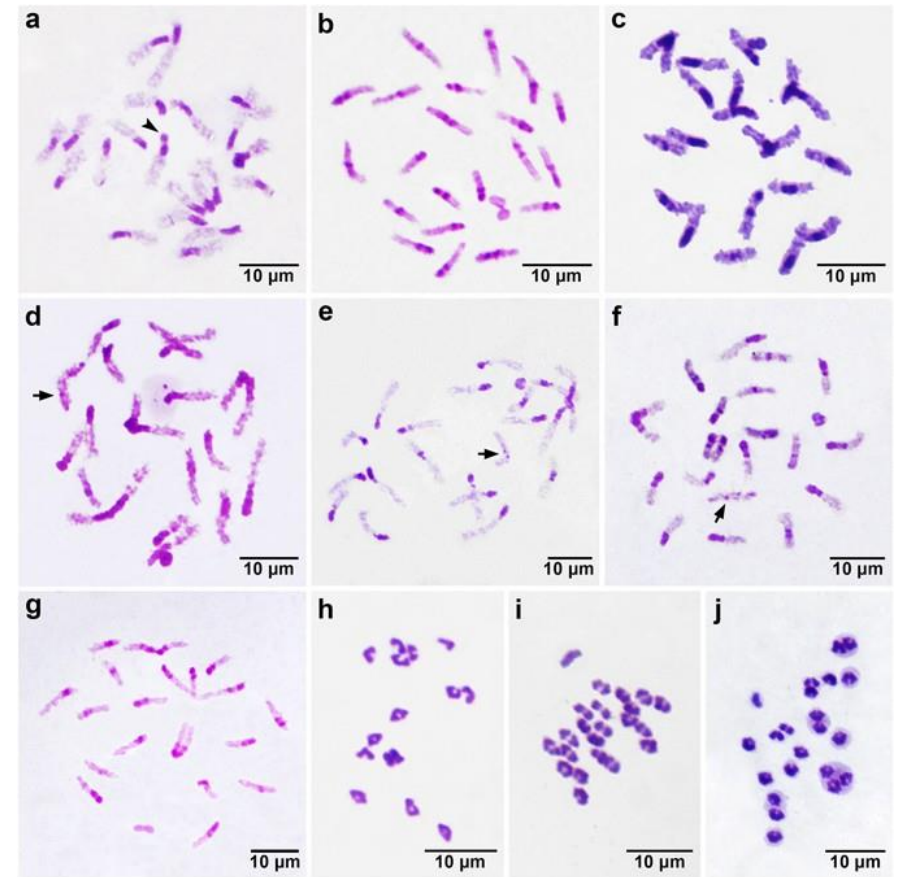
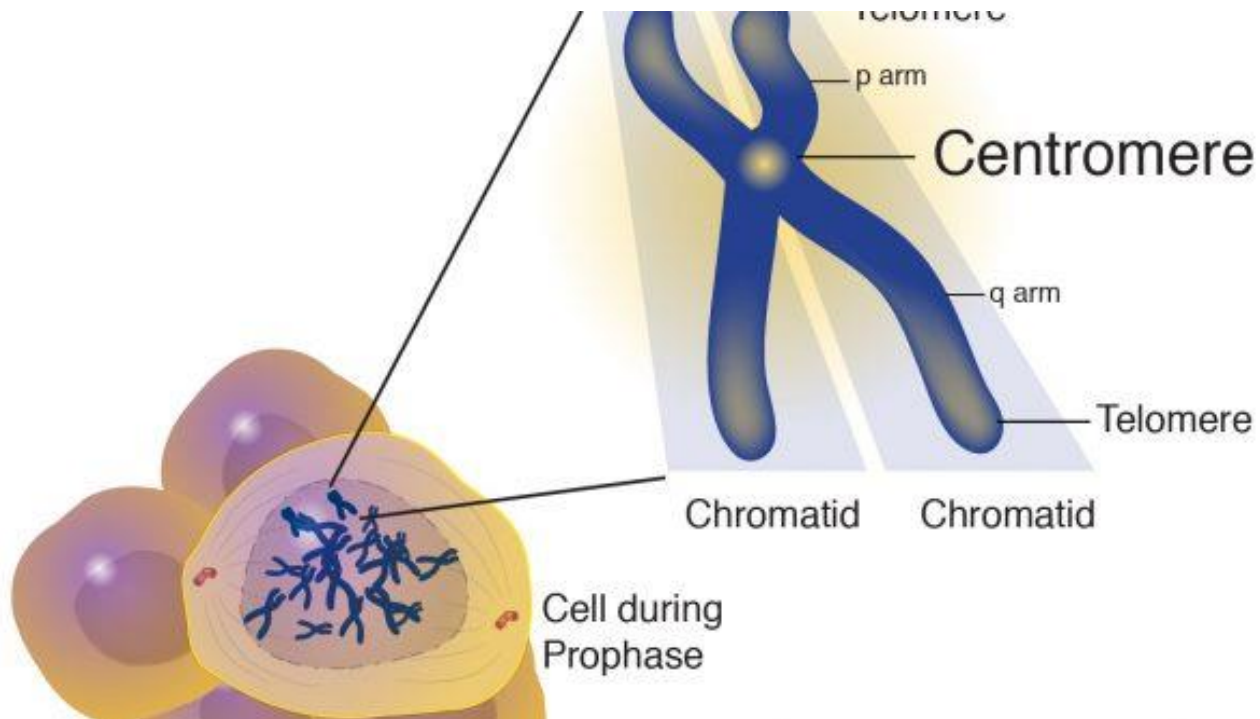


