

FOSSIL FUEL EXPLORATION

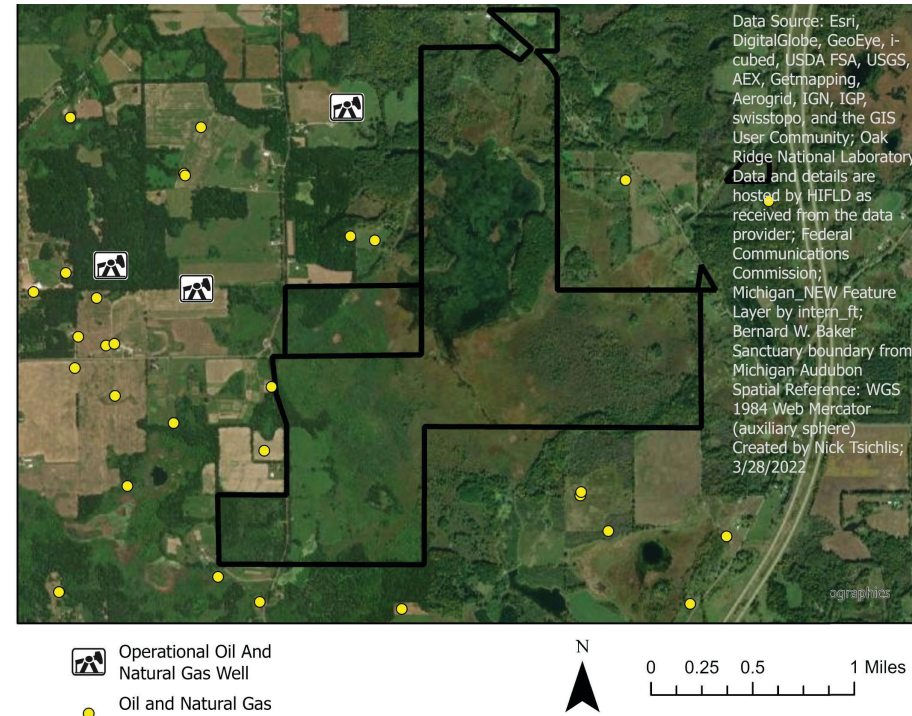


FIGURE 1.3 PROXIMITY OF OIL AND NATURAL GAS WELLS TO BAKER SANCTUARY

Michigan is rich in fossil fuel reserves, and more than 50,000 wells have been drilled in the state since 1925. The lower half of Michigan contains extensive sedimentary deposits that formed as organic matter compacted on an ancient seabed, and this rock contains porous pockets filled with oil and natural gas. It is for this reason that much of the extraction in the state has occurred in the southern half of the Lower Peninsula (Westbrook, 2005). The availability of these resources and their revenue potential has for decades inspired passionate debate amongst Michiganders. Politicians, land managers, and private entities have been forced to weigh ethical concerns regarding the impact of drilling on land, water, and wildlife against the short-term infusions of capital that could be used to stabilize budgets or to finance other ventures.

One of these disagreements occurred in 1975, when Mobil Oil propositioned Michigan Audubon to drill five exploratory wells within the boundaries of Baker Sanctuary. Michigan Audubon was running an annual \$14,000 deficit and the offer, which guaranteed \$100,000 per well, would have alleviated those concerns, and funded additional priorities. Opponents of drilling were adamant that any disturbance of the nesting cranes was too high of a price to pay, no matter how large the monetary reward was. When a proposal to ban all future fossil fuel extraction at Michigan Audubon properties came

up for a vote in 1976 over 50% of the society's members voted for it, but this was less than the two thirds threshold required for it to be added to the organization's bylaws. Mobil Oil then withdrew its original offer (Anderson & Leal, 1991).

This was, however, not the end of the debate. Shortly after Mobil Oil rescinded its offer, Michigan Petroleum was granted access to Baker Sanctuary to explore and drill for oil. Permission was granted with stipulations that were intended to protect the habitat as a refuge for sandhill cranes. Michigan Petroleum was required to drill wells on a slant from a pad at least half a mile from Big Marsh Lake with equipment that was encased in high-efficiency mufflers to reduce sound pollution, and all fluids were contained on site. They were also required to finance studies of potential environmental problems

that could result from their presence in the sanctuary. Michigan Audubon received royalties of \$1 million from these activities, which concluded shortly thereafter (Anderson & Leal, 1991). There has been no fossil fuel exploration or extraction since that time.

