

Introduction

WL 715—Wildlife Research Design

WHAT IS SCIENCE?

- DEFINITIONS OF SCIENCE

-
- 1. FROM LATIN *SCIENS*, MEANING KNOWING
-
- 2. RANDOM HOUSE: A BRANCH OF STUDY DEALING WITH A BODY OF FACTS OR TRUTHS SYSTEMATICALLY ARRANGED AND SHOWING THE OPERATION OF GENERAL LAWS.
-
- 3. OXFORD ENGLISH DICTIONARY: A BRANCH OF STUDY THAT IS CONCERNED WITH A CONNECTED BODY OF DEMONSTRATED TRUTHS OR WITH OBSERVED FACTS.
-
- 4. R. L. ACKOFF AUTHOR OF SCIENTIFIC METHOD: PROCEDURES FOR ANSWERING QUESTIONS, SOLVING PROBLEMS AND DEVELOPING MORE EFFECTIVE PROCEDURES FOR ANSWERING QUESTIONS AND SOLVING PROBLEMS.
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- 5. ROMESBURG: OBJECTIVE, LOGICAL, AND SYSTEMATIC METHODS OF ANALYSIS OF PHENOMENA, DEvised TO PERMIT THE ACCUMULATION OF RELIABLE KNOWLEDGE.

Types of Science

- Sound science? Peer-reviewed science?
- Seven types of science: Peter Macinnis
 - orthodox science or *sensu stricto* science—true science
 - interpretations placed on observations –use of an observation as evidence or support for an hypothesis
 - Fraud—making up results
 - fiddling science—testing half-formed ideas and hypotheses or basing conclusions on stats *a posteriori*
 - Speculation—creative science
 - Polemic –I'd be happy if this was so therefore, it is so
 - Pseudo science—description without hypotheses

WHAT IS THE “SCIENTIFIC METHOD”??

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- SCIENTIFIC METHOD: METHOD OF LOGICALLY APPROACHING A PROBLEM TO DETERMINE KNOWLEDGE OR FACTUAL INFORMATION THAT EXPLAINS PROPERTIES OF FUNCTIONS OF NATURAL SYSTEMS
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Scientific Method

- **1. YOU MUST ASK A QUESTION THAT IS WELL DEFINED, MEASURABLE, AND CONTROLLABLE.**
-
- WHY IS GRASS GREEN? WHAT IS THE CAUSE OF AIDS? WHY DOES SKIN WRINKLE WITH AGE?
-
- THE QUESTIONS THAT ARE ANSWERED BY SCIENTIFIC INVESTIGATION ARE BASED ON OBSERVATIONS AND INFORMATION GAINED THROUGH PREVIOUS RESEARCH OR KNOWLEDGE. ALL WE KNOW THAT BIOLOGY TODAY HAS RESULTED FROM THE COUNTLESS NUMBER OF SCIENTISTS WHO ASKED QUESTIONS.

Scientific Method

- **2. YOU MUST DEVELOP AN HYPOTHESIS, OR A POSSIBLE EXPLANATION TO ANSWER YOUR QUESTION.**
-
- **AN HYPOTHESIS IS A "TENTATIVE EXPLANATION" FOR WHAT WE OBSERVE.**

Scientific Method

- **3. YOU MUST SET UP AN EXPERIMENT TO TEST YOUR HYPOTHESIS.**
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- Experiment must have the ability to be reproduced.