Methodologies in Systematics

Cytotaxonomy



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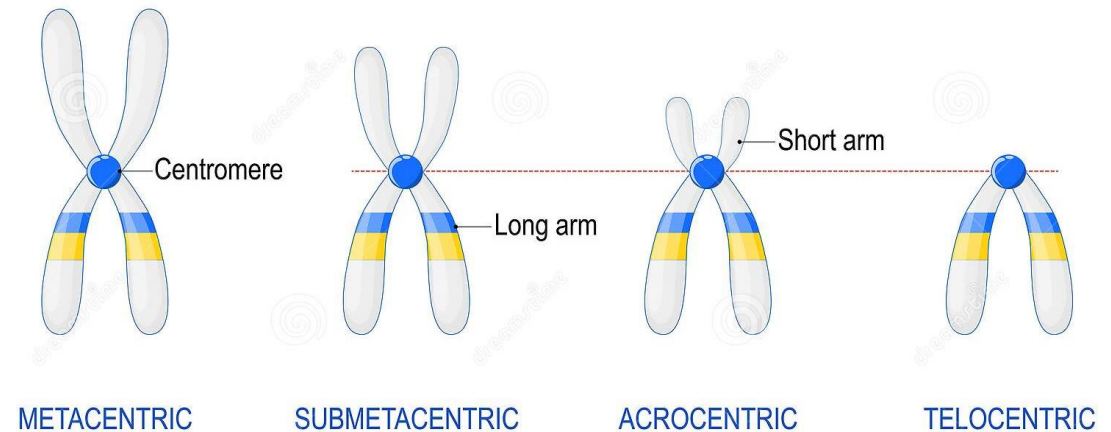
What is Cytotaxonomy

- It is the branch of taxonomy in which organisms are classified according to their chromosomes number, structure and behavior.
- Cytotaxonomy deals with classification and relationship of organism based on their details comparative chromosome analysis



Cytotaxonomy

- Chromosome numbers are determined at the stage mitosis and most cell types carry two sets of chromosomes($2n$) i.e. diploid.
- Depending on the position of centromere chromosome are classified into some categories i.e. Metacentric, Sub-metacentric, Acrocentric, and Telocentric chromosome.
- Position of the chromosome is an important taxonomic character.
- Cytogenetic studies represent both structural and functional homologies among taxa based on their evolutionary conservation.



Cytotaxonomy

- **The number, structure, and behavior of chromosomes is of great value in taxonomy, with chromosome number being the most widely used and quoted character.**
- **Cytology has contributed to tracking the evolutionary history of many organisms, especially primates and flowering plants.**
- **The diagrammatic representation of karyotype is termed as Idiogram.**

Chromosome number

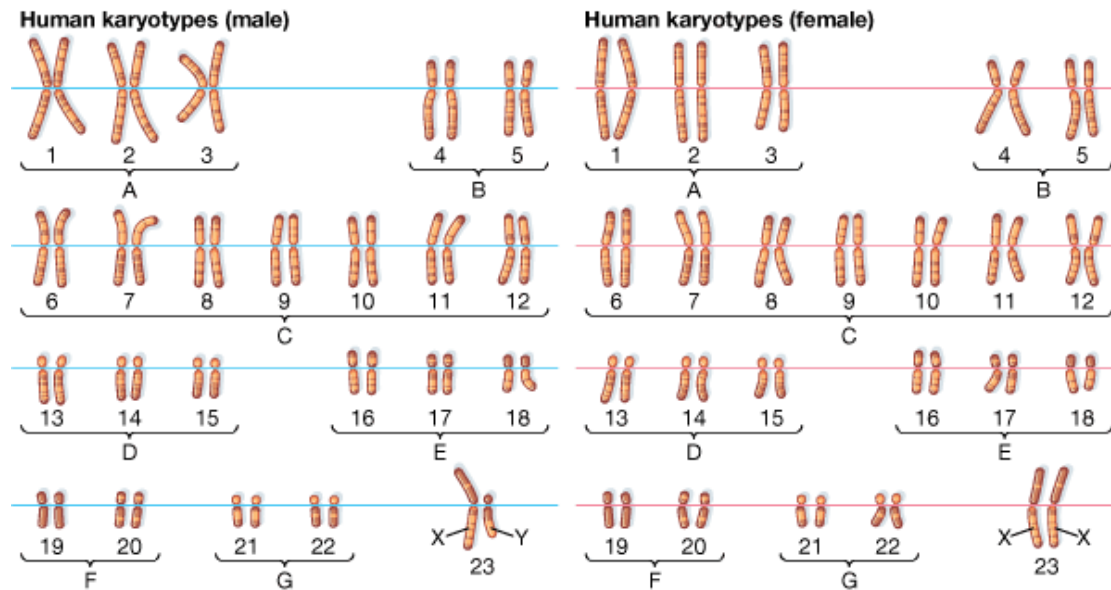
➤ Euploidy

✓ Monoploidy (n)

✓ Diploidy ($2n$)

