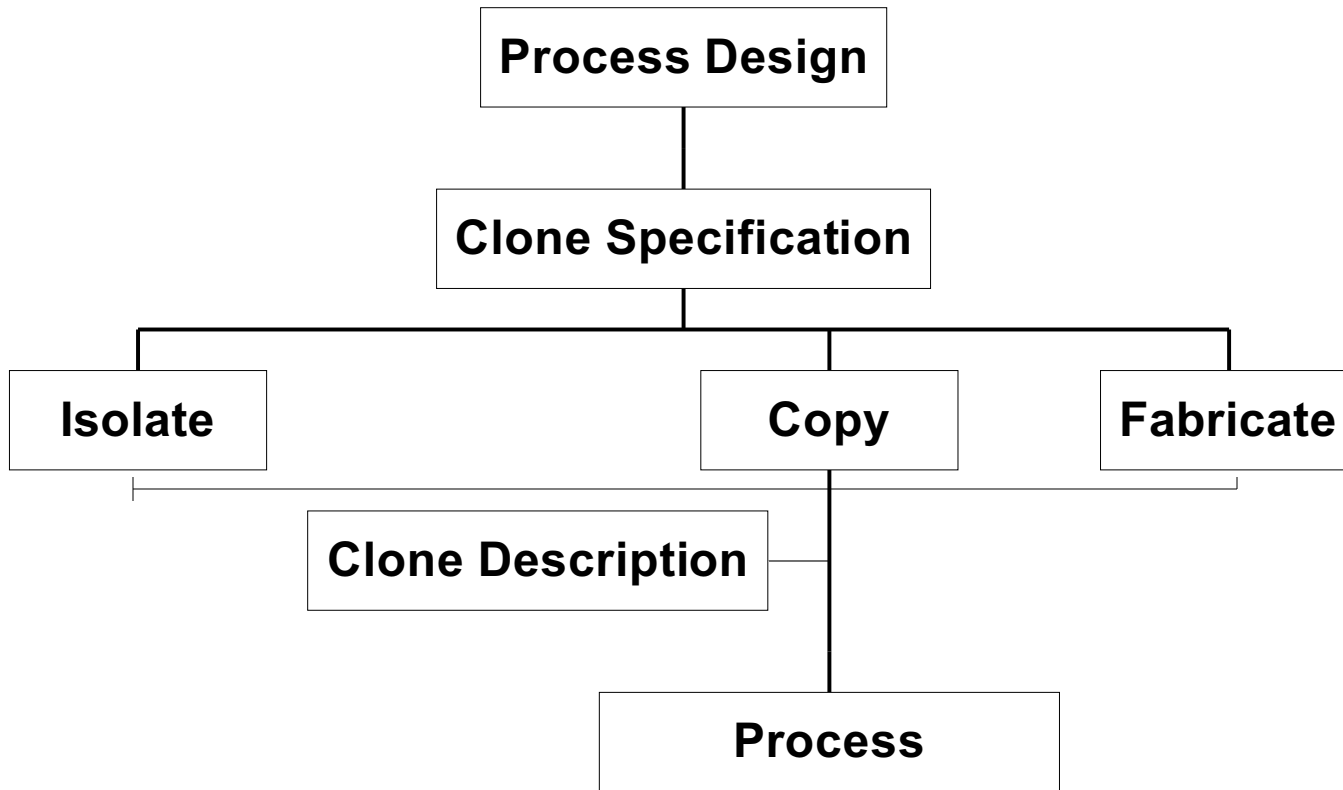


SPECIES DATA: A SEMANTIC AND BOUNDARY PROBLEM?

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CONSIDER :

- **MOLECULAR BIOLOGIST MODELS INSERTION OF NEW GENE**
- **BIOLOGIST FINDS ORGANISM CONTAINING GENE**
- **CHEMIST PREDICTS STRUCTURE AND FUNCTION OF PRODUCT**
- **IMMUNOLOGIST FINDS EPITOPES FOR ANTIBODY ADSORPTION**
- **MICROBIOLOGIST PROJECTS NEW GROWTH RATE, MORPHOLOGY, BIOCHEMISTRY OF THE HOST STRAIN**
- **THE REGULATOR PREDICTS HAZARD AND RISK**
- **THE ECOLOGIST PREDICTS LONG TERM INTERACTIONS**

Taxonomy not exactly congruent with function

OR

To restate Darwin's conclusion: *Clones vary*

P.R. Ehrlich

"The Loss of Diversity: Causes and Consequences"

"The loss of genetically distinct populations within a species is, at the moment, at least as important a problem as the loss of entire species."

The winds changed then, too!