1.5 Property Description

CONTEXT WITHIN REGIONAL LANDSCAPE

Bird Conservation Region

Designing resilient landscapes requires the synthesis of data from multiple sources. Specifically, it is important to understand how ecosystems are affected by anthropogenic activity, how these changes integrate within regional and national trends, and what the effects of these changes are on local populations native flora and fauna. The mission of the Michigan Audubon is intimately tied to the preservation of avian communities in North America, so they utilize a classification system consisting of Bird Conservation Regions (BCRs) in their literature, which are geographic areas that contain certain ecosystems and their associated avian species, and thus have similar management concerns. These regions have been designed and updated by the North American Bird Conservation Initiative (NABCI), an assemblage of scientific and academic

professionals from the United States, Canada, and Mexico (North American Bird Conservation Initiative, 2000). They endeavor to stabilize the populations of native bird species by facilitating collaborations between nation states, governmental agencies, local governments, and engaged citizens on initiatives relevant to the restoration and conservation of ecosystems.

The NABCI aims to increase the effectiveness of conservation initiatives by encouraging the formation of biologically driven bird conservation partnerships, integrating those unions within a larger conservation community, and identifying financial resources available to those organizations (Wildlife Service, North American Waterfowl, & Wetlands Office, 2000). These goals are facilitated by the BCR framework, as nested ecoregions can be partitioned into smaller units for localized ecological planning or aggregated into larger regions to coordinate conservation throughout the range of a particular species. Additionally, because they are not affected by superficial state or national boundaries, it is possible to avoid certain bureaucratic entanglements and to focus on conservation (Bird Studies Canada and NABCI, 2014).

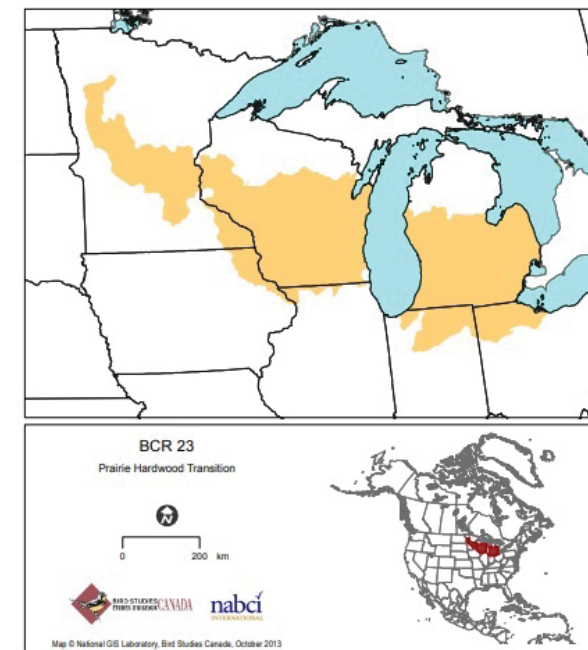


FIGURE 1.4 THE PRAIRIE-HARDWOOD TRANSITION ECOREGION COVERS A SIGNIFICANT PORTION OF THE UPPER MIDWEST (BIRD STUDIES CANADA AND NAVCI,

Baker Sanctuary is located within the Prairie-Transitional Forest Biome and is classified as Bird Conservation Region 23 – Prairie Hardwood Transition. Prior to European settlement, this BCR region was dominated by prairies to the west and south and oak forest to

the north and east, with oak savanna inhabiting the transitional areas in-between. Past glacial activity is responsible for the numerous wetlands and shallow lakes that characterize this region, which provide crucial breeding grounds for native waterfowl (North American Bird Conservation Initiative, 2000).

This land has been heavily impacted by anthropogenic activity, and many forested upland patches have been reduced or eliminated. In Michigan, 16% of BCR 23 is currently classified as urban and 34% is in row crop production, a 50% reduction of the original suitable habitat for migratory species that traditionally depended on this environment for food and breeding sites (Pierce et al., 2014). The widespread loss of forest to urban cover and conventional agriculture as well as the fragmentation of remaining woodlands is an existential issue which threatens the stability of the populations of species that require large, undisturbed patches of high-quality habitat to reproduce successfully. Species that rely on specific cover types present in BCR 23 for breeding habitat include the cerulean warbler, wood thrush, eastern meadowlark, and others (U.S. Fish and Wildlife Service, 2021).

Birds are known to be excellent indicators of ecosystem health and stability due to their large-scale migrations that are far easier to track and record than the movements of other fauna. Since the 1970s, when large-scale monitoring became commonplace, there have been major documented decreases in bird populations. Studies reveal a net loss in total abundance of about 2.9 billion birds in North America, a 29% reduction from 50 years prior (Rosenberg et al., 2019). Currently, there are 99 threatened or endangered species in the United States alone, with 200 more nearing this classification.