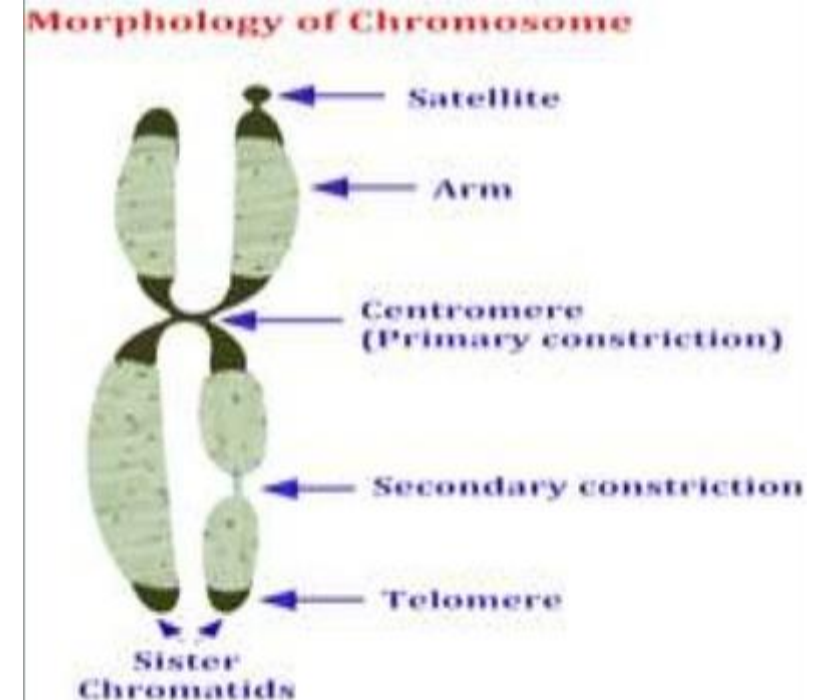
✓ Polyploids (different species of Aster have $n=9$ or $n=18$ or $n=27$)

➤ Aneuploidy (different species of Brassica bear $n=6,7,8,9$, or 10)



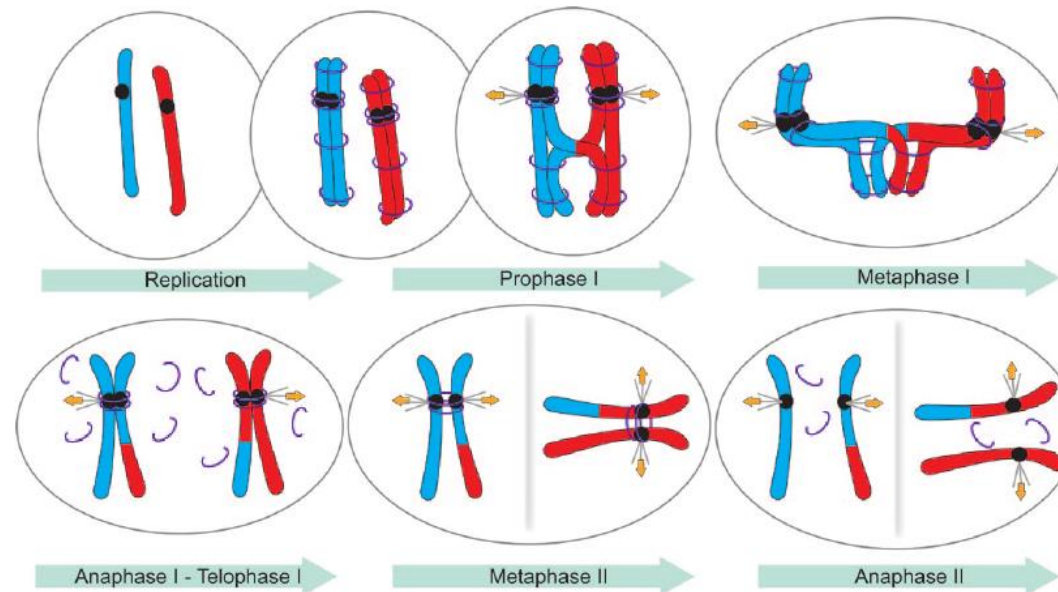
Chromosomal Morphology

- Relative length of the arms of the chromosomes, position of the centomere, presence of satellites, etc. are some character of taxonomic significance
- A secondary contraction may be present near the terminal end of a chromosome, separating its small segments called satellite.
- Chromosome may be symmetrical and asymmetrical



Chromosome Behavior at Meiosis

- Degree of sterility and occurrence of hybridization are determined by the behavior of chromosomes during meiosis
- Abnormalities in meiosis, such as non-pairing, crossing over, unequal interchanges or translocations, bridge formation, lagging chromosomes etc. have all proved to be systematic value.



Significance of cytotaxonomy

- **The role of cytotaxonomy is very important in taxonomic studies. Cytotaxonomy is more significant than physiological taxonomy because it is the comparative study of chromosomes at the molecular level.**
- **Small changes in chromosomes can be detected among the individual.**
- **Chromosomes are constituted by the DNA, variation in the DNA leads to change in chromosome which ultimately causes variation among the individual, species, genus and everything.**

