i ;| iuyÿr

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MEPA

World Ocean Day 2018

i; iuÿr

Prevent Plastic Pollution and Encourage Solutions
for a Healthy Ocean

iuøh mßir wdrCIK wêldßh

uyje, ixj¾Ok yd mßir wud;HdxYh

ixi ldr l uKv,h

WmfoYl ; jh	(	ßh¾woñrd, ^úYdñ l&frdyK fmf¾rdwd¾tim"ùtiù"htim iNdm ; - iuøh mßir wdr l l K wê ldßh wdpd¾h m' î ' g¾k m§m ludr idudkHdê ldl - iuøh mßir wdr l l K wê ldßh c . ; . Kfi l r l<uKdl re$ fufyhï
ixi l rKh	(	; , ; dYk rK ixy iy ldr l<uKdl re^n i kdy r $ jhU& iuøh mßir wdr l l K wê ldßh
ixi l rK iydh	(	t*' ler , k fj frdk ld iy ldr iuø mßir k , Odß iuøh mßir wdr l l K wê ldßh m'wd¾' iOk wfÉlGdwf ír ; k iy ldr iuø mßir k , Odß iuøh mßir wdr l l K wê ldßh ti'tï'Èk lhdw ; f ldr , iy ldr iuø mßir k , OdÍ iuøh mßir wdr l l K wê ldßh t't ï' . ïukm , iy ldr iuø mßir k , OdÍ iuøh mßir wdr l l K wê ldßh ví ,õ'B'f l' úfÊixy iy ldr iuø mßir k , OdÍ iuøh mßir wdr l l K wê ldßh Ô'ví'Èk l ld l reKdr ; k l<uKdl rk iy ldr iuøh mßir wdr l l K wê ldßh
mg l jr ie l iu	(	B'm' o¾Yk kj k ; , l r ; k iy ldr iuø mßir k , Odß iuøh mßir wdr l l K wê ldßh
mldYkh	(	iuøh mßir wdr l l K wê ldßh fkd' 758" f í i , hk mdr" f l d<U 09'
ISBN	(	2279-3208

ixi ldrl igyk

id.r mßirhb;d ikor jjdl fuku th ñ, l, fkdyel iïm; / i lkhl ; jjl nj wmoku' ku; ±k th f.dvìu yd id.r lgh; fy;fjk lufhk ¥lKhg ,l ù we; nj meyeÈ,h' fï ¥lKhk yd mdßißl .eg¿ j,g m<hï fidhk ji 2017 foieïn¾ 01 f lkhdfõ khfrdì kjr§ meje;j tl i; cd;kf. mßir iu¿fõ§" iuøh m,diál fy;fjk id.rh ¥lKh jk wdldrh yd th me;Í we; wdldrh m<n|j fuu lfl;h m<n| úfYl{ hkf. úfYl wjOdkh fhdu lrñk idlÉPd f lreK'

jd¾ll j id.rhg m,diál fuál fgdk ñ,hk 4'8 - 12'7 l mudKhl tl;jk nj f idhdf.k we;'m,diál nE."wirk"ëjr wdïmkk" keõ yd hd;d iy f.dvìñk neyer lrk fkdfhl; m,diál klmdok wj idkfh uyÿm;f, ;ekm; ù fyd uyÿ c,fh mdfjñk mj;' we;eï i:dk j, m,diál øjH l÷f,i uyÿm;f, f.dv .ei we;' tfuku iuyr id.r Ôùk fuu wmøjH j, meg, ñh hh'

iuøh m,diál ¥lKh m<n|j m¿, f,i y÷kd .ekul iÿ ù we;; tu úYd, wNfhd.hg úi÷ï fiùfï wNfhd.h"ny-uyKjr .eg¿jl ixl¾K ;djh yjdolljh' tkï id.rh m,diál ¥lKfhk je<elùu i|yd iuld,k id.r md,k lufõohk iú{dklj fhdod.;h;h'

;k Ndú;d m,diál" llø mudKfh yd kefkd-m,diál hk f;hdldrhu m<n|j wjOdkh fhdu l,h; nj;"tjd fjr< l,dmhkf. muKl uod yeÍu m<n|j wjOdkh fhdu lÍu mudKj; fkdjk nj; ie<l,,g .;h;h' rg wNHk;rfh we; c, ud¾. j,g m,diál øjH tl lÍu j<l jd.;h; nj; mOdk jYfhk wjfndO lr.;h;h'

tfuku id.rhg tl jk m,diál mudKh"mj;k m;pl lrK lufõo" kej; Ndú;h fuku m,diál fy;fjk id.r Ôùk yg iÿjk úkdYh m<n|j; rgl ck;dj fydÈk ±kj; úh h;h' fï m<n| we; k; lhd;ul ùfï§ tjdg wk.; ùu ;,k rgl ck;djf. ukd iyfhd.fhk fj<| fmdf< we; m,diál wju llu" iú, iudch i; j.lul' tfuku jHdmdßlhk i; j.lu jkfk khñ; mñ;kg wkl, jk mßÈ tjd klmdokh lÍu; kej; m;pl lrKhg fhdu lÍu; u`.k ;;jh md,kh lr .ekuh' k; lhd;ul lÍu; wjYH wk.yholjñk ;dlIKl myilï ,nd§u; ;,k fuu lhdoduh úêu; f,i ixúOdkh lÍu rchl i; j.lu jk we;'

