment, in which only the interest on the endowment funds is spent each year. A key issue to address in bank agreements is how to ensure funding of management and monitoring in the first few years of the bank operation, prior to full investment in the endowment from the sale of credits. In addition, if a bank is failing to meet

conservation performance goals, financial commitments for managing the bank site may be secured with bonds or other means.

Site Management Plan:

Bank agreements must include a management plan and designated management entity, usually a nongovernmental organization that is responsible for implementing conservation measures — such as habitat management, restoration or creation — and for managing the site in perpetuity. These management responsibilities may be transferred. For example, a banker may provide management during the habitat creation phase and then transfer management to the state or a nonprofit for ongoing maintenance of the site. Bank agreements typically require that annual management reports be submitted to wildlife agencies.

Monitoring Plan:

Conservation banks establish a monitoring program to determine whether biological goals are being met as well as to inform adaptive management (adjusting management actions in the field based on changes detected through monitoring). Monitoring results are included in the annual management reports (Wheeler and Strock 1995).

[View Enlargement]

Conservation banks could enable farmers to restore and broaden riparian habitat corridors on the edges of their fields. *Above*, narrow strips of habitat adjacent to irrigation ditches in Sutter County.

Conservation Banking

Benefits.

Expanding the use of conservation banks has the potential to provide conservation design features and benefits similar to those of Natural Community Conservation Plans, but with more efficiency. Creating a conservation bank requires less scientific review and needs to satisfy fewer interests; negotiations usually involve just one landowner, a few stakeholders such as a conservation firm, and the wildlife agencies. The review process and agreement on a proposed conservation bank may be accomplished in about 2 years, as they were in the early years of the program. This is less than one-half the time it typically takes to reach agreement on a regional conservation plan (Ruhl et al. 2005).

Establishment.

The selection and approval process for most proposed conservation banks usually begins with the bank proponent identifying a property that meets ecological and financial criteria. The proponents are conservation bank practitioners, including small conservation firms, landowners, biological consultants, real estate companies, developers and nonprofit land management organizations. The basic site criteria proponents seek to satisfy are whether a property is good habitat for impacted species within a region and whether there is a good market for conservation credits due to new development. Next, the bank proponent has preliminary discussions with the wildlife agencies (CDFW 2012). If the wildlife agencies agree that the site has good potential to be a conservation bank, the bank proponent prepares assessments of the biological resources and compiles information on the property title and restrictions. After the site's assessments are completed, the bank proponent and wildlife agencies negotiate the species and/or habitat to be covered by the bank, compatible land uses, mitigation credit values, service area, monitoring plan, habitat needs (creation, restoration or preservation), management plans and the property ownership or easement.

[View Enlargement]

Watercourses and riparian corridors are important areas to protect and restore to maintain habitat connectivity in a region. Conservation banks are an ideal way to conserve or restore riparian habitats along the edges of agricultural lands.

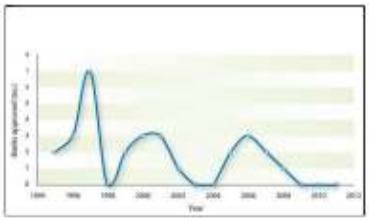
A draft conservation bank agreement and management plan must be prepared and approved by the agencies. After agreements are approved, and land purchases or easements are executed, credits from the bank may be sold (CDFW 2012).

Status.

There is great interest in the potential of conservation banking because — in contrast to the regulatory approach that penalizes landowners for harming species — it creates a market incentive for ranchers and other landowners to conserve wildlife. However, based on the number of new banks approved each year, the program appears to be in decline (fig. 1). Here, we report results of a preliminary investigation into the California Conservation Banking Program, including results of a survey, with particular attention to factors limiting the program's potential to conserve wildlife and natural communities. We also analyze potential reforms to improve the conservation performance of banks while reducing barriers to landowner participation.

