

The Role of Biomarker as a Taxonomic Material and Indicator of Characters Performance on Marine Biota

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Received date: January 05, 2018; Accepted date: March 19, 2018; Published date: March 23, 2018

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Abstract

Taxonomy of marine biota is the process of analyzing the characters that exist in the individual, connecting the available characters and create similarities and inequalities between a large numbers of individuals. It is not easy to find and measure similarities or similarities in great diversity. However, in any biota with such great diversity, there is, of course, a certain similarity or trait even if small and small. This commonality or uniformity that taxonomists use as the basis for classification. The creation of clear taxon boundaries becomes especially important when faced with a high diversity of marine biota, not only in quantity and species but also in the ecosystem and climatic conditions, as well as in the tropics. Given the pattern of phenotypic and genotype variations, it would be difficult to define species boundaries based solely on morphological characters, but to be important in monitoring and evaluating character performance on the basis of this pattern. By recognizing and analyzing this pattern of order, it can serve as the identity of individual characters in the species population. The identity of standardized characters in the character performance index, it can be used to monitor, evaluate and investigate the status and condition of the character's performance at any time either to the genetic material, biota or ecology. This article aims to explain the basic concepts of biomarkers as well as their role as taxonomic materials and performance indicators of the character of a marine biota.

Keywords: Biomarkers; Taxonomic material; Character performance; Performance indicator

Introduction

The term biomarker is still limited to the molecular level, whereas from its roots biomarker stands for the biological marker are the biological measures or markers of a biological existence of an individual. By definition, biomarkers are "characters in an organism measured objectively and can be evaluated as indicators in analyzing a normal biological state and process, a pathogenic process or an individual's response to maintaining the condition".

Essentially, the taxonomy of marine biota is the process of analyzing the characters that exist in the individual, connecting the available [1,2] and creating similarities and inequalities between large numbers of individuals. Henning 1966 suggest that it is not easy to find and measure similarities or similarities in great diversity. However, in any biota with such great diversity, there is, of course, a certain similarity or trait even if small and small. This commonality or uniformity that taxonomists use as the basis for classification. The creation of clear taxon boundaries becomes especially important when faced with a high diversity of marine biota, not only in quantity and species but also in the ecosystem and climatic conditions, as well as in the tropics.

The factor of the lack of material taxonomic characteristic examined and the extent of the dispersion area of the biota, also resulted in not all variations of taxonomic characters can be recorded from existing samples, so that many species are produced which in the future must be reduced again [3-5]. Without background knowledge of the characteristics of marine biota, it is not possible to obtain critical and

sufficient knowledge in the limitation of the taxon, its distribution area, its variability and the consequences of its name and its synonyms. Another factor that also involved is the factor of the subjectivity of researchers in the selection of characters that are considered important and the element of one's appreciation of the characters also affect the work taxonomy [6,7]. If the species restriction is submitted to the researchers, the results will vary greatly according to the researcher's taste. Therefore, Avise [8,9] proposed that in suppressing subjectivity the researcher should be anticipated by the use of all taxonomic character information sources available either morphology, anatomy, physiology, behavior, ecology, geographical distribution, biochemistry, microscopic, and molecular even through quantitative or numerical measures such as meristics, morphometrics and geometric morphometrics.

Differences in the performance of biological characters in groups of individuals with the same genotype are known as the range of individual phenotypes, whereas the difference in performance at the level of dominance caused by different genetic compositions is known by the variety of genotypes [10,11]. Given the pattern of phenotypic and genotype variations, it would be difficult to define species boundaries based solely on morphological characters, but to be important in monitoring and evaluating character performance on the basis of this pattern. According to Swofford, Sullivan [12-14] that although the expression and performance of each biota character are different, the performance of individual characters or species has a unique and specific pattern of order. By recognizing and analyzing this pattern of order, it can serve as the identity of individual characters in the species population. The identity of standardized characters in the character performance index, it can be used to monitor, evaluate and

investigate the status and condition of the character's performance at any time either to the genetic material, biota or ecology.

Based on the above, it is necessary to broaden the fundamental understanding of biomarkers so far, by reviewing the results of biomarker studies that have been pre-applied and applying them to biomarkers comprehensively especially for taxonomic interest and diagnostic performance of individual characters. Conscious biological markers contained in the biota [15]. Therefore, this article as a result of a review of various scientific journals and textbooks that examine biomarkers primarily describe the basic concepts of biomarkers as well as its role as taxonomic material and performance indicators of the character of a marine biota.