2018 ck 08 fjk Èkg fh§ we; c.; id.r Èkfh f;udjg wk.; fjñk wmo m,diál j,k f;dr id.rhl mj;jd .ekug;" id.r mßirhg we¿ï lrñk yd ih¿ fokdf. iyfhd.fhk id.rh i / lug; wem lem fju' i; iuÿr

mgk

; ,uik m<n| úYñ; f;dr;re iy Tjk keröfï wmrew;oelu

uyfoo k, ; ,ufil ±lu wm fndfyd fofklg iykhlu muKh' flfklf. Ôú; ld,fh§ tjek tl ; ,ufilg jvd olkkg yel ùu jdikdjk;hk lymfofklg muKl yñjk ÿ¾,N wji:dj l' ; ,uik myl yhl jgj fndÜgjl iàu hk b;d .duNr uyÿ .ukl w;±lul fuku th ; ,uik ydTjkf. iuømßirh i/ lu fjkfjk fmk iàug wmj Èß.ekùul'

fckúõ fcdkik
ixrlll

2003 § Y ,xldj wdY; uyÿ mfoYfh o iuø Clrmdh ixrlllfhl yd kfõÈldjl jk fckúõ fcdkik wef. z.duNr uyÿ .ufkZ w;±lu ,enjdh' f,dj mrdmyá i:dk lymfhk Y ,xldj tjek Wii w;±lul ,ndÈh yel tl rgl' tfiu Y ,xldj t iïnkOfhk kul Èkd iákfk fndfyd uE; ld,hl igh' tf;l ihji .Kkdjl igY ,xldj wdY; ; ,uik" fvd,*k yd uyÿ llrmdhk m<n|j ëjrhk" fjr<dY; jeihk" úfoi kdúlhk" ; ,uik fidhd hkkk yd ijNdúl úoHd{ hk muKl okkdryilj mej;K'

áh,m .fõlKh yd cd;Hk;r iu¿fjk mij Y ,xldj m<u jrg fï úlh iïnkOfhk wjOdkhg ,l úh'2009 jif¾o iú, w¾nofh kudj; iu`. Y ,xldfõ uyÿ llrmdhk keröu l,máh" ñßii" .d,, yd ;lKdu,h hk uyÿ mfoYhk j, kej; wdrïN úh' j¾;udkfh§ Y ,xldjg meñfKk úfoYlhkf. lhdldrlï ,ehi;j, by<u ;ekl" ; ,uik keröug yñù ;fí'

uyÿ llrmdhk wkdjrKh lÍu

ifÜihk uyÿ llrmdhkf. mßKduh iÿjkfk óg jir ñ,hk 50lg by; mej; bfhdik h.fh igh' fuu i;;j flдÜGdYh Yl;u; fomd iy;j fmd<fõ Ôj; j i;;j fldÜgdYhl' mßKdufh§ flfuk mdo ke; ù ; ,uik f,i uyog ixluKh ù we;f; u,§ ih¿u ijmd i;k f.dvìug wkj¾;kh jjdl fuk' fuu udxY Nlll uyÿ nv fjfik llrmdhk Zmlfigi Z (Pakicetus)f,i ^mli:dkfh fmdi, j¾.hlk fidhdf.k we;& yÿkjk w;r" Tjk k;k ; ,uikf. mfNohk iòyd bjy, jkkg we;'Zmlfigi Z(Pakicetus) n,f,lf. yd lgifilf. ñY; yevhl we; i;;jhl jk w;rhï wdldrhl lru,hl fyd lÿnjl Wryij,olkg ,enfjl'

k;k figik yd ifrkhk hk uyÿ llrmdh f.d; folum¾K f,iu c,c jdik fõ' idudkHfhk Tjkf. YÍrh iug yeve;" ;¾lrEm ^;¾ljl yevh .;& f,i jeã we;' tfy; tl tl j¾.hk wkj fjki yevhk yd mudKfhk hl;h' iuyrekg È. mimi ^mDlÁh& jr, we;u; iuyrek yg flá jr, fydjr, ry;úh yel¡

figik u;iHhk Oej wdY; id.rfh ig krllh wdY; id.rhk oljdo tfuku .x`.d wY;j fudh j,oÔj; jkolkg ,efí'

ifÜihk u;iHhkf. fmdÿ ,llK(

- my ifjk myku i`oyd yev.ei K È.áW, j uLh ^fydïn fydWv ykj& iu. iugwkdl , yeve; YÍrh
- yi uÿfky i:dmkh jK kdi mv jdiÿre f,i mej;u'
- yk mfoYfh by< fldgfi we; iúfYl bkøh" (melon) meyeÈ, f., l fkdue; ùu'
- c,fh fõ.fhk bÈßhg ;,¨ ùug wjYH Yl;u; jr, myàu'
- yei rùu yd k;rùu i`oyd bÈßmi .d;dmev, fyd * ,mr ^fuh <h jr, f,io yÿkjh& wdldrhg mej;u
- mg; mimi .d;d fkdue;' ^wjYlg mgmi .d;d fmkkï l<; tjd fld÷ weg fm< yd iïnkO ù fkdue;&
- YÍrfh f,du wv fyd fkdue; ùu kid thc,.;l ld¾hllu;dj jeälrh'
- b;du; >K fïo ;Ügjl (blubber) iug we;,;k myàu kid YÍr WlK;jh r\ mej;ug WmldÍ fõ'
- wei" uLh yd lk j, myàu c,fh Ôj; ùug wkj¾;kh ù we; w;r tu ,llKhk f.dvìu fjfik llrmdhkf. olkg fkd,efnh'