Assessing Conservation Banks

California has 29 state-approved conservation banks, averaging about 600 acres each (the range is large, from 8 to 6,000 acres). They are clustered in five geographic regions: the South Coast, southern San Joaquin Valley, Sacramento region, East Bay Hills and Santa Rosa Plain (fig. 2). Some of these banks were established within the context of a regional conservation plan, such as a Natural Community Conservation Plan or a Habitat Conservation Plan (HCP). Eight of the 10 banks on the South Coast are within a Natural Community Conservation Plan. Elsewhere, banks were established as stand-alone areas outside of any regional conservation plan; their acreage was selected without benefit of comprehensive regional prioritization of the most ecologically valuable lands.



[View Enlargement]

Fig. 1. Number of conservation banks approved each year in the California program between 1995 and 2011.

Due to the small number of banks statewide, we did not limit our survey to a statistical sample. Instead, we made the effort to interview most of the individuals involved in developing, managing and providing oversight of all the conservation banks in the California program.

The interviews included 36 individuals who have worked on conservation banks in California over the past 15 years: 20 who work for wildlife agencies (the California Department of Fish and Wildlife, or the U.S. Fish and Wildlife Service) and 16 who work in the private sector, including bank owners, conservation bank firms and land management nonprofits and consultancies:

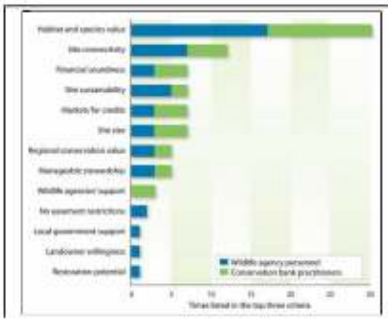
[View Enlargement]

Fig. 2. Regional clusters of conservation banks in California.

- The Department of Fish and Wildlife has one staff person assigned to managing conservation banks in each of the six regional offices. We interviewed all current Fish and Wildlife regional conservation bank managers as well as former managers who had been reassigned in the last 5 years. We also interviewed current and former Fish and Wildlife deputy directors and headquarters staff who have engaged in management of the conservation bank program.
- The U.S. Fish and Wildlife Service has only a couple of field staff devoted to conservation banks in California. We interviewed two senior managers involved in conservation banks in the Pacific Southwest regional office in Sacramento and two field staff serving Southern California.
- With regard to conservation banking practitioners, we attempted to interview managers covering all of the conservation banks in the state. From bank agreement records, we obtained names of the conservation banking firms or private companies and the managers for all of the conservation banks. We completed interviews of current owners, management consultants or management firm representatives of 79% of the banks.

All interviews were conducted by a single investigator either in person or by telephone during December 2011 and January 2012. Answers were summarized and recurring responses were tallied, scoring one point for each person who gave that particular response. We then ranked the answers by total scores (figs. 3 to 6). Respondents were identified as either associated with wildlife agencies or conservation bank practitioners, so differences in responses or priorities of wildlife agencies versus the private sector could be analyzed.

Survey questions were designed to (1) assess the criteria used to select new conservation banks and identify what changes may be needed to ensure that the best sites are selected, (2) assess the challenges and barriers to implementing an effective program and (3) identify policy changes that will improve the program. For each of the 29 bank sites of the California Conservation Banking Program approved by 2011, we also reviewed bank agreements, biological assessments, management and monitoring plans, and annual monitoring reports from the files of regional offices of the California Department of Fish and Wildlife. With regard to monitoring, we assessed whether covered species were useful indicators of the impact of conservation measures (Bunn, unpublished). We also compared regional conservation values of the banks based on the estimates of size, habitat connectivity and habitat diversity (Bunn, unpublished).



Barriers And Reforms

The wildlife agency staff and conservation bank practitioners have very firm ideas regarding the difficulties of conservation banking, and most also had recommendations for reforms.

Site Selection Criteria.

Survey respondents generally agreed on key criteria for selecting a bank site (fig. 3). Among 14 criteria identified, the top two were quality of habitat (score = 29) and site connectivity to similar habitats within the region (score = 12). The next most common criteria were site size, market for credits, and financial soundness and sustainability (score = 7 for each). As expected, conservation banking practitioners emphasized the importance of the market for credits and financial risks more often than wildlife agency respondents.