The Scope of Biomarker

Biomarkers stand for biological markers are biological measures or markers of a biological existence of an individual. By definition, biomarkers are "characteristics that are objectively measured and can be evaluated as indicators of normal biological state and process, pathogenic processes or an individual's response to maintain their condition [16]. In the medical world, the biomarker is a biological feature that can be used to measure the presence or absence of disease or the effects of a treatment [17]. A biomarker generally refers to an indicator that measured from several biological conditions or conditions. This term is also sometimes used to refer to the presence of a substance indicating the existence of a living organism [18].

In term of biomarker comes from the word bio which means biological or living organism and a marker which means marker. So in a narrow sense, biomarkers can be interpreted as a marker on living things. Whereas in the general sense biomarker is defined as biological instructions obtained from the biological elements of the body of an organism that can be used as a guide to an organism. Thus, it can be said that biomarkers are all substances, structures or processes that can be observed and/or measured in the body of the organism, as well as the product of the organism and its effects, can be felt [19-21].

Biomarkers can be classified as markers of exposure, markers of effects and vulnerability markers. The requirement of a biomarker to be used as a guide or indicator of a biota if the marker or marker is relevant and valid. Relevance refers to the suitability of a biomarker to provide information that relates to a question or problem to be known. The use of relevant biomarkers allows the assessment and conclusion of an organism to be appropriate and accountable [22]. While the validity or validation of a biomarker is largely determined by the extent to which the marker can be verified by a measurable method so that the biomarker can be used to predict a statement or biological state of an organism.

According to Wiens [23], biomarkers can be interpreted also as markers or characters that are shown or produced by a biota as a result of organism metabolism. Therefore, a bioindicator can be used as a pen or character indicator of the character shown or displayed as a performance of his character. In the field of health of the existence of a biomarker, it is very important to mitigation types and conditions of a disease.

The Character of the Biota and its Inheritance

The characters or traits represent all the properties or features contained in an individual or species so that with such property the individual can be distinguished or equated with other individuals.

These character features can be categorized into visible and invisible [23,24].

According to Joy and Conn [25], the character is derived from the expression of the genetic material of an organism, in which expression is a series of processes of translation of genetic information, in the order of bases in DNA and RNA, proteins, and eventually into character or phenotype products. Information carried by the genetic material is meaningless to an organism if it is not expressed to be a phenotype. The process of gene expression follows the same stages for all life forms [26-28] explain that there are three basic processes involved in the genetic expression: DNA replication, DNA transcription into RNA, and translations of RNA into polypeptides and subsequently into proteins. DNA replication is the process of doubling the double chains of DNA. At the cellular level, DNA replication occurs prior to cell division. The process of DNA replication can also be done *in vitro* in the polymerase chain reaction process. Transcription in genetics is the manufacture of RNA by copying some of the DNA sequences [29-31]. Transcription is part of a series of genetic expressions. This transcription process converts DNA into RNA and takes place inside the cell nucleus, mitochondria, and plastids. Transcription can be triggered by stimuli from the outside or without stimulation. In the process without stimulation, transcription takes place continuously [32-34]. Meanwhile, genes that require stimulation are usually genes that are only produced at any time; its genes are called regulatory genes because they usually set special mechanisms. The stimulus activates the promoter portion of the nucleus, a segment of the gene that acts as a trap of RNA polymerase located upstream of the part to be copied [35,36].

Kennedy [37] says that the character of an individual is manifested in phenotype. The phenotype can be interpreted as a characteristic of both structural, functional, biochemical, physiological, and observable behavior of an organism controlled by the genotype and the environment and their interaction. The term phenotype includes various levels of gene expression of an organism [38]. At the organism level, the phenotype is something that can be seen, observed, measured, of some nature or character such as eye color, weight, or resistance to a particular disease. At the biochemical level, the phenotype may be the content of certain chemical substances in the body, for example, blood sugar levels. At the molecular level, the phenotype may be the amount of RNA produced or detected by DNA or RNA bands in the electrophoresis process [25,32,39,40].

The phenotypes are determined in part by individual genotypes, in part by the environment in which individuals live, time, and a number of properties, the interaction between genotype and environment [41,42]. Phenotypic observations can be simple to very complex and require special tools and methods. However, due to the genetic expression of a gradual genotype from the molecular level to the individual level, there is often a link between a numbers of phenotypes at different levels.