Grassland species have experienced the largest proportional population loss compared with birds in forest and wetland biomes. Since 1970, grasslands in North America have lost an estimated 700 million breeding individuals from the populations of 31 species (Soulliere et al., 2020; Rosenberg et al., 2019). The causes of this are multifactorial and include widespread habitat loss, the expansion of conventional agricultural practices, and the disruption of migratory and breeding cycles due to climate change and other anthropogenic factors. The introduction of domesticated cats has also negatively impacted bird populations, and it is estimated that they kill between 1.3 and 4 billion

birds per year (Loss et al, 2013). The presence of feral cats and other predators can also negatively affect avian populations in non-lethal ways, as birds alter their behavior to mediate risk, and this can result in less foraging and lower fecundity (Bonnington et al., 2013). This is evident in the Prairie Hardwood Transition in Michigan, which 30 avian species of conservation concern utilize for either breeding grounds, a stopover, or as permanent residence (U.S. Fish and Wildlife Service, 2021). Baker Sanctuary, which is located within BCR 23, represents one of the few remaining undisturbed areas in southwestern Michigan that historically provided habitat for these species. Because of this, the site has significant potential to be a future hub of biodiversity in the region and a haven for a vibrant community of threatened species.

Climate Change

There is broad scientific consensus that the rapid, ongoing changes in global climate patterns are due to the anthropogenic release of carbon dioxide and other greenhouse gases into the atmosphere, and that this will result in a global temperature increase between 1.5°C and 4.5°C within the next century (Albritton & Dokken, 2001). In 2019, global levels of carbon dioxide (CO₂) reached 410ppm, the highest of any period in the last two million years. Global methane (CH₄) and nitrous oxide (N₂O) levels are the highest they have been in the last 800,000 years. Because of this, global temperature has risen more since 1970 than any other 50-year period over the last 2,000 years (IPCC, 2021).

Warmer temperatures are expected to drive changes in the distribution of natural vegetation, and climate model simulations have predicted that there could be equivalent change in the next 200 to 500 years as there was in the previous 7,000 to 10,000 years. In the upper Midwest, the warmer temperatures will facilitate the encroachment of oaks into ecosystems that are now dominated by pine and spruce. Warmer temperatures will lead to drier sites with nutrient poor soils that will experience a higher frequency of fire, all of which will create a feedback loop that prevents succession and favors oak recruitment (Abrams, 1992). It is possible that along with increasing their frequency in the natural landscapes of the upper Midwest, oaks and other hardwoods

will increase their range 500km to the north (Overpeck et al., 1991).

In addition to rising seasonal temperatures, Michigan is also predicted to experience a 5-10% increase in average annual precipitation (Kim et al., 2016). This will increase the frequency and severity of weather events and negatively impact the migration and reproductive cycles of numerous avian species that require stable conditions for food or breeding habitat. It will also disrupt the timing of the life cycles of many species which are interdependent, and together contribute to the resilience of their ecosystems (U.S. Environmental Protection Agency, 2016).

Another noticeable effect of rising global temperatures is a shift in the spring and fall migrations of many North American bird species. Warmer winters have catalyzed changes in the phenology of primary producers, which can cause trophic mismatches for many organisms that are dependent on multiple, specifically timed nutrient pulses throughout the year. In response, the timing of spring and fall migrations of many species has advanced, as they arrive early to access vital food sources and delay their return south due to warmer weather late in the season (Horton et al., 2020). For instance, migratory birds such as the sandhill crane are arriving earlier to the Midwest than 40 years ago (U.S. Environmental Protection Agency, 2016).

This change in timing can disrupt complex relationships in ecosystems when species react to warming at different rates. A migratory species may show up too early for its main food source to have sufficiently fruited and may not be able to find enough to eat. Because shifts in the phenology of flowering plants affects the timing of their nutrient pulses, the bulk of non-migratory fauna are affected as well. The widespread consequences of these changes on the interactions of flora and fauna have yet to be clarified, however it is certain that warming trends in global temperature are responsible for an increase in the frequency and severity of climate extremes, and that this will negatively impact ecosystem function (Butt et al., 2015).

Climate change caused by anthropogenic activity may also be responsible for recent evolutions in the morphology of many migrating bird species. It is understood that phenological changes of primary producers directly affect the seasonal nutritional and habitat needs of migrating species, and it has been observed that

that many of these species have experienced body size decline over the past several decades. Therefore, it has been suggested that changes in body size are the result of the increase in global temperature. However, recent studies have determined that phenological shifts are not directly related to shifts in the morphology of

birds. These findings produce more questions than answers, as widespread phenological and morphological changes continue to occur, and more research is necessary to determine what other factors are involved in the regulation of these traits (Zimova et al., 2021).