Scientific Method

- **4. THE SCIENTIST APPLIES HIS/HER PRESENT KNOWLEDGE TO PREDICT THE EFFECT OF THE INDEPENDENT VARIABLE OR THE DEPENDENT VARIABLE.**
-
- THE PREDICTION IS A STATEMENT OF THE EXPECTED RESULTS OF THE EXPERIMENT BASED ON THE HYPOTHESIS. THE PREDICTION IS OFTEN AN "IF/THEN STATEMENT."
-
- FOR EXAMPLE: IF INCREASING FERTILIZER INCREASES NUMBER OF BEANS, THEN COFFEE BEAN PLANTS TREATED WITH MORE FERTILIZER WILL HAVE MORE BEANS.
-
- PREDICTIONS PROVIDE A REFERENCE POINT FOR THE SCIENTIST. IF PREDICTIONS ARE CONFIRMED, THE SCIENTIST HAS SUPPORTED THE HYPOTHESIS. IF THE PREDICTIONS ARE NOT SUPPORTED, THE HYPOTHESIS IS FALSIFIED. EITHER WAY, THE SCIENTIST HAS INCREASED KNOWLEDGE OF THE PROCESS BEING STUDIED.
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Scientific Method

- **5. PUBLICATION: ONCE SCIENTISTS ARRIVE AT CONCLUSIONS, THEY NEED TO COMMUNICATE THEIR FINDINGS TO OTHERS.**
- IN MOST CASES, SCIENTISTS REPORT THE RESULTS OF THEIR RESEARCH ACTIVITIES IN SCIENTIFIC JOURNALS IN A STANDARD SCIENTIFIC PAPER FORMAT.

Scientific Method

- A SCIENTIFIC PAPER USUALLY INCLUDES THE FOLLOWING PARTS: TITLE, ABSTRACT, INTRODUCTION, METHODS, DISCUSSION, CONCLUSION, AND REFERENCES. THIS PAPER IS WRITTEN FOR SUBMISSION TO A JOURNAL FOR PUBLICATION; OR, THE ABSTRACT ITSELF MAY BE SUBMITTED TO A SOCIETY/CLUB/ORGANIZATION FOR APPROVAL TO PRESENT DATA PERSONALLY TO PEERS/COLLEAGUES.

WHY DO WE NEED A SCIENTIFIC METHOD?

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- 1. CREDIBILITY OR PROFESSIONALISM
- DO WE AS WILDLIFE AND FISHERIES PROFESSIONALS RECEIVE THE SAME DEGREE OF PROFESSIONAL RESPECT AS PHYSICISTS AND PHYSIOLOGISTS?

WHY DO WE NEED A SCIENTIFIC METHOD?

- 2. RATE OF SCIENTIFIC PROGRESS DEPENDS UPON USING EFFICIENT METHODS
- USES AND MISUSES OF THE SCIENTIFIC METHOD HAVE COME UNDER SERIOUS YET CONSTRUCTIVE CRITICISM
-
- H.C. ROMESBURG JWM 45:293-312 "WILDLIFE SCIENCE: GAINING RELIABLE KNOWLEDGE"
-
- ROMESBURG'S PREMISE IS THAT WILDLIFE PROFESSIONALS FOR YEARS HAVE BEEN USING A SCIENTIFIC METHOD THAT HAS PRODUCES UNRELIABLE KNOWLEDGE
-
- ROMESBURG CLAIMS THAT WE ARE ABOUT TO COLLAPSE UNDER THE WEIGHT OF UNTESTED PROPOSITIONS

WHAT IS KNOWLEDGE?

-
- INFORMATION THAT IS FACTUAL OR TRUE (OR AT LEAST THOUGHT TO BE TRUE)
-
- SCIENTIFIC ADVANCE DEPENDS UPON BEING ABLE TO DISTINGUISH TRUTHS FROM UNTRUTHS
-
- DIFFICULT BECAUSE TRUTH IS OFTEN OBSCURED BY OPINION
-
- BY PREVIOUS EXPERIENCE (PRECEPTS, CONCEPTS, CONSTRUCTS)
-
- BY SUBJECTIVE INTERPRETATION
-

HOW DOES SCIENCE DIFFER FROM ART?

