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ON ESTIMATING THE RELATIVE BIOSTRATIGRAPHIC VALUE OF FOSSILS

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Abstract. A linear model is proposed for estimating the relative biostratigraphic value of fossil species. The model represents the quantification of the index fossil concept and is an attempt to incorporate the growing body of quantitative biostratigraphic data now becoming available for analysis. The model contains as parameters to be estimated the vertical and horizontal range and the degree of facies independence for each fossil species used for correlation. Each species is considered as a separate statistical unit. The relative biostratigraphic value (R.B.V.) of a fossil species occurring within a given stratigraphic interval is defined as

$$\text{R.B.V.} = \alpha(1-\mu_v) + (1-\alpha)\mu_h$$

where μ_v is a measure of vertical range, μ_h is a measure of lateral persistence, and α measures the degree of facies independence. The parameters are defined in the interval (0, 1) and are estimated from the data available. A species having the ideal index fossil properties will have a relative biostratigraphic value approaching unity. Range data accumulated for large groups of fossils are summarized by ranking species according to their biostratigraphic value. This ranking facilitates the subsequent biostratigraphic correlations. Group measures of correlation are defined by forming linear combinations of species where each species is weighted according to its relative biostratigraphic value. An application of the model to a problem of biostratigraphic correlation for a part of the Middle Tertiary is presented.

INTRODUCTION

In a recent critical review, Jeletzky (1965) took to task those who would use the fossil percentage comparison method as a basis for biostratigraphic correlation. He argued that an individual fossil species is a unique product of the evolutionary process and is characterized by its own degree of adaptation to the changing environment through geologic time. Consequently, the assumption that fossil species in samples can be treated as equal statistical units for comparison is strictly false. Fossil species vary in their usefulness as biostratigraphic markers. He added, furthermore, that it would be impossible to devise any method for expressing numerically the degree of biostratigraphic usefulness of a fossil.

More recently, Cockbain (1966) proposed the entropy function as a numerical measure of the relative biostratigraphic usefulness of a fossil. The entropy function measures the amount of information to be gained by knowing the geologic range of a species and the probability of its occurrence within a given stratigraphic interval. Although it provides a quantitative measure of relative biostratigraphic value, as Cockbain (1966, p. 207) pointed out, the obvious difficulty lies in assigning probabilities which can be agreed upon and the subsequent use that can be made of any general weighting factor which is applicable in all areas. The measure he proposed takes into account the geologic range of a species but not its geographic distribution. Both factors must be considered in determining the biostratigraphic value of any species.

The purpose of this paper is to propose a quantitative measure of biostratigraphic correlation which takes into account the geologic range and geographic distribution of fossil species and at the same time incorporates the body of quantitative biostratigraphic data now becoming available for analysis. To the extent that is possible, the measure that is put forward represents the quantification of the index fossil concept. More explicitly, a linear model is proposed which incorporates as parameters to be estimated the vertical and horizontal range and the degree of facies independence of a fossil species considered useful for biostratigraphic correlation. A relative biostratigraphic value is assigned each species. Each species is considered a separate statistical entity having its own distribution.

As will be seeen, group measures of correlation can be defined by forming linear combinations of species where each species is weighted according to its relative biostratigraphic value. In areas where data on a large number of fossil species are available, biostratigraphic analysis is aided greatly by ranking species according to their relative biostratigraphic value. Once an interval has been subdivided into different biostratigraphic units, the recognition of these units in other areas can be achieved through the use of paleontologic filters. Unknown samples can be classified as belonging to a particular biostratigraphic unit depending on whether or not they can pass through the corresponding filter. As a beginning, let us consider the concepts of a model and its implications in biostratigraphic correlation.

THE BASIC CONCEPT

Fossil species vary in their usefulness as biostratigraphic markers. It is largely for this reason that the index or guide fossil concept has become the cornerstone of biostratigraphic correlation. The generally recognized attributes of the ideal index fossil are: (1) ease of recognition, (2) limited geologic range, (3) widespread geographic distribution, and (4) facies independence. The first of these is essentially a taxonomic problem. Either a species is readily identifiable or it is not. The remaining attributes, however, refer to the stratigraphic occurrence of a species and lend themselves to a quantitative interpretation. We wish to incorporate these attributes into a model which will yield a measure of the relative biostratigraphic usefulness of a fossil species. The measure is relative in the sense that it is defined within a given stratigraphic interval.