CONDITIONS AT BAKER SANCTUARY

Landcover

The National Land Cover Database (NLCD) shows, at a 30-meter spatial resolution, the surrounding land cover. The most abundant land cover around the sanctuary appears to be cultivated crops and woody wetlands. Inside the sanctuary, woody wetlands dominate the land cover present.

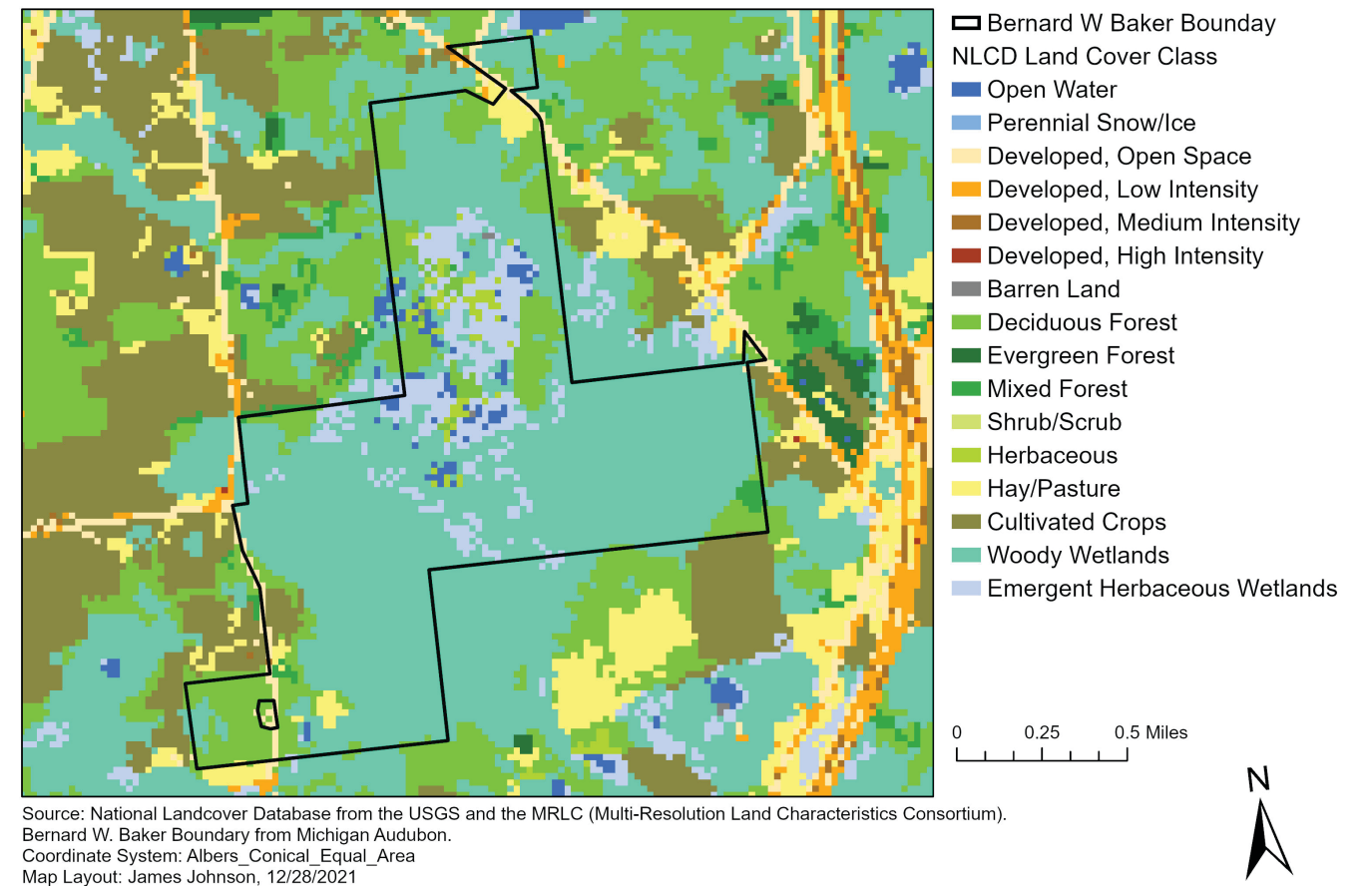


FIGURE 1.5 NLCD LAND COVER OF AND AROUND BERNARD W. BAKER SANCTUARY