Akvatická ekotoxikologie

Sedimenty

Advantages and limitations of sediment toxicity tests

Advantages

- Provide a direct measure of benthic effects.
- Limited special equipment is required.
- Methods are rapid and inexpensive.
- Legal and scientific precedence exist for use; ASTM standards are available.
- Tests with spiked chemicals provide data on cause-effect relationships.
- Sediment toxicity tests can be applied to all chemicals of concern:
- Tests applied to field samples reflect cumulative effects of all contaminants and contaminant interactions. Toxicity tests are amenable to field validation.

Advantages and limitations of sediment toxicity tests

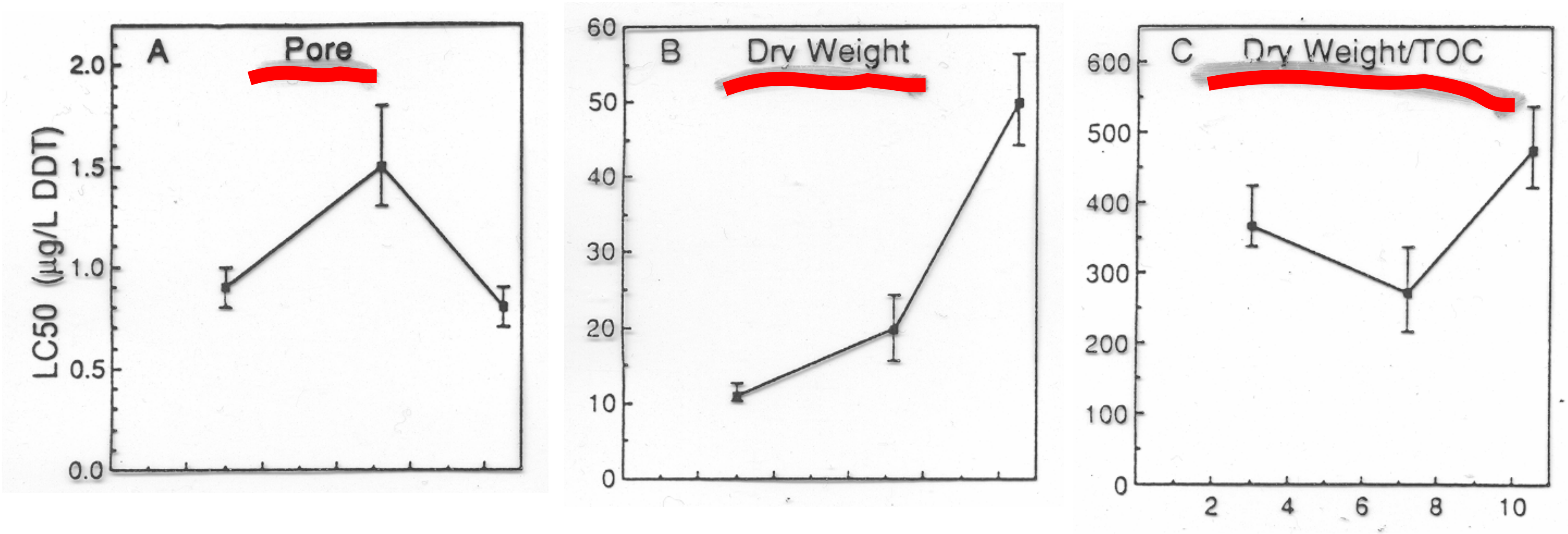
Limitations

- Sediment collection, handling, and storage may alter bioavailability.
- Spiked sediment may not be representative of field-contaminated sediment.
- Natural geochemical characteristics of sediment may affect the response of test organisms.
- Indigenous animals may be present in field-collected sediments.
- Route of exposure may be uncertain and data generated in sediment toxicity tests may be difficult to interpret if factors controlling the bioavailability of contaminants in sediment are unknown.
- Tests applied to field samples cannot discriminate effects of individual chemicals.
- Few comparisons have been made of methods or species.
- Only a few chronic methods for measuring sublethal effects have been developed or extensively evaluated. Laboratory tests have inherent limitations in predicting ecological effects.
- Tests do not directly address human health effects.

Table .7. Commonly used species for whole-sediment toxicity testing

Organism	Endpoint	Test duration (d)	Habitat	Feeding habit
Freshwater				
Hyalella azteca (amphipod)°	S, G, R	28	Burrow, epibenthic	Deposit feeder
Diporeia sp. (amphipod)"	S .	28	Burrow, infaunal	Deposit feeder
Chironomus riparius (midge)"	S. G, E	l4	Tube dweller	Suspension and deposit
Chironomus rentans (midge)"	S, G	10	Tube dweller	Suspension and deposit
Hexagenia limbata (mayfly)`	S, G, V	10	Tube dweller	Suspension and deposit
Ceriodaphnia dubia (cladoceran)	S, R	7	Water column	Suspension feeder
Daphnia magna (cladoceran)"	S, G, R	10	Water column	Suspension feeder
Lumbriculus variegatus`	S, G, R	28	Burrow, infaunaU	Deposit feeder
Tubifex tubifex	S	28	Burrow, infaunal/epibenthic	Deposit feeder
Salt water				
Rhepoxymius abronius (amphipod)r	S	l0	Burrow, infaunal	Deposit feeder, predator
Eohaustorius estaurius (amphipod)"	S	10	Burrow, infaunal	Deposit feeder
Ampeiisca ubdita (amphipod)`	S, G, R	20	Tube dweller	Suspension and deposit
Grundidiarela japonica (amphipod)`	S, G	10	Tube dwcller	Deposit feeder
Hyalella azteca (amphipod)"	S, G. R	28	Burrow, epibenthiu	Deposit fceder
Leptocheirus plumurosus (amphipod)	S, G, R	28	Burrow, infaunal	Deposit feeder
Neanthes sp. (polychaetey	S, G, R	85	Tube dwcller	Deposit feeder
Capiteffa capitata (polychaete)`	S, G, R	35	Tube dweller	Deposit fecdcr
Nereis virens (polychaete)'	S	12	Tube dweller	Dcposit feeder