Comparative Chromosomal Analysis

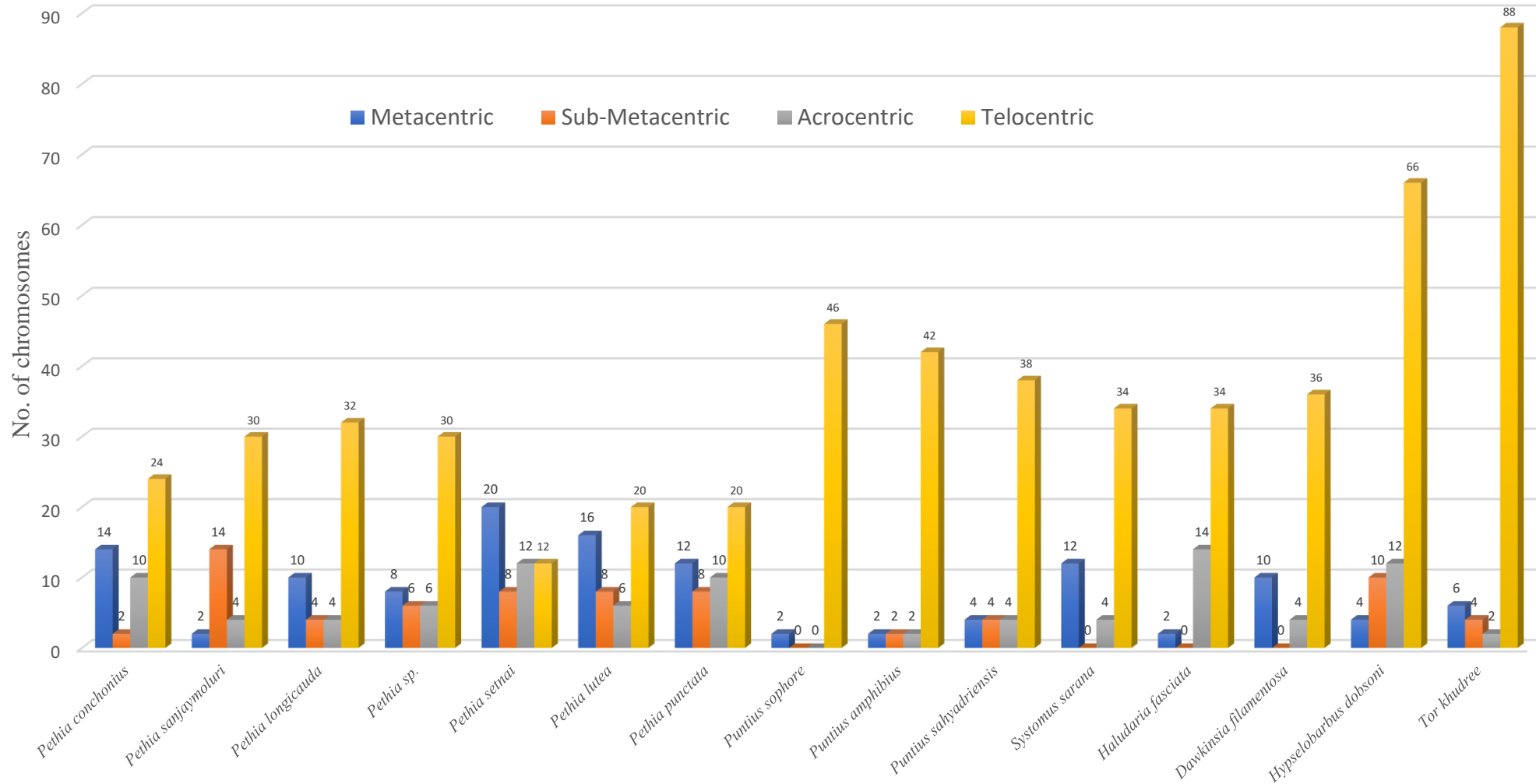
- In present study, 15 barb species were karyologically studied, of which 11 species karyotypes is reported first time.
- In *Pethia* genus $2n=50$ no. of chromosomes is with a dominant exception of *Pethia setnai* ($2n=52$),

Sr no.	Name of fish	M	Sm	A	T	Total no.
1	<i>Pethia conchonius</i>	14	2	10	24	50
2	<i>Pethia sanjaymoluri</i> *	2	14	4	30	50
3	<i>Pethia longicauda</i> *	10	4	4	32	50
4	<i>Pethia sp.</i> *	8	6	6	30	50
5	<i>Pethia lutea</i> *	16	8	6	20	50
6	<i>Pethia punctata</i> *	12	8	10	20	50
7	<i>Pethia setnai</i> *	20	8	12	12	52
8	<i>Puntius sophore</i>	2	0	0	46	48
9	<i>Puntius amphibius</i> *	2	2	2	42	48
10	<i>Puntius sahyadriensis</i> *	4	4	4	38	50
11	<i>Systomus sarana</i>	12	0	4	34	50
12	<i>Haludaria fasciata</i> *	2	0	14	34	50
13	<i>Dawkinsia filamentosa</i> *	10	0	4	36	50
14	<i>Hypselobarbus dobsoni</i> *	4	10	12	66	92
15	<i>Tor khudree</i>	6	4	2	88	100

