Prey Selection

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Prey Selection

Predation is a very complex set of behaviours, but to examine predatory behaviour one must first define what predatory means; according to Grier (1984) "predator comes from the latin praedari which means to take by force or to plunder. Other relative terms such as raptorial and carnivorous also have roots in words meaning "to seize" and "flesh-eating" respectively" (357). Predation, Grier also notes is not one consecutive behaviour but is made up of different components, and is greatly affected by rhythms, daily and yearly. Predation also is influenced by the presence of a mate, of offspring, the density of prey, and the competition by other predatory and scavenging organisms (p. 363).

Movement, Curio (1976) points out, from the slightest movement to complete loss of control, will induce vulnerability, and fright, flight, and distress also induce vulnerability because of physiological mechanisms (119-120).

One would assume that the most obvious effect of predation would be hunger, but because of the physiological aspects hunger will not be dealt with at this time, only to show that hunger is not the only deciding predatory behaviour.

Large carnivores show a consistency in killing methods. The work of Kruuk (1972), in observations of hyenas, Schaller (1972), in observations of lions, and Miller, Gunn, and Broughton (1985), in observations of wolves, have each shown a predator's tendency to surplus killing when prey density is optimal and vulnerable, such as the time of parturition. This surplus killing is not prompted by hunger as most of the carcasses are not fed upon by the predator. Thus, other mechanisms are present at the time of predatory behavior, and hunger is not the only deciding factor in triggering predatory behaviors.

Mech (1988) recounts an interaction between 7 wolves and a herd of 11 adult and 3 calf musk oxen in the High Arctic. The wolves were in the process of killing two calves, when one wolf left the kill and attacked another fleeing calf. If hunger was the only reason for the kill, the wolves should have enjoyed their feast rather than attacking the third fleeing animal, but perhaps the stimulus of a fleeing animal triggered the attack response. Miller, Gunn, and Broughton (1985) also reported surplus killing while examining the calving grounds of the Beverly caribou in the Northwest Territories. They found the carcasses of 34 caribou calves which had been killed within minutes of each other, within the previous 24 hours, and found that 17 of them had not been fed upon by the wolves. This case may also cause one to hypothesise that some other triggering mechanisms were the cause of the surplus killing rather than hunger alone.

Large carnivores are also more apt to prey upon those animals that are weak and sick (Mech p. 258). Mech states that a moose which stands its ground has a better chance of fending off an attack than if it runs. He further speculates that the non-running animal inhibits the wolves which may need this stimulus to follow through on the attack process. A moose which runs is almost always chased. The appropriate predatory behavior of the wolf may be affected by those cues that are displayed by the fleeing moose. They may be visual cues, auditory cues, or olfactory cues. The flight of the prey will elicit the chase which is usually a very short distance. (p. 201). Curio (1976) proposes that sick and wounded animals often show the same subtle cues that are found in old animals, and these cues may be the reason that sick, old, and injured animals are singled out for attack (pp. 130-131).

To examine predation one has to examine the evolutionary aspects of predatory behaviour and Krebs and Dawkins 1984 state that natural selection has favoured those behaviors that have successfully taken advantage of another animals signals, no matter how small, minute, exotic, or ritualistic. Manipulation of another organism has been evolutionary favored. Predators have been evolutionary successful due to their ability to read even the most subtle cues exhibited by their prey, which is what Krebs and Dawkins call "mind reading". The ability to read the subtle body messages may help the predator to single out and capture a prey, or to cancel an attack that may be too dangerous or non-beneficial to continue, thus, this ability would improve the predator's fitness. Krebs and Dawkins also point out that for a signal or cue to be informative to the receiver of the signal it must be somewhat surprising in order to have the message detected. It must be able to be differentiated from the background noise, and inform the receiver of a unique message (pp. 383-387). Such an effect is also found in humans.

Berlyne (1960), in examining primates and humans, found that novel stimuli are more likely to attract visual orienting movements than stimuli that have occurred in the recent past. Subjects were presented with two sets of pictures on a screen. One side of the screen showed pictures which were highly repetitive, while the other side showed pictures which were novel stimuli. Subjects spent more time fixating on the novel than the recurring stimuli. This experiment dealt with short term novelty and Berlyne states that "long term novelty may be most potent in eliciting fixations, when presented to an intermediate degree. (p. 98)". Paying attention to novelty is found in many different animals.

Kruuk (1972) has done an extensive indepth survey of hyena behaviors, and states that hyenas pay a great deal of attention to unusual behaviour of animals. At night a wildebeest which is disoriented by the lights of an automobile allows the hyenas an advantage when an attack is under way. One of the most significant of Kruuk's reports concerns wildebeests. He reports a significant observation of Lamprey (1960) who painted the horns of a number of wildebeests white. In the following months a extreme proportion of these wildebeests were killed (p. 154). The details of this report are by personal conversation, and not part of an empirical study. One might ask what mechanisms would contribute to this occurance.

The confusion effect states that animals aggregate together for the sake of safety in numbers, and "the confusion experienced by predators in singling out and tracking individual prey in a group" (Landeau & Terborgh, 1986, p. 1372). Landeau and Terborgh also state that the presence of a morphologically "odd" individual in the prey group may increase the success of a predator. Thus there is a surprise element which causes the predator to attend to the surprise stimulus.

