

THE UNIVERSITY OF MICHIGAN
Biological Station

*Observations on the Winter Ecology
of Red Fox (Vulpes fulva)
on South Manitou Island, Michigan*

Technical Report No. 3

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and
JOHN E. GANNON

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INTRODUCTION

Gull Point, located on the northeast side of South Manitou Island in Lake Michigan, has served as an important nesting site for both Ring-billed Gulls (*Larus delawarensis*) and Herring Gulls (*L. argentatus*) for the past three decades. The Ring-billed Gull population increased from 4 immatures in 1940 (Hatt et. al 1948) to 5,175 pairs in 1975 (Southern 1976). Most of this increase probably has occurred since the early 1960's when this species experienced a population explosion in the Great Lakes (Ludwig 1966). In contrast, the Herring Gull colony, which included 1,500 nests in 1959 (Vent 1973), declined to 474 pairs in 1975 (Southern 1976).

Studies of the gull colony (Scharf 1970; Southern 1976 and personal communication) provided data on annual population density, hatching rates, and chick mortality. In the early 1970's it became evident that chick mortality was increasing. Temporary measures were taken to prevent disturbance of the colony, by blocking it off and restricting access. However, chick mortality for the 1975 nesting season was estimated at 92% (Southern 1976). The primary cause appeared to be predation by red fox (*Vulpes fulva*), based on evidence of

raids on the colony and actual kills (Southern 1976).

During the course of these gull studies, South Manitou Island was incorporated into the Sleeping Bear Dunes National Lakeshore, under the protection of the National Park Service. The Park Service initiated this study to determine the present status of red fox on the island. Objectives of the study were to estimate the size of the fox population, determine food habits, range and movement, and assess the ecological interrelationship between the fox and other organisms on the island, with emphasis on fox-gull interaction. This investigation was conducted during winter and was designed to augment observations on fox-gull interactions made during spring and summer by Southern (1976).

REVIEW OF PERTINENT LITERATURE

The red fox (*Vulpes fulva*) is the size of a small dog. Its average weight is 3.6 to 6.8 kg (8 to 15 lb.) and rarely exceeds 11 kg (25 lb.). Body length averages 56 to 64 cm (22 to 25 inches) and the tail is 36 to 41 cm (14 to 16 inches) long (Garlough 1945; Arnold 1956; Burt and Grossenheider 1964).

Activity and movement patterns of the fox fluctuate both diurnally and seasonally. Winter is the period of greatest movement. Daytime activity during winter is also greater than at other seasons. Arnold (1956) reported that a fox travels about five miles in an average winter night.

Seasonal movements were found to be directly affected by weather and climate (Ables 1969). Activity patterns are also markedly affected by prey population size and availability (Storm 1965). Home range size varies but usually averages 2.6 to 5.2 km² (1 to 2 square miles) (Burt and Grossenheider 1964).

Fox families remain more or less united, living within a mile or less of the natal den until late September or October. The male pups leave home first, and move up to 24 km (15 miles) away. However, one adult male traveled 36.8 km (23 miles) in 11 days (Sheldon 1950). The female pups also disperse widely, but not as far as the males. Average adult female dispersal was 3.2 km (2 miles). It appears that adult females establish the home range and the males are "residents." Hines (1953) suggested that females may wander widely during January and February in response to initiation of the oestrus cycle and may continue if unmated.

The breeding season of the red fox usually begins in December with January and February as the peak period. However, variations have been reported (Hines 1953). Gestation is normally 50-51 days with most young being born in March or April. Normally fox have only one litter per year (Burt and Grossenheider 1964). Hines (1953) reported that in Wisconsin, an average pair of red foxes produced 5.1 young per year. Arnold (1956) also reported this figure for Michigan.

Young are born in a den. Dens are most often found on east, south, and southeast hillsides, usually located two-thirds of the way up the slope. Dens can be found in many different habitats (Hines 1953). Sheldon (1950) found that some of the largest and most used dens in New York were in woods near open fields. Fox dens are located underground and dry, well-drained sites are preferred (Scott and Selko 1939).