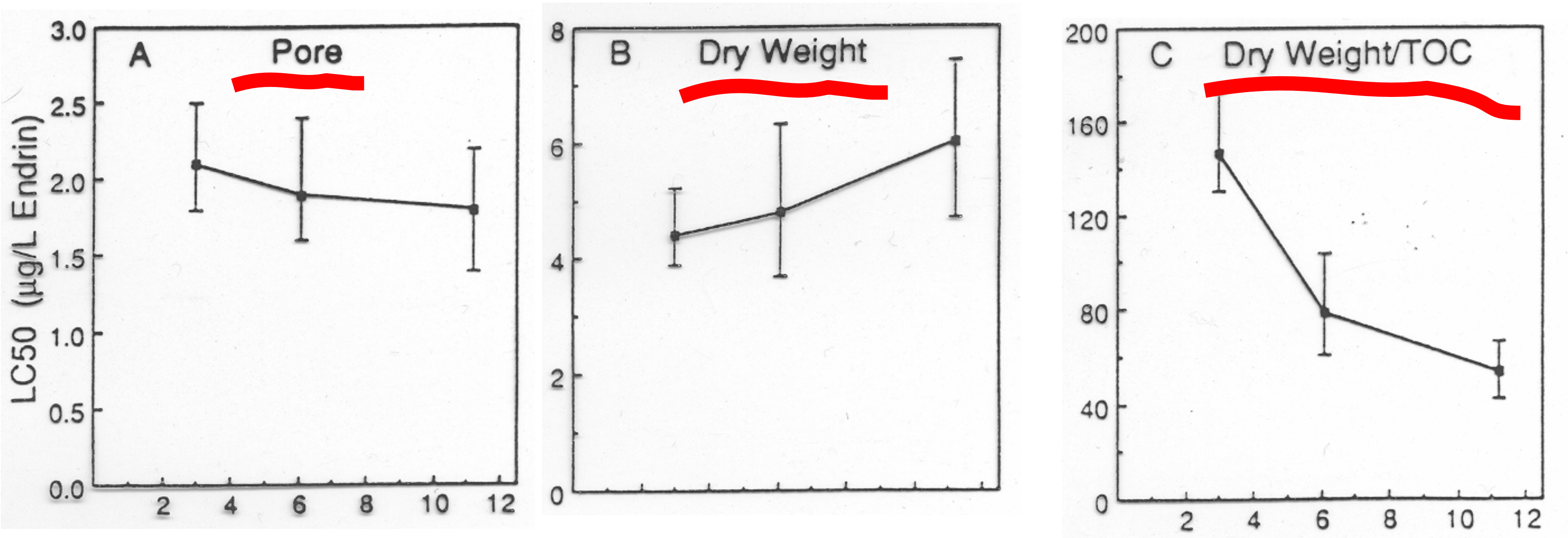
DDT LC50 concentrations and 95% confidence intervals **at three sediment total organic carbon concentrations** for ***Hyalella azteca***.



Percent Sediment Total Organic Carbon (TOC)

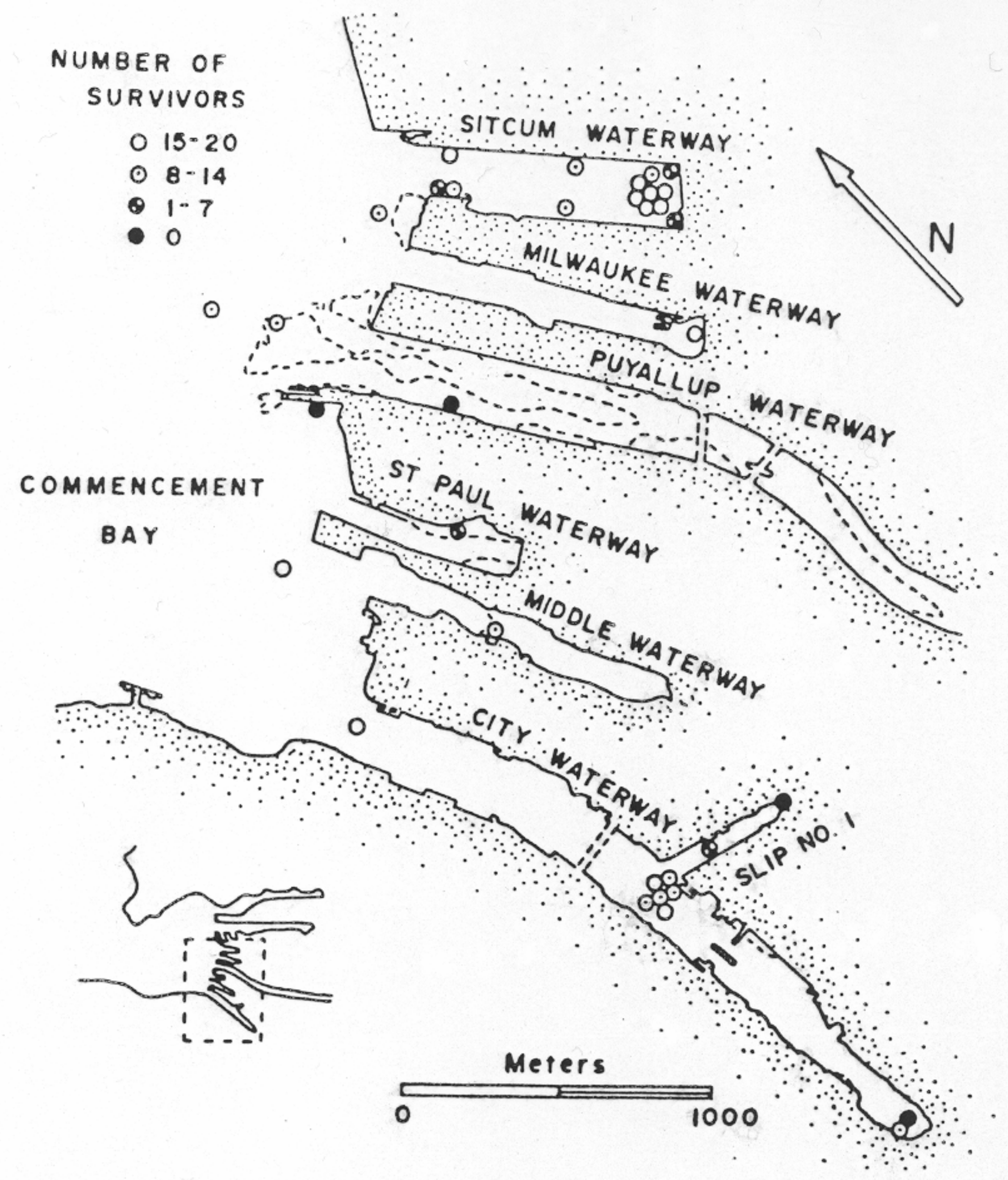
Modified from Nebeker et al. (1989). (Reprinted with permission from Nebeker. A. V, Schuytema, G. S.. Griffis, W. L.. Barbitta, J. A., Carey, L. A.: Effect of sediment organic carbon on survival of *Hyalella azteca* exposed to DDT and endrin, Environmental Toticology and Chemistry, 8(8):705-718. Copyright 1989 SETAC).