Such an effect was found by Dunham (1977) who coloured the white chela patch on the diogenid hermit crab and found a significantly lower success rate in agonistic (fighting) behavior of the painted crab when confronted with another non-painted hermit crab. The natural selection had allowed for the white patch to serve some purpose in agonistic displays and the removal of the stimulus interfered with the natural process. The absence of the chela white may have served as a surprise element to the non-painted hermit crab which in turn was not influenced by other cues. The cue the white patch may have provided was absent and thus the non-painted crab did not read those cues and was more successful. One must ask then why this would happen? What was going on here? Is there a theory to help understand the mechanisms involved? Research has shown that yes there is and much of the work has been done was initiated by interest in the benefits of cryptic coloration.

One of the earliest experiments in survival of cryptic prey was done by Isely (1938) using different birds and insects. He found that those insects which did not blend into their backgrounds were more vulnerable to predation by the birds, in significant numbers. He concluded that those insects which were conspicuous were more prone to attack. Future work with cryptic prey made the same conclusions (Isely,(1947); Dice,(1947); and Sumner (1934), (1935)).

The first research in this area dealt with cryptic prey, and its effect on protection from predation. Much later Tinbergen (1960) investigated the predator prey relationship and it has been his theory of search image which has been in the fore for the past 20 years. Much of how organisms differentiate specific objects has been explained by Tinbergen's (1960) hypothesis of a strategy of "specific search image" (SSI), or "learning to see", which states that animals learn to prefer those foods that they have had experience in finding previously. Novel prey or food choices are rejected in favour of more familiar choices. The more experience with a certain food choice the more the animal will chose that choice. The existence of the search image concept is extremely controversial and has been widely investigated.

Guilford and Dawkins (1987) suggest that search image hypothesis is not totally valid and suggests that search rate has, in some cases, the same effect as a search image strategy. Search rate hypothesis predicts adjusting search rate for one cryptic prey will enhance the ability to detect other equally cryptic prey. This would be achieved by learning to spend a long time looking at a particular patch of the environment, and the more cryptic the prey the longer the time required to detect the prey. Though Guilford and Dawkins espouse the search rate hypothesis over the search image hypothesis, they also concede that there is a problem in totally proving their ideas as internal physiological mechanisms are at work that cannot be totally measured. They also concede that both may work together, sequentially, or in different situations at different times. Grier (1984) and Curio also have problems with the concept of search image.

For some time the issue of prey selection centred around the three theories, search image, search rate, and conspicuousness, but when Mueller (1968) first examined the influences of search image, oddity, and conspicuousness with goshawks Accipiter gentilis and pigeons Columba livia. His conclusions at this time were inconclusive. In further experiments with six American kestrels (Falco sparverius), two broad-winged hawks (Bueteo platypterus) and prey of white laboratory mice (1972), and American kestrels and laboratory white mice (1972), he found that predators shown a preference for those prey which are different or odd rather than conspicuous.

Landeau and Terborgh (1986) in investigating oddity and the confusion effect in predation also conclude that oddity rather than prior experience, or conspicuousness resulted in "increased attack rate by nearly three-fold and the incidence of capture by nearly five-fold" (p. 1377). Two experiments were run using 6-8 large-mouth bass, and silvery minnows as prey, some dyed blue. Experiments were done in two environments making the minnows conspicuous or neutral. Results showed, as well as other conclusions, that in an exhibition of the concussion effect, odd prey more vulnerable without bias as to the colour of the prey, and odd prey increased the vulnerability of the total group, while decreasing its own vulnerability. Landeau and Terborgh speculate as to the adaptive value of mixed aggregations, and how this grouping can have selective advantage.

Thus some work has been done on some animals regarding predatory behaviour of odd and conspicuous prey, and as yet there does not seem to be a definite conclusion as to which aspect is most effectual. The door is open for more research, and for the future application of that research.

How would one apply this research? To do this one must go back to Lamprey's observation of the wildebeests with the painted horns. In attempting to understand why one would paint the horns of a wildebeest, only one explanation seems plausible. He was not looking for the effects of oddity or conspicuousness, but probably marked the animals to follow them, or to keep track of certain individuals or herds. This seemingly simple marking became an invasion resulting in the wildebeests' vulnerability. Researcher must be careful in the use of markings that might upset the animals' social interactions.

Such interference was found by Burley (1986) who found the different coloured bands placed on the legs of zebra finches

(Poephila guttata) interfered with the mating success of some of the birds. This seemingly innocuous marking resulted in upsetting the social interactions, and eventually the reproductive success of the "unattractive" individuals, which had nothing to do with the inherent factors relative to natural selection. Thus researchers must take extreme care in the type, color, and placement of markers on animals of all kinds.

Another implication for the determination of the oddity or conspicuousness research is the use of this information against those who object to the reintroduction of large carnivores into the depopulated areas that once were their range. If one could show that these large carnivores do not drastically reduced ungulate herds but rather cull out the sick, the old, and the injured animals, which resultes in a more balanced, and healthy herd, as well as a more balanced ecosysem, then perhaps there might be some concession to the reintroduction of large carnivours. One such example of this balanced is Isle Royal.

On Isle Royal 100 years ago there were no moose or wolf populations (Aber and Melillo, 1991). The island was a mixture of forest and wetland, perfect for the moose which became part of the island system about 80 years ago. The island was abundant in food and cover and devoid of the moose's main enemy; the wolf. The moose populations grew so enormously over the next 20 years that eventually the vegetative structure of the island was modified, which eventually resulted in a massive die-off of moose from starvation in 1933-37. Once the moose populations were lowered there was an increase of foliage again, and this resulted in a gradual increase in moose populations. As the moose populations increased the food supply decreased, and again another massive die-off in 1948-50. This boom and crash of moose population and vegetation became a pattern until between 1945-50 when wolves entered the area over the winter ice. The wolves stabilised the moose populations which again stabilised the vegetation boom and crash. The wolf system was kept in balance by the territoriality which soon emerged, with different packs of wolves claiming different territories on the island. The resulting confrontation between environment, moose, and wolf resulted in a strong ecosystem, a stronger moose population, and a home for the highly misunderstood wolf.

