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MANGROVE ECOSYSTEMS

A MANUAL FOR THE ASSESSMENT OF BIODIVERSITY

A follow up of the
National Agricultural Technology Project
(NATP.), ICAR.

Mangrove Ecosystem Biodiversity :
Its Influence on the Natural Recruitment of
Selected Commercially Important Finfish and Shellfish
Species in Fisheries

Edited by :
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Estimation of Primary Productivity (Modified Light and Dark bottle Oxygen method)

G.S.D. Selvaraj

Principle:

This method is based on the estimation of dissolved oxygen in the water samples (ml/l) by Winkler's method. Three BOD bottles are used for this purpose. The DO content in the initial (I), Dark (D) and Light (L) bottles with a capacity of 125 or 250 ml after specific incubation period are utilized to calculate the primary productivity. The incubation period various with the nature of water sample such as 3.0 hours for sea water whereas 2.5 hours for shallow estuarine water. The incubation is done in light for the same in 'L' bottle and in dark 'D' bottle, while sample in I bottle is fixed by winkler 'A' and 'B' at the initial stage of experiment. Gross Primary (Photosynthetic) Production (GPP) is determined by using L-D values extrapolated for 12 light hours of the day. Net Primary (Photosynthetic) Production (NPP) of oxygen is obtained from either L-I or 0.8 (L-D) value (calculated for 12 light hours of the day) whichever comes closer to (but less than) L-D value. If the L-I value falls much below 0.8 (L-D) value, it indicates that bacterial interference (other biochemical oxidation process) is more in the water samples. At times, L-I value exceeds L-D value. In such cases , 0.8 (L-D) value should be taken into account to assess NPP.

Reagents required:

All the reagents used in Winkler's method to determine dissolved oxygen (ml/l) in water samples.

Note: Normality of Sodium thiosulphate solution should not exceed 0.005 (for more accuracy).

Procedure:

Filtered water samples through zooplankton filters (0.4mm mesh size) are preferred in Primary productivity experiments to minimise the interference of zooplankton and suspended particles. Water samples are collected in plastic bucket and kept undisturbed for few minutes for uniform distribution of phytoplankton. Collect water samples always in the series of 'L', 'D' and 'I' labelled 125 or 250 ml BOD glass bottles without entangling air bubbles and close the lids gently. The filtered water samples thus collected are set for incubation atleast 30 minutes (30 minutes to one hour) after sampling to bring the micro organisms physiologically stabilized inside the 'I', 'D' and 'L' bottle. Fix the 'I' bottle with Winkler 'A' and 'B' reagents and keep the 'L' bottle exposed to uniform light and 'D' bottle in darkness (enclosed in dark bags or wrap with thick black cloth or any similar material) in the Laboratory or Research Vessel under simulated *in situ* environment at room (normal) temperature during incubation time. Fix 'L' and 'D' bottles after incubation time with Winkler 'A' and 'B' and determine dissolved oxygen values upto three decimal points for 'I', 'D' and 'L' bottle samples.

Calculation:

GPP = (L-D) value in ml O_2/ l per 12 light hours per day

NPP = (L-I) or 0.8 (L-D) value in ml O_2/ l per 12 light hours per day (whichever is applicable)

For uniformity, 0.8 (L-D) per 12 hrs may be considered for NPP.

Conversion factor: 1 ml O_2 released by photosynthesis is equivalent to 0.536 mg C.

Average photosynthetic Quotient (PQ) =1.25

Hence , 1 ml O_2 = $\frac{0.536}{1.25}$ = 0.429 mg. C.

GPP or NPP value of oxygen (ml O_2/l/D) multiplied by 0.429 would give the Primary (Photsynthetic) Productivity value in mg.C/l/d.

Note: If the oxygen value obtained for GPP/NPP is in mg O_2/l , then 1 mg O_2 released = 0.375 mg.C, which , when divided by the PQ(1.25) , would give 0.3 mg.C.

GPP or NPP value of oxygen (mg O_2 /l/d) multiplied by 0.3 would give the Primary (Photosynthetic) Productivity value in mg.C/l/d.

mg.C/l/d = g.C/m^3/d

Primary productivity values of surface water samples are normally expressed in g.C/m^3 /d . If the value is very less, this may be converted into mg.C/m^3/d.

Assessment of column production:

To determine the column production of the euphotic zone, collect water samples at different depths using Casella or Nansen's Water Sampler and conduct simulated *in situ* incubation experiments as cited above. Assess the GPP and NPP values at different depths and calculate the values as follows:

Column Production (g.C/m^2 /d) =

$$\frac{f}{1000} \times \left[\frac{(a+b)}{2}(d_1-d_0)\right] + \left[\frac{(b+c)}{2}(d_2-d_1)\right] + \text{——————}$$

where, f = Factor = 1 (for *in situ* and simulated *in situ* experiments.)

a,b,c,d = GPP/NPP values in mg.C/m^3/d.

d_0, d_1, d_2, d_3 = Depth in meters (d_0= surface)

1000 = To convert mg.C into g.C. value

Note: For shallow culture ponds (less than 2m depth), half the surface production (GPP/NPP) value (g.C/m^3/d) is considered as the Column Production of the pond (g.C/m^2/d).

Suggested References

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