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Science

FINDINGS

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"Science affects the way we think together."

Lewis Thomas

MILITARY MANEUVERS AND BIODIVERSITY: STRANGE ARRANGEMENTS IN SOUTHERN CALIFORNIA



A Declining populations of California cougars and other wildlife are a concern in rapidly developing southern California.

"Restoration ecology will be the dominant art form of the 21st century."

Ross Kiestler

Generally, when the Marines are sent in, the intent is not to save flora and fauna. So what a turnaround to realize that the Marines, thus far, are largely responsible for having maintained biodiversity in the beleaguered coastal lands between Los Angeles and San Diego.

There may not be an area in the country under greater pressure to urbanize than the 50-by 83-mile rectangle of land between these two hungry cities. There certainly is no more valuable piece of real estate than

the Marine Corps Base Camp Pendleton, with its 17 miles of untouched California coastline and almost 123,000 acres of unbuilt land.

Of course, they won't sell. They have to have that real estate to practice their beach landings, among other things, but the pressure to urbanize foists on them an unanticipated role in the area: protectors of biodiversity.

"The Marines are rapidly becoming the island of biodiversity in the sea of development," says Ross Kiestler, leader of the PNW Research Station's Global Biological Diversity Team. He was a lead researcher in the study exploring how urban growth and change might affect biodiversity in the rapidly developing southern California region.

IN SUMMARY

How can we maintain biodiversity as human population levels continue to increase at a rapid rate? This issue of Science Findings focuses on southern California, one of the richest areas of biodiversity in the country, and home to 1.5 million people. Pacific Northwest Research scientist Ross Kiestler, in conjunction with a cooperative research agreement with Harvard University, developed six models to illustrate how development might impact the area. Kiestler's approach was this: rather than focusing on how to keep people out to save biodiversity, how can we keep people in the area with the least amount of biological damage?

Kiestler's alternative futures range from "currently expected" (based on current housing plans of a three-county area in California) to "highly unusual" (encouraging development in a single area and away from sites critical for biodiversity).

The study acknowledges that all scenarios may have a negative bearing on biodiversity. Kiestler believes we should instead look to improve current development plans, seek alternatives to accommodate population growth and biodiversity, and then determine at what scale such alternatives should be considered.

The study concludes that options for the maintenance of biodiversity will be used up by 2010. Either biodiversity will be preserved by then or it will not.

And what biodiversity there is. The region includes the Marine base and a large portion of the Cleveland National Forest, including the San Mateo Wilderness Area. It is one of the richest areas of biodiversity in the country, with over 200 species of plants and animals listed by Federal or state agencies as threatened, endangered, or rare, including the least Bell's vireo, the coastal cactus wren, and the California gnatcatcher. Declining populations of California cougars are also of concern.

The study area supports various habitat types, including coastal lagoons and estuaries, coastal scrub areas, maritime-influenced chaparral and shrub communities, oak woodlands, coniferous mountain areas, and dry, hot, sparsely vegetated deserts.



KEY FINDINGS



- Flood control and biodiversity are directly linked. This is especially a problem for Camp Pendleton, whose upstream watersheds are open to development.
- Fire management and biodiversity are directly linked. Fire suppression due to development can allow some vegetation types to disappear and increase the risk of catastrophic fire due to fuel buildup.
- Options for the maintenance of biodiversity will be used up by 2010. Either biodiversity will be preserved by then or it will not.

PRESERVING BIODIVERSITY: KEEP PEOPLE OUT?

The State of California predicts human population in the area will grow by more than 500,000 between now and 2010. The area is managed by three counties, along with several state and Federal agencies, and is already home to 1.5 million people.

Specifically, the spread of development eats up habitat by grading, paving, ornamental landscaping, and other human activities. Indirect effects from changes in the hydrology regime and from fire suppression also affect habitat and, ultimately, biodiversity.