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The Effect of Oddity

on Frequency and Duration of Predatory Attending

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Running Head: Oddity

Abstract

Over the last 50 years four theories of predation have emerged which explain a predator's prey selection. Tinbergen (1960) proposed that search image is the dominant factor when novel cryptic prey is the goal. Others feel that conspicuousness, search rate, and oddity are important. The newest controversy to emerge is the oddity-conspicuousness debate. To investigate the influence of oddity on search rate, 1 cougar will be studied with and without an oddity stimulus (odd deer). It is expected that the cougar will spend more time watching the deer when it is "odd" than when it is not, and that predatory attending behaviours will increase with the presence of the odd stimulus.

The Effect of Oddity on Frequency and Duration of Predatory Attending

The North American continent's wildlife has been depopulated immensely, and many who are aware of the vital ecological balance in the environmental system wish to restore some of that balance by reintroducing large carnivores into some areas where they have been eliminated. One of the arguments against this proposal is the objection of some who feel that large carnivores such as bear, wolf, cougar, and others will decimate the existing herds of ungulates which these large carnivores prey upon. There are those like Mech (1981) who argue that the presence of large predators does not destroy existing herds, but culls out the sick, the hurt, and the old. This results in a better, stronger, herd, as well as a balanced ecosystem

One such example of this balance between predator, prey, and ecosystem is Isle Royal, where 100 years ago there were no moose or wolf populations (Aber and Melillo, 1991). The island was a mixture of forest and wetland, perfect for the moose which became part of the island system about 80 years ago. The island was abundant in food and cover and devoid of the moose's main enemy; the wolf. The moose populations grew so enormously over the next 20 years that eventually the vegetative structure of the island was modified, which eventually resulted in a massive die-off of moose from starvation in 1933-37. Once the moose populations were lowered there was an increase of foliage again, and resulted in a gradual increase in moose populations. As the moose populations increased the food supply decreased, and again another massive die-off in 1948-50. This boom and crash of moose population and vegetation became a pattern until between 1945-50 when wolves entered the area over the winter ice. The wolves stabilised the moose populations which again stabilised the vegetation boom and crash. The wolf system was kept in balance by the territoriality which soon emerged, with different packs of wolves claiming different territories on the island. The resulting confrontation between environment, moose, and wolf resulted in a strong ecosystem, a stronger moose population, and a home for the highly misunderstood wolf.

Predation is, in some cases, highly misunderstood. One would assume that the most obvious precipitates of predation would be hunger, but is not the only deciding factor in triggering predatory behaviour. Because of the physiological aspects, hunger will not be dealt with, except to show that this tendency to kill when hunger cannot be an issue can be found in the large carnivores' consistency of killing methods. Kruuk (1972), in dealing with hyenas and their prey, Schaller (1972), in dealing with lions and their prey, and Miller, Gunn, and Broughton (1985), in dealing with wolves and buffalo, each have demonstrated a tendency to surplus killing when prey density is optimal and vulnerable. This surplus killing is not prompted by hunger as most of the carcasses are not fed upon by the predator. Thus, other mechanisms are present for triggering predatory behaviour.

These mechanisms are directly related to the signals the predator recognises as evidence of vulnerability. Krebs and Dawkins (1986) examined the evolutionary aspects of signal manipulation of other organisms, and how evolution has favoured those behaviours which take advantage of this manipulation. They postulate that animals can predict another animals behaviour on the basis of sensitive cues. An animal would benefit by capturing the prey or by abolishing a chase when prey may be too dangerous to approach. This could be done the by reading of subtle cues. Mech (1984) also says much the same thing in his observations of wolf-moose interactions, and Kruuk (1972) notes that hyenas pay much attention to those animals who are different than the rest.

It is possible that these same cues, or signals, would be seen in different animals at different times. Curio (1976) proposes that sick and wounded animals often show the same subtle cues that are found in old animals, and these cues may be the reason that sick, old, and injured animals are singled out for attack: the cues are the same, and trigger the same behaviour in the predator.

Predation has been examined empirically for over fifty years, and early examiners of prey selection (Dice, 1947; Isley, 1938; and Sumner, 1934 and 1935) found that prey that was conspicuous (different than the background) was more prone to predation than those animals which were inconspicuous (not different than the background). The first research in this area dealt with cryptic prey, and its effect on protection from predation.

Much later Tinbergen (1960) investigated the predator prey relationship and it has been his theory of search image which has been in the fore for the past 20 years. Much of how organisms differentiate specific objects has been explained by Tinbergen's hypothesis of a strategy of "specific search image" (SSI), or "learning to see", which states that animals learn to prefer those foods that they have had experience in finding previously. Novel prey or food choices are rejected in favour of more familiar choices. The more experience with a certain food choice the more the animal will chose that choice. The existence of the search image concept is extremely controversial and has been widely investigated (Curio, Grier, Guilford and Dawkins, and Mueller).

Guilford and Dawkins (1987) suggest that search image hypothesis is not totally valid, and suggest that search rate has, in some cases, the same effect as a search image strategy. Search rate hypothesis predicts adjusting search rate for one cryptic prey will enhance the ability to detect other equally cryptic prey. Adjusting search rate for cryptic prey will be achieved by learning to spend a long time looking at a particular patch of the environment, and the more cryptic the prey the longer the time required to detect the prey. Though Guilford and Dawkins espouse the search rate hypothesis over the search image hypothesis they also concede that there is a problem in totally proving their ideas as internal physiological mechanisms are at work that cannot be totally measured. They also concede that both may work together, sequentially, or in different situations at different times. Grier (1984) and Curio (1976) also have problems with the concept of search image.