Sanderson and Kim [43] suggest that characters by expressed traits can be divided into two groups: qualitative or non-metric and quantitative or metric characters. The qualitative character is the inherited character of the parent in its derivative that is visible to the invisible, so it can be used as a comparison between the derivative and the parent. While quantitative characters lead to measurable characters that cannot be explained directly through the law of inheritance Mendel. Both of these characters can explain that each organism has its own distinctive features that are always passed down through generations through the process of reproduction [42,44]. A qualitative

character is a feature that classifies each individual into one or more distinct groups of the invisible. Qualitative characters include the outward features of directly-visible individuals, such as colors, shapes, genetic defects, such as the inability to breed and genetic polymorphisms [45-48]. The distinctiveness of qualitative characters is that there are variations that are easily visible or discontinuous.

Schander and Sunberg explain that the quantitative character is a measurable character and shows a continuous distribution in the population. The quantitative character difference in organisms is in the degree or degree of difference. Quantitative characters include length, width, weight, height, life graduation, percentage dressing, which is usually measured in units or units [49-53]. Since the quantitative character is measured, it is often referred to as a metric or numerical character. In one population, the quantitative character is described by the central tendency as well as its distribution around the trend, which includes mean or mean, variant, standard deviation, the coefficient of diversity and distribution. A theoretical normal distribution is described as a bell-shaped curve [54].

Buckley and Chambers argue that quantitative characters are more controlled by the environment. Environment plays an important role in the expression of quantitative characters. The environment affects the production of the individual phenotype so that it varies. The environment is a major factor contributing to the continuous production of quantitative phenotypes in the population. Because the quantitative phenotype raises continuous variation, then a way of studying it by using the variant or diversity analysis contained in the population.

Cameron and Mardulyn [55] reported that each character is assumed to describe its genotype as the color characteristics of the gastropod shell. A genotype produces only one kind of phenotype, otherwise, a phenotype is the result of the activity of a genotype. However, the relationship between genotype and phenotype is influenced by genetic phenomena, such as expression, penetration, and pleiotropic. A genotype can produce various phenotypes because the genotype interacts with its environment during the process of growth and development of the organism. Characters such as body weight, body size, and protein content show a wide range of phenotypes and are numerical [56-59]. To examine the inheritance of quantitative characters it is necessary to see why a character has various phenotypes. Quantitative characters can occur because different genotypes exist in an individual group. This is common when a character is controlled by many loci and involves many genes or polygenic.

There are inherited and non-inherited characters. Inherited qualitative characters are caused by the influence of a single or monogenic gene, while inherited quantitative characters are influenced by many genes or polygenic pairs [60-63]. The inheritance of the quantitative character to its derivatives shows the difference between the individual is not very sharp between good and bad characters. The concept of polygenic is used to explain the formation of quantitative characters. Quantitative characters from many genes with the influence of each gene are very small because each gene segregates according to Mendel's theory [64-69] and is strongly influenced by the environment. Nevertheless, Fisher's explanation still places the genes that govern quantitative characters as abstract because they are only concepts. The proof of the existence of genes that regulate quantitative characters begins to open up after the availability of many genetic markers to enable the creation of a genetic map that reaches most of the chromosomes. Genetic markers are used to indicate the allelic

situation in a particular chromosome part. Allele variation in a genetic marker will be the genotype in the locus on the chromosome [70,71]

Brandon and Burian [72-76] explain that inheritance of character from elder to descendant usually follows certain patterns that are peculiar to each organism. The derived characters show that each species has a specific, almost identical character from generation to generation, even this character has been around since the beginning [77]. For example, gastropods generally have a body covered by a lime shell, different phenotypes for each species. According to Faith [78] and Trueman that the character performance transmitted in its derivatives, there is a difference between individuals although still in one species proportionately. Species diversity among populations will show different variations of individual shapes as well because diversity represents the overall variation of genes, species, environments in which they live [79-83]. Such variations can be either qualitative or quantitative character that can happen to individuals in a species. Variations of diversity are found in almost every character that is easiest to hard to observe, such as color, height, width, weight, volume, size, shape, and response to external or environmental factors. The proportion of the genetic variability to the phenotype variety for a given character can be measured on each derivative or individual [11].