"Pressure from population expansion is of course the main challenge to biodiversity," Kiester says. "Our team looked at the population growth predictions and decided they were a given—that train had already left the station. Then, rather than trying to show how important it is to keep the people out to save the biodiversity, we attempted, by modeling, to get them into the area with the least amount of biological damage."

Thus six assessments of alternative futures for the area were developed. They were based on 10 spatially explicit dynamic models, including hydrology, fire, vegetation, biodiversity and visual amenity. Soils models evaluate the agricultural productivity of the area's soils. Hydrology models predict 25-year storm hydrographs, flooding heights and water discharge, and the resulting soil moisture. Fire models assess the need for fire in maintaining vegetation habitat and the risks of fire and fire suppression. The visual model assesses scenic preferences for the region's landscape.

This is a fire and flood landscape, an "Old Testament" landscape, in Kiester's words. Management for biodiversity is guaranteed to be difficult in the area; it combines fire suppression in residential areas, limits on controlled burns, highly developed areas, increasing pressure for building on the uplands, heavy storms, farmers using steep slopes for avocado orchards, and multiple ownerships.

Major communication barriers once existed between some of the management jurisdictions. "At the beginning of the study, Camp Pendleton's map of its land use and San Diego County's map of the base's land use were completely different," Kiester recalls. "The base used categories such as 'impact zone' and 'maneuvers' where the county listed only 'open space.' Getting all parties to agree to a common set of land use designations made working together much easier."

Purpose of PNW Science Findings

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MILITARY BASE PROVIDES BIODIVERSITY

So how does the Marine base come to be such a bastion of biodiversity? Diverse habitat, unbuilt coastline, connectivity of ecosystems as it abuts the San Mateo Wilderness Area and is close to the Santa Rosa Plateau Ecological Reserve. "Add to that its extreme vulnerability to flood damage—in fact a desire not to be washed out to sea—and its protection of the Bell's least vireo, a threatened riparian bird, and you find a strong interest in biodiversity issues and research," Kiester notes.

The very existence of the base may be a major reason there is still time to take action toward wise management of biodiversity during development, he says.

The very urgency of action moved the research project in its own way. The team was made up of both ecologists and landscape architects, degreed professionals and students, and the alternative futures were put together in a design studio at Harvard, in a pressure cooker atmosphere.

"In a way, the student involvement was one of the most exciting parts of the project,"

MODELS OFFER ALTERNATIVES

The six alternative futures that emerged from the design studio ranged from the currently expected to the highly unusual. The baseline scenario examined was Plans Build-Out, based on current local plans of the three counties, the base, and other Federal and state landowners. It presumes the pursuit of these plans with no additional constraints.

Alternative 1, Spread, incorporates continued development of single-family residences of medium density in the valleys and extensive rural residential growth with altered vegetation throughout the landscape. Alternative 2, Spread with Conservation 2010, follows the same pattern, but then assumes that by 2010 the public's desire to protect remaining areas from development will have increased and that remaining areas of high-conservation priority, such as riparian areas or coast sage scrub, will be protected by purchase or other means.

"These alternatives are essentially our efforts to model what a developer would do to the landscape," says Kiester. "We took the present condition and modeled it to 2010, then to what we called Build-Out.

MANAGEMENT IMPLICATIONS
<ul style="list-style-type: none">• Projected population growth will have a negative effect on biodiversity, no matter how it is managed. However, there are a number of options that reduce the negative effects, while still accommodating the population growth.• A completely integrated, spatially explicit approach gets the different constituencies to adopt a common language, thus overcoming a major communication barrier and paving the way to more collaborative, less emotional approaches to biodiversity management.• Actions of individual landowners matter a great deal in determining the future of the region's biodiversity. Winning the hearts and minds of people, particularly those with 5-acre rural residential lots, in the cause of preserving biodiversity, will be a crucial component of any successful development plan.

Kiester says. "Ecologists normally work in years as their unit of time, landscape architects in months. Here the students were given the problem, and told to come up with six feasible alternative futures based on the certainty of development and to come up with their first solution in 24 hours. It certainly forced them to focus on overall concepts." The design students then worked on initial ideas for about 6 months.