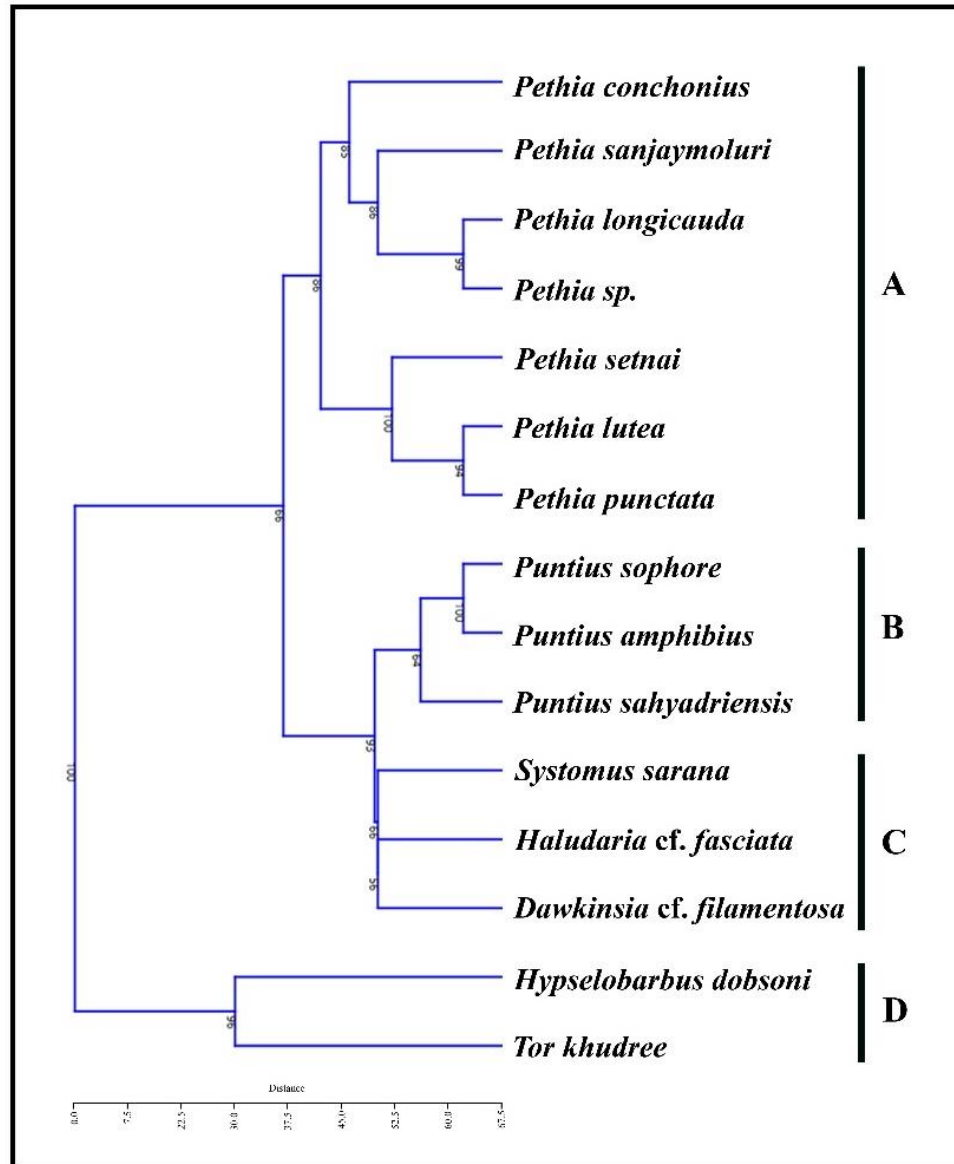
➤ Cytological study in barb fishes showed notable variation ($2n=48$ to $2n=100$) in chromosomes number.

* First report

Comparative chromosomal analysis of barb fish species.



Genetic (chromosomal) similarities between the species



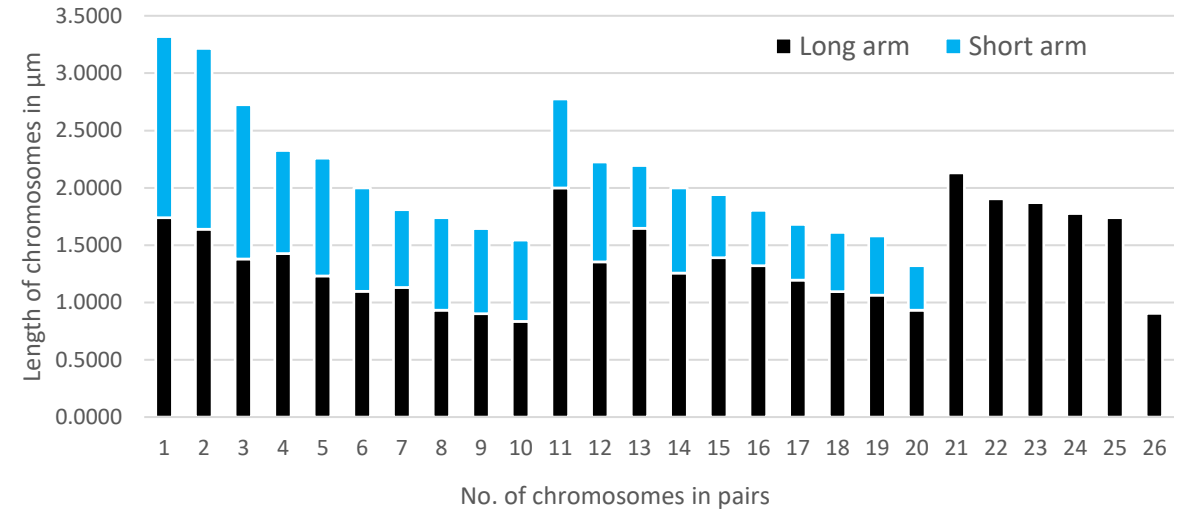
- The dendrogram calculated from the chromosome data showing precise representation of the relationships between different species of barb

The outlining of dendrogram shows genetic similarities between the genera when the bootstrap value is 1000 replications by Paired group (UPGA) algorithm.