Biomarker as a Material of Taxonomic Characters

Taxonomic characters are the characters or traits or attributes of a taxon that can differentiate or be used to differentiate between another taxon [12]. According to Mayr [42] and Hibbert [84] that every living has its own characters. The characters are very diverse and can cause important differences and serve as distinguishing characters. Each taxon must have characters that cause a different taxon than another, but not every character can be used as a distinction between a taxon and another. There are characters that sometimes have no significant meaning even though they are noticeable. Buschbeck reported that sex between male and female chickens has a different coat color pattern, the age effect between caterpillar, cocoon, and butterfly, then the shape of the body is also different; the influence of the environment, the color of the chameleon's body becomes fluid [85-88]. On the other hand, the dappled pattern on the mosquito's foot is sufficient to distinguish between two groups of mosquitoes of different species, so that the bottles on the feet of the mosquito are said to have taxonomic value.

Sneath and Dunn stated that each taxonomic character has values that can be qualitative or quantitative. Characters related to colors, shapes, patterns and structures are qualitative characters. While characters that describe weight, dimensions such as size, length, and number are quantitative characters. Qualitative characters are more useful in discriminating taxa at higher taxonomic levels above, whereas quantitative characters are widely used to distinguish categories of taxonomies at lower levels under the species.

According to de Queiroz and Poe [89] that only taxonomic characters can be used as taxonomic differentiators and are called taxonomic characters. Taxonomic characters can be used at the level of molecular biology to the population and in the lowest classification hierarchy of species to the widest kingdom. Dolorosa and Schoppe [90-93] explained that there are two main functions of the taxonomic character: taxonomic characters have a function as a diagnostic aspect that means, the character will be the character of the taxon. Thus it will not be wrong with the other taxon, and serves as an indicator of kinship means, with the characters owned can be used to look closely at the kinship relationship between a taxon with another taxon [94-98].

The function of taxonomic character is indispensable in classification activities and species identification because of the main activity of classification and identification is the observation of taxonomic characters of a taxon group.

Duarte and Wagner explain that the use of taxonomic characters must be very careful in taxonomy, which means to be chosen which really has taxonomic significance. It added that in the taxonomy based on morphological or qualitative characters, the characters have no taxonomic meaning, ie the characters caused by differences in age, sex, habitat, season, and diet [99,100]. Differences in age can affect morphological appearance, such as between cowrie larvae, juvenile cowrie, and adult cowrie adult appearance is very different. In addition, the life phases of animals undergoing metamorphosis also show very different performers such as insect larvae and adult forms are also different. Differences in sex can make animal appearances different like male and female guppies. Differences in habitat cause the appearance of animals is also different. Seasonal differences have a major effect on animal morphology as they relate to adaptation for survival purposes. Differences in diet and type of food can cause body color changes for example, in fish the body color is strongly influenced by the type of food consumed [101].

Sokal, Felsenstein and Kirchoff [12,100] explained that the cautious use of taxonomic characters is necessary because among the taxonomic characters themselves have a high taxonomic weight and low. The higher the taxonomic weight, the higher the trust level of the character. High-weighted characters are usually wide-ranging and very stable. In animals there is a vertebra is a taxonomically high-weighted character, on the contrary differences in skin color patterns, have a low weight. The high-taxonomic character is widely used to distinguish taxon on the order category up. Meanwhile, the lower taxonomic character is used more in the lower category under the order. The use of taxonomic characters should also be noted as well as adaptation issues, so as to minimize possible errors. Adaptation can cause character changes. Character changes may occur due to adjustments to the overall environment such as body shape, special adaptation, isolation mechanisms, and adaptation due to competition [102-103]

Regarding the types and kinds of taxonomic characters, [12] say that many taxonomic characters, but generally can be grouped into groups of qualitative or non-numerical and quantitative or numerical characters. Qualitative character groups include morphological, physiological, behavioral, ecological, geographic, biochemical and molecular character. While the numerical character groups include: meristics, morphometrics, and geometric morphometrics.

Wagner and Joy [25,104,105] reported that the group of taxonomic morphological characters is the characters of the body parts of organisms that have taxonomic value. Morphological taxonomic characters include external morphological characters, special structures, anatomy, embryology, karyotype, as well as microscopic including cytologic and histological. Lewis [105-107] explain that the outer morphological characters are all morphological characters possessed by the animal as a whole such as body shape, bird beaks, fish fins, the number and shape of certain body structures such as gills, and body color patterns. Specific structural morphological characters are certain taxonomic body structures such as the positions of the genital holes in reptile members, color patterns on the surface of the cowrie shell and the structure of the mouth on insects. The anatomical taxonomic character is an internal morphological structure of an organism such as the number of lungs, the order and number of vertebrae, the presence or absence of fish swimming bubbles, heart

