The Incorporation of GIS into an Evolving Ecological Approach for Tiger Conservation

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Tigers have become one of the most well-known conservation topics to date. It is the only species that has initiated a meeting between countries to save a single species, demonstrating the intense care for the animal as well as the devastating plight it is facing. In the midst of heavy poaching, habitat degradation, and human persecution, their numbers have fallen dramatically within a small period of time. Efforts are being taken to determine the best way to conserve what population there is left and to hopefully increase the chance of survival. In the past these efforts have been focused on single species conservation but over time this movement has developed and incorporated new techniques. These new forms of conservation have provided greater knowledge of the tiger and its habitats along with setting the base for new policy action.

Many of the early conservation efforts were focused on single species conservation in where research was concentrated on understanding the animal in question and not expanding much beyond this. In most cases this meant estimating and monitoring populations. As a result there was information pertaining to where tigers may be, how many there be, and individual characteristics of a single tiger. This became most apparent when looking at GIS maps created from the subsequent information demonstrating tiger range and movement (Royle et al. 2009). Often times camera traps were utilized as a capture recapture method to obtaining this information from which the data was integrated to map form. By observing these maps, this narrow focus became well covered as well as began to display its downfalls. Tigers live solitary lives in large spaces where they often move, proving to be an elusive species. These preferred methods at the time were expensive, and while they provided information on individual tiger’s whereabouts they did not produce the necessary information to influence action (Linkie M. et al., 2006). As the realization of this became apparent the field research of tigers began to evolve to cover a larger spectrum.

The present research efforts have come to focus on an ecological approach rather than single species method. In this way information obtained covers not just movement and population estimates but topics such as habitat preference, prey species, and population interactions as well. As a result knowledge is better-rounded, covering all aspects pertinent to the tiger’s survival. This has become evident when comparing evolving techniques and mapping products from the two strategies. GIS has now been incorporated to cover three main topics, the first being research tactic. Before information is garnered maps are created to demonstrate how the research is being done. Karanth et al. (2006) utilize GIS in this way, displaying where camera traps were placed in the research area. Upon observing this information they were then able to reassess their original placements and expand their test area. As a result the consequential map incorporated 3 areas of camera traps along with where each camera trap was placed. In this
way they were better able to research the transient movement of the species and place a base for similar future research. Development within the use of GIS in a new conservation paradigm allowed Karanth et al. (2006) to better focus the research while in the middle of the process. Many recent research efforts have expanded further upon the incorporation of GIS in an ecological approach to conservation.

The second being a tangible value system for tiger habitat. Now not only is the tiger being studied but the contiguous habitat they occupy. Through understanding habitat preference it is possible to understand what areas must be conserved that are not and what value the habitat space is that is conserved. Carroll et al. (2006) focus their map figures on determining what habitat is best and configuring what natural boundaries there may be discontinuing movement throughout multiple areas. They categorized each habitat to incorporate vegetation type, topographic information, climatic conditions, and human impact from which each habitat was ranked, resulting in a map distinguishing the best existing habitat space for tigers. Other research has taken a similar approach but expanded its efforts to incorporate information not just pertaining to the tiger subpopulation but what actions must follow to conserve the species. Many develop ranking systems of non-protected areas in order to show where corridors would fit best to increase movement between populations (Johnsingh, 2006). The map created in these situations incorporates protected areas with suggested cites for preservation. Wikramanayake et al. 1998 take this step further in the hopes of protecting enough space to provide substantial space for tigers to fulfill all their ecological needs. The resultant map in this case incorporates habitat values of protected space and non-protected space in where “what if” situations are incorporated. Subsequent maps focus on mapping what the habitat might resemble if poaching increased or decreased, habitat degradation stopped or developed, and if population numbers fluctuated. It is then determined how well a population may persist in a habitat area. Carlos et al. (2012) follows in these footsteps in determining whether Amur tigers could possibly be reintroduced to the original range of the now extinct Caspian tiger. These GIS applications formulate concepts as to how to develop better conservation efforts and where these efforts should be focused. The ecological focus here begins to greatly expand the field.

Lastly GIS has developed within the field to conform to an expanding ecological approach by not only focusing on a biological level but an anthropogenic one as well. The greatest threat to tiger survival is not ecological boundaries but rather human resultant interruptions. Mapping human disruptions provides a basis for how anthropogenic sources can be altered as well. This is apparent in Nyhus et al. (2004). Nyhus focused on understanding human tiger conflicts and the mindset of local inhabitants within the researched area. The result was a map encoded with the locations of attacks, information pertaining to the victim, information about the tiger, and the following events as compared to degradation of tiger habitat. Areas were then color coded displaying the danger of each area along with a large database about local interpretations of the attack. As a result it was determined that those areas where farms met forest edges were the most likely to experience tiger-human conflict. Upon discovery of this information, habitat fragmentation and farming techniques can be subsequently addressed.

The conservation spectrum has developed and changed throughout the years to better accommodate the needs of tiger sub-populations. Along with this the GIS techniques and uses
have expanded to better demonstrate pertinent information. It is this growth that must continue in order further the efforts. Possible areas of expansion might be to formulate maps as conservation action is put in place. Mapping the changes to populations as corridors are introduced, poaching diminished, and prey increased as compared to previous maps may provide a timeline and a rate of change which in turn may delineate how long it will take for the tiger population to fully recover. GIS could also be incorporated to demonstrate where political action is occurring or areas where this support is lacking. It may then become evident as to where conservation efforts must be concentrated or where they are more likely to be concentrated. In all it would be best that GIS expand to include both human perspectives along with biological attributes as it has done in the past.