Preference in novel food choices, may also be generalized to human behaviour. Berlyne (1965) looked at the effect of novel stimuli, and how they are more likely to attract visual orienting movements than stimuli that have repeatedly occurred in the recent past in humans. People are shown two sets of pictures on a screen. One side showed repeated stimuli, and the other side had new stimuli. Subjects spent more time fixating on the novel stimuli rather than the recurring stimuli. One can only speculate on how one aspect of this choice of novel stimuli over more familiar stimuli is related to the prey selection of predators, but the mere presence of a new or surprising stimulus results in more attention being paid to that stimulus.

In Mueller's (1969) investigation of the contributions of predation he first concluded that conspicuousness was the deciding factor, but with subsequent investigations (1971, 1975) he concluded that oddity was more effective in predicting predatory success. This hypothesis is also further supported by Landau and Terborgh (1986). Conspicuousness is defined as a prey which is different from the background, while oddity is defined as a prey which is different from the rest.

In the research done so far the focus has been on various birds and insects (Isley, Dice), birds and mice (Dice, Mueller), fish (Landau and Terborgh, Sumner,), birds (Mueller), but very little has been done on large animals. Kruuk (1972) refers to an observation of Lamprey (1960) who painted the horns of a number of wildebeests in the Ngorongoro Conservation Area in Africa. These painted wildebeests were severely preyed upon, and within a short time most were dead due to predation. No other empirical study has been done on larger animals at this time. This project deals with the predatory stimulus mechanisms in a cougar (Felis concolor) and white tailed deer (Odocoileus virginianus).

Using this observation as a basis for experimentation a cougar and deer were used to test the effects of oddity on predation. It is expected that oddity will contribute to the amount of time a cougar spends attending to the "odd" deer, and those behaviors that are consistent with predatory attending will increase. Predatory attending behaviours include sitting and watching deer, laying watching deer, standing and watching deer, crouching watching deer, crouching to the ground watching deer, stalking deer, rushing deer, up on fence watching deer, and watching deer under fence. It is further hypothesized that other behaviours will decrease with an "odd" deer, walking, trotting, running, grooming, sitting and watching others, standing and watching others, laying watching others, crouching watching others, and crouching to the ground watching others.

Method

Subject

The predator was a four years old female cougar enclosed in a small zoo. Ritz, was born and raised in captivity, and has had her front paws de-clawed. She shares her enclosure with Saber, a four year old neutered male, that was also born and raised in captivity, who also has had his front paws de-clawed. The cougar enclosure (see Fig. 1) is 109.73 m and 104.85 m by 85.34 and 53.65 m and is completely self-contained within the deer enclosure. The cougar enclosure contains an elevated platform approximately 91.44 cm from the ground and a shelter 121.92 cm x 152.4 cm x 91.44 cm. The enclosure is surrounded on three sides by a metal barrier 91.44 cm high, thus the cougars can only see the deer if they take advantage of the elevated platform, sit upon the shelter, stand up against the fence, watch the deer under the fence, or if the deer pass by the fourth side not enclosed by the 91.44 cm high barrier. At all times deer are visible to the cougars from the elevated sites. Because of the cougars' histories neither has had experience as predator to live deer, but several birds and ducks have been preyed upon when they have ventured into the cougar enclosure. Only the female was observed because of her preference for the elevated platform area, and because she appears to be much more active than the male, thus making observations more predictable.

The deer herd consists of 17 white tailed deer (5 males, and 12 females of various ages most, of which were born in the zoo).

The stimulus deer is a 4 year old female deer, Suzie, which was orphaned in the wild and has been hand raised. Suzie was chosen because she is accustomed to being handled by humans, and was deemed to be cooperative for the painting procedure. Though slightly aloof, she is an accepted member of the herd, and appears not to be ostracized by the other members.

The "odd" deer will be the independent variable, and the frequency and duration of behaviours the dependent variables.

Material

A 52 item ethogram was been developed over the preceding months (available from the experimenter). The observer used a Superscope audio tape recorder, model number C-104, to keep a running commentary on the behaviours observed. To aid in determining exact times for each behaviour a Timex quartz triatholon wrist watch, with timer, was used to keep track of the one minute intervals.

Procedure

Before the experimental period a reliability study was conducted and resulted in a frequency reliability coefficient of .990 and a duration reliability coefficient of .999. All observations were recorded at a approximately 182 cm high vantage point, from the same spot each day. The experiment was conducted from December 21, 1990 to January 8, 1991, for 12 non-consecutive days. To be sure the time would include the cougars most active period and the deer's most active period the experiment was run in the morning from 8 to 12 with observations of 40 min.

The experimenter used an ABAB design: three days of baseline, three days of experimental paint procedure, three days of baseline, and three days of experimental paint procedure. During the baseline procedure the experimenter entered the deer enclosure and handled the deer much the same manner, and spent approximately the same amount of time with the deer as in the experimental paint procedure. Observations of frequency and duration were recorded following the handling. During the experimental session Suzie was painted with approximately 56.82 milligrams of white, nontoxic, water soluble paint (Ceramcoat E White BO-57) from the centre of her rump down the outside of each leg, consistent with the flow of the deer's bristles. White was used as it would make her odd in the herd, according to the definition, but would not make her conspicuous with the snow covered background. Observations were again recorded as to the time and type of behaviours observed. To assure the deer's cooperation during the paint procedure she was feed apples each day of the experiment.