Chromosomes Pair	Ls	L1	LT	RL	CI	AR	Chromosome type
1	1.5794	1.7406	3.3200	0.0638	0.5243	1.1020	Metacentric
2	1.5754	1.6397	3.2150	0.0618	0.5100	1.0408	Metacentric
3	1.3443	1.3807	2.7250	0.0524	0.5067	1.0270	Metacentric
4	0.8968	1.4282	2.3250	0.0447	0.6143	1.5926	Metacentric
5	1.0273	1.2327	2.2600	0.0434	0.5455	1.2000	Metacentric
6	0.9032	1.0968	2.0000	0.0384	0.5484	1.2143	Metacentric
7	0.6788	1.1313	1.8100	0.0348	0.6250	1.6667	Metacentric
8	0.8056	0.9344	1.7400	0.0334	0.5370	1.1600	Metacentric
9	0.7419	0.9031	1.6450	0.0316	0.5490	1.2174	Metacentric
10	0.7081	0.8369	1.5450	0.0297	0.5417	1.1818	Metacentric
11	0.5488	1.6463	2.1950	0.0422	0.7500	3.0000	Sub-metacentric
12	0.7744	2.0006	2.7750	0.0533	0.7209	2.5833	Sub-metacentric
13	0.8707	1.3543	2.2250	0.0428	0.6087	1.5556	Sub-metacentric
14	0.7419	1.2581	2.0000	0.0384	0.6290	1.6957	Sub-metacentric
15	0.5497	1.3903	1.9400	0.0373	0.7167	2.5294	Acrocentric
16	0.4835	1.3215	1.8050	0.0347	0.7321	2.7333	Acrocentric
17	0.4846	1.1954	1.6800	0.0323	0.7115	2.4667	Acrocentric
18	0.5152	1.0948	1.6100	0.0309	0.6800	2.1250	Acrocentric
19	0.5159	1.0641	1.5800	0.0304	0.6735	2.0625	Acrocentric
20	0.3863	0.9337	1.3200	0.0254	0.7073	2.4167	Acrocentric
21	0.0000	2.1300	2.1300	0.0409	1.0000	0.0000	Telocentric
22	0.0000	1.9050	1.9050	0.0366	1.0000	0.0000	Telocentric
23	0.0000	1.8700	1.8700	0.0359	1.0000	0.0000	Telocentric
24	0.0000	1.7750	1.7750	0.0341	1.0000	0.0000	Telocentric
25	0.0000	1.7400	1.7400	0.0334	1.0000	0.0000	Telocentric
26	0.0000	0.9050	0.9050	0.0174	1.0000	0.0000	Telocentric

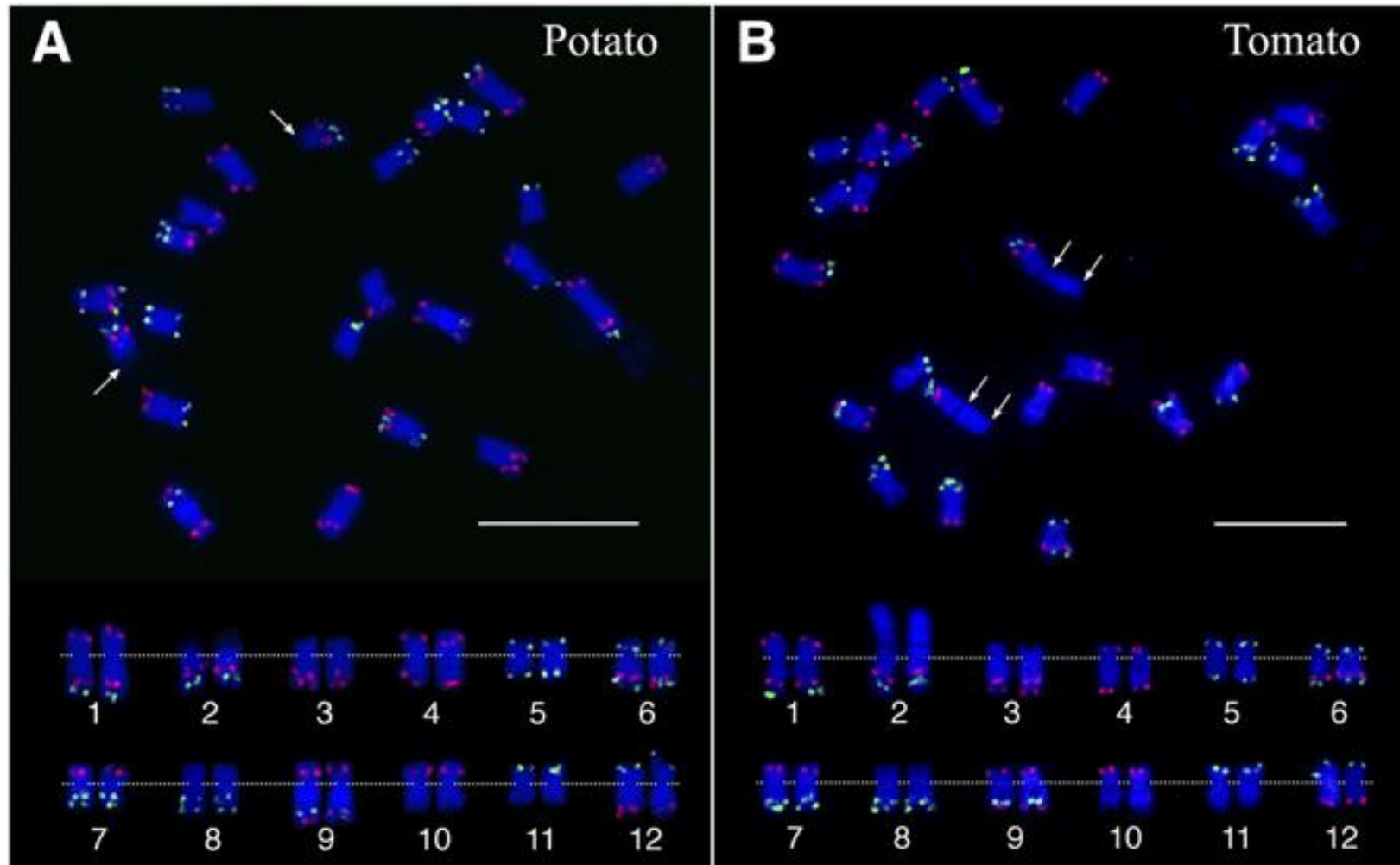
Table- Chromosome morphometric measurements