structure, and skeletal structures in frog limbs. Embryological characters are characters that can be observed during embryonic development processes such as the number of dermal layers, the presence of gill slits in the chordate, the embryological phase phases, the reduced structure, and the development of embryos in eggs or not. The taxonomic character of a karyotype is a character at the chromosome level such as the chromosome formula, the structure and the number of chromosomes. The number, size, and shape of chromosomes can have important taxonomic values. Microscopic taxonomic characters including cytologic and histologic are characters at the cellular and tissue level such as cell and tissue structure, presence or absence of specific cell and tissue components, and differences in cell organ and tissue material [108].

Sokal and Mitchell [12,109] explain that the group of physiological taxonomic characters is the characters of physiological organisms. Most physiological characters are difficult to preserve and not easily observed. However, with certain methods and tools, physiological characters can be detected and can be used for taxonomy ie metabolite products such as metabolism results of the body, body secretions products such as secretions of certain glands, and mechanisms of organism response to changes in the environment.

Nelson and Ritson [110,111] explain that groups of ecological taxonomic characters are related to the environment or habitat in which a species lives. Ecological characteristics include habitat, food, host, parasite and population dynamics. Each animal has its own habitat and its characteristic. There is a biota at a glance difficult to distinguish based on observation of morphological characters, but by looking at their habitats, such as clear water, cloudy water, fresh water, seawater or brackish water, the organism can be distinguished. Each animal has a typical feed and feeding type. Existing organisms look very similar, but by looking at the type of food and how to eat it will look very different because it belongs to different species. There is a special relationship between the parasite animal with its host or host. There is a parasite whose appearance is very similar, but because it lives on a different host, it can be used as the basis for differentiating its species. In addition, the host occupied will give a certain reaction when occupied by the parasite, a reaction in the form of resistance to parasites or effects that arise.

Sanmartin and Vav Veller [112] explained that a group of taxonomic character behaviors is a character that arises due to the particular behavior of the taxon group. Behavior is closely related to the living environment of both biotic and abiotic. The behavior of the breeding season and eating behavior of several organisms varies. There are organisms that look very similar, live mixed in one colony, but at the time of breeding season the two types will only look the difference because the behavior of marriage dance is shown very different because it belongs to different types [113].

Lipscomb and Matz [114,115] explain that the group of biochemical taxonomic characters is a character in the form of chemical reaction process and biochemical content of the organism's body. Biochemical characters are also somewhat difficult to be preserved and observed because they require special methods and tools. Each taxon group has a unique biochemical character such as the proximate content and content, ash and mineral content, and enzymatic reactions in the body or secretions, and protein content in various tissues and organs of the body.

Stoeckle [116] and Weeler [117] explain that groups of biomolecular characters are the development of biochemical characters, but are

observed more specifically at the molecular level. The biomolecular taxonomic characters include DNA sequence, RNA-DNA ratio, protein profile, and amino acids. Many organisms are found to have been destroyed larvae or fossilized, making it very difficult to identify them. For the purposes of classification and taxonomy, molecular biology technology is helpful for determining its identity [118].

Grandcolas [119] explain that geographical taxonomic groups of characters are characters that arise from the influence of geographic conditions. Geographical characters are used when associated with zoogeography and macroevolution. Organisms that live in open rivers and underground rivers in caves, exhibit different taxonomic characteristics.

According to Farris [120], the most easily observed taxonomic character is limited to a group of taxonomic characteristics of the general or outer morphology of organisms. With the increasing complexity of taxonomic and identification problems, the use of assistive devices to detect taxonomic characters began to be used. The development of computer science technology at this time, is very instrumental in the observation and measurement of various taxonomic characters that used to be difficult, now started a lot and easy to do with high-capacity microscopy, PCR techniques, various detection tools, and utilization of high-performance computer software [26, 39,40].

Biomarkers as Indicators of Biological Character Performance

Character performance is the appearance or appointment of a character possessed by the individual. The diversity of organismal characters such as morphology, anatomy, physiology, biochemistry, behavior, ecological and geological factors leads to different lifestyles of organisms [121]. According to Beckner and Balakrishnan suggests that in the genetic concept, each species is a genuine population and each individual can mix with its species population. This mixing leads to the appearance of variations in character performance between individuals and increases in proportion to the wider population distribution area.