fuu bkøh wkj¾;khkg wu;rj ny;rhl figik llrmdhk yg uyfob;d .eUre mfoYj, jeä fõ,dj l lñ§ug yelhdj l we;' Tjkf. fuu wkj¾;k w;r ldnkvfhdl ihâ jdhj ord iàfï wêl yelhdj;" .eUre uyfo we; oejek; mvkh ord iàug yel mßÈ Wri lyrfh we; yelhdj; úfYl;fõ'

idukHfhk ;,uid" fvd,*k yd u,,k w;r we; meyeÈ, fjki kï úfYl; úYd,;jhh' wfkl; mOdk;u fjkil ï f,i ie<lh yel fl nf,k ;, fyd o; we; nj" yevh fyd my< ykfõ we; o; ixLHdj" fydïn mfoYfh Wi fyd c,h úirúh yel Wi yd fydun mfoYfh yevh fõ' ;,uid yg o; fyd nf,k ;, mygd we;' fndfydu hl o; iy; ;,uik Y ,xldj wjg uyfok yujk w;r Tjkf. Wv wekfoo; oelh fkdyel' ih¨u fvd,*k u; iHhk yg úYd, mudKhl o; we;' Tjk yg W, yeve; o; Wv yd há wekfoo lkg ,efnk w;r ßfidf. fvd,*kf. Wv wekfoo; oelh fkdyel'

nf,k ;, iy; ;,uid yd o; iy; ;,uid

ih¨u ifÜihk u; iHhk Tjkf. uLfh myàu yd fmdlKh ,ndfok luh wkj úoHd;ul ldKv fol lg fnfo' tkï nf,k ;,uik yd o; iy; ;,uik hkfjk' i; ;j úoHdjg wkj nf,k ;,uik Wmf.d;h j Mysticetes ^ñiáiÜi& f,i y`ÿkjk w;r ty j¾.hk 16 l oekg fidhdf.k we;' by< yk mfoYfh ig my<g we; nf,k kï j fl lfhdák ;, we; Mysticetes yg o; wju fõ' fmrKh lr wdydr .k ^fmrd nÈkkk&' m,ek lgk" lvd i; ;j m, jdx. fyd lvd u; iHhk wdydrhg .kfk nf,k ;, wdOdrfhk c,h fmrd bj; lÍfuk mijh'

o; iy; ;,uik fyd wfkl; ;,uik fvd,*k uyÿ W!rk" Odontocetes Wmf.d;hg wh; jk w;r Tjk wdydr ,nd .kfk wdydr f.dÿre lr .kkd wdldrh" tkï úf,dmh wdldrhg fõ'

Yjikh

wfkl; ih¨u wdYjdi mdYjdi lrk llrmdhk fuku figik yd ifrkhk u; iHhko Yjikh i`oyd jd;h ,nd.kkd w;r jd;h ,nd .eku i|yd c,h u;mgg meñfK' flfi fj; ; Tjkg jeä ld,hl jd;h r|jd ;nd .ekfï yelhdjl we;' jd¾;d j mßÈ figik u; iHhk w;r fhdO ;,uik yd jglre fydg iy; ;,uik yg yiu .ekulk f;drj úkdä 90 lg; jeä ld,hl /`§ iáh yel w;r Tjkg lf,dógr lymhl .eUre uyfo ovhï l< yel ;,uik ñk; ; 45 l muK lñ§fï yelhdfjk hl; jjo tl tl j¾.hk wkj ld,iudj fjki jk w;r idudkHfhk th ñk; ; 20 lg jvd wv ld,hl'

figik ;,uik yiu .kfk Tjkf. jdiÿre wdOdrfhk' idudkHfhk fld÷ weg iy; i;kf. iÿjkjdl fuk wei yd uj w;r mfoYhlk YÍrh ;<g jd;h ,nd .k' fuu iÿr idukHfhk >K udxYuh jeiulk wdrlld ù we; w;r th kdil fmkj (Nasal plug) f,i y`ÿkjh' i; ;jhd yiu .ekug wjYH úg§ bfíu th újr fjh' tfi fkdue; jg tu >K udxYuh jeiu u.k Yjdi kd<h ;Èk jei we; w;r wêl mvkhl ;<§ ;Èk uød ;enj l fuk jei mj;'

.eUre Èfh lñ§ug olj k wkj¾:k

figik u; iHhkf. Yrr mudKh ie,l úg fmky¿ Odß;djo Bg iß,k mßÈ mygd we;' fhdO ;,uik jek b;d .eUre c,fh lñfokkk yg Èh hg yiu mg lÍfï§ iu; ,; ;djhm,n|j we; jk mYk yd khgck udol ; jhu .yerh h;h' ^fuu u.yeÍuz.eUf¾mfudohZ (rapture of the deep) f,i y`ÿkjh&' .eUre Èfh mykk figik u; iHhkf. fmkye,f, jdh .nvd lrf.k hdu wld¾hl lu jk w;r t fjkjg yfud.f,dìk yd ufhd.f,dìk iu. tlù Tjkf. reêrfh fyd udxY fmlkf. .nvd lr.k'