[View Enlargement]

Fig. 3. Most important criteria for selecting and approving conservation banks identified by survey respondents.

[View Enlargement]

The giant garter snake and red-legged frog are species of concern protected by conservation banks in the California program.

Barriers To Site Selection Or Approval.

Interviewees were asked to identify the three greatest challenges to selecting or approving a conservation bank site (fig. 4). Fifteen different challenges were identified. Among all respondents, the three most frequently mentioned were (1) lack of staff in wildlife agencies dedicated to handling conservation banks (score = 8), (2) the long and bureaucratic approval process (score = 7) and (3) difficulty in assessing costs and financial risks (score = 4). The next most common challenges identified were ensuring conservation success, determining service area, getting agencies to agree, determining credit value and release schedule, finding sites that meet habitat and species criteria, and assessing the market for credits (score = 3 for each).

Tough Issues To Resolve.

Respondents identified 19 issues that were the most difficult to resolve for approval of a conservation bank (fig 5). Of these, the two identified most often by wildlife agency respondents were reaching agreement on the number of credits warranted by the wildlife values at the site (score = 7) and determining the service area (score = 6). Conservation banking practitioners had scattered responses, with only one or two points each identifying a dozen issues, including title and easement issues (score = 2), estimating cost (score = 2) and length of the process (score = 2) (fig. 5). The number of challenges identified highlights the complexity of the process. Negotiations regarding approval can be stalled over disagreement on any or several of these difficult issues.

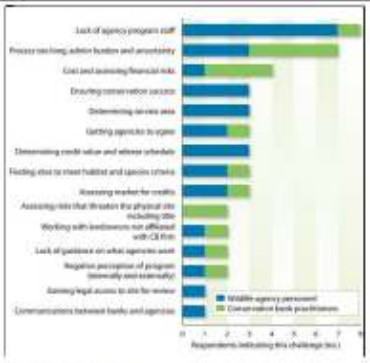


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Fig. 4. Challenges of site selection and approval identified by respondents.

Major Barriers To Approval.

Conservation banking practitioners most frequently said that the number one challenge is the lengthy approval process, requiring 2 to 7 years. The wildlife agencies indicated that the excessive length of the process is mainly due to the lack of staff dedicated to the program, which slows site reviews and conservation bank application processing. Conservation banking practitioners said that the second most difficult challenge is assessing the costs and financial risks of a proposed bank.

Agreement On Major Barriers.

Considering all of these challenges and issues, wildlife agencies and conservation banking practitioners were in close agreement on the major barriers to the development of new conservation banks (fig. 6). The most commonly identified barriers were (1) the approval process is too long (score = 16), (2) the upfront and management costs are too high (score = 12), (3) a market for credits is lacking (score = 7) and (4) parties disagree over who should hold the bank endowment for management in perpetuity (score = 6).

Guidelines For Creation.

Wildlife agencies have provided very general guidelines for the selection of conservation bank sites. When asked if they recommended changes to state and federal guidance on conservation bank selection criteria, three-quarters of the wildlife agency respondents and more than half of the conservation banking

respondents recommended changes. The most frequent recommendation by wildlife agency respondents was to include clear selection criteria in regulations (score = 7). The next most common point, emphasized more by conservation banking practitioners, was that criteria must have flexibility due to the tremendous variability of regions and environmental conditions. (Data not shown.)

Reforms To Facilitate Creation.

When asked to recommend changes to the site selection and approval process that would facilitate creation of conservation banks with high habitat and ecological value, the most common response by far was to determine the highest-priority lands for conservation in a region before designating banks there (score = 10). The next most common responses were early communication between bankers and agency staff regarding the site of a proposed bank (score = 4) and adding dedicated conservation banking program staff in the agencies (score = 3). (Data not shown.)

Major Barriers To Long-Term Viability.

We also asked respondents to assess the greatest challenges of managing or supervising established banks. Lack of staff was the most common response of wildlife agency respondents (score = 14). Some wildlife agencies also pointed to weak monitoring programs and difficulty making changes as part of adaptive management. Conservation banking practitioners tended to highlight site operational issues, including incompatible uses of adjacent lands, controlling invasive vegetation, preventing unauthorized use and keeping management costs down. (Data not shown.)