The overall biostratigraphic value of any fossil species is a function of its geologic range and geographic distribution. We may refer to these as the vertical and the horizontal range. As a first approximation, we can assume this relationship to be a simple linear function. It does not follow, however, that these two factors are of equal importance in determining the relative biostratigraphic value of a fossil species. Therefore, we need to find some way to weight the relative importance of each of these factors.

Each species reflects its environment. Certain robust species are less sensitive to their immediate environment and are found in the fossil record distributed over several different sedimentary facies. These species are considered to be facies-independent. Other species, though occurring in widely separate areas, are found associated with a single sedimentary facies. These speices are considered facies-dependent. Both types of species, however, may be significant as biostratigraphic markers. The degree of facies independence can be used to determine how much weight is to be given to the vertical and horizontal range in determining the relative biostratigraphic value of any single species.

We now have three parameters which describe the spatial distribution of a fossil species. We refer to these as the vertical range, the lateral persistence, and the degree of facies independence. Within broadly defined stratigraphic units, the values of these parameters may be estimated from the available biostratigraphic data.

THE LINEAR MODEL

The model proposed for estimating the relative biostratigraphic value (R.B.V.) of a fossil species within a given stratigraphic interval is defined as

$$\text{R.B.V.} = \alpha(1-\mu_v) + (1-\alpha)\mu_h \tag{1}$$

where μ_v is the vertical range, μ_h is the lateral persistence, and α is a measure of facies independence. The values of the parameters are bounded in the interval (0, 1) so that

$$0 \leqslant \mu_v, \mu_h, \alpha \leqslant 1.$$

It follows that

$$0 \leqslant \text{R.B.V.} \leqslant 1.$$

The significance of having α as part of the linear model in (1) is shown in Fig. 1. Three diagrams are presented for different values of α. The vertical range, μ_v, is plotted against the lateral persistence, μ_h, for the values of $\alpha = 0$, 0.5, 1. The lines of constant relative biostratigraphic value are shown as contours in each of the diagrams. The slope for each set of contours for each α is equal to $(1-\alpha)/\alpha$.

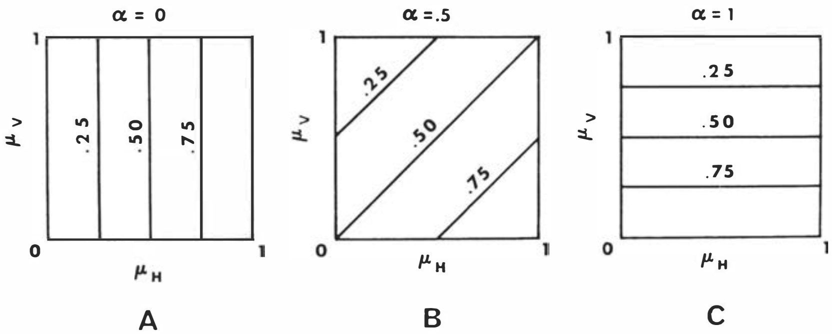

Fig. 1. Vertical range μ_v versus lateral persistence μ_h. Contour lines represent the relative biostratigraphic values. α is the measure of facies independence. *A*, α = 0.0 *B*, α = 0.5. *C*, α = 1.0.

A species having the ideal qualities of an index fossil, namely, restricted vertical range ($\mu_v \to 0$), widespread geographic distribution ($\mu_h \to 1$), and facies independence ($\alpha \to 1$), will have a relative biostratigraphic value approaching unity. Moreover, a species occurring over a wide area ($\mu_h \to 1$) but which is associated with only a single facies ($\alpha \to 0$) similarly will have a relative biostratigraphic value approaching unity. Thus, fossil species considered to be facies-independent ($\alpha \cong 1$) will be valued more for their occurrence within narrow vertical limits while species considered to be facies-dependent ($\alpha \cong 0$) will be valued more for their widespread geographic distribution.