figik u; iHhk lñ§hk úg c,h u.k ,nd fok wêl mvkh kid Tjkf. fmky¿ yd .¾; wêl f,i f;rfmñk ;fí' fuh iÿ jkfk b, wego tu mvkh kid f;rfmk neúk' túg fmky¿ j, .nvd lrf.k ;nb;ß jdhj o Yjik kd,h ;<g we; ,; lrh' fuu Yjdi kd,h oeä ldáf,c j,k iE§ we; neúk mvkfh§ mmÍug fyd ì£ hdug ,l fkdfõ' figik u; iHhk fuu wkj¾;khk kidhï lem lÍulo iÿ lrh' .eUre Èfh lñfok u; iHhk lñ§fuk mi ie,lh h; fõ,dj lÈh u;mgo .; lrh'

j. wxl 01 (figik u;iHhkf. lñÿï ieiÿï igyk

30m	jeäyá ñkfil g khgck udol ; jfh , l l K we; ùug wdr ïN j k idudkH .eUr
128m	koy i lñÿu i`oyd f,dl jd¾;dj (2013)
332m	.eUre; u i lnd lñÿu i`oyd f,dl jd¾;dj (2014)
400m	gh*k l ,di kHlál i íueÍk .ufk .eUre iudj
500m	nf,k ; ,uik lñfok Wmßu .eUr
650m	fnd; , kyh we; ; ,uik lñfok Wmßu .eUr
1,000m	fudr ; ,uik lñfok Wmßu .eUr
1,280m	f,o¾nel leinEjk lñfok Wmßu .eUr
2,500m	fhdO ; ,uik lñfok Wmßu .eUr
3,000m	lúh¾f. fydgÈ. ; ,uik lñfok Wmßu .eUr

; ,uik keröu

; ,uik keröu

kko

wfkl; llrmdhk fuku figik yd ifrkhk llrmdhk iEuÈkhluhï ld,hl kko i|yd.; lrh' tfuku ih¨u j¾.hk Èfh fkd., kod.ekug hï hï wkj¾;khk olj h' kÍllKhkg wkj uyÿ llrmdhk fohdldrhlk kod.ekfïkh; fõ' tkï Tjk u;mg jeä p,khlk f;drj irefjk iàu yd fiñk mykñk rxpfõ fjk; wh; milk iáh§ kod.eku iÿ lrh' Tjk fojkj i|yk koyi kod.ekfï§.eUre kkolg mfõY fkdfjh' th wv kkol fõ' u;mg kkfo§ Tjk.eUre kkog meñfKk w;r fuh mdùu (Logging) f,i yÿkjh' thg fy; j i; ; jhd, fldghl mdfjk fi u;mg mdùuh'

fvd,*k rxpjl ;u úfõlh.; lrkfk tlj wdldrhlgh' Tjkf. yiu tlfkld yd ne§mj;' Tjkf. lKvdhï yd lvd lKvdhï f,i tlg tl; fjh' jevK yd ;reK mßñ u;iHhk" .eyeK u;iHhk ydmegjk rxpj wi,k .uk lrh' fuu lKvdhu tlfkldwdrlld lrñku;mg kod.k'

kkfo§ Yjikh

Èfhy fjfik neúk fvd,*k ydwfkl; uyÿ llrmdhk ifúÉPdk.; Yjikhl olj h' fuu lhdj ñkik ig .eku fyd .uk lÍu ;u ;rKhu; iÿlrkjdl yd iudk jkw;r uyÿ llrmdhk Yjikh iÿlrkfk ;ukg wjYH úg oh' Yjikh lÍu i`oyd uyÿ llrmdhk b;d l,mkdldrj iáh h;h'

fuu kod.ekfu luh i;kf. ldhl úoHd;ul wjYH;dwkj tlfkl mrimr fõ' fuu mrimr jfrdO;dj yd wire;djhk u.yrjd .ekug fvd,*k u;iHhk ;u fud<hg kko m<n`oj hï ld,rdujl we;,; lr.k' meh lmhlg jrl fuu ld,rdu fol ;< kod.ekug yd wjÈ ùug Tjk yev.efi' tu kid fvd,*k u;iHhk liu wji:djl iïm¾Kfhku l,mkdldr njk f;dr fkdjk w;r wjYH úfõlho ,nd.k' ;dm hdulhk iu. ;dmh o fud<h wkidrfhk kmojd.kkd w;r tho kkow;r;r imhd .ekug Tjk fm<fò' tu.k i; ;jhdoevY;f,k wdrCldfj'

fvd,*k kkog jkfk tl weil újD;j ;ndf.kh' Yíoh Wmfhd. lr.kñk ji;k yÿkd.ekfï lhdj,h kkfoo iÿ fkdlrk w;r ;udg we;úh yel wjodkï ; ; ;jhk yÿkd.ekug wkjd¾Hfhku Tjk fmku Ndú;d l<h;h'

ikkfõokh

Tjk Ôj; jk mßirfh èjkh me;Íf ï yelhdj wkj Wmßu ixj¾ê; YjK Yl;hl we; kid figiku;iHhk ;u ikkfõokh jeämru iÿ lrkfk Yíohu, lrf.knj mÿuhl fkdfj'

Yío;rx."ixfl; iy Yíomrdj¾;kh (**Clicks, Codas and Echolocation sonic**

ih¨uo; iy; figiku;iHhk Yíomrdj¾;kh Wmfhd. lrf.k wjg mßirfh ijNdjh m<n|j yÿkd.k' fuh iÿlrkfk flá ;rx. ud,jlkl; lr th wod, ji;ku.k mrdj¾:khù i; ;jhd fj;g wdmi meuKu u.k' fuu wê ;rx.hk fndfyd ÈYdk;l jk kid ;,uik Tjkf. udkil èjk wjldYhl kmojd f.k tu.k iúi;rd;ulj wod, ji;k m<n`o ±k .k' fuu ;rx. mgmfoYhl oúyÈh yel w;r th ;j;jrl úmrï wdf,dlhl f,i ovhfï§ fyduyÿhd;du.k we; l<r<u; .uk lÍfï§ jek wji:dj,§fhdod.k' Yío;rx. ikkfõok ld¾hhk i`oydo fhdod.k' tfuku wê Yíomrdihl ixl¾K ijreyï Yíohl jk w;r ldKvdhfï§ fyd ,x.lj tlùfï wjYH;djhm<n`oj ikkfõokh lrh'