Kiester believes there is an element of artistic creativity required in this kind of conceptual work. And such creativity sometimes overrules the little stuff ecologists can get stuck on: "what we see as questions they don't necessarily even see."

Although none of the six alternatives in any way improved biodiversity, these two alternatives, along with Plans Build-Out, really showed some stark truths clearly."

He notes, that flood control and biodiversity are directly linked. As upstream development proceeds and runoff increases, floods become more severe and biodiversity suffers.

"This is especially a problem for Camp Pendleton, whose upstream watersheds are open to development. It is less of a problem in Orange County where much of the upstream watersheds are protected by the Cleveland National Forest," he says.

The other direct link to biodiversity is fire management. As more development occurs, fires are prevented and controlled more. This allows some vegetation types to disappear through succession and also increases the risk of catastrophic fire as fuels build up, Kiester notes.

The remaining three alternatives, which Kiester refers to as "the epistemological equivalents of a dream," incorporate some more radical approaches to protecting

biodiversity while still incorporating the projected population growth. Alternative 3, Private Conservation, addresses biodiversity on the level of individual commitment to protection. It assumes that the greatest threats to biological diversity and ecological integrity in the region are fragmentation and isolation of habitat. It further assumes that public resources to acquire land for conservation will be unavailable into the foreseeable future.

Kiester explains that this alternative would encourage private conservation through private ownership of property and environmentally sensitive low-density residential development in and near ecologically important areas. "It presumes that the benefits of thoughtful development will outweigh the potential risks associated with very low density housing," he says. "Then there is a shift towards the spread alternative into the future because the most critical landscape will have been privately protected as soon as possible." Several zoning options exist for encouraging this kind of controlled development.

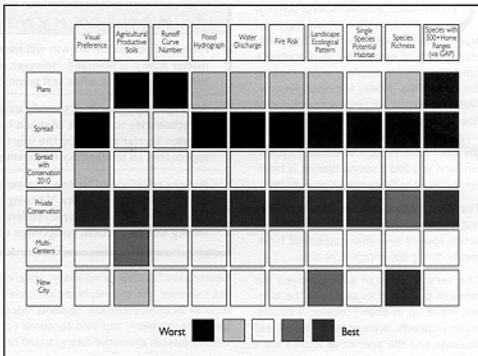
MULTICENTERS SPOTLIGHT URBAN DEVELOPMENT

Alternative 4, Multicenters, identifies a small number of development centers. Centers were located to create least impact to biodiversity near intersections of major roads, and on developable land that is neither steep nor wet. Lands susceptible to fragmentation by urban development are purchased, and the strategy emphasizes linking currently protected habitats to ensure sustainability of listed species.

In an effort to concentrate development, and to try to control the social forces that determine where it happens, Alternative 5, New City, encourages potential development within a single area appropriate for urban development and away from areas critical for biodiversity. The new single center would incorporate existing urban areas as satellite communities.

"This is simply an attempt to create the smallest possible footprint on the landscape," Kiester points out. "Naturally the city would be designed with strategies that include total water catchment management, gray water and tertiary treatment systems, water recharge, waste management, and recycling. In fact, the alternative could be a model for the development of future large communities."

All alternative futures include both a scenic highway route to promote appreciation of



A Summary of the comparative impacts of the several alternative futures.

the biological richness of the area and a wildlife crossing of Interstate 15 to connect habitat, particularly for larger species.

The models compared all scenarios, incorporating three ways of assessing biodiversity: landscape ecological pattern—the existing mosaic of the background matrix and

patches connected by corridors; single species potential habitat—the possible home ranges for selected vertebrates based on food, nesting, and behavior requirements; and species richness—the abundance of species associated with each habitat type.