- WHAT IS ART?
-
- RANDOM HOUSE DICTIONARY OF THE ENGLISH LANGUAGE: THE QUALITY, PRODUCTION, OR EXPRESSION, ACCORDING TO AESTHETIC PRINCIPLES, OF WHAT IS BEAUTIFUL, APPEALING, OR OF MORE THAN ORDINARY SIGNIFICANCE
- OXFORD ENGLISH DICTIONARY
- A PURSUIT OR OCCUPATION IN WHICH SKILL IS DIRECTED TOWARD THE GRATIFICATION OF TASTE OR PRODUCTION OF WHAT IS BEAUTIFUL
-
- THE OBJECTIVE OF ART IS TO GIVE HUMANS PLEASANT FEELINGS
-
- METHODS ARE VARIED AND UNSTRUCTURED

ART VS. SCIENCE:

- SCIENCE DEALS WITH KNOWLEDGE: ART WITH FEELING
-
- IN ART: METHOD IS INDEPENDENT OF PERSON WHO USES IT.
-
- SCIENCE DEALS WITH UNDERSTANDING
- ART DEALS WITH AESTHETICS
-
- SCIENCE CAN BE ART INASMUCH AS UNDERSTANDING PRODUCES A SENSE OF AESTHETICS IN THE SCIENTIST--SERENDIPITY
-
- UNDERSTANDING CAN, UPON REFLECTION, PROMOTE DEEP FEELINGS OF CREATIVITY AND BEAUTY--ASK ANY SCIENTIST
-
- KNOWLEDGE: WHAT DO WE MEAN TO KNOW SOMETHING?

HOW DO WE ESTABLISH CORRESPONDENCE BETWEEN OPINIONS AND FACTS?

- 1. SELF EVIDENT: SYSTEM COMPLEXITY IS RELATED TO NUMBER OF SYSTEM COMPONENTS
-
- WHOLE IS GREATER THAN THE SUM OF ITS PARTS

Self-Evident Truths

- The American Declaration of Independence in 1787 held, in part: "We hold these truths to be self-evident, that all men are created equal, that they are endowed by their creator with certain unalienable rights, that among these are life, liberty, and the pursuit of happiness. That to secure these rights, governments are instituted among men, deriving their just powers from the consent of the governed, that whenever any form of government becomes destructive of these ends, it is the right of the people to alter or abolish it, and to institute new government, laying its foundations on such principles and organizing its powers in such form, as to them shall seem most likely to effect their safety and happiness."

HOW DO WE ESTABLISH THESE CORRESPONDENCES BETWEEN OPINIONS AND FACTS?

- 2. LOGICAL ARGUMENT
-
- IF THIS IS TRUE THEN THAT IS TRUE
-
- TWO TYPES OF LOGICAL REASONING
-
- **INDUCTIVE REASONING:** GENERALIZATIONS ARE ARRIVED AT BY INDIVIDUAL OBSERVATIONS
-
- EXAMPLE: SAMPLE SEVERAL ANIMALS FROM THE WATER
-
- OBSERVATIONS: DUCKS, SEALS HAVE WEBBED FEET
-
- INDUCTIVE GENERALIZATION: AQUATIC ANIMALS HAVE WEBBED FEET
-
-
- **DEDUCTIVE REASONING:** FROM GENERALIZATION TO SPECIFIC CASE
-
- IF AQUATIC ANIMALS HAVE WEBBED FEET THEN ANIMALS SELECTED FROM WATER WILL HAVE WEBBED FEET

HOW DO WE ESTABLISH THESE CORRESPONDENCES BETWEEN OPINIONS AND FACTS?

- 3. OBSERVATION OR EXPERIMENTATION
-
- 4. EXPERT OPINION (COURT OF LAW) (NOT SCIENCE)
-
- 5. MAJORITY OPINION (POLITICS, NOT SCIENCE)
-

CONCEPTUAL MODEL OF SCIENCE

- **CONCEPT:** THE MOST ELEMENTARY ORGANIZATION OF SENSE PERCEPTION
-
- **CONSTRUCT:** STRUCTURE OR SYSTEMATIC WAY OF EVALUATING CONCEPTS
-
- IMAGINE WHAT IS MEANT BY THE WORD SOFT WITHOUT USING THE WORD; THIS IMAGE IS THE CONCEPT
-
- IF WE SAY SOMETHING IS SOFT, WE KNOW ITS MEANING
-
- THE CONSTRUCT SOFT IS GIVEN BY AN OPERATIONAL DEFINITION
-
- IF ONE MATERIAL SCRATCHES ANOTHER, BUT NOT VISA VERSA THEN IT IS SOFTER