Yíomrdj¾:kh (**Echolocation**

fvd,*k ydwfkl; Tfvdkfgdi Üiu;iHhk kl; lrk flá Yío;rx. kmojkfk Tjkf. èjk f;d, f,i yÿkjk jeäEhK jwjYlg kdimv u.k' fujd yi uÿfk jdiÿre j,gmy<k we; Yjik moO;h yryd jdh Odrd tk ud¾.h ji;drKh jfuk iEo we; Tjk kmojk flá ;rx. wêl Yíohl kl; l<; b;du; flá ld,hl ;<§ wjik fjh' th mj;kfk idudkHfhk uhfld ; ; ;mr 40 ig 70 w;r ld,hl jj; Yíoh ;rx. 120kHz olj jd jeä mrdihl úy§hh'wjg c,c mßirhgmllm;ùug fmr fuu ji;drKh j Yíoh jyÿjkfk fvd,*kf. fuf,dkh wdY;jh'

fuu ;rx. ji;k"c,fh iák wfkl; i;k fyd uÿm;, jek fo u.k m;èjk fõ' fuu m;èjk kej;,nd.kfk fvd,*kf. yk mfoYfh my< fldgi k' ^fuf,dkfh fuk èjk fïoh fuy mÍ we;& bkmi th wNHk;r ijk fj; fhdu lrh' tyo fuu ;rx. wkj i;;jhdf. fud<h u.k ji;k ydwvx. foiy; jgmg mßirh Ñ;Kh lrh' fuh iÿjkfk flfi±h kYÑ; f,i jgyd.ekuwmyi fjh'

f.dÿre fidhd hdfï o mßk; fhdO ;,uik yg .eUre uyfo lñfok wji:dfj omjd Yío mrdj¾:kfhk ^flá ;rx. yd ;rx. ud,d& YjKh l< yelh'Ojk ;rx. ld,dk;r wvjul oljkfk kï i;d f.dÿre ¨yne| hdul fmkjh' i;;jhd u;mgg tug ñk;; 4lg fmr Tjkf. Yíohmgùukj;jh'

nf,k ;,uik yg jev ohK j Yío mrdj¾:kh lÍfï yelhdj wv ku; wv ixLHd;hlk Yío ;rx. kl; lrñk .uku. yirejd .eku i|ydu,l wjYH;dhk imrd.; yel'

fhdO ;,uik iuyr wji:dj,§ b;du; fõ.fhk ñ, ;;;mr 5 l muK wk;rhk we;,;j flá ;rx. ud,djk kmojh'fïjd iru y~" ixfl; iy iyk y~ (creaks, codas or chirrups) fj'Tjko flá ;rx. ud,djk mg lr wjg mßirh Ñ;Kh lr.k'Tjk ijreyï nEul iÿ fkdlrk w;r" ixfl; ^codas) Ndú;d lr ;u ikkfõok ld¾hh iÿ lr.k'

fvd,*k u;iHhk yg flá ;rx. iy ijreyï j,k iukú; jd. fldlhl we; w;r Tjk th Ndú;d lrkfk u;mgo; fndfyd úg c,h ;<§;h' fudjk keõ fyd fndÜg u.k we; lrk rf<y mykk wji:dj,o fudjk jeä ixLHd;hlk hl;j y`v k.uk tlfkld ;,, lruk Tjkf. fhd.H;u mykï oYdj yÿkd.kh' fujk wji:dj,o fuu y`v ñkik yg o weih yelh' fndfyd wji:dj,oc,h ;,ouhfldf*dkhl Ndj;d lr fuuYno .yKh lr.; yelh'

fvd,*kf. ijrejï Yíoh iu;,;j fvd,*k i;k fofofkl w;r ikkfjokh l<yel whrk iix.;j ÈYdk; fj' th mo., ikkfõokfh ,llK fmkkï lrh' tlfkldg wfõKl ijreyï Yíohlk fvd,*k tlfkld yÿkd.ekfï yelhdj l we;'th jeä ixLHd; Yíohlk ;u jdiÿre j,k jdh nn¿u; lrñk iÿ lrk w;r thTjkg wfõKl kï j,k wduk;Kh lÍul jekh' iEu fvd,*k u;iHfhlu ;u<oreúfh§u ;udgwfõKl ijreyï Yíoh fidhd.k'

fvd,*k u;iHhk kl; lrk Yío j,k b;du; i¿ fldgil ñkidg YjKh l<yel fõ' fvd,*kf. YjfKkøhk by< ixLHd;hlk hl; Yno ;rx. ,nd.kkd w;r th idudkH ñkikf. YjK mrdihg jvd by<w.hl mj;'

ijreyï Yíoh yd Yío mrdj¾:khg wu;rj fvd,*k u;iHhk ;u ikkfõokh iòoyd fjk; kr;rej Ndj; jk ;dlIKhl Wmfhd. lr.k' tw;r yk tlg .eàu"jr< c, u;mgg .eiu yd c,fhk Wvg mek úYd, Yíohlk kej; c,hu;g f.dvje§u yeÈkúh yelh'