Reforms To Facilitate Long-Term Viability.

Interviewees were asked if there are any issues that need to be resolved to ensure the long-term viability of the conservation bank program. Three-quarters of the interviewees — including 80% of the wildlife agency and 66% of the conservation banking practitioner respondents — said that reform would be required for the long-term viability of the program. (Data not shown.)

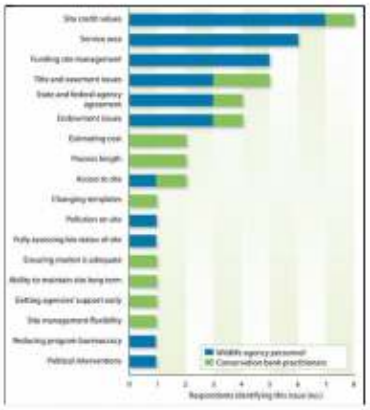

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Fig. 5. Most difficult issues to resolve for approval of a conservation bank identified by survey respondents.

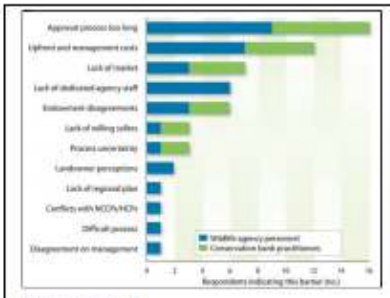

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Fig. 6. Barriers to new conservation banks identified by survey respondents.

Wildlife agency respondents said that the most important issues to resolve were adding dedicated agency staff (score = 8) and establishing new policy about who should be permitted to hold endowments (score = 4). Conservation banking practitioners said that the most important issues to resolve for the program's long-term viability were agency cooperation and consistency (score = 5) and establishment of regional management of conservation banks (score = 4). Both wildlife agency and conservation banking practitioner respondents highlighted the need for common standards for conservation banks. Wildlife agency respondents are more inclined to suggest that these standards and other requirements of the conservation bank program be formalized in statutes and regulations.

Evaluating Conservation Banks.

In the 1990s, there were high expectations that California's innovative conservation banking program would provide an effective market-driven mechanism for developers, ranchers and other landowners to conserve species and natural communities impacted by rapid development. Conservation banking was authorized with just a brief executive policy statement; there was no legislative deliberation or mandate (Wheeler and Strock 1995). Now with a record of 18-plus years, it is time to evaluate whether the program is meeting expectations and contributing to achieving conservation goals.

We analyzed the challenges and potential improvements of the California program with both the conservation and financial requirements in mind. In addition to conserving species, program success requires that the business of conserving priority lands and achieving conservation objectives be profitable for landowners and conservation banking firms. If conservation banks fail to conserve species and natural communities as planned, the wildlife agencies will be under pressure from the public and policymakers to discontinue the program. If the financial risks of conservation banking are too high, the private sector will cease to develop new banks.

Ecological Value.

The 29 conservation banks under the California program were established under a wide variety of environmental circumstances and differ in their regional ecological value. Even within regions (fig. 2), the value of banks varies widely based on the ecological criteria of size of the site, connectivity to adjacent natural lands and biodiversity. For example, the ecological values of sites on the Santa Rosa Plain were

similar, while values varied widely among sites in the Central Valley. Eight of the 10 banks on the South Coast were established within the context of a regional conservation plan. Still other banks were established as stand-alone projects without the benefit of any regional plan or comprehensive prioritization of ecologically valuable areas.

Monitoring.

Conservation banks generally support only very limited monitoring programs, and very basic annual or seasonal surveys of species and parameters such as water level in vernal pools or depth of thatch in upland grasslands. Monitoring programs will provide data of limited value unless they are carefully designed, with defined goals, hypotheses and consideration of statistical power (Field et al. 2005; Legg and Nagy 2006; Lindenmayer and Likens 2010; Noon 2003). A preliminary review of the monitoring plans and annual monitoring reports for each bank found that monitoring usually focuses on the covered species for which a bank was established. However, a bank's conservation measures are not likely to be related to the abundance of highly mobile at-risk species such as Swainson's hawk (*Buteo swainsoni*), burrowing owl (*Athene cunicularia*) and kit fox (*Vulpes macrotis*) because they have home ranges much larger than the typical bank. Furthermore, monitoring of such species at bank properties is not likely to elucidate whether changes in abundance are due to factors at the site or due to regional factors.