CONCEPTUAL MODEL OF SCIENCE

- | • CONCEPT | CONSTRUCT |
|----------------------------|------------------|
| • HABITAT DIVERSITY | ? |
| • SPECIES DIVERSITY | ? |
| • HABITAT SELECTION | ? |

CONCEPTUAL MODEL OF SCIENCE

- **THEORY:** DERIVED FROM CONSTRUCTS, RELATIONSHIPS AMONG CONCEPTS
-
- FROM OUR PERCEPTIONS WE FORM CONCEPTS
-
- FROM OUR CONCEPTS, WE FORM CONSTRUCTS TO PROVIDE A MEANS OF MAKING COMPARISONS
-
- FROM THESE CONSTRUCTS THAT ENABLE USE TO EVALUATE RELATIONSHIPS LINKING THE CONSTRUCTS, WE FORM BROAD GENERALIZATIONS, WHICH WE CALL LAWS, PRINCIPLES, AND THEORIES
-
- OUR THEORIES HELP US TO REVISE OLD CONCEPTS OR GUIDE THE FORMULATION OF NEW ONES--THE PROCESS IS CIRCULAR
-
- THESE THEORIES ARE THE CAPSTONE GUIDING SCIENTIFIC PROGRESS
-

CONCEPTUAL MODEL OF SCIENCE

- **THEORY**
-
- A. A COHERENT SET OF HYPOTHETICAL PRINCIPLES FORMING THE GENERAL FRAME OF REFERENCE FOR A FIELD OF INQUIRY
-
- B. ROMESBURG: A BROAD GENERAL CONJECTURE ABOUT A PROCESS
-
- EXAMPLE: LOTKA-VOLTERRA COMPETITION EQUATIONS REPRESENT A PROPOSITION OF HOW CHANGES IN CARRYING CAPACITY OF SPECIES WILL INFLUENCE SYSTEM STABILITY
-
- GOAL OF SCIENCE: DEVELOPMENT OF RELIABLE LAWS, PRINCIPLES, AND THEORIES
-

CONCEPTUAL MODEL OF SCIENCE

- **LAWS AND PRINCIPLES:**
-
- A. A GENERAL FUNDAMENTAL TRUTH
-
- B. A GENERALIZATION ACCEPTED AS TRUE OR BASIC
-
- FROM WEBSTER'S THIRD INTERNATIONAL DICTIONARY
-

METHODS OF SCIENCE

-
- THERE IS NO ONE WAY TO TRANSLATE FACTS INTO RELIABLE THEORY
-
- CONCEPTS-----FACTS
-
- CONSTRUCTS
-
- LAWS, PRINCIPLES
-
-
- INSTEAD THERE ARE SEVERAL METHODS EACH SUITED TO A DIFFERENT PURPOSE OR REQUIRED UNDER DIFFERENT CONSTRAINTS
-

METHODS OF SCIENCE

- 1. INDUCTION: METHOD OF OBTAINING KNOWLEDGE THROUGH INDUCTIVE REASONING
-
- INDUCTIVE REASONING: PROCESS WHEREBY GENERALIZATIONS ABOUT THE WHOLE ARE MADE FROM SPECIFIC OBSERVATIONS.

