THE BIOLOGY AND MANAGEMENT OF WILD RUMINANTS

CHAPTER THREE

# SENSES, COMMUNICATIONS, AND THE USE OF SPACE

by

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# CHAPTER 3. SENSES, COMMUNICATIONS, AND THE USE OF SPACE

The abilities of animals to receive and interpret stimuli from their environment are prime determinants of the potentials for the animal's responses. It is obvious that animals which cannot see are unable to respond to visual stimuli, and the same can be said for other senses. Animals do not detect and respond in an "all or none" way however; sight and other sensory capabilities vary between individuals and change due to environmental factors.

A functional approach to the concept environment, discussed in Moen (1973), considers the environment as a complex of dynamic interactions, different from the habitat of an animal, which is a descriptive term for the place where a species is found. Thus deer habitat is the kind of a place where deer live. A deer's environment, however, includes the whole array of functional stimuli that may illicit a response by the animal.

Functional organism-environment relationships may be divided into four groups discussed in Moen (1973; 18). They are:

1. Stimulus does not reach organism. There is no functional relationship.

2. Stimulus reaches organism but is not detected. There is no functional relationship.

3. Stimulus reaches organism and is detected, but causes no response aside from detection. This relationship is of little importance to either the organism or the ecologist.

4. Stimulus reaches organism, is detected neurologically or physiologically, and organism responds to stimulus. This is the most important kind of relationship for the ecologist to consider.

There are important time dimensions to the organism-environment relationships, including those that are operational at a given moment, those that have been operational, called the historical environment, and those that could become operational, called the potential environment (Mason and Langenheim 1957 and Moen 1973; 21).

Operational environments are constantly changing, yet remain fairly stable unless some particularly important stimulus is detected. A bedded moose may hear the intermittent calls of blue jays, but pays little or no attention to them. Such stimuli are detected but do not cause a response; they are not really operational because they are filtered out. A pack of wolves, however, will alert the moose and possibly cause flight behavior. The operational effects are different due to the historical environment of the moose, which includes potential responses that could be both genetically determined and learned.

Historical environments, which consist of both genetically-determined and learned responses, determine what and how animals respond to operational stimuli. A newborn must rely on its genetically-determined historical environment, and the young of some wild ruminants do just that as they lie prostrate and remain motionless when approached. This hiding behavior is also accompanied by alarm bradycardia (Moen et al. 1978), which occurs even when members of their own species approach them. As experience is gained, learning occurs, individual deer are recognized, and the responses of the fawns to other deer are different. The fawn recognizes its mother, and may move toward her as she approaches. A fox, however, would be avoided rather than approached, especially after learning encounters had occurred.

Potential environments include all that animals can respond to when future environmental stimuli are received. The basic neurological senses of animals, plus their physiological sensitivity to environmental factors not detected neurologically, determine what components of their habitat become part of their functional environment.

It is important to recognize that environments are only partially defined by animals' senses. Those environmental influences that are not detected neurologically but do have physiological impacts can be very important parts of an animal's environment. Radioactivity, for example, is not detected by the senses, but it may cause genetic changes that become a part of the historical genetic environment, with significant potential effects on offspring.

Since functional environments are so dependent on the neurological and physiologial capabilities of animals to respond, it is unfortunate that so little is known about these capabilities in wild ruminants. The behavior of most wild ruminants has been described quite well, but there have been few experiments to test sensory perception and responses under different conditions.

CHAPTER THREE includes discussions and reference lists for the basic sensory capabilities of wild ruminants (TOPIC I), communications (TOPIC 2), and descriptions of their use of space (TOPIC 3).