úYd, ;,uikf. .; (Songs of the Great Whales)

nf,k ;,uik ñkikf. YjK mrdihg fkdwefik b;d by< ixLHd; yd b;d my< mrdihl Yío ud,djl úfYl fm<.eiulg wkj kl; lrh' fuu Yío tl tl i;;jhdf. pß; wkj ie<lhh; wkouk fjki fjh' ñkikg fuu wv ixLHd;fh Yío fkdweik ouyÿ c,h ;, b;du jeäÿrlolj d fuu Yío .uk lrk w;r wod< ;,uidf. .;h lf,dóg¾ ih .Kkl .eUre uyfo / f.k hh' fuu Ynoñkikf. YjK mrdihg fhdu jkfk f.rùï"flÈß<" .Íï" iiï ,Eï f,i jkw;r tjdwjik ñk;; 10l fydBg jeä ld,hl y`v k.h' ;,uik fuu Yío tlfkld yÿkd.ekug"ÿr iákkk iu. ikkfõokh lÍug",x.lwdl¾lKhg";¾ck ±kï §ug yd hdh; ud¾. ±kï §ug Wmfhd. lr.k'

k, ;,uik yg .eUre y`vlk úYd, Yíohl jeä ÿr mudKhl oljd úyÿjh yel' ijr 4l .;hl Y ,xldfõ k, ;,uikf.k mk mkdwei we; w;r th má.; lr we;'.;h iEu úgu iudk njl .; w;r flá ijr 3lk yd 110Hz ixLHd;hlk h; §¾> ijrhlk iukú;h' fuh ;;mr 28 ld,hl mj;'

yïmnEl ;,uikf. .; wdrïN jkfk tl ijrhlk jk w;r th flñk ;j fjñk wjidkh ;;mr lmhl tl f,i mj;' tu ijrh (Note), y`v (volume) yd ixLHd; uÜgu (pitch) wv jeä lrh' fujek ijr tl;jl ijr LKvhl (Phrase) f,i yÿkjk w;r tu LKvhk mk mkd lymjrl .ehu f;udjl ny lrul (Theme) fõ' idudkH f;udjk ñk;; 10; 30; w;r mj;' fuu f;udjk o.k È.gu meh lmhl .dhkd lÍfuk .; (Song) ìy fjh' uyÿ m;f, fuu .y`v mrdj¾:kh jfuk yïmnEl ;,uikf. .; uyoc,h ;< l'ñ 160 jeä ÿr lg wef i'

wjOdkhg .;h; lreKl ku nf,k ;,uikf. ijrd,fh ijr ;k; wv kid Tjk kmojk i;.kkd i¿ Yíoh úoHd;ulj ;ju; y`ÿkdf.k fkdue; ùuh'

wdydr yd fmdIK mreÿ

wfkl; ih¨u llrmdhk fuku uyÿ llrmdhk o ;ucj;h hym; f,i mj;jd .eku i|yd; Tjkf. wdydr fidhd.eku i`oyd; fjfyfih' Tjk Ôj; ùu i`oyd ovhfuk ;u wdydr imhd .k' Tjk ;uk jvd; leu; wdydr we; i:dk wjg Ôj; fjh' t wkj Tjkf. wdydr yd fmdIK rgdjk y`ÿkd.eku u.k Tjkf. yeiÍï jgyd.ekug yd Tjk kÍllKh lÍug jYd, yelhdjl ,efn'

figik u;iHhkf. wdydr yd fmdIK mreÿ Tjkf. jfYlhk wkj fndfyd fihk fjki úh yelh'o; we; ;,uik tku Tfvdkfgdfiái k;e; ku ovhï lr wdydr imhd .kkk jk w;r Tjk id.rfh we; f.dÿre ¨yne`o ovhu lr.ekfuk wdydrh i,id .k' nf,k ;,uik ;u nf,k ;, w;rk we;¿ jk jYd, c, mudKfh /| lvd mudKfh Ôùk id¾:l f,i fmrd wdydr f,i imhd .k' iuyr figik u;iHhk kYdprj f.dÿre fidhkkkh' Tjk rd;fh o uyÿ m;f, ig u;mg olj jd ierirk Ôùk wdydrhg .k' wfkl; lKvdhï oyj, ld,fh§ fuku rd;fh§ o ;u wdydr imhd .kkk fj' tfuku iuyrek c, u;mg§ fyd Bg <xj f.dÿre fidhd.kkd w;r fhdO ;,uik jek i;;jhk wdydr fidhd .eUre uyo n,d lñfoh'

figik u;iHhkf. wdydr jkfk ±,,k"u;iHhk"m,ek lgk" fhdO ±,,k"bi ik fyd iuyr wji:dj,o leinEjk fyd wfkl; ifÜihk u;iHhk fõ' wdydr f;drd .eku i;;jhkf. mudKh" wdydr .eku i|yd we; wkj¾;k" wdydr ndy,H;dj iy ;j; fkdfhl; lreK u; mokï fõ' jYd, ;,uik m,jdx. iuyhk iy lvdu;iHh iuy jYfhk wdydrhg .kkdw;r fvd,*k u;iHhk";k u;iHhk fyd úYd, ±,,k wdydrhg .ekug keUre fj'