Ideogram



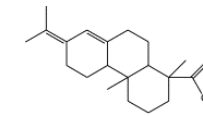
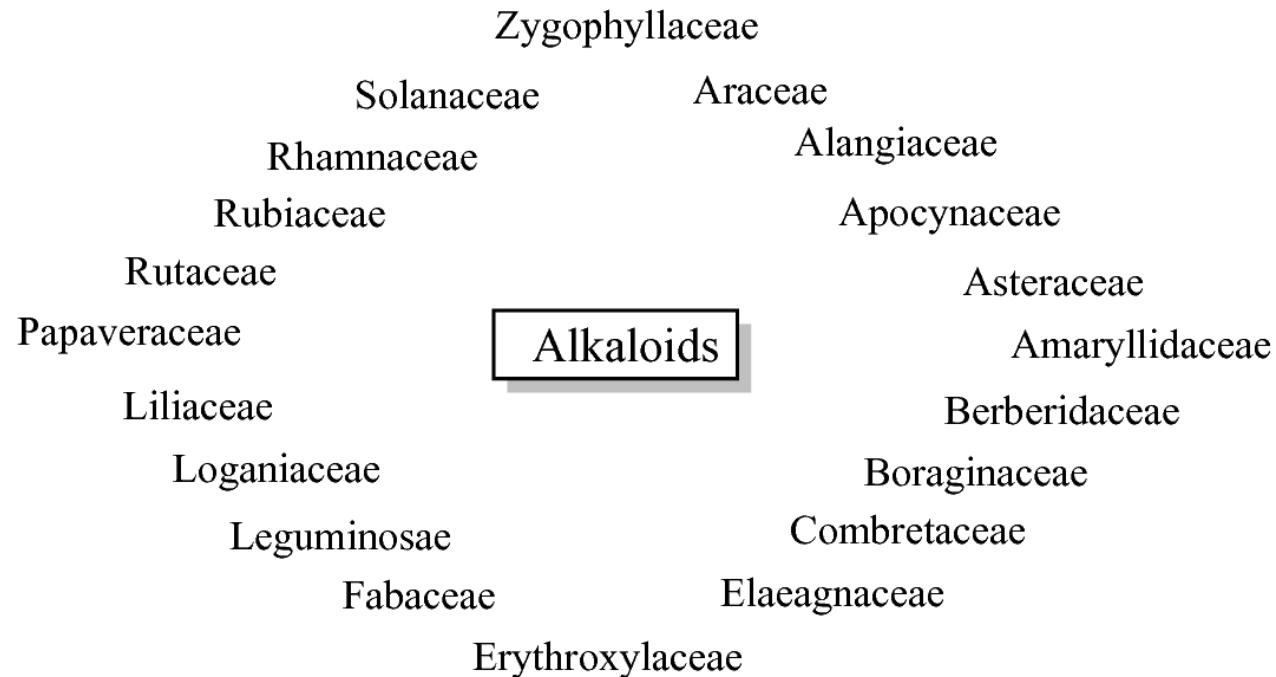
The present investigation is the **first-time report of karyological analysis of species *P. setnai*.**

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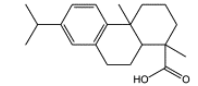


Methodologies in Systematics

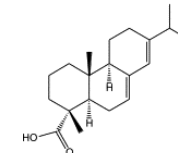
Chemotaxonomy



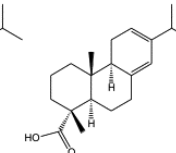
Neobietic acid



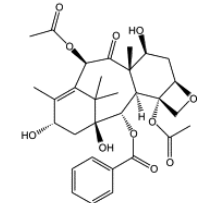
Dehydroabietic acid



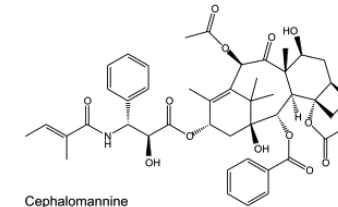
Abietic acid



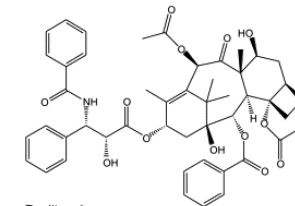
Levopimaric acid



Baccatin III



Cephalomannine



Paclitaxel

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What is Chemotaxonomy

- Taxonomy is the theory and practice of classification.
- This system of classification relies on the chemical similarity of a taxon, i.e. it is based on the existence of relationship between constituents in various plants & animals.
- It is the latest system of classification that gives more scope for understanding the relationship between chemical constituents, their biosynthesis and their possible action.