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|---|---|---|---|---|---|---|---|
| aubo | dodo | nyny | 1220 | ---- | v 3, lives of game animals | seton,et | 1929 |
| aubo | ccth | spil | 250 | ---- | animal visi: what anim see | smythe,rh | 1961 |
| aubo | prha | ecnj | 171 | ---- | behavio aspects of ecology | klopfer,ph | 1962 |
| aubo | anth | nyny | 305 | ---- | the sense of animas & men | milne,l; milne,mj | 1962 |
| aubo | olbo | edsc | 653 | ---- | animal dispersion, soc beh | wynne-edwards,vc | 1962 |
| edbo | elpu | nyny | 933 | ---- | acoustic behavior of anima | busnel,rg, | 1963 |
| aubo | phli | nyny | 240 | ---- | the senses of animals | matthews,lh; knig | 1963 |
| edbo | acpr | nyny | 159 | ---- | natural hist of aggression | carthy,jd; ebling | 1964 |
| edbo | uchp | chil | 307 | ---- | soc behav, organiza, verte | etkin,w | 1964 |
| aubo | blai | nyny | 204 | ---- | animal communication | frings,h; frings, | 1964 |
| aubo | cnha | loen | 132 | ---- | vision in vertebrates | tansley,k | 1965 |
| aubo | meth | loen | 150 | ---- | soci behav, animals, verte | tinbergen,n | 1965 |
| aubo | macm | nyny | 113 | ---- | sensory mechanisms | case,j | 1966 |
| aubo | macm | nyny | 118 | ---- | integral animal behavior | davis,d | 1966 |
| aubo | jwis | nyny | 432 | ---- | pattern of animal communit | elton,cs | 1966 |
| aubo | mhbc | nyny | 534 | ---- | anim behav: ethol, com psy | hinde,ra | 1966 |
| aubo | jwis | nyny | 771 | ---- | mechanisms of animal behav | marler,p; hamilto | 1966 |
| aubo | prha | ecnj | 297 | ---- | introdu to animal behavior | klopfer,ph; hailm | 1967 |
| aubo | hill | loen | 760 | ---- | the chemical senses | moncrieff,rw | 1967 |
| aubo | thcr | nyny | 182 | ---- | communi in the animl world | evans,wf | 1968 |
| aubo | plpr | nyny | 418 | ---- | ethology of mammals | ewer,rf | 1968 |
| edbo | saco | phpa | 563 | ---- | abnormal behavior in anima | fox,mw | 1968 |
| aubo | epdu | nyny | 298 | ---- | the magic of the senses | droscher,vb | 1969 |
| aubo | tapl | nyny | 183 | ---- | animal senses | burton,r | 1970 |
| edbo | apcc | nyny | 412 | ---- | comm, chem sig: advan chem | johnston,jw,jr; / | 1970 |
| edbo | acpr | nyny | 336 | ---- | chemical ecology | simeone,jb; sondh | 1970 |
| aubo | uchp | chil | 349 | ---- | animal behavior | scott,jp | 1972 |
| aubo | whfr | sfca | 458 | ---- | wildlife ecology | moen,an | 1973 |
| edbo | dohr | stpa | 416 | ---- | territory | stokes,aw | 1974 |
| edbo | acpr | nyny | 344 | ---- | mamm olfact, reprod, behav | doty,rl | 1976 |
| edbo | wiwi | bama | 532 | ---- | the behav of domestic anim | hafez,ese | 1976 |
| edbo | plpc | nyny | 609 | ---- | chemical signals, vertebra | muller-schwarze,/ | 1977 |
| edbo | jwis | nyny | 364 | ---- | quantitative ethology | colgon,pw | 1978 |
| aubo | mhbc | nyny | 452 | ---- | comparative animl behavior | devisbury,da | 1978 |
| edbo | wiso | wadc | 206 | ---- | animal behavior | teague,rd,ed; moe | 1979 |
| edbo | acpr | nyny | 540 | ---- | biochemistry taste, olfctn | cagan,rh; kare,mr | 1980 |
| aubo | fost | nyny | 426 | cerv | antelope, deer, north amer | caton,jd | 1877 |
| edbo | stac | hapa | 668 | od-- | deer of north america | taylor,wp | 1956 |
| aubo | ucap | beca | 567 | odhe | a herd of mule deer | linsdale,jm; tomi | 1953 |
| edbo | unbp | line | 605 | odhe | mule, black-tailed, no ame | wallmo,oc | 1981 |

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|---|---|---|---|---|---|---|---|
| aubo | oxup | loen | 215 | ceel | herd, red dee, stud, behav | darling,ff | 1937 |
| aubo | cite | oxen | 74 | ceel | ecology of red deer | mitchell,b; stai/ | 1977 |
| edbo | wimi | wadc | .... | ceel | ecology,mngmnt, n amer elk | thomas,jw; towei in pr | |
| aubo | uwyp | lawy | 294 | ceel | n amer elk: ecol,behav,mgt | boyce,ms; hayden- | 1979 |
| aubo | stac | hapa | 238 | anam | prnghrn antlp & its mngmnt | einarsen,as | 1948 |
| aubo | stac | hapa | 225 | anam | hunting pronghorn antelope | popowski,b | 1959 |
| aubo | uopr | nook | 247 | ov-- | the great ark of the wild | clark,jl | 1964 |
| aubo | uchp | chil | 383 | ovca | mount sheep: behavi, evolu | geist,v | 1971 |
| aubo | qupr | oton | 166 | obmo | muskoxen,biol,taxon,canada | tener,js | 1965 |
| edbo | iucn | mosw | 940 | many | behav & its rela to mangmt | geist,v; walther, | 1974 |
| edbo | stac | hapa | 494 | many | big game, n amer, ecol,mgt | schmidt,jl; gilbe | 1978 |
| aubo | acpr | nyny | 202 | ungu | reproductive behav, ungula | fraser,af | 1968 |