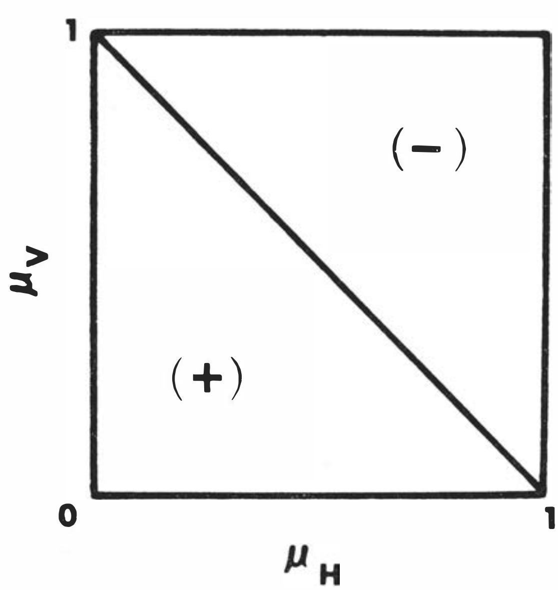

Fig. 2. The effect on the relative biostratigraphic value of a species by increasing the value of α. (+) represents an increase in the relative biostratigraphic value. (—) represents a decrease in the relative biostratigraphic value.

The effect on the relative biostratigraphic value of a species by increasing the measure of facies independence is seen in Fig. 2. Points which fall within the upper right portion of the diagram will result in lower relative biostratigraphic values for an increase in α whereas points which fall within the lower left portion of the diagram will result in higher relative biostratigraphic values for an increase in α. The parts of the diagram are marked with a (−) and a (+), respectively.

To see this more clearly, we can rewrite (1) as

$$\text{R.B.V.} = \alpha[1 - (\mu_v + \mu_h)] + \mu_h. \qquad (2)$$

The equation for the line dividing the two portions of the diagram is given by $\mu_v + \mu_h = 1$. Clearly, points lying above the line will have a negative effect on (2) for an increase in α whereas points lying below the line will have a positive effect for an increase in α.

A further property of the equation given in (1) is that a species not found within the given stratigraphic interval will have a relative biostratigraphic value equal to α. For a non-reported species, $\mu_v = \mu_h = 0$; therefore, R.B.V. = α. Because similar environments are thought to have existed at different times in the geologic past and because a species lives only once, this property of the model is a reasonable consequence of the basic assumptions. Consider now a species which occurs within an interval and which has the same degree of facies independence as a species which is not found to occur in the same interval. Clearly, if the relative biostratigraphic value of the reported

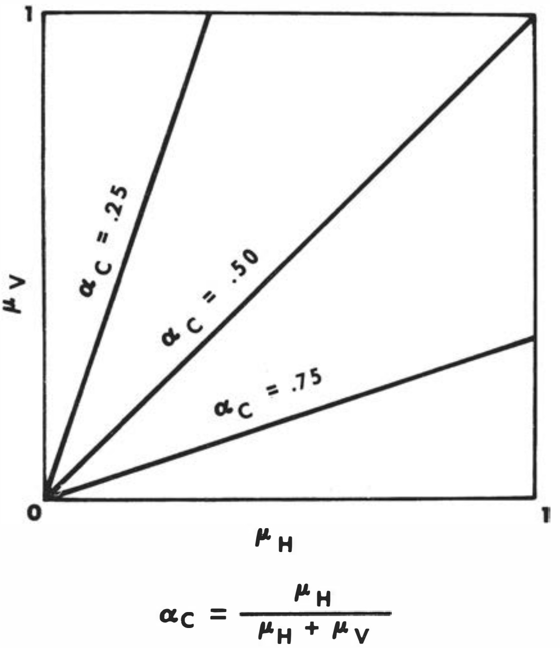

Fig. 3. Selected critical boundaries for determining whether a species has greater correlation value than a non-reported species having the same value of α. The critical region is defined as the area lying above the line defined by the equation given above. The critical values of α shown are 0.25, 0.50, and 0.75.