Endrin LC50 concentrations and 95% confidence intervals **at three sediment total organic carbon concentrations** for ***Hyalella azteca***.



Percent Sediment
Total Organic Carbon (TOC)

Modified from Nebeker et al. (1989). (Reprinted with permission from Nebeker. A. V, Schuytema, G. S.. Griffis, W. L.. Barbitta, J. A., Carey, L. A.: Effect of sediment organic carbon on survival of *Hyalella azteca* exposed to DDT and endrin, Environmental Toticology and Chemistry, 8(8):705-718. Copyright 1989 SETAC).



Survival of the infaunal amphipod, Rhepoxynius abronius **in sediment** from waterways adjacent to Commencement Bay, Washington.

(Reprinted from Marine Rollulion Ruffetin 13: Swnrtz, R. C., Deben, W A., Sercu, K. A., Lamberson, J. O., Sediment toxicity and the distribution of amphipods in Commencement Bay, Washington, USA, pp. 359-364, Copyright 1982, with permission from Pergamon Press Ltd, Headington Hill Hall, Oxford OX3 OBW, UK.)

Table 6. Mean survival of Rhepoxynius abronius and distribution of amphipods in Commencemenl Bay, Washington and adjacent waterways"

Station	Survival (%)	All amphipods S	All amphipods N	Phoxocephalid amphipods S	Phoxocephalid amphipods N
Commencement Bay Transect					
Deep disposal site (DSI)	86 A	6.4 A	15.4 A	1.2	3
Transect station (DSII)	89 A	5.4 A	12.0 AB	2.4	6.2
Transect station (DSIII)	88 A	5.6 A	18.6 A	1.6	9.6
Transect station (DSIV)	89 A	2.8 AB	6.2 BC	0.8	2.2
Shallow disposal site (DSV)	86 A	2.2 B	3.0 CD	0.5	0.8
Browns Point (B)	76 B	5.0 A	11.4 AB	0	0
Hylebos Waterway (HI)	61 B	1.4 B	2.6 D	0	0
Silcum Waterway (SI)	89 A	1.2 B	1.6 D	0	0
Blah Waterway (LI)	86 A	1.4 B	1.4 D	0	0
City Waterway (CII)	71 B	0	0	0	0