Food of the red fox consists of insects, small mammals, carrion, berries and other fruits, and vegetation (Murie 1936; Hines 1953; Arnold 1956; Burt and Grossenheider 1964; Johnson 1970). Johnson (1970) stated that on Isle Royale the red fox also fed on the leftovers from moose kills made by wolves. Garbage piles are also sources of food items. Kruuk (1964) reported that gulls in all stages of development from eggs to adults were used as a food source.

When food is plentiful or the kill provides more than enough to sate the fox's appetite, the fox will cache the excess. On later occasions when food is scarce and hunting yields are inadequate, these caches are highly valued and utilized completely (Murie 1936).

Most of the above information has been obtained from mainland populations of red fox. Comparatively little is known of fox ecology on insular habitats. However, gull colonies on islands are known to be particularly vulnerable to mammalian predation, especially by foxes and raccoons (Pimlott 1952; Ludwig 1962; Kruuk 1964; Bergman 1966; Kadlec 1971).

DESCRIPTION OF THE STUDY AREA

South Manitou Island is located 9.6 km (6 miles) off the mainland from Glen Arbor, Michigan (fig. 1). It is one of two islands within the boundary of the Sleeping Bear Dunes National Lakeshore. The island is accessible by private boat or the Manitou Mail Service boat (based in Leland, Michigan).

The island encompasses 20.7 km² (8 square miles), with a total area of 1,812.9 ha (4,480 acres). Shoreline length is 20.8 km (13 miles) (National Park Service 1970).

South Manitou Island offers a varied habitat, from sandy beaches and active sand dunes with juniper to hardwood forests on the captured dunes and higher central and western portions of the island (fig. 2). A conifer forest on the eastern half of the island consists of arbor vitae, balsam and jack pine. Cleared lands, mainly reverted to meadow with bramble and sumac, as well as an old apple orchard,