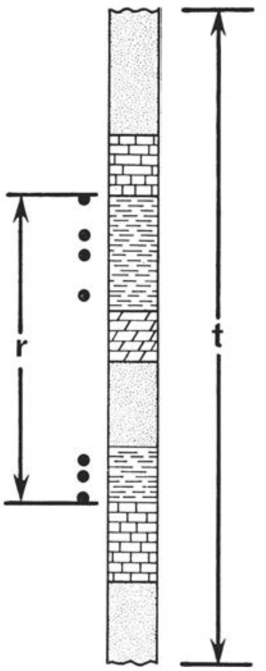

Fig. 4. Idealized vertical section. The dots represent the positions in the section where a particular fossil species is found to occur. *r* represents the local range of the species; *t* represents the total stratigraphic interval of interest.

species is less than the value of the measure of its degree of facies independence, it is no more useful for biostratigraphic correlation than is the reported absence of the other species. For a given species to be considered useful for correlation, then,

$$\text{R.B.V.} > \alpha_c$$

where α_c is the measure of the degree of facies independence for that particular species. By rearranging terms in (1), it is not difficult to show that for a given α, the critical value is defined in terms of the vertical range and lateral persistence by

$$\alpha_c = \mu_h/(\mu_h + \mu_v).$$

The critical boundaries for $\alpha_c = 0.25$, 0.50, 0.75, are shown in Fig. 3.

ESTIMATION OF PARAMETERS

Until now, we have not considered how the parameters in the model are to be estimated. The model as defined, however, should be independent of any method that might be proposed to estimate the parameters; for this reason, the problem of parameter estimation can be treated separately. For instance, estimates of the parameters could be based solely on past experience using the best current judgement of the paleontologist. On the other hand, the parameters could be estimated by means of a complicated procedure based on a set of existing data. Either way would be consistent with the model. The method of estimation, therefore, has to be considered as an integral part of the correlation process. Unfortunately, most biostratigraphic data are not collected systematically. The difficulties inherent in establishing adequate sampling procedures in biostratigraphic work make it unlikely that a uniform approach to data acquisition is near at hand. Therefore, the method used to estimate parameters in the model will depend largely upon the data that are available and the manner in which the data are collected.

An example of how the vertical range of a fossil species can be estimated from a single stratigraphic section is shown in Fig. 4. The dots represent horizons where a particular species occurs. The local vertical range for this particular species is estimated by

$$v = r/t \tag{3}$$

where r is the local range in thickness of the species and t is the total thickness of the stratigraphic interval in which it is desired to measure the relative biostratigraphic values for a number of species. The range of a species is defined relative to the stratigraphic interval studied. For n localities containing the same stratigraphic interval, the vertical range is estimated as

$$v = \max (v_1, v_2, \cdots, v_n) \tag{4}$$

where v is the maximum of the local vertical range values determined at each locality. The maximum rather than the mean of the values is chosen to allow for lateral variation in facies.

The lateral persistence of a species for the same n localities can be estimated as the proportion of the localities where the species occurs. Thus,

$$h = \frac{1}{n} \sum_{i=1}^{n} x_i \tag{5}$$

where

$$x_i = \begin{cases} 1 & \text{species present at } i\text{th locality} \\ 0 & \text{species absent at } i\text{th locality} \end{cases}$$

Here, lateral variation of facies is measured indirectly by the lateral persistence of a species.

The most difficult parameter to estimate in the model is the degree of facies independence of a species. At the minimum, it is necessary to have a detailed knowledge of the lithologic relationships and faunal associations within the stratigraphic interval of interest. Even so, the partitioning of the interval into environmental units that reflect the controls on the occurrence and distribution of the enclosed species is usually a difficult task. If the total number of facies can be estimated, however, the degree of facies independence of a particular species can be defined as the fraction of the total number of facies in which the species occurs. Facies types known to occur outside the area of interest could also be included. Another approach would be to assign each species a rank order of facies independence and use the normalized rank orders as the values for α. Whichever method of estimation is used, it is clear that the choice will have an influence on the subsequent biostratigraphic analysis.