After all traces of the paint were eradicated the procedure was repeated, so that there were six sessions of baseline and six sessions of stimulus.

Results

Of the nine predatory attending behaviors five were not observed (crouching watching deer, crouching to the ground watching deer, stalking deer, rushing deer, and watching deer under fence) The duration and the frequency of predatory behaviors should have increased, but the hypothesis that oddity would increase predatory attending was not supported, nor was there a decrease in other behavoiors. The experimental condition appeared to have little or no effect, and there was no consistency during the two conditions. One such example is of the target behavior STWD (Standing Watching Deer) which had a frequency of 1 - 4 during baseline, and a of 1 - 4 during the paint procedure: absolutely no difference. Each duration was .13 -.20 sec in baseline, and .13 -.96 sec: virtually no difference (see Figure 2).

After examining the data the assumption was made that the cougar's behaviour may be more subtle that frequency and duration might show, and a study of sequencing of behaviors was done to see if the cougar organized its time differently in the two conditions. This was done with the use of transitions matrices and chi square analysis. Results show there was a distinct pattern to the way the cougar organized its behavior x =7919.604 $\underline{p} < .001$, with one degree of freedom. Thought the sample size is quite small the measures are quite robust.

The differences in the two conditions are very subtle (see Fig 3). There are two clustering of behaviors which did occur: UOFWD (up on fence watching deer) and UOFWO (up on fence watching other) have a high probability of occurring together, but no probability of occurring after or before any other behavior in both conditions, while bodily function clustering SN, SC, and DEF (sniffing, scratching and defecation) in the two conditions was quite different. The target behaviors of LWD, SIWD, STWD, also show somewhat different patterns in the two conditions. They appear to be more clustered into activities than in the baseline condition with J (jump) being the preceding activity. This is quite logical when one realizes that most of the predatory attending behaviours could only occur after the cougar jumped up onto the elevated platform. The clustering also suggests more active predatory attending in the paint condition than the baseline, where the behaviors are more dispersed.

Discussion

Though the differences in frequency and duration were not found, the sequencing in behaviors do show a slight difference. Whether or not the difference is due to the paint condition is difficult to ascertain. There were many empty cells in the matrices which indicates that a longer study is in order than the 12 days of observation. A longer study may fill in many of the empty cells and more distinct patterns of behavior may emerge.

A longitudinal study may show the differences in frequency and duration which were originally expected. The major reason why duration and frequency differences were not found was perhaps the difference in the weather over the 12 days of the experiment which affected the cougar's and the deer's activity levels. The temperature ranged from +1 degrees centigrade on the first day to the lowest level of -22 degrees centigrade the sixth day. The average over the four conditions also varied considerably from a high of -4 degrees centigrade on the first paint condition to a low of -16.5 degrees centigrade over the last experimental and baseline condition (see Fig 4). The longer experimental period would more evenly distribute the temperature fluctuations and other variables which the weather affected across the conditions.

The amount of traffic in the park affect the behaviours of the cougar. People traffic was heavy to very light, and the presence of dogs, vehicles, birds, and even a helicopter tended to affect the cougar's behavior. The cougar's most dramatic responses was to small children, and it was to only these small children that the crouch and crouch to the ground behaviors were seen. This dramatic response to small children requires more investigation, as the same behaviors were not found in response to adults or larger sized children.

Another variable which affected the deer's activity level provided an unforseen confound. On the third day after observations the park staff placed evergreens in the small area of the deer enclosure. This provided shelter from the weather, and browse for the deer, This also provided a confound which the experiment had no control over. The deer tended to spend much of the time in the now protected area rather than range throughout the enclosure, which eventually limited the cougar's attention to them.

There appears to be a need for a longer experimental period than the 12 days as in this project. The longer time span would distribute the temperature fluctuations, and other variables which the weather affected, more evenly across the conditions. A seasonal project may also be in order, using different color paints for different seasons.

There is perhaps now also a need to intoduce the conspicuous variable and a comparison of odd and conspicuous stimuli. A longitudinal study over the four seasons, with different colours of paint to fit the season, and with the two conditions of consicouousnes and oddity may better answer the question of what is the real triggering mechanism for predatory behaviors.

But this could be only the beginning, as movement oddity and movement conspicuousness may be more predictive, and many feel that olfactory cues are perhaps the best predictor of predatory behaviors. A future study is quite possible and perhaps necessary to truly disseminate what the triggering mechanisms are.

One may also have too look for support of Guilford and Dawkins view that there may very well be several mechanisms at work, either individually or in tandem, to produce a behavior which is beneficial to the predator. How this might be done has not yet been decided, but does leave the issue open for future study.