METHODS OF SCIENCE

- FRANCIS BACON'S INDUCTIVE LOGIC (ENGLISH PHILOSOPHER 1600)
-
- PERCEPTUAL EXPERIENCES
-
- UNORDERED FACTS
-
- DEFINITION, CLASSIFICATION, MEASUREMENT
-
- ORDERED FACTS
-
- INDUCTIVE GENERALIZATIONS
-
- LAWS AND THEORY CONSTRUCTION
-
- EXPLANATION (UNDERSTANDING)

INDUCTIVE LOGIC

- MAIN ACTIVITY OF WILDLIFE SCIENCE
-
- CONSIDER THE FOLLOWING EXAMPLES
-
- 1. SUPPOSE THAT WE SAMPLE SMALL GAME ABUNDANCE ALONG THE EDGE OF WOODLOT AND FIELD AND FIND ABUNDANCE SIGNIFICANTLY GREATER LONG THE EDGE. WE WOULD CONCLUDE THAT THERE IS AN ASSOCIATION
-
- REPEAT THE OBSERVATION SEVERAL TIMES WE MIGHT DECLARE A LAW OF ASSOCIATION

INDUCTIVE LOGIC

- USES: A. UNIFY MANY OBSERVATIONS
- B. ORGANIZE DATA
- C. ALLOWS US TO PREDICT WHAT WOULD HAPPEN IN OTHER SITUATIONS
-
- IMPORTANCE OF RANDOM SAMPLE TO ENSURE SAMPLING OF ENTIRE POPULATION
-
- STATISTICS COME IN HERE TO BRING OUT PATTERNS
-
- LIMITATIONS
-
- 1. DESCRIBE DATA ONLY
-
- 2. NO WAY TO INFER FROM INDUCTIVE REASONING (WHY)
-
- NO REAL SCIENTIFIC UNDERSTANDING IS ACHIEVED

METHODS OF SCIENCE

- RETRODUCTION: LOGICAL INFERENCE USED TO EXPLAIN GENERALIZATIONS OBTAINED THROUGH INDUCTION
-
- NEXT LOGICAL STEP FOLLOWING INDUCTION
-
- WE OBSERVE A PATTERN IN NATURE AND WE THEN POSE AN EXPLANATION
-
- THESE ARE REALLY NOTHING MORE THAN A HYPOTHESIS, BUT OFTEN THEY ARE TAKEN AS EXPLANATION
-

RETRODUCTION

- EXAMPLE: G. GULLION (MINNESOTA)
-
- OBSERVED FEWER SUCCESSFUL BROODS OF RUFFED GROUSE IN SPRUCE-ASPEN FOREST THAN IN OPEN ASPEN STAND
-
- CONCLUDED THAT ASPEN IS BETTER BROOD REARING HABITAT THAN SPRUCE
-
- LOGICAL
-
- HIGH MANAGEMENT SIGNIFICANCE
-
- CONCLUDED THAT LOW-GROWING BRANCHES OF SPRUCE PROVIDE COVER FOR PREDATORS AND THAT HIGHER VULNERABILITY OF BROODS TO PREDATION RESULTS IN HIGHER MORTALITY
-

RETRODUCTION

- RETRODUCTION IS THE METHOD OF CIRCUMSTANTIAL EVIDENCE IN COURTS
-
- IT IS NOT RELIABLE IN SCIENCE BECAUSE ALTERNATE HYPOTHESES CAN OFTEN BE GENERATED FROM SAME SET OF FACTS
-
- I.E., GREATER FOOD AVAILABILITY IN ASPEN
-
- MAY LEAD TO SPURIOUS MANAGEMENT
-
- PREDATOR CONTROL WOULD IMPROVE VALUE OF SPRUCE HABITAT IN ONE SITUATION, BUT NOT THE OTHER
-
- ROMESBURG'S GREATEST BEEF WAS NOT THAT WE USE RETRODUCTIVE LOGIC, BUT RATHER THAT HYPOTHESES SO GENERATED OFTEN BECOME ACCEPTED AS LAW.