Purpose of chemotaxonomy

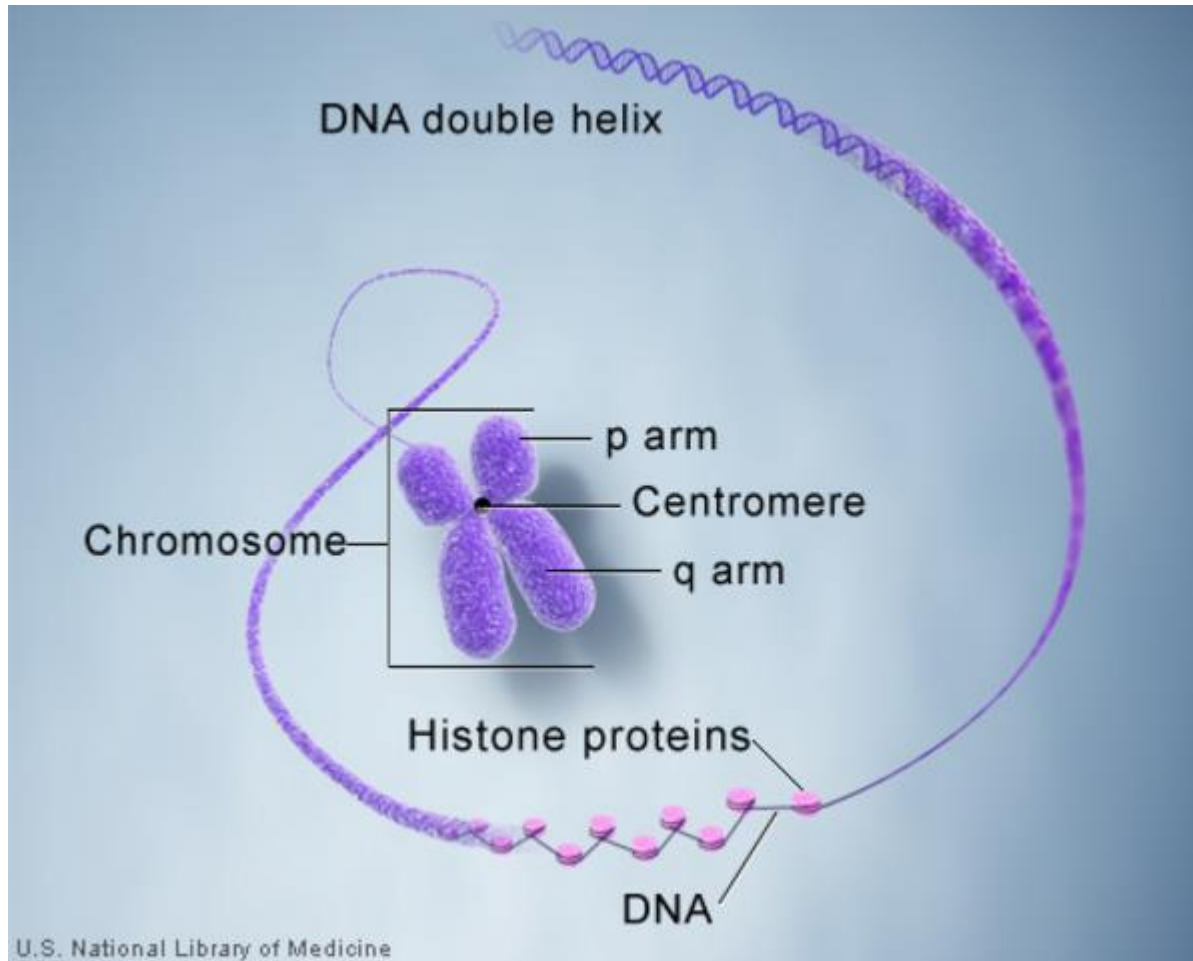
- **1. To improve the existing system of plants differentiation.**
- **2. To develop the present day knowledge of natural relationship of plants**
- **Two broad categories of compounds are used in chemotaxonomy:**
 - ✓ **Primary metabolites secondary metabolites**
 - ✓ **Primary metabolites, are parts of vital metabolic pathways, most of them are of universal occurrence and is utilized by the plant itself for growth and development. Eg: Starch, chlorophyll, aleurone grain, citric acid, aconitic acid, etc. Secondary metabolites present in plant, is used for protection and defence. Eg: Glycoside, alkaloid, volatile oil, flavonoid and plant phenol.**

The following plants are present in plants for plant classification

- a. Non - protein amino acids
- b. Phenolics
- c. Betalins
- d. Alkoloids
- e. Terpenoids and steroids
- f. Crystals
- g. Immunological reactions

Cytotaxonomy & chemotaxonomy

Cytotaxonomy	Chemotaxonomy
(1) Cytotaxonomy is (taxonomy) the classification of organisms based upon their cellular structure and function, and especially based on the number and structure of these chromosomes.	(1) Chemotaxonomy is (biochemistry, genetic) the classification of taxonomy of organisms based on differences and similarities in biochemistry that the organisms base has in common.
(2) Taxonomy which is based upon the cytological information of a cell like its chromosome number, its bacteria etc. is called cytotaxonomy.	(2) Taxonomy which is based upon chemical constituents of plants like DNA sequence etc. is called chemotaxonomy.
(3) Cytotaxonomy is based on the number of chromosomes and their behavior.	(3) Chemotaxonomy based on the chemical constituent of chromosomes.
(4) Cytotaxonomy deals with the relationship and classification of organisms.	(4) Chemotaxonomy only that it is based on chemical constituents/.
(5) The nomenclature used to describe the chromosome morphology was the one proposed by Levan et al.	(5) The method of classification of biology was the proposal by Merriam-Webster.



*Thank
You*