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| ZOBEA | 12--2 | 219 | 250 | cerv | ethologi obsrvatns, n amer | geist,v | 1966 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
|---|---|---|---|---|---|---|---|
| MDCBA | 5---- | 1 | 64 | odvi | w-tailed deer of minnesota | erickson,ab; gunv | 1961 |
| MDCRA | 14--- | 1 | 80 | odvi | michigan white-tailed deer | jenkins,dh; bartl | 1959 |
| RWLBA | 6---2 | 153 | 325 | odvi | w-t deer of the adirondcks | townsend,mt; smit | 933 |
| RWLBA | 6---2 | 327 | 385 | odvi | wntr, spr obsrv, adirndcks | spiker,cj | 1933 |
| WCDBA | 14--- | 1 | 282 | odvi | white-tailed deer, wiscons | dahlberg,bl; guet | 1956 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
|---|---|---|---|---|---|---|---|
| AZWBA | 3---- | 1 | 109 | odhe | in arizona chaparral | swank,wg | 1958 |
| CAFGA | 26--2 | 139 | 166 | odhe | calif deer, rcky mt mule d | mclean,dd | 1940 |
| CFGGA | 8---- | 1 | 163 | odhe | life hist, managemt, calif | taber,rd; dasmann | 1958 |
| CGFPA | 4---- | 1 | 39 | odhe | lit review, mvmnts & captr | siglin,rj | 1965 |
| CGFPA | 7---- | 1 | 26 | odhe | literature review on behav | dorrance,mj | 1967 |
| JOMAA | 37--2 | 143 | 164 | odhe | behavior, populatn ecology | dasmann,rf; taber | 1956 |

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|---|---|---|---|---|---|---|---|
| UCPZA | 88--- | 1 | 209 | ceel | tule elk: hist, behav, eco | mccullough,dr | 1969 |
| WLMOA | 16--- | 1 | 49 | ceel | status, ecol, roosevel elk | harper,ja; harn/ | 1967 |
| WLMOA | 24--- | 1 | 66 | ceel | the sun river elk herd | knight,rr | 1970 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
|---|---|---|---|---|---|---|---|
| AMNAA | 52--2 | 392 | 399 | alal | observ in yellowstone park | mcmillan,jf | 1954 |
| BEHAA | 20--3 | 377 | 416 | alal | behavi in british columbia | geist,v | 1963 |
| FUNAA | 8.... | 40 | 43 | alal | moose habits and habitat | rush,wm | 1946 |
| JOMAA | 39--1 | 128 | 139 | alal | summr obsrvtns, behv,ontar | de vos,a | 1958 |
| MUZPA | 25--- | 1 | 44 | alal | the moose of isle royale | murie,a | 1934 |
| NCANA | 101-- | 1 | 436 | alal | ecol, proc inter sym, pt 1 | bedard,j | 1974 |
| NCANA | 101-- | 437 | 735 | alal | ecol, proc inter sym, pt 2 | bedard,j | 1974 |
| VLUBB | 22-15 | 74 | 82 | alal | [elk behav, leningr, russ] | timofeeva,ek | 1967 |
| ZOOLA | 41-14 | 105 | 118 | alal | ecol behav popula dynamics | denniston,rh | 1956 |

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|---|---|---|---|---|---|---|---|
| BPURD | 2---- | 1 | 215 | rata | ecol, caribou, prudhoe bay | white,rg; thomso/ | 1975 |
| CWRSB | 38--- | 1 | 71 | rata | biology, kaminuriak popula | dauphine,tc,jr | 1976 |
| UABPA | 3---- | 1 | 44 | rata | behav of barren-ground car | pruitt,wo | 1960 |
| UABPA | 8---- | 1 | 82 | rata | ecology, managment, sweden | skunke,f | 1969 |
| WMBAA | 10A-- | 1 | 79 | rata | prelim investigation, pt 1 | banfield,awf | 1954 |
| WMBAA | 10B-- | 1 | 112 | rata | prelim investigation, pt 2 | banfield,awf | 1954 |
| WMBAA | 12--- | 1 | 148 | rata | caribou, continued studies | kelsall,jp | 1957 |
| WMBAA | 15--- | 1 | 145 | rata | barrn gr carib, coop study | kelsall,jp | 1960 |