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Figure 1

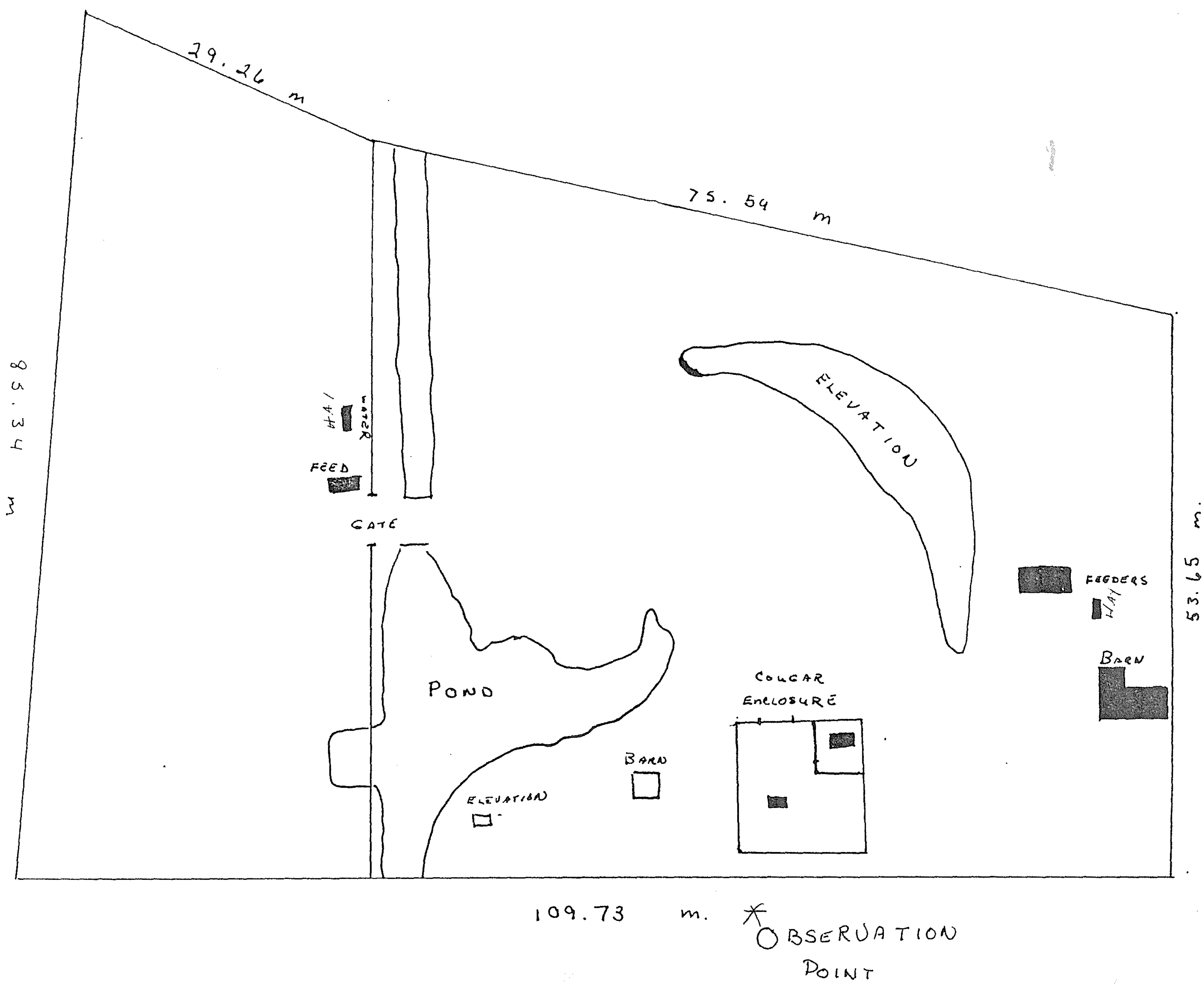
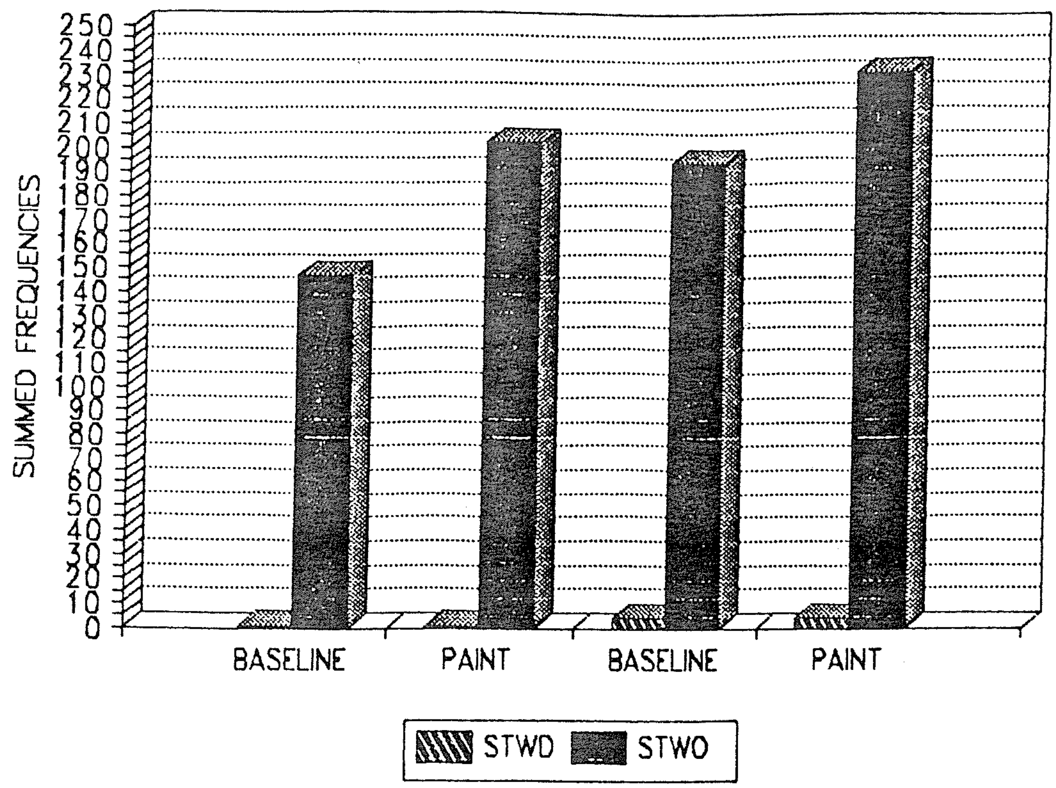