Charles Darwin, letters to Joseph Hooker:

- "I am almost convinced ... that species are not (it is like confessing to murder) immutable."
- "After describing a set of forms as distinct species, tearing up my M.S., and making them separate, and then making them one again I have gnashed, my teeth, cursed species, and asked what sin I had committed to be so punished"

A DICTIONARY OF MICROBIAL TAXONOMIC USAGE

S. T. COWAN

- SPECIES (abbreviated to sp. or spp. (plural)).
- A category, definable only in terms of position (below genus) in a hierarchical system.
- A taxonomic group, definable in terms of the characters of the constituent members.
- A concept; that it is useful cannot be denied, but the user must realize that the species does not exist and is not an entity.
- *To summarize: a species is a group of organisms defined more or less subjectively by the criteria chosen by the taxonomist to show to best advantage and as far as possible put into practice his individual concept of what a species is.*

CODES OF NOMENCLATURE

- VIRUSES => ICTV
- FUNGI, ALGAE => BOTANICAL CODE
- PROTOZOA, ALGAE => ZOOLOGICAL CODE
- BACTERIA => BACTERIOLOGICAL CODE

N. Snow

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With respect to grass taxonomy, it is my opinion that too many local "forms" have been accorded formal taxonomic recognition. If locally distinct variation becomes badly (or completely) blurred in a global context, then the taxonomist probably lacks the data to convincingly argue for the distinctness of that local entity, and hence the need for formal recognition (even if the local populations have fixed, regional genetic variation).

Mary Seddon

Curator (Terrestrial Mollusca), Nat.Mus.& Gall.Wales

In some countries there are populations which for example on conchological, anatomical and genetic grounds appear to be ecophenotypes. The taxonomists place these at population level, but some workers, principally conservationists try to argue that these are species. Part of the problem appears to be a perception that only if a taxa has specific status can the politicians be persuaded that these unique populations merit positive action for conservation.

COMPARISON BETWEEN A "PROBE" METHOD AND CULTURE

% OF POSITIVE SITES SAMPLED

ORGANISM IDENTIFIED	PROBE [+] CULT [+]	PROBE [+] CULT [-]	PROBE [-] CULT [+]	LEVEL OF AGREE- MENT
<i>A. actinomycetemcomitans</i>	0	11	0	0
<i>Actinomyces viscosus</i>	72	6	11	81
<i>Bacteriodes forsythus</i>	22	33	0	40
<i>Bacteroides gingivalis</i>	33	11	0	75
<i>Bacteroides intermedius</i>	44	6	11	72
<i>Capnocytophaga species</i>	11	17	44	15
<i>Eikenella corrodens</i>	6	6	11	26
<i>Eubacterium saburreum</i>	11	11	6	39
<i>Fusobacterium nucleatum</i>	50	17	11	64
<i>Streptococcus mutans</i>	6	22	6	18
<i>Streptococcus sanguis</i>	39	17	28	46
<i>Wolinella recta</i>	17	44	0	28

DEFINE IN OPERATIONAL DATABASE TERMS:

=> ISOLATE

=> STRAIN

=> SPECIES

ISOLATE

- **OBSERVATIONS OF A CLONE**
- **A SINGLE ASSEMBLAGE OF DATA (A RECORD)**
 - ▶ **PHENOTYPE**
 - ▶ **SEROTYPE**
 - ▶ **GENOTYPE**
 - ▶ **VIRULENCE**
 - ▶ **HOST RANGE**
- **ONE "TRUE" VALUE/OBSERVATION**
- **INCIDENCE = ISOLATE CAN ONLY OCCUR ONCE**
- **SOURCE OF ISOLATION USUALLY QUITE IMPORTANT**

STRAIN

- **SERIES OF ISOLATES THAT ARE "IDENTICAL"**
- **ISOLATE RECORDS COMPARED TO ESTABLISH IDENTITY**
- **ANY SINGLE ISOLATE THE DEFINITIVE RECORD**
- **INCIDENCE OF STRAIN - TWO STEP PROCESS**
 - **IDENTITY = EXACT MATCH TO THE DEFINITION**
 - **TIME AND PLACE OF ISOLATION**
- **ONLY THE INCIDENCE DATA IS FURTHER ANALYZABLE**

SPECIES

- **ONE RECORD COMPUTED FROM MULTIPLE ISOLATE RECORDS**
- **ISOLATES DIFFERENT, BUT NOT TOO DIFFERENT**
- **OPERATIONAL SPECIES DEFINITION -TWO COMPONENTS:**
 - ▶ **IDEALIZED STRAIN DESCRIPTION, e.g.,**
 - **HYPOTHETICAL MEDIAN ORGANISM**
 - ▶ **DECISION BOUNDARY OF ALLOWABLE VARIATION**
 - **CODIFIED (COMPUTED STATISTIC)**
 - **PERSONALLY OPERATIONAL**
 - **EXPERIENCE**
 - **KEY**

PRIMARY VERSUS DERIVED INFORMATION

Salt tolerance vs. requirement

Growth in sodium ion-free medium.

No growth in sodium ion-free medium.

Species of <i>Bacillus</i>	No. Of Cultures	20°	33°	37°	45°	50°	55°	60°	65°	70°
<i>Stearothermophilus</i>	87	0	10	73	81	87	87	87	87	45
<i>coagulans</i>	73	53	73	73	73	72	66	23	0	
<i>subtilis</i>	154	154	154	154	150	105	0			
<i>brevis</i>	57	57	57	57	38	16	7	0		
<i>circulans</i>	55	55	55	51	18	6	1	0		
<i>pumilis</i>	65	65	65	65	64	43	0			
<i>macerans</i>	13	13	13	13	13	9	0			
<i>cereus</i>	50	50	50	50	23	0				
<i>sphaericus</i>	42	42	42	42	15	0				

CONCLUSIONS

- Species names are useful pointers to information
- Species names are **NOT** revealed truth or immutable
- Scientific names and the source of that name must be used to avoid ambiguity at the species level
- Adequate annotation must describe in detail all known attributes of the clone studied