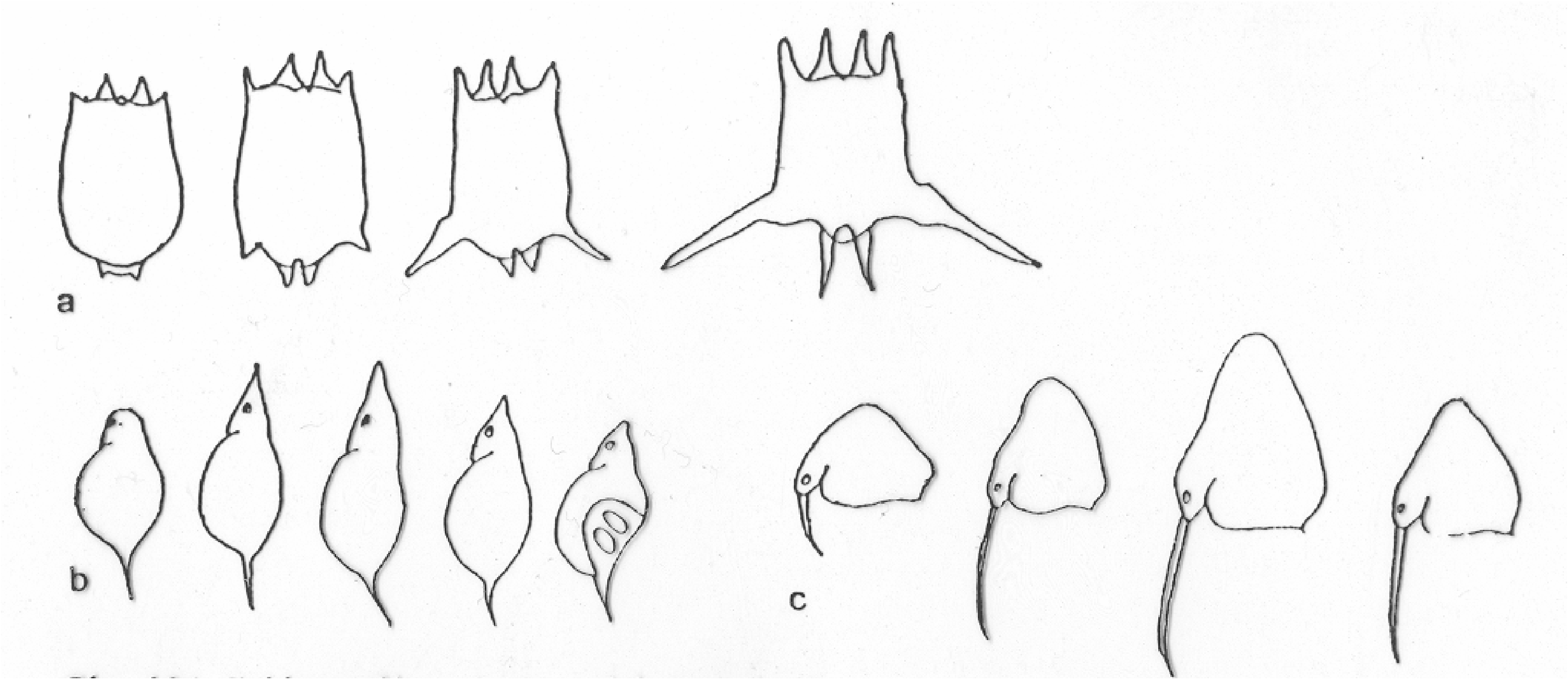
Density data are mean **number of individuals** (N) and mean **number of species** (5) in the 0.1m^2 grab sample. Survival of amphipods in the Yaquina Bay control was 9l%. Means sharing a common letter in each column are not significantly different.

Modified from Swanz et al., 1992.

Table 2. Sediment quality assessment procedures

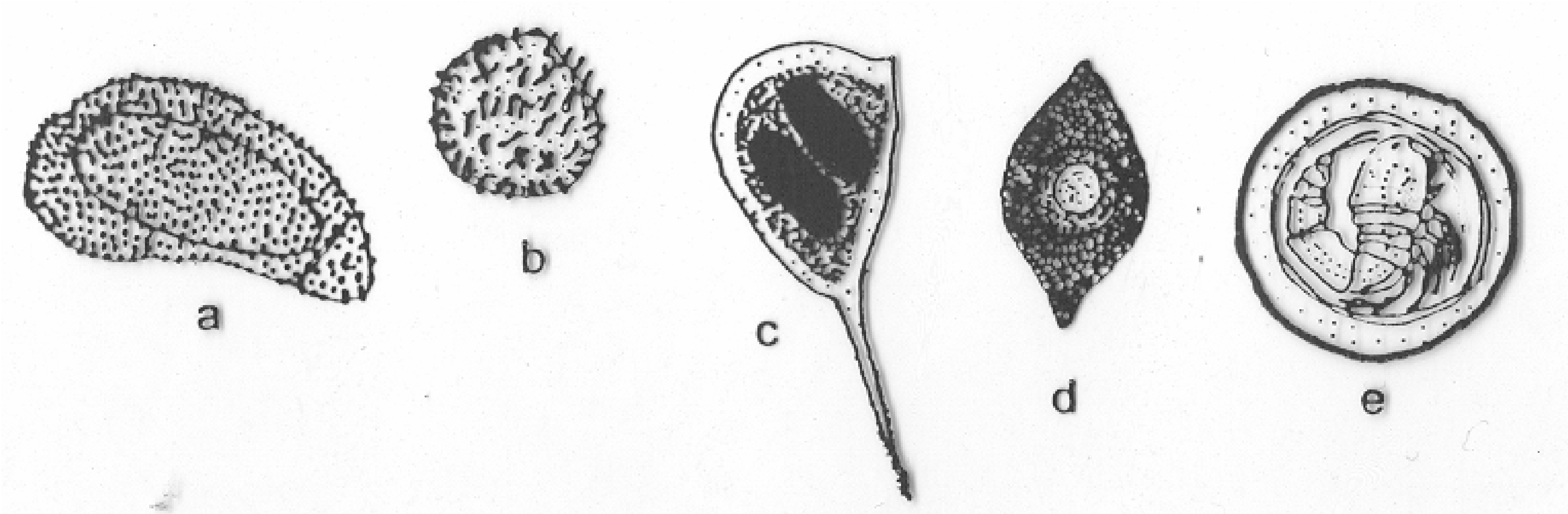
Method	Type: Numeric	Type: Descriptive	Type: Combination	Approach
Equilibrium partitioning	*			A sediment quality value for a given contaminant is determined by calculating the sediment concentration of the contaminant that corresponds to an interstitial water concentration equivalent to the U.S. EPA water quality criterion for the contaminant.
Tissue residues	*			Safe sediment concentrations of specific chemicals are established by determining the sediment chemical concentration that results in acceptable tissue residues.
Interstitial water toxicity	*			Toxicity of interstitial water is quantified and identification evaluation procedures are applied to identify and quantify chemical components responsible for sediment toxicity.
Benthic community structure		*		Environmental degradation is measured by evaluating alterations in benthic community structure.
Whole-sediment toxicity and sediment spiking	*	*	*	Test organisms are exposed to sediments that may contain known ar unknown quantities of potentially toxic chemicals. At the end of a specified time period, the response of the test organisms is examined in relation to a specified end point. Dose-response relationships can be established by exposing test organisms to sediments that have been spiked with known amounts of chemicals or mixtures of chemicals.
Sediment quality triad	*	*	*	Sediment chemical contamination, sediment toxicity, and benthic community structure are measured on the same sediment sample. Correspondence between sediment chemistry, toxicity, and field effects is used to determine sediment concentrations that discriminate conditions of minimal, uncertain, and major biological effect.
Apparent effects threshold	*	*	*	The sediment concentration of a contaminant above which statistically significant biological effects (e.g., sediment toxicity) are always expected. AET values are empirically derived from paired ticld data for sediment chemistry and a range of biological effects indicators.