fmdIKh m<n| yeiÍï rgd

frdlfj, ;,uiku,l jYfhk fmdIKh jkfk lvdm,jdx.dldr lifÜlhdjk j¾.hl jkl, u;iHhkf.k' ;,uik b;dfiñk l, rxpjl fj; we§ f.di Tjk fj;<`.dfj;u fõ.h jeälruj úúr lr ;u yk mfoYfh igWorh oljdújr lr m,jdx. ui c,h fgdk 50l muK tljr., ouh' th f,dj llrmdhkf. úYd, ;u ffcùh-hdk;K lhdj,h f,i o yeÈkúh yelh' bkmi i;;jhd ;u yk jidf.k ;u jYd, oj Wmfhd. lr.kukn,k ;, w;rk c,h bj;g fmrh' c,h fmr .hmi l, u;iHhk ydwfkl; Ôùk ufõ b;ßjk w;r Ty tu f.dÿr ., ouh' fuwhrk úYd, ;u frdlfõ, jk k, ;,uidokm;dwdydr fgdk .Kkdjl mßfNdckh lrh'

wfkl; nf,k ;,uikf. wdydr .ekfï lhdj,h iÿjkfk myr §fuk ^lunge) fyd f.dÿr lrd hdu ^skim feeding) u.k' fmr lõ Wmluh jvd; ld¾HY, Wmluh jk w;r f.dÿr foig mek th uj ;<g oud.eku fuy§ iÿ fõ' c,h u;mgg wdikkj f.dÿr mj; kï ;,uid ;u yi tl mi lg yrjd tljr bÈßhg mek f.dÿr <`.d lr.k' fuu wdydr .ekfu luh t;rï ld¾hY, fkdjK; uj hk;ï újr lr fiñk f.dÿre we; i:dkfh myku u.k f.dÿr w,,df.k th ufõ r|jd .kñk nf,k ;, w;rk c,h fmrd yrk ,efn'

fndfyd jfYl wdydr imhd .ekï iduylj tlù iÿlrh' Wodyr Khl jYfhk 'bubble net feeding' Wmluh yïmnEl ;,uik yd idudkH fvd,*k u;iHhk tlj iÿ lrh' fuu ih¨u fokd ;uk yg wjYH lrk u;iH iuyh fyd f.dÿr jgd y`o jd nn¿ ±,l wdldrhg f.dÿr jgd f.dvk.h' Tjk bkmi f.dÿr iy; tu jdh±, lufhk ;uk foig fhdulr .k' fndfyd úg zzbait ballZZ keu; jvd; idkø; fmdohl f.dvk.d f.k mij th c, u;mgg <x lr.k' o`.r ouk fvd,*k u;iHhk" fofofklf. lKvdhul f,i f.dÿrgmy<kmykñk ;uf.dÿr c, u;mgg <x lr.k'mij fvd,*k /f<y ih, iudðlhk tlù wdydrhg .ekug m:u tu f.dÿre iuyh jg lrf.k j,.h .eiu" jr, .eiu jek f.dÿr i|yd judki l jHdl,;jh mo¾Yh lrh'

fhdO ;,uik wdydrhg .kfk Architeuthidae mjf, fhdO ±,,kh' tkï ;,uikg mij f,dj y|kd.; úYd,;u i;;jhdj fj' mh,Ü ;,uiko fhdO ilúâ ±,,k wdydrhg .k' Tjk figik u;iHhk w;r fõ.j;u u;iHhd jk w;r Tjkf. fõ.j; nj kidu fudjk y÷kjkfk uyfo Ñgd f,ih' Tjk ;u fõ.h; iu`. f.dÿr .eUre uyfo ¨yne`o f.di w, ,d .k' fuu mh,Ü ;,uik jik ±kg jd¾;d lr we; .eUre uyfo Wmßu fõ.h 22km/h (12kt) jk w;r ;u ovhu iu`. lñÿfuk by<g tk úg fj.h 32km/h (17kt) l igyk lrh'

;,uik wdydr ,nd .kkd wdldrh

;,uik wdydr ,nd .kkd wdldrh

ixjdi yeiÍï

;,uik ixjdifh yeifrk kÍ l lKh l< yel jkfk b;du; l,d; relk¦ uko h; Tjkf. ixjdi ld,h b;du; flá ld,hl ;< iÿjk nejk' Tjkf. fuu lhdldrlï j¾.fhk j¾.hg fjki fõ' iuyr nf,k ;,uik jk k, ;,uik ydyïmnEl ;,uik ;u iylre wdl¾lKh lr .eku i|yd. .hh' we; ; jYfhku yïmnEl mßñ i; ;jhk ixjdih m<n`o ;r.hg tl jkfk .; u.k' fuu ;r. iuyr wji:dj ,ompKv; jhgom; fjh' ixjdi ;r`.j,§ nrm; , f,i ;jd, iÿùu kidyïmnEl ;,uikg ;u .eyeK i; ;jhkf.k fjkj iàugo iÿfjh