According to Hibbett [122] that the performance of a species' biological character, with the same genetic material, does not in itself appear appropriately to different individuals in the species population. Character appearance is influenced by environmental factors during individual growth and development process. Individuals with similar genetic material may have different character performance, not only in different individuals but also in different parts of the body in the same individual. Individuals in the juvenile period may differ from those of adults. Biota that lives and grow in closed areas can be different from those that live and thrive in open areas.

Differences in the performance of biological characters in the same group of genotypes are known by the variety of individual phenotypes, whereas the difference in performance at the dominant level caused by different genetic compositions is known by the variety of genotypes. Given the pattern of phenotypic and genotype variations, it would be difficult to define species boundaries based solely on morphological characters, but to be important in monitoring and evaluating character performance on the basis of this pattern [123-126]

The performance of organism's biological characteristics is measured and observed through various indicators or markers [127-130] i.e. morphology, meristem, morphometric, geometric morphology, biochemistry and biomolecular or genetic. The character

performance indicator is an individual identifier that is visible to the eye or detected by a particular tool. Markers of biological character performance show the genotype of an individual, expressed through the appearance of an individual phenotype.

Wiens[131,132] and Smith [133] explains that the performance indicators of morphological characters are the performance of characters that appear on the structure, pattern, and shape of individual body parts. Performance of morphological characters is easy to see and observed with the naked eye to not use aids such as magnifying glass and microscope. The performance of morphological characters has long been widely used by scientists and practitioners to assess and determine the biological status and condition of an individual, such as the color, number, size and shape of a particular organ or part of an individual. Although easy and still widely used, but the marker of morphological character performance is considered unstable and very subjective. In addition, the markers of morphological characters and their numbers are limited, qualitative and to observe it must wait until the character is visible.

Roth [128] and Philipe [127] explain that performance indicators of meristic characters are the performance of individual characters that relate to countable morphological characters or counting methods. Performing character of meristic on gastropod, cowrie not as much as found in fish even study of meristic character very rarely done to the mollusk. Some meristic characters that count such as the number of teeth on the lips of the shell, the teeth on the radula, and the number of a twist on the shell. Although the number of indices is limited, it is considered to be very stable so that it can be a good guide in the taxonomy and performance indicators of the biological character of the biota.

Blackith, Gatesy and Elewa explains that performance indicators of morphometric characters are the character-related performance of variations and changes in the size of body shapes and structures of organisms or measuring methods. Each individual has a specific and different size between one organism and another in the same age group. The morphometric character indicator is based on a set of measurement data representing a variety of shapes and sizes of the biota. Measurements of morphometric characters are used to measure the specific characteristics and relationship of variation in a stock of marine biota populations. The size of the morphemic character is of absolute size and the size of the ratio or ratio depends on the purpose of measurement. The unit of measure used for the purposes of taxonomy and identification is a measure of comparison, whereas for the assessment and monitoring of individual conditions and status are used units of absolute size [134,135].

Bookstein explain that each individual *Cypraea annulus* has different morphometric characteristics depending on geographic, genetic, age, sex, and environmental factors [136]. Distribution and variation of morphometric characters that appear is a response to the physical environment where the species live. Sufficient performance data of morphometric characters is obtained by selecting specimens that are considered to have a stable morphological character. The specimens were used to measure morphometric characters at the juvenile, adult and fossil levels [137-139].

Huson [140,141] suggest that morphometric character analysis of fish has been done, but still little for mollusks, even there is no specific guidance related to the morphometric character of fish or mollusk. Performance morphometric characters in principle measure the characters on certain parts on the body surface of the organism either

directly or digitally with the help of software. Although there is no standard guideline for measuring the morphometric character of gastropods, it is generally measured by the distance of two outermost points to the shell parts such as the length, width, height and weight of the shell.

Duarte, Elewa, Sidlauskas explained that the performance of geometric morphometric characters is the development of morphometric character size by involving the basic method of coordinates as well as mathematical, statistical and computational techniques. Geometric morphometric character indicators are important for describing and analyzing the shape and condition of an individual [142]. Geometric morphometric or GM measurement methods are different from traditional morphometric methods that are considered too little information on the size and shape of the organism. Geometric morphometrics is a morphometric approach in which the size of individual shapes is expressed as geometric coordinates and describes and compares them with mathematical and statistical approaches. The GM method allows each form to be visualized according to size and shape [12] and it is appropriate to investigate the evolution signals as well as the performance of individual characters in groups of organisms [60].