29.26 m
75.54 m
85.34 m
53.65 m
109.73 m.
ELEVATION
HAY
WATER
FEED
GATE
POND
FEEDERS
HAY
BARN
COUGAR
ENCLOSURE
BARN
ELEVATION
OBSERVATION
POINT

Figure 2

FREQUENCY



DURATION

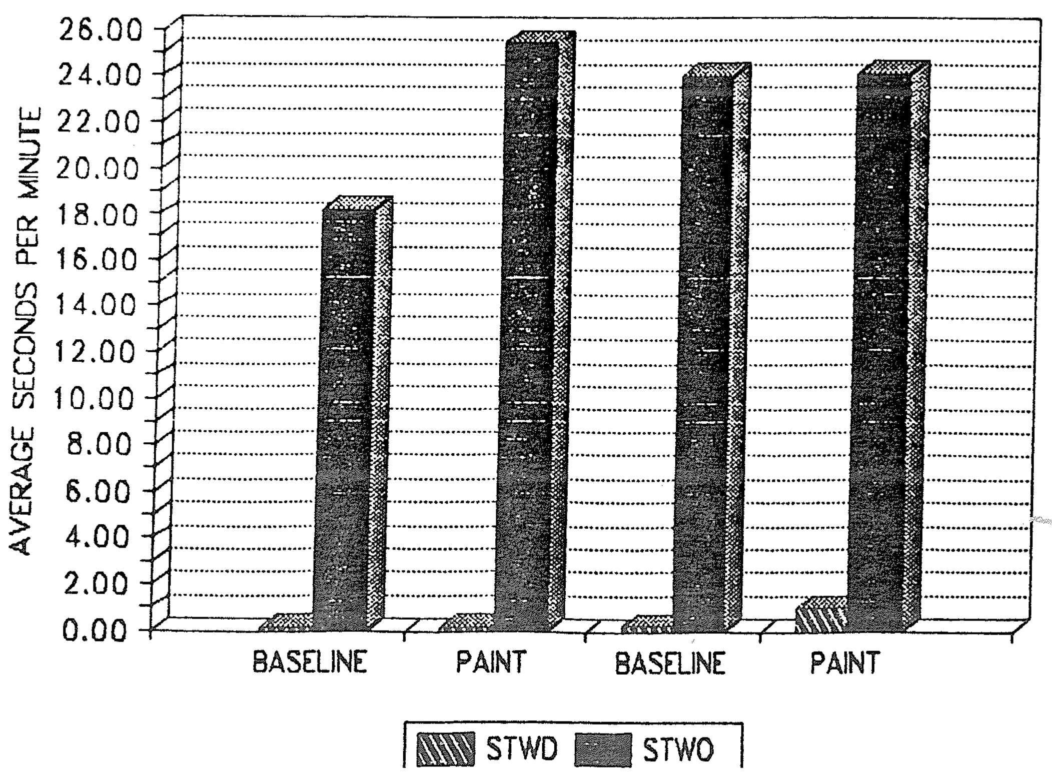
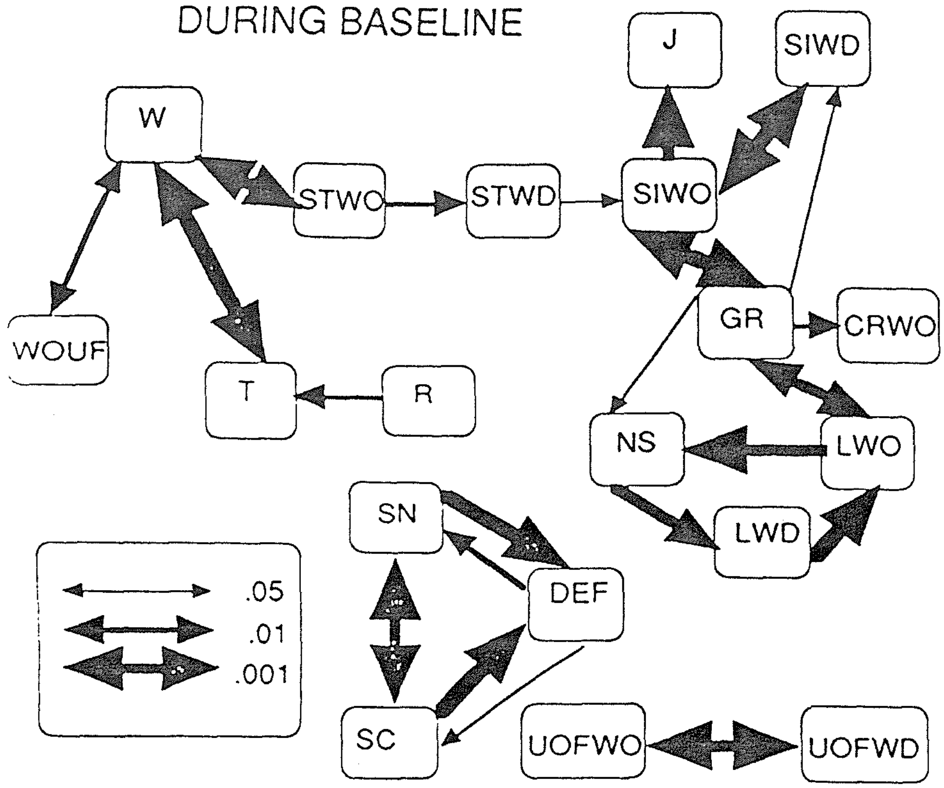