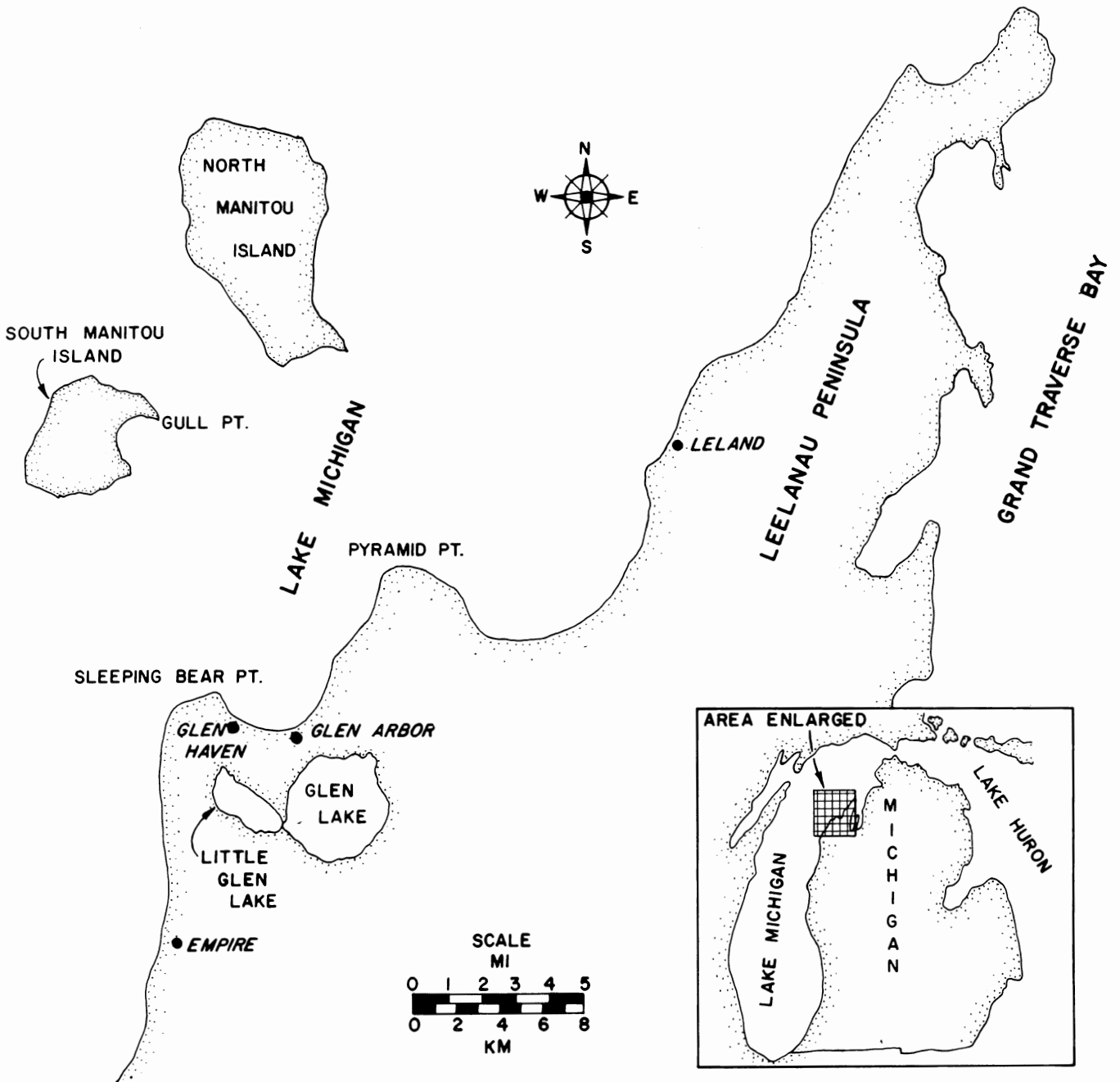
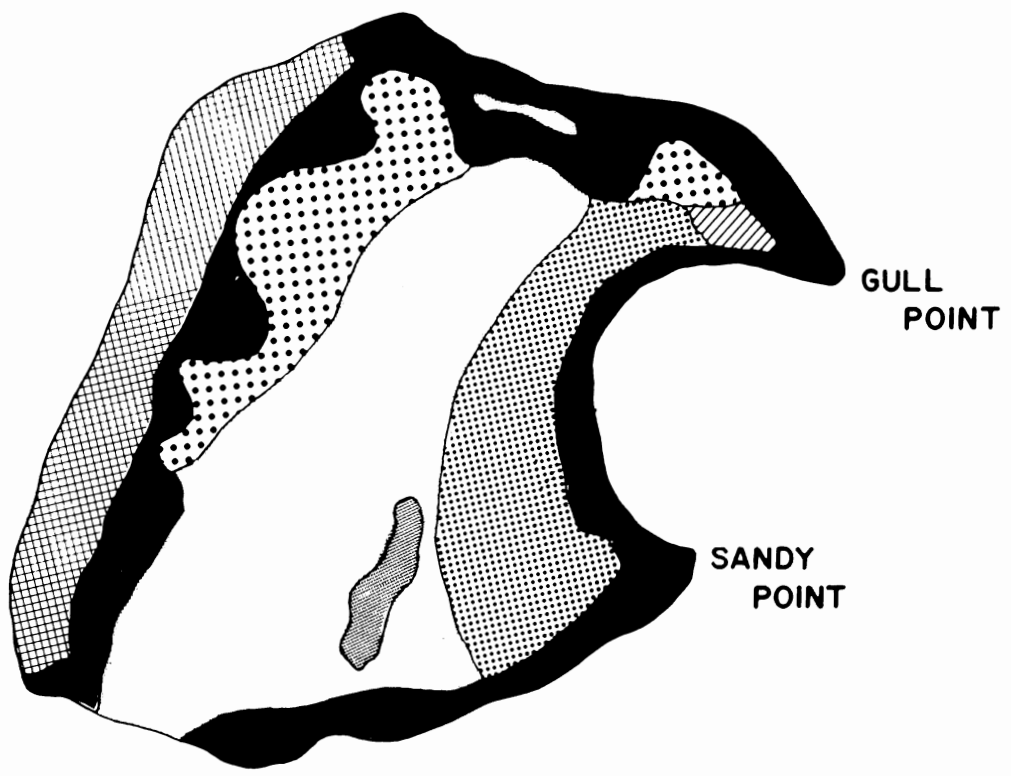
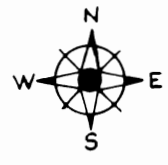