Sokal [12] suggest that the development of statistical techniques of multiple or multivariate variables such as variance analysis, factor analysis, major component analysis, cluster and discriminant analysis as well as the advancement of numerical methods in the size of morphological forms or characters, have led to GM as a new field for modern morphometric studies. Geometric morphometric measurements are not only linear or linear, but their spatial angles, and their coordinate positions depend on the size of the organism. The use of GM has been widely applied to both biological and paleontological organisms. The approach of GM in detecting the performance of organism characters is highly accurate, objective and can be repeated without bias because it is done digitally.

Rohlf explain that geometric morphometric approaches are based on mark marks or landmarks. Landmarks are the points or points the location made on the organism in the form of a digital image or image. The locations of these points are discrete and may serve as the same marker or identifier on all specimens studied. The locations of these points are known as dot-point sequences or anatomic homologous points. Each landmark is expressed as a coordinate position of two-dimensional coordinate X and Y or three-dimensional coordinates namely: X, Y, and Z. Complete landmarks serve as object or organism characters for the purpose of geometric morphometric analysis. For form analysis to be well described, all the features or variables that are not included in the shape, size, location and rotation effects, need to be identified and eliminated.

Lutzoni, Posada [143,144], Avise explained that the biochemical character performance indicator is a macromolecular character that is a major component in living cells such as proteins, sugars, fats, and minerals. Biochemical character measurement usually requires a special tool or method to observe it. Past performance studies of biota use many biochemical character markers, such as for determining blood type or presence of a disease with serological tests. Geneticists often use biochemical characters using an isoenzyme marker. The isoenzyme character is codominant so it can be used in segregated populations with heterozygous individuals [145-147]. Isoenzyme character is quite discriminatory and not easily affected by the environment, but the isoenzyme character is expressed only in time and in certain organs only. In addition, the weakness of the isoenzyme

character is not much in number and the analysis takes time and cost [147].

Kress, Meyer and Barrett revealed that the bimolecular character performance indicator is a character that relies on biomolecular applicative properties such as DNA sequence, RNA-DNA ratio, and amino acid sequence. The biomolecular character is very stable because DNA is innate and highly unaffected by the environment. Biomolecular characters began to be applied since the discovery of restriction endonuclease enzyme, PCR technique and gel electrophoresis technique. Support from the field of computer automation, robotics, and bioinformatics to sequencing techniques makes biomolecular markers a relatively economical thing to do [148,149].

Avise [8] explained that performance indicators of biomolecular characters are used extensively for diverse uses that are usually diagnostic and forensic as DNA fingerprints on forensic evidence; serological testing to determine the presence of certain diseases; genetic map making; marker or MAS assisted selection; description of genetic diversity; analysis of human ethnic kinship relationships; analysis of kinship and taxonomy; environmental quality analysis; as well as analysis of foodstuff content.

Weir and Meier explain that the performance indicators of individual characters at the molecular level are the analysis of DNA and RNA material. A variety of rapid DNA analysis methods have been identified and found to be based on specific targets such as to target the entire genome used by AFLP by Savelkoul 1999, RAPD by Power, 1996, ERIC by Hulton 1991, BOX by Martin 1992, REP by Gibson 1984, and PFGE by Tenover 1995. In addition, DNA analysis methods targeting only a cluster of genes such as ribotyping in operon rm by Khetawat 1999, or for target genes individually used ARDRA by Vogel and T-RFLP by on encoding 16SrRNA, IIR by Garcia-Martinez, as well as mobile genetic elements by Gordon.

Ebach [150] and Beaumont [151] proposed that biomolecular character indicators can be used to analyze the characteristics of molecular genetics, evolution, the linking of specific genes to specific characters, parent search, quantitative characters loci analysis, and revision of classification. Common DNA marker analysis methods such as Restriction Fragment Length Polymorphism or RFLP, Random Amplified Polymorphic DNA or RAPD, Amplified Fragment Length Polymorphism or AFLP, and Microsatellite or Simple Sequence Repeat or SSR.