AN APPLICATION OF THE MODEL

As a test of the model, we consider the biostratigraphic data collected and reported on by Deboo (1965). Deboo undertook to study the nature of the microfaunal changes across the boundary between the Jacksonian and Vicksburgian stages in eastern Mississippi and western Alabama and to determine its relationship with the Eocene and Oligocene series. Range data for over 200 microfaunal species were obtained from samples collected from four continuously exposed sections and one composite section. Range charts were prepared indicating the presence or absence of each species for each sampled horizon. Range data for three microfossil groups, ostracods, planktonic foraminifers, and benthonic foraminifers were collected. A total of 194 species which included 45 species of ostracods, 17 species of planktonic foraminifers, and 132 species of benthonic foraminifers were selected for biostratigraphic analysis. The range data for these species constitute the basis for estimating the relative biostratigraphic value for each reported species.

Using equations (3), (4), and (5), the vertical range and lateral persistence for each of the 194 species were calculated and the results plotted for the three microfossil groups are shown in Fig. 5. The wide range of scatter evident on this diagram indicates that the species in each of the three groups exhibit considerable variation in their distribution. It is interesting to note that the points are concentrated in the lower left and upper right portions of the diagrams. Of the three groups, the benthonic foraminifers appear the best suited for biostratigraphic correlation. The reason for this will be discussed later.

To calculate the relative biostratigraphic value, a value of α must be defined for each species. Without having access to the detailed lithologic data for this study, an arbitrary value of α equal to 0.5 was assigned each species. This is not entirely appropriate considering that the planktonic forms are certain to be more facies independent than the benthonic forms. Without the lithologic information, however, there is no satisfactory way to assign a different value of α for each species which is consistent with the model being proposed.

For α set equal to 0.5, the relative biostratigraphic value of each species was calculated according to (1); the results are tabulated in the form of a histogram in Fig. 6. What was suggestive in the diagrams of Fig. 5 is now readily apparent. The set of relative biostratigraphic values calculated for the 194 species forms a continuous distribution extending over the interval from zero to one. Moreover, the distribution is unimodal and has a strong central tendency. The median value for the distribution is 0.62. There is a sharp break in the distribution at a relative biostratigraphic value corresponding to 0.5. This coincides with the threshold value of 0.5 based on the value chosen for the parameter α. Therefore, species whose relative biostratigraphic value falls below 0,5 are to be considered no more useful for biostratigraphic correlation than is any species not

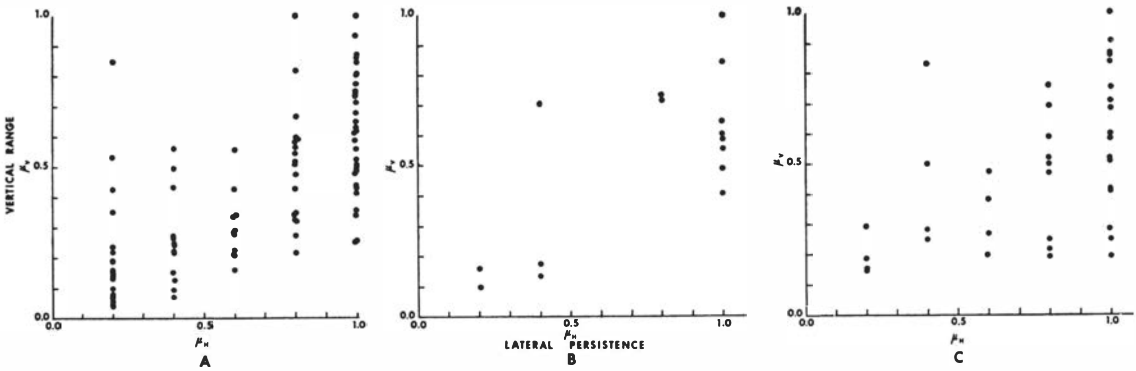

Fig. 5. Vertical range versus lateral persistence plotted for 194 species based on data taken from Deboo (1965). *A,* Ostracods; *B,* planktonic foraminifers; *C,* benthonic foraminifers.

found in the interval. In this instance, 29 species can be eliminated for correlation purposes by this reasoning.