RETRODUCTION

- ERRINGTON (1945) IN A STUDY OF PROCESSES REGULATING BOBWHITE SURVIVAL OVERWINTER FORMED THE VIEW USING INDUCTION AND RETRODUCTION THAT WINTER MORTALITY COULD BE GOVERNED BY A THRESHOLD OF THE HABITAT “SECURITY” THAT REMAINED APPROXIMATELY FROM YEAR TO YEAR
-
- IMPLIED THAT SPORT-HUNTING REMOVED SURPLUS
-
- IMPLIED NO STOCK-PILING OF GAME POSSIBLE
-
- NEVER TESTED
-
- CORNERSTONE OF GAME MANAGEMENT
-
- EXAMPLE OF UNRELIABLE KNOWLEDGE BECOMING AXIOMATIC IN WILDLIFE MANAGEMENT
-

HYPOTHETICO-DEDUCTIVE METHOD

- A. WHAT IS IT?
-
- EMPLOYS HYPOTHESIS TESTING AND DEDUCTIVE REASONING TO ARRIVE AT EXPLANATION.
-
- BEGINS WITH A BROAD IMAGE OF THE ORDER OF THE NATURAL WORLD
-
- REMEMBER INDUCTIVE PROCESSES USED DESCRIPTIVE RESEARCH TO ORDER PREVIOUSLY UNORDERED FACTS
-
- USES DEDUCTIVE PROCESSES TO DETERMINE CONSEQUENCES OF THIS BROAD IMAGE OF THE NATURAL WORLD
-
- DEDUCTIVE LOGIC: THE PROCESS OF REASONING FROM GENERAL PRINCIPLES TO SPECIFICS
-
- OPPOSITE OF INDUCTION
-
- GENERALLY , DEDUCTION MAY BE COINED IN IF THEN PROPOSITIONS
-
- IF GENERAL PROPOSITION IS TRUE, THEN A PARTICULAR SPECIFIC CONSEQUENCE

HYPOTHETICO-DEDUCTIVE METHOD

- EMPLOYS HYPOTHESIS TESTING AND DEDUCTIVE REASONING TO ARRIVE AT KNOWLEDGE
-
- STRONG INFERENCE (PLATT 1964)
-
- POPPERIAN MODEL OF SCIENCE (POPPER AND HARVEY 1969)

HYPOTHETICO-DEDUCTIVE MODEL

-
- SEVERAL PHILOSOPHERS HAVE DECREED THAT IT IS THE ONLY PURE MANNER OF ACCRUING SCIENTIFIC UNDERSTANDING
-
- PLATT, J.R. 1964. STRONG INFERENCE, SCIENCE 146:347-353
-
-
-
- POPPER, K. R. 1959. THE LOGIC OF SCIENTIFIC DISCOVERY, BASIC BOOKS, NEW YORK
-
-
- (POPPERIAN MODEL OF SCIENCE)
- PURISTS CLAIM THAT ANYTHING ELSE IS "PSEUDO-SCIENCE"

HYPOTHETICO-DEDUCTIVE METHOD

- PERCEPTUAL EXPERIENCES
-
- IMAGE OF REAL WORLD STRUCTURE
-
- MODEL (FORMAL REPRESENTATION OF THE IMAGE)
-
- HYPOTHESIS
-
- EXPERIMENTAL DESIGN
-
- DATA COLLECTION
-
- VERIFICATION PROCEDURES (STATISTICAL TESTS)
-
- LAWS AND THEORY
-
- EXPLANATION

HYPOTHETICO-DEDUCTIVE METHOD

- RUFFED GROUSE EXAMPLE
-
- DETERMINED FROM EMPIRICAL OBSERVATION THAT RUFFED GROUSE NUMBERS WERE HIGHER IN ASPEN THAN IN SPRUCE
-
- HYPOTHESIZED, BASED ON RETRODUCTION, THAT LOWER BRANCHES OF SPRUCE TREES PROVIDED CONCEALMENT COVER FOR PREDATORS
-
- MIGHT HYPOTHESIZE IF THIS IS TRUE THEN
-
- REMOVAL OF LOWER SPRUCE BRANCHES WOULD INCREASE GROUSE NUMBERS
-
- REMOVAL OF PREDATORS WOULD INCREASE GROUSE NUMBERS
-

IS H-D METHOD THE ONLY VALID APPROACH TO SCIENCE IN ECOLOGY?