Goodwin and Beaumont explain that RFLP is a molecular technique based on polymorphism caused by substitution of the nucleotide base, insertion, deletion, or translocation that may occur in the past. RFLP aims to exploit DNA polymorphisms in the genomes of organisms by utilizing molecular marker technology. RFLP techniques utilize specific restriction sites or endonuclease in the genome of an organism. A restriction enzyme is an enzyme that intersects DNA strands on a sugar-phosphate framework without damaging the base, in a familiar order. The sequence of recognition is often a DNA sequence that places the restriction enzyme and cuts on the sequence. The result of genomic cutting using certain restriction enzymes will result in differences in the length of the DNA fragment, which shows the distance from the enzyme restriction sites in an organism's genome. The fragmented genome can then be analyzed according to the research objectives as can be seen whether the target sequence has changed due to the substitution of the nucleotide base, insertion, deletion, or translocation.

Weir, Benzie and Beaumont (2010) explain that the RAPD method is able to detect the nucleotide sequence by using only one primer. The primers will bind to the single strand of the one genome and to the strands of their partner's DNA in the opposite direction. As long as the primary attachment site remains at an amplified range in general no more than 5000 base pairs or bp, it will obtain amplification DNA products [152,153]. According to Simmons [154,155] that RAPD is widely used to analyze the diversity of genetic traits in various studies with consideration, among others, not requiring background knowledge of the genome to be analyzed, primers used are universal means can be used for prokaryotes and eukaryotes, which are relatively unlimited, the materials used are relatively cheaper, the preparation is easier, and yields faster results than other molecular analyzes. The use of RAPD is relatively easy, inexpensive, and analyzed at the DNA level, so early detection and selection can be done on the properties of resistance to biotic and abiotic factors, the characters that are quantitative, as well as the existence of duplicate specimens, can be avoided [155].

Goodwin and Beaumont explain that SSR is a simple repetitive sequence of DNA with simple or short repetitive fragments that have the highest variation in the genomes of organisms. This fragment is known as minisatellite or microsatellite. Minisatellite is a repetitive DNA usually between 10-60 base pairs [157-159]. SSRs have fewer repeating units ranging from 1 to 6 base pairs, contained in very large quantities and spread in the genome. Variations of these fragments are the result of changes in the number of copies of the original loop known as the variable number of tandem repeats or VNTR. Because very high levels of polymorphism can be detected with this fragment, VNTR is recognized as a potent tool for fingerprinting and organism identification. This fragment can also be used to study inter and intra-population diversity, ecological studies, calculate genetic distance and study evolution. Short sequences of DNA microsatellites with sequencing DNA sequences are sustainable, allowing many primers designed to amplify specific sites using PCR [160,161]. If these primers are used to amplify certain SSR loci, then each primer will produce polymorphism in the form of different amplification length known as Simple Sequence Length Polymorphism or SSLP. Each polymorphism length represents one allele of a locus [162,163]. Differences in length of polymorphism occur because of the difference in the number of repeating units at specific SSR loci. The diversity of the number of replicates in microsatellite can be detected by electrophoresis of amplified DNA products in standard gel sequences, which can separate the fragments that distinguish each nucleotide. Microsatellite DNA is present in large quantities and spreads in the genome. The general form of repetition of DNA microsatellite is a simple repetition of two bases. Microsatellite DNA with ease and speed using PCR technology, codominant, and easily interpreted makes microsatellite a good marker in gene mapping [164].

Weirsay that the main objective of the study of biomolecular characters is to observe whether there has been a shift in character between individuals in a population. Knowledge of character transfer is important because it can be used as an indicator to determine the life status and performance conditions of an individual in its population in nature ([165]. Biomolecular characters are used as the basis for the classification of individuals in a population, phylogenetic construction, parent search, identification of markers of a particular nature, and revise the taxonomy of organisms [166].

Benzie [166], Terry and Whiting [167] and Sorensen [168] proposed that biomolecular characters serve as indicators of the genetic diversity

of individuals or populations of a species. This genetic diversity has significance in assessing and monitoring the stability and fitness resistance of a population. Loss of genetic diversity will reduce the species' ability to adapt to environmental change. Genetic diversity has a direct and indirect impact on population, community and ecosystem performance [169]. Information on genetic diversity is very important to determine the level of individual fitness in the population so that the management of genetic resources in the population can be sustainable and sustainable.

Conclusion

Understanding the meaning and limitations of a marine organism's biomarkers is essential and fundamental. Not only for the sake of disease diagnosis or to the extent of the molecular level, but rather for the wider use of the material as a taxonomic character and guidance of character performance of a marine biota and as a marker in early detection of the condition and quality of biota in marine waters. Since the biomarker encompasses all the features, sizes, elements and products possessed and produced by a biota, it is necessary to conduct research to utilize all biomarkers on an individual in relevance and validity.

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