Challenges And Key Reforms

The results of our survey indicate that both the private and public sectors of the conservation banking community understand the principles of conservation biology and generally agree on the important ecological and financial criteria for good bank sites (fig. 3). This is significant because efforts to improve a program involve change, and change is always easier when the stakeholders agree on the goals. Most survey respondents agree that the conservation banking program has numerous challenges and that changes are needed to the site approval process, program standards, guidelines and policies.

Challenges.

The approval of new conservation banks and long-term management of established banks face many challenges (table 1). Conservation bankers identified the lengthy and uncertain review process as the number one challenge to gaining approval for a new conservation bank (figs. 4 and 6). By a wide margin, wildlife agency staff identified the number one problem as the lack of staff assigned to the program, which is also partly responsible for the slow review process. Several agency staff also agreed with the bankers that the lengthy process is a major problem.

Altogether, our survey of the conservation banking community and our analyses of the bank monitoring programs and site ecological parameters identified 22 site selection challenges and 15 management challenges (table 1), all of which can be linked to three fundamental problems: (1) lack of clear standards and regulations, (2) lack of sufficient well-trained program-dedicated wildlife agency staff and (3) the inefficiency and ecological constraints of approving and managing stand-alone banks. Solving these three problems will solve or reduce many of the other issues identified by wildlife agency staff, the private sector and our program analyses (table 1). Addressing these problems will also enhance the long-term viability of conservation banking as an effective tool for mitigating the impacts of development.

[View Enlargement]

The California Conservation Banking Program protects Swainson's hawk, another species of concern in the state.

Key Reforms.

Three actions will address these fundamental problems, and many of the challenges that face conservation banking: (1) the enactment of state conservation banking standards in statutes and regulations, (2) securing funding for adequate agency staff and (3) establishing a regional approach to planning and monitoring. These reforms are necessary if conservation banking is to achieve its potential for mitigating the negative impacts of development on species of concern.

Establishing Legal Standards

Wildlife agency personnel and conservation banking practitioners indicated that a high priority for reform was establishing standards for approving new banks, designing and evaluating monitoring programs and reviewing conservation performance. Conservation

banking practitioners also highlighted the importance of guidelines or standards being consistent and not changing from year to year once the approval process has begun for a particular site. From the conservation banking practitioner point of view, it is critical that standards do not change after they have invested a year or more on studies and negotiations for easement, endowment and management agreements. Clear and stable standards reduce uncertainty and the length of the approval process — two of the greatest barriers and risks for landowners and conservation bank firms.

Clear standards also assist the agency reviewers and lead to more consistent evaluations of proposed conservation banks. However, wildlife agencies and conservation banking practitioners emphasized that standards must have some flexibility because land use and ecological circumstances are so varied from one region to another and among different natural communities. While most wildlife agencies and conservation banking practitioners agree that standards would improve the program, the latter are reluctant to suggest that those standards be adopted in formal regulations.

However, in January this year, a new state law (SB 1148) established clear guidance for one aspect of the conservation banking program, the application process and timeline. This conservation banking statute is an important first step, and regulations will help to eliminate or reduce many of the major challenges identified by the conservation banking community (fig. 6).

Wildlife Agency Staffing

The new law may also help to address inadequate staffing by mandating that fees be assessed to cover costs of the program. This increases the likelihood that funding will be provided for dedicated program personnel. Legislatively mandated programs have higher priority for funding and staffing. Additional laws and regulations are still needed to standardize the process for reaching agreement on some of the most contentious elements of banks: regional conservation priorities, credit value and schedule, service area, and monitoring requirements.