- THE CASE FOR EXPLORATORY RESEARCH
-
- QUINN, J.F. AND A. E. DUNHAM 1983. ON HYPOTHESIS TESTING IN ECOLOGY AND EVOLUTION. AMERICAN NATURALIST
-
- 1. MULTIPLE CAUSES 'EXPLAIN' MANY IF NOT MOST ECOLOGICAL PROCESSES
-
- NOT POSSIBLE IN PRINCIPLE TO PERFORM EXPERIMENTS THAT DISPROVE FACTORS OPERATING SIMULTANEOUSLY
-
- 2. TREATING POSSIBLE CONTRIBUTING CAUSES AS DISTINGUISHABLE HYPOTHESES LEADS TO UNIVARIATE STATISTICAL TESTS. HOWEVER, THE BEHAVIOR OF MULTIVARIATE PROCESSES MAY NOT BE INFERRED FROM UNIVARIATE TESTS IF THERE ARE STRONG INTERACTIONS AMONG CONTRIBUTING CAUSES
-
-

MULTIPLE CAUSES

- THEORIES OF PLANT SUCCESSION:
-
- 1. FACILITATION: CLASSICAL VIEW OF SUCCESSION IN WHICH COLONIST ARE REQUIRED FOR ESTABLISHMENT OF LATER SPECIES (SOIL FORMATION, NITROGEN FIXATION)
-
- 2. INHIBITION: EARLY SPECIES INHIBIT THE ESTABLISHMENT OF LATER SPECIES
-
- TEST BETWEEN TWO THEORIES
-
- DO LATE-SUCCESSIONAL SPECIES ESTABLISH MORE RAPIDLY OR LESS RAPIDLY RELATIVE TO A CONTROL, IN PLOTS WHERE THE EARLY SPECIES HAVE BEEN REMOVED
-
- CASE A. IMAGINE CASE WHERE LOW DENSITIES FACILITATE, BUT HIGH DENSITIES INHIBIT
-
- TWO EXPERIMENTS COULD SHOW DIFFERENT RESPONSES
-
- CASE B. SOME EARLY COLONISTS (I.E., NITROGEN FIXERS) MAY FACILITATE WHEREAS OTHERS MAY INHIBIT
-

CONCLUSION:

- H-D INFERENCE IS A POWERFUL TOOL FOR REMOVING UNCERTAINTY FROM OUR UNDERSTANDING OF THE NATURAL WORLD
-
- A. ECOLOGY IS NOT ALWAYS BLESSED WITH CLEAR CUT MUTUALLY EXCLUSIVE HYPOTHESES FOR TESTING
-
- B. EXPLORATORY DATA ANALYSIS CAN HELP REFINE DEVELOPMENT OF EMPIRICAL MODELS THAT MAY BE USEFUL FOR MANAGEMENT
-
- C. BOTH EXPLORATORY AND H-D METHODS ARE IMPORTANT COMPONENTS OF ANY RESEARCH PROJECT
-
- D. WHAT IS IMPORTANT IS TO UNDERSTAND THE ROLE AND LIMITATIONS OF EACH IN RESEARCH

EMPIRICAL VS THEORETICAL MODELING

- EMPIRICAL MODELING MAY
-
- A. ENABLE PREDICTIONS FOR MANAGEMENT, HABITAT ASSESSMENT
-
- B. THEY, IN THEMSELVES DO NOT EXPLAIN PROCESSES, STUDY THE RESULTS OF PROCESSES
-
- C. BUT STILL USEFUL IN MAKING PREDICTIONS
-
- THEORETICAL MODELS
-
- A. EXPLAIN PROCESSES-CHIEF ROLE EXPLANATORY
-
- B. BASIC SCIENCE, UNDERSTANDING THAT ENABLES SCIENTISTS TO MAKE PREDICTIONS OUTSIDE THE REALM IN WHICH THEY WERE DEVELOPED
-
- C. GUIDES CHOICE OF EXPERIMENTS, DATA GATHERING
-
- D. DEVELOPED THROUGH H-D METHOD ONLY