The original approach to conserving tiger populations was to focus efforts on estimating population sizes. This is apparent in early GIS maps in where individuals may be pinpointed or population numbers defined. The lack of useful information apart from this led to the evolution of an ecological based approach in where newly formed GIS maps and techniques not only mapped habitats and populations but created a ranking system and suggestions for incorporations of newly protected areas. It is this evolution that has helped all those involved better understand the tiger’s movements and ways and may one day save the tiger.

Literature Cited


Annotated Bibliography


Carlos et al. discusses the possibility of reintroducing Amur Tigers into the historical range of the Caspian Tiger due to their genetic similarities. This is in the hopes that in doing so tiger populations will recover. Along with this the paper focuses on the suitability of the Caspian Tiger habitat for tiger reintroduction and the struggles these areas now face. They use GIS maps to present both the historical presence of the Amur Tiger along with the status of the habitat range. The paper is one of the more recent publications with many writers who are accomplished within the tiger conservation field. Together this provides a strong and current base of knowledge of the plight of tigers along with the current applications of GIS systems within this field. The paper forms a new and different outlook on tiger conservation, where most look to monitor current populations this research offers a new active solution. The study is beneficial in that uses new techniques in different ways and provides a different outlook when researching this topic.


This paper looks to assess tiger habitat, focusing not only protected areas but those that surround it and their viability as a suitable habitat space. Using this information Carlos et al. then suggests where to introduce newly protected areas in order to create more habitat space along with greater connectivity. Population estimation models along with a focus on hindrances and opportunities add value to the created matrix. GIS was then used to estimate tiger population within different habitat types and to then use this information as a suggestion for most preferred habitat types. A ranking system was applied on a raster format from which a map was created to delineate the best option for additional tiger habitat. The use of GIS in this paper is different from past research and is proving to be a favorable use as it is seen in other
papers cited here. GIS is no longer simply used to estimate population numbers but rather
applied at an ecological view and then used to formulate new suggestions for action in the
conservation field. The research is validated through its use of techniques which are supported
by numerous other reputable papers.

**Johnsingh, A.J.T. 2006. Status and Conservation of the Tiger in Uttarakhand, Northern India.**
Ambio 35:135-137.

Johnsingh states this part of Northern area has long been protected. Within this protected area
there are 4 blocks of tiger population of which there is little interaction or connectivity. In order
to combat this, using previous information, Johnsingh suggests where new protected areas
should be incorporated not to just create additional suitable habitat but to also increase
connectivity in the hopes of prohibiting the further formation of metapopulations. GIS systems
are utilized to display where these 4 populations live and where these areas of connectivity
could be incorporated. Along with this GIS is used to define habitat types and natural
boundaries which prevent tiger movement. Once again, as seen in this paper, research is
focusing greater on ecology rather than just a single species and utilizing new techniques to do
so. This outlook helps determine the growth of the field and why this approach is beneficial
when attempting to conserve and expand tiger populations. The use of GIS within this research
also allows a very remote area to be monitored throughout the conservation community.


Photographic capture-recapture sampling is a popular form of examining population dynamics.
Karanth et al. utilize this popular form but employ the resultant information for new techniques
within the GIS field. Camera traps were mapped using GPS coordinates, but because they were
testing transient movement of individual tigers, the maps were used to reassess camera sights.
They were then able to expand their camera trap sights until the acceptable limit was
determined. Most often GIS is used to analyze resultant information but in this case it is used to
describe the process. Future research, as a result, can mimic this project in order to better the
use of camera traps. This form of GIS also created a time related tiger abundance which had not
been done previously. U. K. Karanth is a well-established conservationist which provides
firmness behind these newly created techniques.

**Linkie, M., G. Chapron, D. J. Martyr, J. Holden, and N. Leader-Williams. 2006. Assessing the
Viability of Tiger Subpopulations in a Fragmented Landscape.** Journal of Applied Ecology
43:576-586.

Linkie et al.’s paper demonstrates an integrative and new approach to GIS very well. The
research focused on tiger habitat preference for subpopulations in Sumatra in where detection
non-detection surveys were utilized. They created a raster format grid in where each boxol had
relevant information and then overlaid it on a forest cover map. Each boxol was then given a
ranking number based off of ecological and anthropogenic influences. They then normalized
the maps by dividing abundance by area. The resultant maps provide a matrix of best suited
habitats for tigers not only environmentally based but as a result of poaching as well. This
integration of human and ecological pressures provides information for biologists and policy makers alike. This is the precipice for an ecologically based outlook on tiger conservation considering that most papers here are cited in 2006.


Nyhus et al. focus on one area of tiger decimation: human impact. They integrate both scientific information along with interview responses to create a detailed picture of conflict areas. Together they use this information to map the area based on habitat type, victims, and following events. The map displays which are the most dangerous areas and why. Often GIS is used solely for biological purposes but Nyhus et al. have used it to describe interactions and present how these interactions are impacting tiger and human life. This can help those who live there change their understandings of tigers resulting in a different approach to tiger conservation. This paper, written in 2004 just about 2 years before most other reputable papers cited here, seems to influence others within this field by straying away from the strict biological adherence and application of GIS and conservation. It is this that provides an interesting look at tiger conservation through the years.


The paper cited here is most notable for its many authors who are renowned in the field and prove to be initiators of an ecological based conservation method. Its creation in 1998 marks the momentous movement from an individual species focus to ecology focus. The research looks at where to include connected pathways for tigers and what if situations. The result was a graph system in where areas were ranked on suitability, poaching pressures, and connectivity. Along with this maps were created to determine how the landscape would differ if poaching was lessened and connectivity increased. From these multiple types of graphs Wikramanayake et al. determine where tigers are most likely to persist in the long run. Many of these authors are further cited in numerous other papers in this list adding to the validity of those and this paper. It is a paper in where the benefits of a new system can be seen.