Adaptace a oscilace



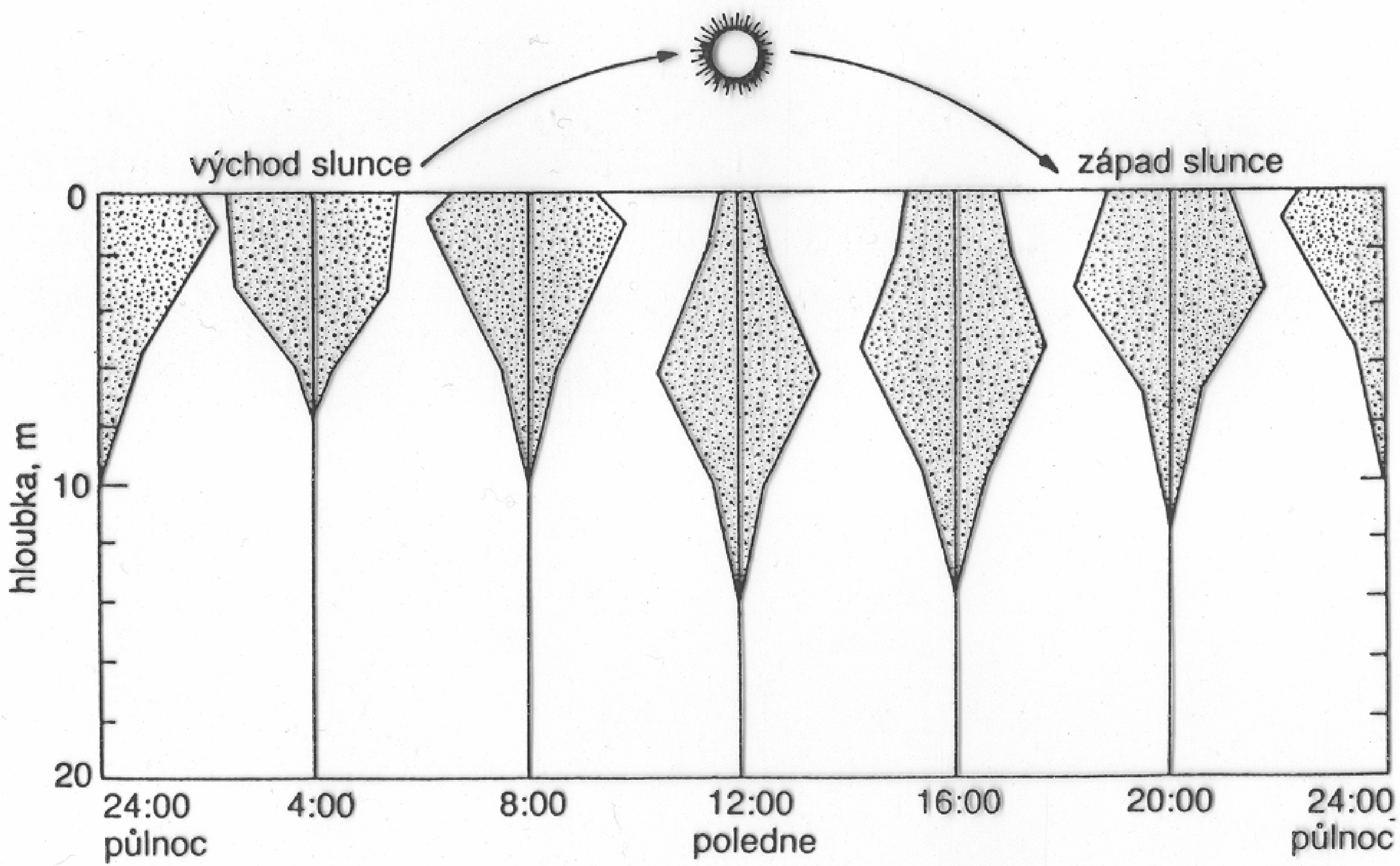
Cyklomorfózy planktonních organismů:

a – vířník *Brachyonus calyciflorus*, b – perloočka *Daphnia cucullata*, c – perloočka *Bosmina coregoni*