Fig. 1. Location of the study area, South Manitou Island, in northern Lake Michigan (45° N., 86° W.).

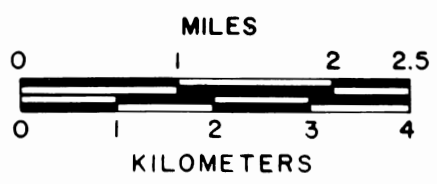
LAKE MICHIGAN



VEGETATION MAP OF SOUTH MANITOU ISLAND

SCALE

LEGEND



- STABILIZED DUNE
- BEACH & ACTIVE DUNE
- MORAINAL BLUFF & PLATEAU
- MAPLE - BEECH
- PINE - OAK - ASPEN
- HEATH
- FLORENCE LAKE

Fig. 2. Major vegetation zones on South Manitou Island (Redrawn from National Park Service 1970).

occur in the central portion. Island vegetation also includes a cattail marsh and sedge growth on the shores of the only inland lake on the island, Florence Lake.

Four cottages are located on this inland lake (one on the west and three on the east side). Other buildings on the island include old farmhouses, barns and outbuildings, some livable and others beyond repair. The major concentration of dwellings is on the eastern shore of the island, on the only harbor. Several summer cottages, the park ranger's quarters, a small store and marina are located here. There have been no year-round residents since 1974.

Gull Point, the location of the gull colony, is situated at the northeastern tip of the island and just across the bay from the heaviest concentration of buildings.

METHODS

Limited funds permitted only one field trip. Late winter was selected to take advantage of snow cover which would aid in tracking both fox and prey species. Prior to the field investigation, the study team made an aerial survey of the island (on 26 February 1976) by private plane to determine areas of the island most frequently preferred by fox and prey species. Greatest activity was evident in the northern half of the island.

The field study was conducted the first week in March (1-5 March 1976). The study team remained on the island during this period. A systematic ground search was completed with the aid of compasses and a map of the island marked off with a 1/4-mile grid system. This method is most feasible for searching large areas (Scott and Selko 1939).

The search was concentrated most heavily in the northern portion of the island and the gull colony location, since the aerial survey had shown that this was the area of greatest fox activity. The remainder of the island was searched less extensively.

Standard tracking procedures were followed to determine possible den sites, hunting areas, cache and kill sites, and general range and movement. All study team members took field notes for later comparison and analysis.

Fox scat samples were collected and placed in plastic bags for later analysis in the laboratory to determine food sources.

RESULTS AND DISCUSSION

Our investigation revealed that red fox travelled throughout the island during the winter. Occasionally tracks were followed almost the full length of the island. Most heavily used areas included the pine-oak-aspen forests, the beach

and active dunes, and the heath and juniper habitat (fig. 2).

The fox hunted rabbits and other prey species in the pine-oak-aspen habitat, where most rabbit activity occurred. Fox travelled the ridges and made the kills in the valley. Two cottontail rabbit (*Sylvilagus floridanus*) kill sites were recorded in this area, within 100 meters of each other. At one site, the rabbit had been partially consumed after the kill, but at the other site the rabbit had evidently been carried away. No snowshoe hare (*Lepus americanus*) kill sites were observed.