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|---|---|---|---|---|---|---|---|
| AMNAA | 43--2 | 257 | 354 | anam | life hist,ecol,rng use,tex | buechner,hk | 1947 |
| CAFGA | 30--4 | 221 | 241 | anam | prong-hornd antlp in calif | mclean,dd | 1944 |

anam continued on the next page

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|---|---|---|---|---|---|---|---|
| CGFPA | 3---- | 1 | 28 | anam | litera revi on prong behav | prenzlow,ej | 1965 |
| CGFPA | 17--- | 1 | 16 | anam | some behav patterns of the | prenzlow,ej; gil/ | 1968 |
| JOMAA | 3---- | 82 | 105 | anam | the prong-horn | skinner,mp | 1922 |

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| NPSMD | 161-- | 1 | 161 | bibi | bison, yellowston nat park | meagher,mm | 1973 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
|---|---|---|---|---|---|---|---|
| AMNAA | 24--3 | 505 | 580 | ov-- | distribut, variat, no amer | cowan,imct | 1940 |
| AZWBA | 1---- | 1 | 153 | ov-- | desert bighorn | russo,jp | 1956 |
| WLMOA | 4---- | 1 | 174 | ov-- | united sta, past to future | buechner,hk | 1960 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
|---|---|---|---|---|---|---|---|
| AMNAA | 56--2 | 297 | 324 | ovca | ecology of mountain sheep | mccann,lj | 1956 |
| CAFNA | 77--2 | 77 | 94 | ovca | behavior of a bighorn herd | blood,da | 1963 |
| CJZOA | 46--5 | 899 | 904 | ovca | ovda,delay soc, phys matur | geist,v | 1968 |
| IGWBA | 1---- | 1 | 154 | ovca | stat, life hist, mgt, idah | smith,dr | 1954 |
| JOMAA | 18--2 | 205 | 212 | ovca | prelim study, yllwstn n pk | mills,hb | 1937 |
| JOMAA | 20--4 | 440 | 455 | ovca | bighorn sheep of texas | davis,wb; taylor, | 1939 |
| JOMAA | 24--1 | 1 | 11 | ovca | notes on life histor, colo | spencer,cc | 1943 |
| SCBUB | 35--6 | 29 | 76 | ovca | survey, sierra nevada bigh | jones,fl | 1950 |
| WGFBA | 1---- | 1 | 127 | ovca | wyoming bighorn study | honess,rf; frost, | 1942 |
| WLMOA | 4---- | 1 | 174 | ovca | bighorn sheep in the u s | buechner,hk | 1960 |
| XNFSA | 6---- | 1 | 242 | ovca | bighorn of death valley | welles,re; welles | 1961 |

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| XNFSA | 5---- | 1 | 238 | ovda | the wolves of mt mckinley | murie,a | 1944 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
|---|---|---|---|---|---|---|---|
| WMBAA | 9---- | 1 | 34 | obmo | prelim stud,ellesmr is,nwt | tener,js | 1954 |

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|---|---|---|---|---|---|---|---|
| CAFNA | 81--1 | 1 | 22 | oram | obsrvtns,kootenay nt pk,bc | holroyd,jc | 1967 |
| CGFPA | 8---- | 1 | 23 | oram | literature review, ecology | hibbs,ld | 1966 |
| IGWBA | 2---- | 1 | 142 | oram | life history, mgtmt, idaho | brandborg,sm | 1955 |

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| SCZFA | 113-- | 660 | 668 | caca | [obs behav roe dee; germa] | eiberle,k | 1962 |
| ZEJAA | 8---2 | 61 | 81 | caca | behavior of roe bucks | hennig,r | 1962 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
|---|---|---|---|---|---|---|---|
| ZOGAA | 33... | 65 | 78 | momo | behav of moschus moschifer | fradich,h | 1966 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
|---|---|---|---|---|---|---|---|
| MRLTA | 41--3 | 34 | 40 | dogo | feral goats, british colum | geist,v | 1960 |

| CODEN | VO-NU | BEPA | ENPA | ANIM | KEY WORDS | AUTHORS | YEAR |
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| PZSLA | 142-1 | 129 | 163 | dosh | study, feral pop, st kilda | boyd,m; doney,jm/ | 1964 |

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| JTBIA | 2---1 | 63 | 68 | ---- | environments of anim, plan | browning,to | 1962 |
| QRBIA | 22--- | 283 | 314 | ---- | life tabls, natrl pop anim | deevey,es | 1947 |

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