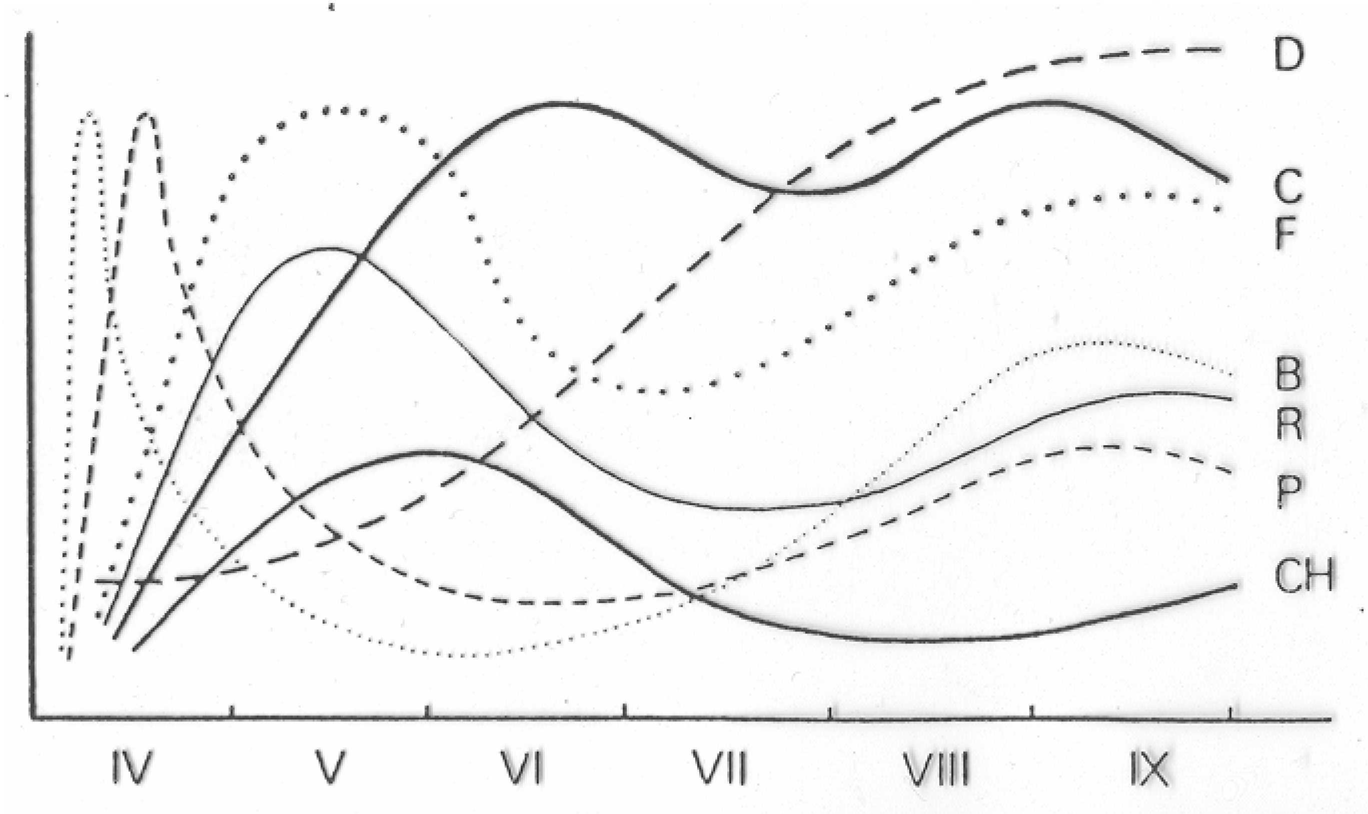
Trvalá stádia vodních bezobratlých:

a – trvalá vajíčka **vířníka**, b – gemule **houby**, c – efipium s trvalými vajíčky perloočky rodu ***Daphnia***, d – statoblast **mechovky**, c – encystovaná **plazivka**



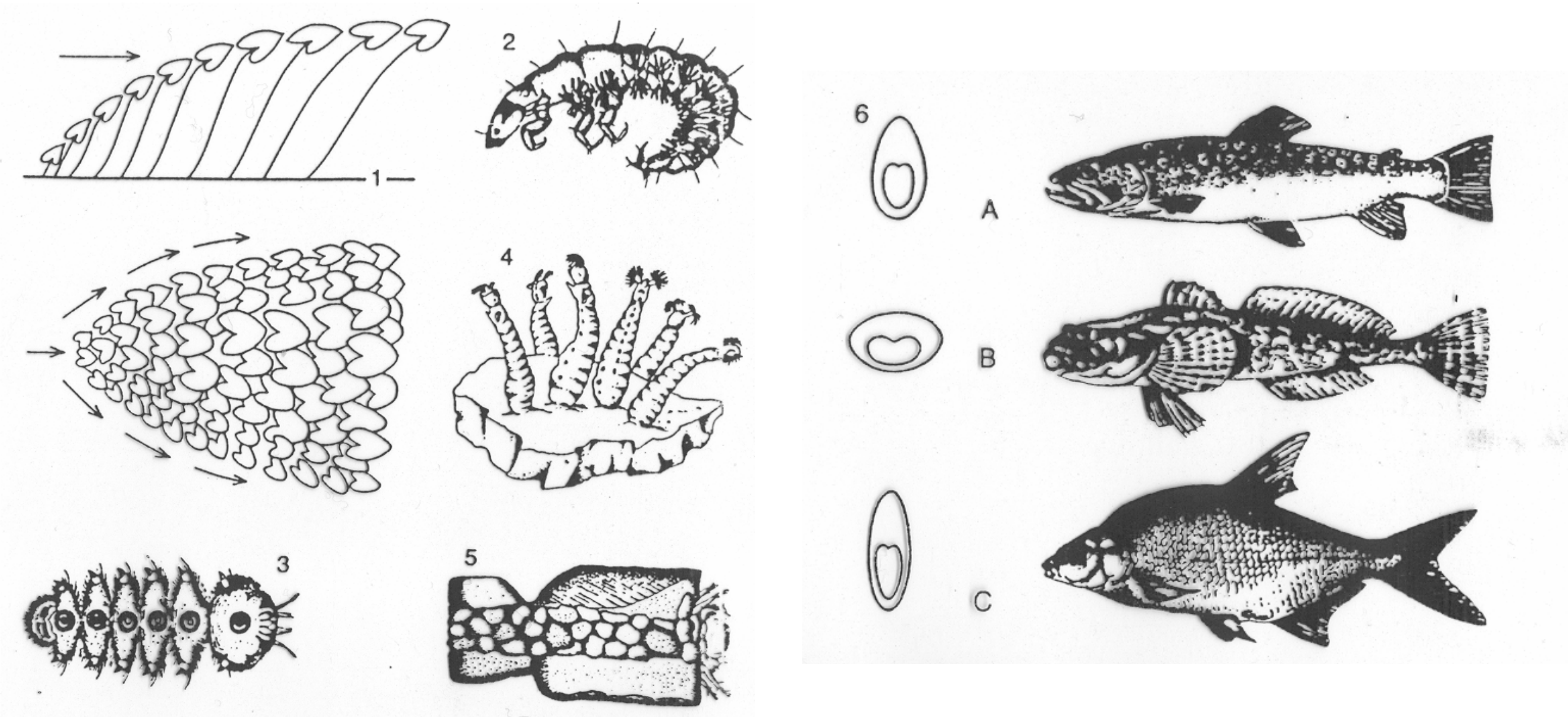
Vertikální **cirkadianní migrace planktonních živočichů**. Po setmění vyplouvají živočichové z hlubších vrstev vody k hladině a po rozednění naopak ze svrchních vrstev vody sestupují do hloubky. Šířka polygonů na grafu vyjadřuje relativní četnost jedinců v různých hloubkách - vztaženo na celou populaci planktontů N (podle Whitekera, 1975)