Figure 3

SEQUENCE OF BEHAVIORS DURING BASELINE



SEQUENCE OF BEHAVIORS DURING PAINT CONDITION

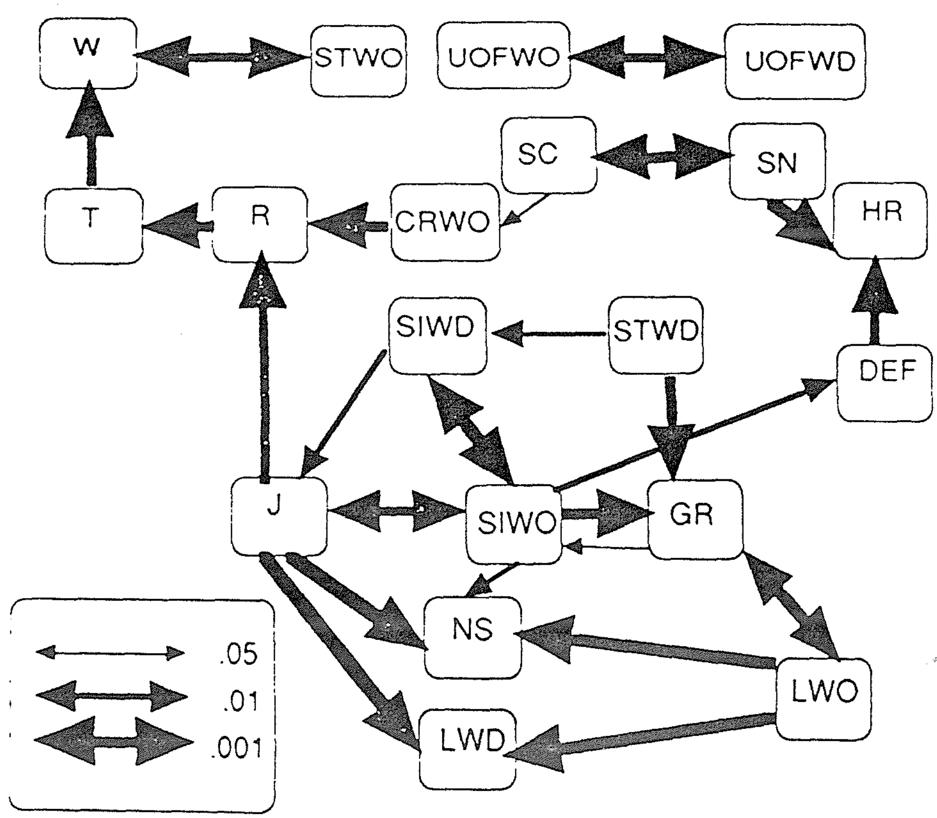
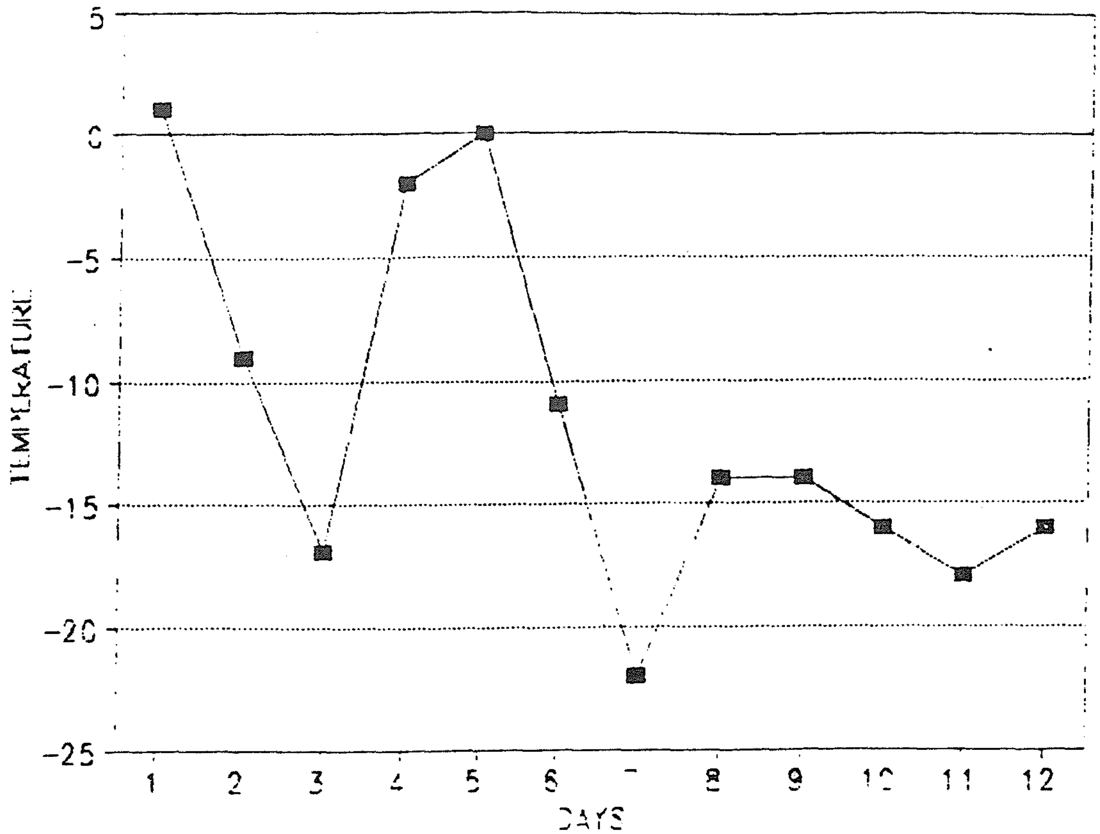


Figure 4

TEMPERATURE RANGE



TEMPERATURE RANGE