Evidence of cache sites and collection of floating and beached carrion for food was observed in the beach and active dune area. The shore was littered with dead alewives (*Alosa pseudoharengus*) and they were observed floating in on the waves for quite a distance from shore. A 200-m section of beach with a heavy concentration of dead alewives was thoroughly examined. It was evident that fox had been consuming the alewives on the shore. The bodies had been eaten but the heads remained.

Fox tracks led from the beach to the dunes, where 10 to 12 cache sites were discovered. They were always located in or near the juniper bushes. The fish were cached in the bottom of a hole made in the snow, and covered with 8 to 10 cm (3 to 4 inches) of snow. Each cache had one or

two fish. They were strongly fox-scented, probably from being urinated upon. The fox tracks in this area indicated that at least two individuals were hunting together or one followed the other very closely.

In the heath and juniper, fox had bedded down and had used the high ground for observation points. Most of these observation sites provided a clear view of the gull colony. Gulls were already congregating in the colony area. Evidence was found within the nesting areas that fox had been stalking the gulls. No actual kill sites were found, but large blood spots in the colony area indicated that predation on gulls may have occurred. However, there was no firm evidence that gulls were being used as a food source at that time. Shafts of small feathers were found in 12% of the scat samples (Table 1). However, it was not possible to identify them to species or family.

Tracks and holes around all the apple trees in the orchard provided obvious evidence that fox were digging up and eating apples. This was later confirmed by scat analysis (Table 1). Apple cores and seeds were the most frequent food item, occurring in 68% of the scat samples (Table 1).

There was very little evidence of rodent activity on the island and only one sighting. The deer mouse (*Peromyscus maniculatus gracilis*) is the only mouse species found

Table 1. Frequency of occurrence (in percent) of food items in 16 red fox scat samples collected on South Manitou Island.

<u>Food Item</u>	<u>Occurrence %</u>
Apples	68
Bird feathers	37
Mammal hair	31
<i>Peromyscus</i> bones	12
Sand-cherry pits	12
Insect remains	12
Fish bones	6

there (Hatt et al. 1948; Scharf 1973). Apparently they were too scarce to provide a dependable food source for the fox, since few rodent remains were found in the scat samples (Table 1).

Red fox were observed during the day near Florence Lake, near the top of the sand dunes at the north end of the island, and in the old apple orchard. Several foxes were heard at night, and at least three individuals were heard at the same time, barking from three different locations. Although it was not possible to determine actual size of individuals, comparison of tracks revealed a definite variation in size. One runt individual, about one-half the size of a normal adult, was observed at close range near the apple orchard.

Based on food availability, island size, audible and visible signs of activity, and actual sightings, the fox population was estimated at five to seven individuals. This would indicate a relatively high population density in relation to island size and available food sources.

Following our investigation, Southern (1976) reported that populations of both Herring Gulls and Ring-billed Gulls declined to 309 and 3,935 pairs, respectively during summer, 1976. Juvenile mortality was even higher (>99%) in 1976 than in 1975 (92%). A fox deterrent program was initiated but experienced little success. One female of average size was shot by the ornithological team.

Fox-gull interaction on South Manitou Island is influenced by several factors. Availability of prey species other than gulls was apparently low in 1975-76. We observed little evidence of small mammal activity on the island. Scharf (1973) indicated that extreme population fluctuations are common for preferred prey species, such as rabbits and mice.

The habitat in the northern portion of the island, especially in the vicinity of Gull Point, appears to be most favorable for fox and its prey species. Red fox prefers a dry, well-drained den, and such den sites are usually found where slopes are 5 to 10% or more (Scott and Selko 1939). Most ridges and dunes in the northern portion of the island exhibit these requirements. The most preferable habitat for rabbits is also found in the northern portion of the island.