Sukcese v rybníku s mírně přesazenou obsádkou ryb po jarním napuštění.

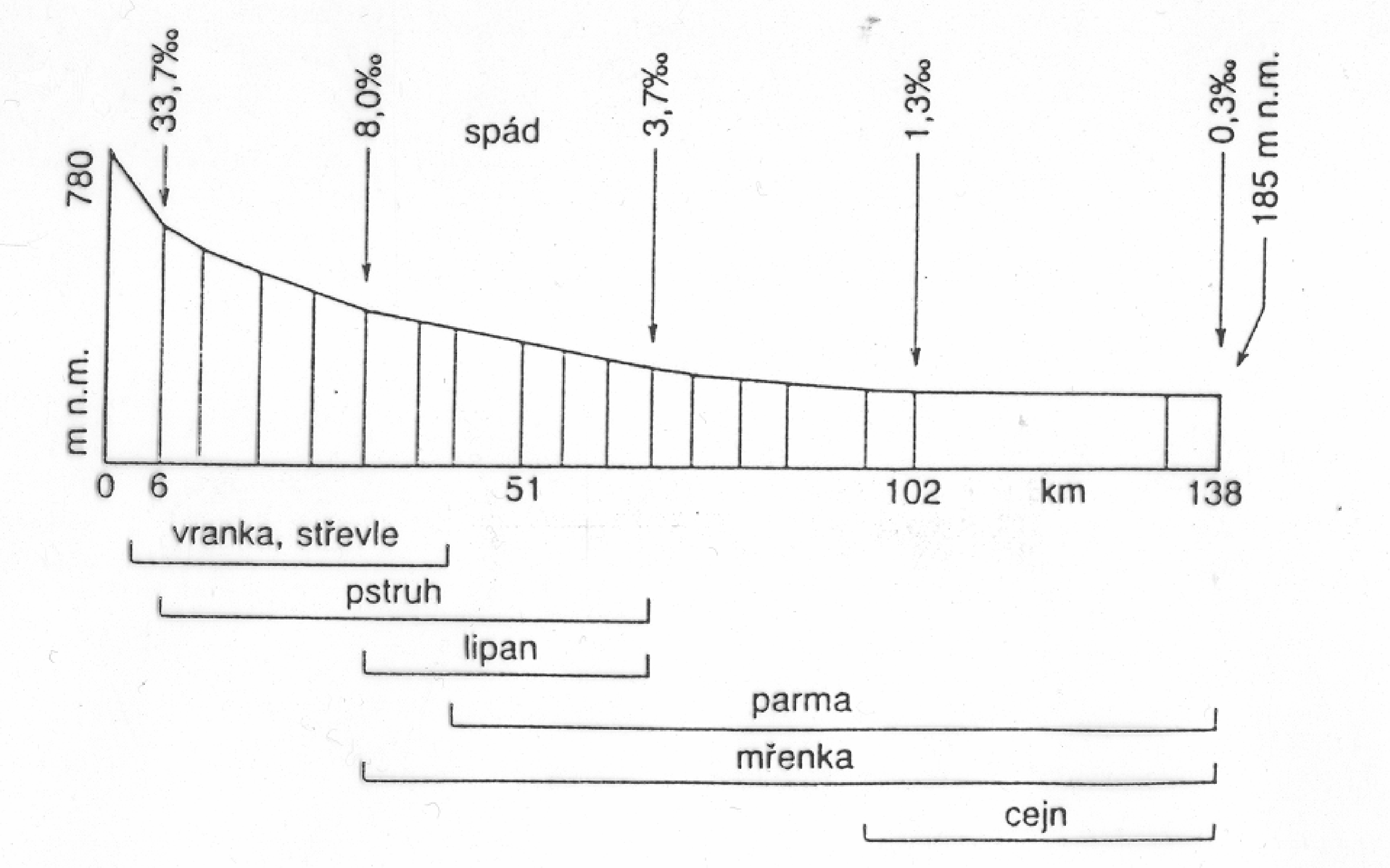


Velikost obsádky je vyjádřena biomasou, množství ostatních skupin abundancí:

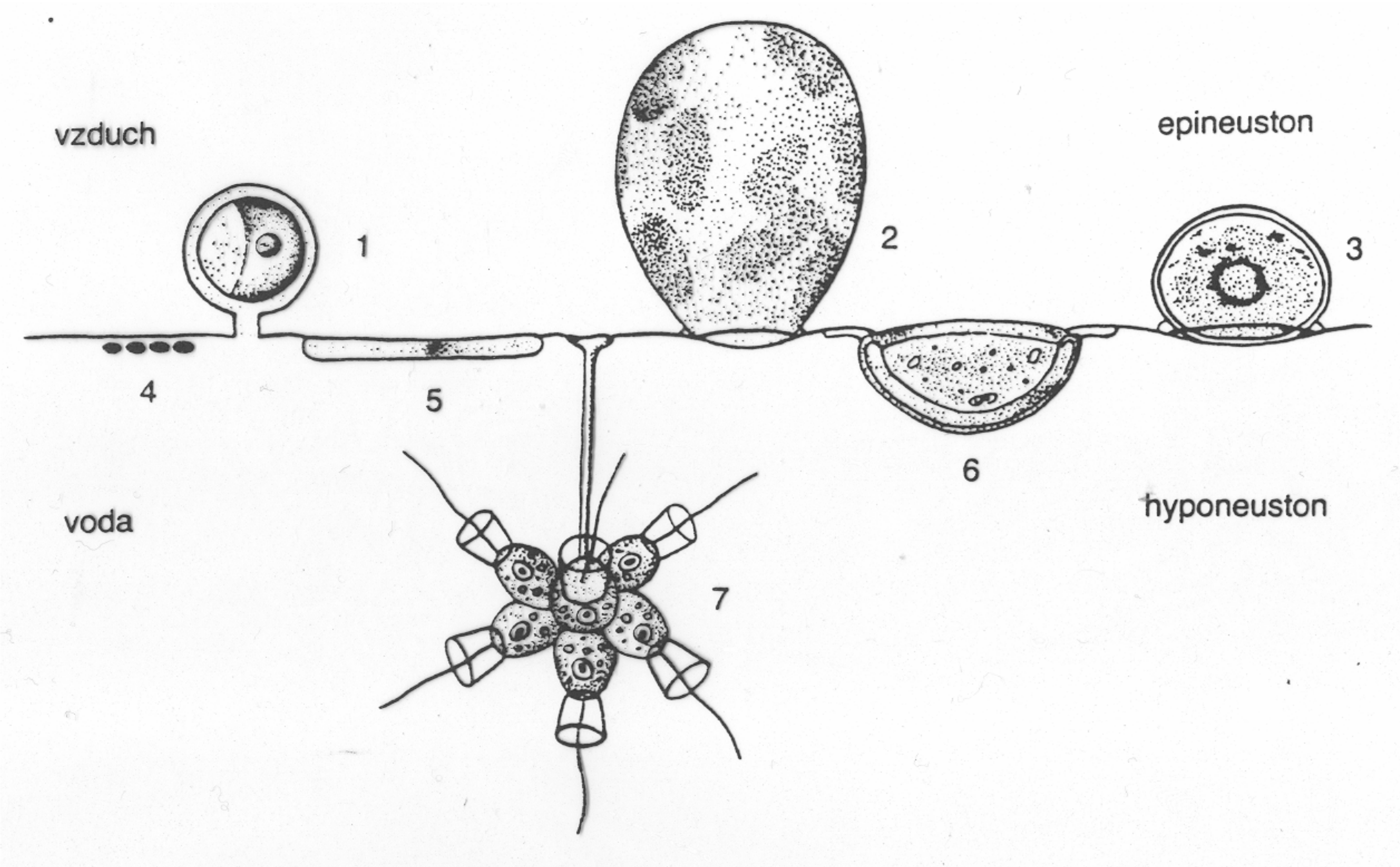
B - bakterie, P - prvoci, P - fytoplankton, R - vířníci, C - perloočky a buchanky, CH - pakomáři, D - obsádka ryb



Příklady různých adaptací organismů na vliv proudění: 1 utváření listů a řapíku *Nuphar luteum*, 2 přichycování k podkladu pomocí háčku na končetinách a pošinkách (larva chrostíka), 3 silně zploštělý typ larvy *Blephanicera* s břišními přísavkami, 4 přidržovácí poloha larev muchniček, 5 boční zátěže schránky larvy chrostíka *Silo*, 6 příčný a podélný profil těla ryb: A lososovitá ryba z proudící vody, B vrankovitý typ těla (dno tekoucí vody), C cejnovitý tvar těla (volná voda pomalejších toků a nádrží), podle různých autorů



Rybí pásma a překrývání výskytu dominantních druhů ichtyofauny na příkladu polské řeky Raba (Starmach, 1956, upraveno)



Ukázka příslušníků neustonních organismů. Epineuston: 1 *Chromatophyton rosanoffi,* 2 *Botrydiopsis arhiza,* 3 *Neustococcus emersus.* Hyponeuston: 4 *Lampropedia hyalina,* 5 *Navicula sp.,* 6 *Codonosiga botrytis,* 7 *Arcelia* sp. (podle Ruttnera, 1962)