COMMON THEORETICAL MODEL

- THEORY OF ISLAND BIOGEOGRAPHY
-
- SPECIES DIVERSITY OF AN ISLAND IS DUE TO INVASION RATES OF NEW SPECIES, EXTINCTION RATES OF OLD SPECIES, SIZE OF ISLAND AND DISTANCE OF ISLAND TO MAINLAND

HYPOTHESIS FORMATION

-
- BAKER AND ALLEN 1968. HYPOTHESIS, PREDICTION, AND IMPLICATION IN BIOLOGY. ADDISON-WESLEY PUBL. COM.
-
- HYPOTHESIS: ANY PROPOSITION THAT CAN BE TRUE OR FALSE
-
- A. THIS LAKE CONTAINS WALLEYE
-
- B. THIS DEER WEIGHS 150 LBS
-
- ANY INVESTIGATIONAL PURSUIT CAN BE CAST INTO THE FORM OF A YES NO HYPOTHESIS
-
- A. HOME RANGE OF BEARS IS DIFFERENT THAN A MOUSE
-
- B. DISTRIBUTION OF MIGRATORY ELK DIFFERS BETWEEN SUMMER AND FALL
-
- HOME RANGE OF ELK IS 5 SQ. MILES
-
- ANY PURELY DESCRIPTIVE STUDY CAN BE CAST IN THE FORM OF A DECLARATIVE YES/NO STATEMENT
-

HYPOTHESIS FORMATION

- WITHOUT A CONCEPTUAL MODEL BEHIND IT ,THE HYPOTHESIS IS A SO WHAT HYPOTHESIS
-
- DESCRIPTION VS SCIENTIFIC HYPOTHESIS
-
- SCIENTIFIC HYPOTHESIS: A TENTATIVE EXPLANATION PUT FORTH TO ACCOUNT FOR AN OBSERVED PHENOMENA
-
- ANSWERS THE WHY QUESTION
-
- DESCRIPTIVE RESEARCH ANSWERS THE WHO, WHERE, WHAT, OR WHEN QUESTIONS
-
- MERELY DOCUMENT PHENOMENA

HYPOTHESIS FORMATION

- THE HYPOTHETICO-DEDUCTIVE MODEL OF SCIENTIFIC METHOD
-
- PERCEPTUAL EXPER. EVALUATE ELK HOME RANGES
- Ho: HOME RANGES VARY BETWEEN SEASONS
- (DESCRIPTIVE HYPOTHESIS)
-
- MODEL SUMMER>SPRING>WINTER (INDUCTION)
-
-
- SCIENTIFIC Ho: SEASONAL HOME RANGES ARE RELATED
- HYPOTHESES TO HUMAN DISTURBANCE
- (RETRODUCTION)
-
- Ho: IF H IS TRUE THEN SUMMER RANGES
- WHERE HUMAN DISTURBANCE IS
- CURTAILED SHOULD BE SMALLER THAN IN
- DISTURBED RANGES (DEDUCTION)
-
- EXPERIMENTAL
- DESIGN
-
- DATA COLLECTION
-
- VERIFICATION
- PROCEDURES

PROBLEMS IN FORMULATING AND TESTING SCIENTIFIC HYPOTHESES

-
- A. THEY ARE EXPENSIVE
-
- B. THEY REQUIRE OFTEN IMPOSSIBLE CONTROL OVER ENVIRONMENTAL VARIABLES
-
- C. THEY ARE TIME CONSUMING
-
- FOR THESE REASONS, MOST M.S. RESEARCH OCCURS AT THE DESCRIPTIVE LEVEL
-
- NOT ALWAYS THE MOST EFFICIENT METHOD WHEN WE CONSIDER SCIENTIFIC PROGRESS
-