The proximity of the gull colony to most favorable denning and hunting areas may explain the frequent presence of fox in the colony. The large concentration of gulls in the colony offers an obvious attraction as an alternate food source when populations of other prey species are low. It is also possible that adult fox take immature pups into the colony from nearby dens to provide them with hunting experience.

The fact that fox have been killing gulls during their nesting season cannot be dismissed, but the primary reason may be accessibility by a few fox rather than predation by a large number of fox as indicated by Southern (1976). He estimated that three or four family groups occurred on the island. Considering normal home range, the island should not be able to support more than four to eight individuals. The low number of actual sightings of fox by Park Service personnel, researchers, and others also indicates a rather small number of individuals. Furthermore, efforts to hunt and trap fox have met with little success, also indicating a low population size.

MANAGEMENT IMPLICATIONS

The fox population on South Manitou Island has undoubtedly experienced extreme fluctuations since its initial appearance on the island and has probably become non-existent at times. Access of fox to the island is limited to especially cold and prolonged winters when an ice bridge forms between the island and the mainland. Such ice bridges have been infrequent during recent decades. Likewise, the gull colony has probably established itself on Gull Point, flourished for a time, and then abandoned this nesting site many times over the past centuries.

Since the National Park Service wishes to manage South Manitou Island as a wilderness area, it appears logical to allow both fox and gull populations to wax and wane without human intervention. On the other hand, Park Service personnel may wish to institute a gull management program when broader aspects of gull ecology in the Lake Michigan basin are considered.

Herring and Ring-billed Gull populations have been threatened by many human disturbances in Lake Michigan, especially destruction of nesting habitat and insecticide pollution. Gull Point on South Manitou Island represents one of the few remaining nesting sites for gulls in Lake Michigan. Therefore, a management program to protect the gull colony through eradication of foxes on the island may be worthy of serious consideration. In essence, the fox population might be considered a more readily replaceable resource than the gull colony. If later reintroduction of fox on the island became desirable, this could be accomplished without serious difficulty. In contrast, if foxes cause abandonment of this nesting site, it may take many decades before a gull colony becomes reestablished there.

A different gull management problem occurred in recent years off the coast of Massachusetts. Reduction of the Herring Gull population was attempted to alleviate

gull-aircraft collision problems. Foxes and raccoons were introduced on islands that contained gull colonies but had no mammalian predators. These predator introductions caused major reductions in colony size and occasionally total abandonment of the site. However, the predators proved difficult to maintain on the islands (Kadlec 1971). This study is an indication of the vulnerability of gulls to mammalian predation during the nesting season. In addition, it reveals that many islands are probably marginal habitats for mammalian predators.

On South Manitou Island, the sighting of a runt individual indicates that the fox population there is existing under stressful conditions. Consequently, a management program to protect the gulls by eliminating the fox population on South Manitou Island may not be contrary to long-term natural ecological consequences on such an insular habitat.

SUMMARY AND CONCLUSIONS

The red fox population of South Manitou Island included approximately five to seven individuals in March 1976. Since no previous fox population records are available for the island, we cannot determine if this represents an increase or decrease in population density, although it appears fairly high in relation to island size. The population will naturally fluctuate in response to changes in food availability.

Winter food sources for red fox consisted primarily of apples, edible flotsam (mainly alewives), and rabbits, supplemented with mice and bird life. There was no clear evidence that gulls were used as a food source during March.

Range and movement of the red fox involved the entire island, but activities were most heavily concentrated in the northern portion. The proximity of hunting and denning areas to the gull colony makes fox-gull interaction inevitable.

Easy accessibility of the colony and its concentration of prey (gulls) is probably the main motivating factor for gull kills, rather than fox population size. Scat samples did not include any identifiable gull remains, which suggests that fox prefer or have easier access to other food items during winter.

If the National Park Service wishes to protect South Manitou Island as a wilderness area, both fox and gull populations should be permitted to determine their natural ecological balance without human intervention. However, if preservation of the gull colony is a more valuable goal, the Park Service may wish to institute a management program to eliminate the fox population on the island.

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