[View Enlargement]

TABLE 1. Three major policy changes that address most of the challenges and barriers of conservation banking identified by survey respondents

Regional Planning

The state and federal wildlife agencies should develop regional conservation plans for conservation banking. This would reduce or solve many of the major challenges of the bank selection and approval process and the ongoing management of approved sites (table 1). While conservation banking was originally conceived as a positive alternative to project-by-project mitigation, the creation of stand-alone conservation banks suffers many of the limitations of single project mitigation. Several of the earliest banks were developed in the conservation planning area of a Natural Community Conservation Plan in Southern California to protect coastal sage scrub habitat of the threatened California gnatcatcher among other species. As such, these banks could be evaluated for their regional conservation value and their contribution to the designed reserve network of the regional plans.

Drawbacks Of Stand-Alone Banks.

More recently approved banks are stand-alone banks. The ecological evaluation of stand-alone banks is based on a biological assessment of the site and site visits. The initial biological assessments of conservation banks, performed early in the site review process, are generally very basic and lack a comprehensive evaluation of the regional ecological context as well as a site's contribution to regional biodiversity and connectivity (Noss et al. 1997). Lacking the regional analyses, sites cannot be compared and ranked, and inferior sites may be approved. This may explain why the ecological value of sites within a region, like the Central Valley, varies widely. In this case, the conservation banking program is not achieving its full potential.

The lack of regional analyses and planning also makes the task of objectively evaluating the conservation value of a proposed bank very difficult. Conservation bankers and agency scientists conduct their own analyses, and this can lead to much disagreement on the conservation value of a site, delaying or stalling the review process.

Stand-alone banks may not provide the best ecological value if they are reviewed apart from a regional analysis of conservation priorities or at a more relevant ecological scale (du Toit 2010).

Monitoring.

Regional planning and coordination will also improve monitoring of bank performance. Conservation banks must have a monitoring program (USFWS 2003; Wheeler and Strock 1995). There are two problems with establishing a separate monitoring program for each conservation bank. First, the monitoring at the scale of a single bank site, without comparison to regional species or habitat trends, is unable to distinguish the impacts of conservation measures from those of regional environmental changes (du Toit 2010; Noon 2003; Bunn, unpublished). Second, banks have very limited funding for monitoring, and it is not efficient to manage separate monitoring programs for each bank. Allowing landowners or conservation bank firms to pool resources for regional monitoring would be more efficient and would provide better data to assess the impact of conservation measures at the site level versus changes caused by regional factors.

Conservation Priorities.

Regional planning could pre-identify regional conservation priorities, important reserve areas and corridors, biodiversity hotspots and threats to wildlife resources (Kiesecker et al. 2009). This kind of prior regional analysis would expedite the assessment of credit values, determination of appropriate service area and agreement among regulatory agencies and bankers on the conservation value of a proposed bank site relative to the other potential sites in a region. A portion of the upfront fund commitment for each bank and a portion of the bank management funds should be pooled in a regional endowment to support regional planning and monitoring of conservation banks.

Nationwide, there are now over 120 approved conservation banks covering 100,000 acres. State wildlife departments and the U.S. Fish and Wildlife Service continue to approve more conservation banks each year. Lessons learned from the California Conservation Banking Program can help guide efforts to improve such programs nationwide. If it is to be a successful mechanism for mitigation, conservation banking must achieve conservation goals and be profitable for landowners and banking practitioners. Making conservation banking programs a viable economic option for more landowners will require new policies to establish clear and stable standards, and to fund dedicated agency staff to coordinate the review process for proposed banks and to supervise established banks. Policies requiring regional approaches to prioritize lands and design monitoring programs would both increase the performance of conservation banking and make site selection and approval more efficient. Without program reform, the program is too difficult or risky for most landowners, and many properties with tremendous wildlife value may never be available for conservation banking. The new conservation banking law is an important first step, but does not yet provide guidance on prioritizing sites, nor on addressing regional planning or monitoring.

[View Enlargement]

California rangelands managed under a conservation bank can provide excellent habitat for burrowing owls. Burrowing owls benefit from several conservation banks in the Central Valley.

[View Enlargement]

Conservation banks may be one of the best mechanisms for protecting key habitat of San Joaquin kit foxes on private lands.

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Author Notes

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