At the high end of the distribution, a break occurs at a relative biostratigraphic value corresponding to 0.80. Only eleven species or slightly over five per cent of the total number of species have relative biostratigraphic values exceeding this value. The eleven species are listed in Table I ranked in decreasing order of their relative biostratigraphic value. Listed are the relative biostratigraphic value, lateral persistence, vertical range, and the biostratigraphic unit in which each species occurs. The biostratigraphic zones and subzones given are those adopted by Deboo (1965, p. 6, Fig. 3) The boundary of the *Cribohantkenina "danvillensis"* subzone has been modified slightly by raising its lower boundary for the composite section made up of localities 1, 2, and 3 from between sample number 16 and 15 to between sample number 15 and 14 (Deboo, 1965, Pls. 1 and 2). With this change, the species listed in Table I are restricted in their occurrence to a single zone or subzone. With the exception of *Bolivina alazanensis,* all were recognized by Deboo to be so restricted. Other reported species, however, are restricted in their occurrence within a single zone or subzone, but their relative biostratigraphic values are lower and, hence, they are regarded not as useful for the purposes of correlation. None of the species is restricted to the *"Cythereis" blanpiedi* subzone. As proposed by Deboo (1965, p. 13), this subzone extends from the first occurrence of *"Cythereis" blanpiedi* and other named species up to, but not including the lowest occurrence of *Lepidocyclina mantelli.* A definition of this type poses difficulties for correlation since the recognition of the biostratigraphic unit depends upon the reported absence of a species. The alternative is to base the definition on the concurrent ranges of selected fossils. A partial list of such fossils is given by Deboo (1965, p. 13). The minimum number of species that can be used to define a concurrent range zone or subzone is, of course two. The two species with the highest relative biostratigraphic values and whose occurrence in the section overlaps the adjacent unit above and below the *"Cythereis" blanpiedi* subzone are *Trachylebereis montgomeryensis* (R.B.V. = 0.796) and *Propontocypris mississippiensis* (R.B.V. = 0.793).

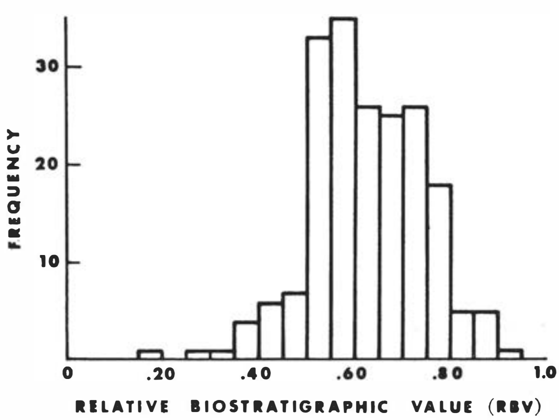

Fig. 6. Histogram showing distribution of relative biostratigraphic values for 194 microfossils based on data from Deboo (1965). The measure of facies independence for all species was set equal to 0.5.

The list of species given in Table I coupled

Table I. *Biostratigraphic Analysis of Deboo's (1965) Data*

Measure of facies independence equal to 0.5 for all species. Biostratigraphic units represented: *A, Lepidocyclina mantelli* zone; *B, "Cythereis" blanpiedi* subzone, *Spondylus dumosus* zone; *C, Cribohantkenina "danvillensis"* subzone, *S. Dumosus* zone; *D, Floridina antiqua* zone

Rank order	Relative biostratigraphic value	Lateral persistence	Vertical range	Species	Stratigraphic occurrence A	B	C	D
1	0.903	1.0	0.194	*Cytheretta jacksonensis*				×
2	0.876	1.0	0.249	*Clithrocytheridea garretti*				×
3	0.876	1.0	0.249	*Sigmomorphina costifera*				×
4	0.876	1.0	0.249	*Clithrocytheridea grigsbyi*				×
5	0.876	1.0	0.249	*Textularia dibollensis*				×
6	0.859	1.0	0.282	*Jugosocythereis vicksburgensis*	×			
7	0.829	1.0	0.341	*Vulvulina advena*			×	
8	0.829	1.0	0.341	*Bolivina alazanensis*			×	
9	0.829	1.0	0.341	*Anomalina cocoaensis*			×	
10	0.825	1.0	0.350	*Saracenaria ornatula*			×	
11	0.803	0.8	0.194	*"Cythereis" hysonensis*				×