CONSEQUENCES TO BIODIVERSITY

The study found that the direct consequences on biodiversity of all scenarios is negative, no two ways about it, Kiester says. All will lose agriculturally productive soils and cause increased erosion and sedimentation. All will cause a change in soil moisture, a reduction in water tables in the river basins, and a dramatic increase in flood discharges. Upland biodiversity also will be altered owing to increased fire suppression and reduced soil moisture.

In all the alternatives, the landscape ecological pattern is increasingly fragmented and some of the most important single species, such as the gnatcatcher and the cougar, will be seriously affected, their long-term survival in doubt, Kiester says.

"None of this should come as a surprise. But, seen from a human perspective, this should not be seen as an overall disaster. Instead, the next question is, Can we do better than the current plans? Are there alternatives that can accommodate both the population growth and the high biodiversity? And at what scale should such alternatives be considered?" he asks.

Four investigations at different scales sought to answer these questions. The first is the proposed restoration for riparian habitat of three abandoned sewage treatment ponds at Camp Pendleton. The second analyzes a subdivision, and a proposal to enable wildlife to move more easily through the landscape when houses are built and occupied. The third compares alternative devel-

opment-guideline strategies for an undeveloped third-order watershed. The whole-landscape comparison is the fourth.

The most compellingly hopeful future for the whole landscape occurs under the Private Conservation scenario. "If the development process can be managed well, these private land management policies may be the most effective," Kiester says. "Multicenters and New City do seem to be plausible strategies for biodiversity, although no one underestimates the difficulties in implementing development patterns that diverge substantially from current plans."

LANDOWNERS: KEY PLAYERS IN BIODIVERSITY FUTURE

Kiester emphasizes that the actions of private landowners, especially owners of rural residential lots of around 5 acres, have a critical impact on determining the future of biodiversity in the region. If they retain the native vegetation overall, he says, they will maintain substantial numbers of species. If they use the land for other purposes, they will not.

Any of the alternative futures could incorporate the smaller scale strategies investigated. "There are many opportunities at a subregional scale to manage or improve conditions for high biodiversity," Kiester says. "An area can accommodate development and still maintain biodiversity by acknowledging some common sense constraints to development on steep slopes and flood-prone riparian zones."

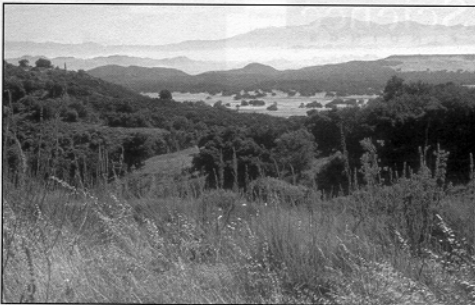
The Marine base will get more involved in planning for the region, Kiester believes, because of off-base influences on their environmental systems. The conflict between training missions and environmental management is bound to increase, and the prevailing view of the base as "open space" by other jurisdictions can no longer hold. The whole landscape study has made clear that none of the public lands, including the base and the Cleveland National Forest, can be seen any longer as isolated, self-contained and self-managed entities.

A final conclusion from the study is simple, if chilling: options for the maintenance of biodiversity will be used up by 2010. Either biodiversity will be preserved by then, or it will not be preserved.

The study, and Kiester, conclude: "Timing is everything. Most of the long-term future pattern of biodiversity in the region will be set within the next 15 years, and most development decisions that will shape that future will be made much sooner. The window of need, and of opportunity, is now."

"A man must make his opportunity, as oft as find it."

Francis Bacon 1561-1626



A The actions of private landowners can have a critical impact on determining the future of biodiversity.

FOR FURTHER READING

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WRITER'S PROFILE

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SCIENTIST PROFILE



Ross Kiester grew up not far from Camp Pendleton in the days when it was wonderful to be interested in herpetology. With a Ph.D. in Biology from Harvard, where he was also a Junior Fellow, he has published on herpetology, biogeography, ecology, evolution, and the philosophy of science. He has worked on planning issues, particularly ecosystem management, with the Forest Service. He is team leader of the Global Biological Diversity Team at the PNW Research Station.

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