with the two above named species reduces to a basic minimum the number of species necessary to define the four biostratigraphic units recognized in the original study. More explicitly, we can devise a classification function of the form

$$z_{ik} = \sum_{j=1}^{n_i} w_{ij} x_{jk} \quad (x_j; j \varepsilon G_i) \tag{6}$$

where G_i represents the subset of n_i species which characterize the ith biostratigraphic unit, w_{ij} represents the normalized relative biostratigraphic value of the jth species contained in G_i, so that

$$\sum_{j=1}^{n_i} w_{ij} = 1 \quad w_{ij} \geqslant 0, \tag{7}$$

and

x_{jk} is defined for the kth sample as

$$x_{jk} = \begin{cases} 1 \; j\text{th species within } G_i \text{ present in the } k\text{th sample} \\ 0 \; j\text{th species within } G_i \text{ absent in the } k\text{th sample;} \end{cases}$$

thus, z_{ik} is the normalized score which indicates the degree to which the kth sample belongs to the ith biostratigraphic unit. The kth sample is classified as belonging to the jth biostratigraphic unit where

$$z_{jk} = \max(z_{1k}, z_{2k}, \cdots, z_{nk})\, 0 \leqslant z_{jk} \leqslant 1.$$

Therefore, the sample is classified into one of the n defined biostratigraphic units.

We inquire now whether by using a few selected species, a result similar to the one in the original study can be obtained. The normalized relative biostratigraphic values of the critical species in each biostratigraphic unit are listed in Table II. For completeness and to give greater stability to the classification function, five more species have been added. These species become the elements of the filter defined for each biostratigraphic unit

Table II. *Paleontologic Filter Coefficients*

Normalized relative biostratigraphic values for species which characterize the biostratigraphic units listed in Table I.

No.	Species	Filter coefficients A	B	C	D
1	*Jugosocythereis vicksburgensis*	1.000	—	—	—
2	*Trachyleberis montgomeryensis*	—	0.390	—	—
3	*Propontocypris mississippiensis*	—	0.390	—	—
4	*Trachyleberidea blanpiedi*	—	0.220	—	—
5	*Vulvulina advena*	—	—	0.167	—
6	*Bolivina alazensis*	—	—	0.167	—
7	*Anomalina cocoaensis*	—	—	0.167	—
8	*Saracenaria ornatula*	—	—	0.167	—
9	*Hastigerina danvillensis*	—	—	0.167	—
10	*Cribohantkenina inflata*	—	—	0.165	—
11	*Cytheretta jacksonensis*	—	—	—	0.173
12	*Clithrocytheridea garretti*	—	—	—	0.168
13	*Sigmomorphina costifera*	—	—	—	0.168
14	*Clithrocytheridea grigsbyi*	—	—	—	0.168
15	*Textularia dibollensis*	—	—	—	0.168
16	*"Cythereis" hysonensis*	—	—	—	0.155

Table III. *Results of biostratigraphic correlation using a classification function*

Sample numbers and section numbers correspond to the data of Deboo (1965). The letters refer to the biostratigraphic units listed in Table I. NC means that the sample did not contain any of the species listed in Table II. Letters in italics indicate the biostratigraphic boundaries established by Deboo.

Sample no.	Section no. 1	2	3	4	5
1	A	A	A	A	A
2	A	*A*	A	*A*	*A*
3	*A*	NC	*A*	B	B
4	B	B	B	B	*B*
5	B	*B*	B	*B*	C
6	B	B	B	*C*	*C*
7	*NC*	C	B	C	D
8	NC	C	*B*	*C*	D
9	NC	C	C	D	D
10	C	C	C		D
11	C	*C*	*C*		
12	C	D	D		
13	C	D	D		
14	C				
15	*D*				
16	D				
17	D				

and the corresponding values are used as the weighting coefficients in (6) and which satisfy (7). The 62 samples taken in the study were classified using this approach and the results are tabulated in Table III. Noting the previous boundary change, there is a near perfect agreement with the original classification.

One may question why the planktonic foraminifers did not figure more prominently in defining the biostratigraphic units with this approach. The explanation perhaps lies in the distribution of the sample localities. In the study, the samples were taken more or less parallel to the depositional strike of the strata; hence, the benthonic foraminifers along with the ostracod species occurred with greater persistence because of the more limited changes in environment. Had it been possible to collect more samples down the depositional slope, the planktonic foraminifers may have proved to have had greater biostratigraphic value. For this reason, it is probable that the relative biostratigraphic value of the planktonic foraminifers were underestimated. This is viewed as a limitation due to sampling, however, and not a defect in the underlying model.

LIMITATIONS OF THE MODEL

There are obvious limitations in this approach to biostratigraphic correlation. Because of the nature of biostratigraphic data and the manner in which the data are collected, it is expecting too much at the present time to be able to prescribe a completely quantitative approach. There are simply too many chance factors operating in the sampling and recording of most types of biostratigraphic data. Moreover, it is only rarely that systematic collecting can be undertaken over a wide area. For this reason, the model that is proposed is best adapted for intra-basin correlation where the samples collected are representative of a local area. It is doubtful whether the present approach would be suitable for inter-basinal correlation much less for inter-continental correlation.

In the construction of the model, the important parameter lacking is a measure of faunal succession which would reflect the evolutionary aspect of the fossil record. As Jeletzky (1965, p. 135) points out, the "evolutionary lineage" method of correlation is coming into ever greater use. It follows that an evolutionary factor should be incorporated into any quantitative model. Evolution, of course, connotes change and this change is reflected in the faunal variations one observes from one sample to the next in a vertical sequence. To give such a change mathematical expression in a model requires second order terms. These terms amount to finite differences in the discrete case or derivatives in the continuous case. A linear model incorporating an evolutionary factor would require an additional parameter whose value could be estimated by noting the magnitude of change in a vertical succession. The addition of an evolutionary factor parameter in the model, however, remains for the future.

SUMMARY AND CONCLUSIONS

A linear model has been proposed for estimating the relative biostratigraphic value of fossil species. The model is based on the assumption that a species having the attributes desirable of an index fossil will have a high relative biostratigraphic value. Similarly, a facies bound species with a widespread geographic distribution will also have a high relative biostratigraphic value. The factors affecting the biostratigraphic value of the two species types are different, however. By use of the model, range data accumulated for a large number of species over a wide area may be conveniently summarized by ranking the species according to their relative biostratigraphic value. The ranking of species not only facilitates the subsequent biostratigraphic correlations, but it also provides a basis for constructing paleontologic filters for biostratigraphic classification in which weighted linear combinations of fossil species characterize particular biostratigraphic units. This allows greater stratigraphic value to be placed on some species than on others.

The model is an attempt to focus attention on the use of statistical methods in biostratigraphic correlation, to encourage the collection of more quantitative data, and to examine more closely the basis of correlation in biostratigraphy. New methods of correlation having these goals as objectives should stimulate greater interest among paleontologists in the problems of correlation and ultimately to reduce these problems to those which are amenable to mathematical solution.

Sommaire. L'auteur présente un modèle linéaire pour la détermination de la valeur biostratigraphique relative de chaque espèce de fossiles. Le modèle présente en quantités mesurables la notion de fossile de zone. Les paramètres à considérer sont la répartition verticale et horizontale et le degré d'indépendance du facies pour chaque espèce dont on se sert pour établir les correlations. Chacune des espèces est traitée comme une unité statistique indépendante. La valeur biostratigraphique relative (en anglais R.B.V.) d'une espèce fossile présente en une espace de temps donnée a été ainsi définie:

$$\text{R.B.V.} = \alpha(1-\mu_v) + (1-\alpha)\mu_h$$

où μ_v représente la répartition verticale, μ_h l'extension horizontale et α le degré d'indépendance du facies. Les paramètres ont été définis dans l'intervalle (0, 1) et déterminés par les données obtenues. Une espèce ayant les qualités idéales d'un fossile de zone aura une R.B.V. approchant d'unité. On a additionné les données sur la répartition verticale de grands groupes de fossiles en rangeant les espèces selon leur valeur biostratigraphique. Cet ordre facilite ensuite le travail d'établir les correlations. Les valeurs d'un certain groupe pour les correlations ont été définies dans une combinaison linéaire des espèces où chaque espèce reçoit le coefficient de sa valeur biostratigraphique.

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