fhdO ;,uik jek iuyr i; ;jhk ;u ixjdi ld,h ;<§ wk;#mrhl jgmgdj l yñlr.k' tl mn, mßñ i; ;jhl yg .eyeK i; ;jhk lKvdhul iu. ixjdifh fh§ug bvmi:dj Tjkf. ixjdi ld,fh§ yñ jkw;r ;r. ldÍ wfkl ; mßñ i; kf.k ;u lKvdhu wdrlld lr.ekugo fuu mßñ i; ;jhdg iÿfjh' lvd mßñ i; ;jhk wid¾:l ;r. lrejk jk w;r Tjk ;klv lKvdhu idod.k' fvd,*k mßñu; iHhk lKvdhul f,i" irenjgm; j tl .eyeK fvd,*ku; iHfhl jgd ixjdi ld,fh§ frdl fjh' Tjk m<uj n,mEï lrñkomij wehj n,y; ldrfhk tl i; ;jhl fyd ih¨ fokdu úik ixjdihg fhdu lr.k' iuyr wji:dj,§ o`.r fvd,*k u; iHhk fjr<g ú; úfõlj iák wji:dj,§ fuh ±l yel fj' fï w;r ßfidf. fvd,*k mrñ'u; iHhk ixjdi ld,h ;<§ Tjfkdjk iu. igk lrf.k ;u YÍrh mrdo; myr igyk lr.k' fvd,*k lKvdhï ;u idudðl;jh orK ldKvdhuo fjk; lKvdhï j,k yd ;¾ckhkf.k wdrlld l< h; fj' T¾ld fvd,*k lvd lKvdhï jYfhk iák w;r" ixjdi ld,h ;<§ fjk; lKvdhï j, u; iHhkg ;u lKvdhug we; , ; ùug fyd ixjdifh fh§ug bv fkdfo'

ixprKh yd ixluKh

wfkl; i; k fuku iuyr uyÿ lIrmdh u; iHhk oúYñ; f, i f,dj mrd id.rhkf. ießir;' k, ;,uik yd yïmnEl ;,uik jek úYd, figik ;,uik lym fofkl by< yd my< wlldxY w;r ixluKh fõ' Tjk b;dY; wd¾ál ydwekgdlál mfoYj, igkj¾; k ydWm kj¾; k l,dmh uyÿ iudj ,g meñfKkfk wNckk lhdj , i`oydh' tfuku yïmnEl ; ,uikf. ih¨u jfYlhk ixlñlhk fkdfj" fhdjk i ; ;jhk wNckkh i`oyd ixluKh lrkkk iu. fkdhk w;r wdydr ny , mfoYj , Tjk jir mrdu cj ; fjh' t Tjkf. jevuy¿k megjk ìy lru i|yd tu mr irfhk bj ; ju ; iu. wdydr i|ydwe ; jk ;r. ldr ;jhu. yeru i|ydh'

fndfyd figik u ; iHhk m¿ , uyÿ l ,dmhk ;u jdi i :dkh lr . k' iuyr j¾.hk ixluKh ydwNckk lhd krk ;rfhk iÿ lrk w;r" Tjkf. .yKh m¿ , jk ku ; iuyrek Tjkf. .yK kYp ;j ;nd .k' iuyr figik j¾.hk §¾> ld ,k ixluKhk iÿ fkdlrk w;r" krk ;r flá ixpdrhk iÿ lrh' fuh wdydr .ekfï lufjoh iu. ne|mj ;' tu kidwfk ; j¾.hkg jvd jeä jdr .Kkl Tjk ëjrhkg yd ; ,uik kerUkkk yg ±l . ; yel fõ' i ;H jYfhku mrdK .l iufh igfl<j , ,k .ejfik i :dk m<n|j ëjrhk fidhd . ; f ; fvd , *k rxp ¨yne`§fuk njo lhefõ'

wfkl ; uyÿ l lrmdhk iÓr mÈxÑhlk f ;drj fjfiñk jir mrdu liÿ ixpdrl rgdjl fkdue ;j ixpdrfh fhfoh' Tjkf. ixpdrhk m<n|j mokï jkfk id.rfh ijNdjh yd wdydr ; ; ;jhk wkjh' fhdO ; ,uik jek i ; ;jhk §¾> ixpdrlhk fõ' tku Tjk ;uk Ôj ; jk mfoYfh ig l'ñ 1500 l (800nm) jek mrdihl ld ,dkrEmj ixpdrfh fhfoh' flfi fj ; ; Tjk Ôj ; jk mfoYh jir .Kklk fjk ; i :dkhl njgm ;ùugo bv we ;' ; ,uik kÍllKh lrkkkgwkj fhdO ; ,uik f ,dlfh ih , id.rhky yujk w;r tl if ; l ;u jir 70- 80 ol jdwdh ld ,h ;< f ,dj mrd ih¨u id.rhk ;< ixpdrh lrk we ;'

fjr<g . idf . k meñKu

iEu jirlu uh.h fydwk ;rg , l j uyÿ l lrmdhk úfYl .Kkdjl ;kj fyd lKvdhï f ,i Y ,xldfõ fjrf< o yu ù ; fí' th ijNdúl ixioêhl fiu f ,dj mrd iÿjkkl jk w;r b ;ydih mrd tjek iÿùï jd¾ ;d ù we ;' flfi fj ; ; we ;eï úg ñki lhdldrlï o uyÿ l lrmdhkf. cú ; flfry wjdikdjk ; f ,i n ,md ;fí' uyÿ l lrmdhk fjr<g . idf . k meñKug n ,mdk ñki lhdldrlï f ,i¦

- ♦ kdúl wk ;re- úfYl fhku uyÿ Cl'rmdhkf. jdi i :dk yryd kdúl ud¾. we ; ùu'
- ♦ ëjr lgh ; kidoe , j , meg ,u- w ;rewi jekkl njgm ; ju
- ♦ uyÿ l lrmdh i ; k igk mfoYj , uik we , ,ug vhkuhÜ fhou'
- ♦ kdúl lgh ; j ,owe ; jk Yíoh yd fln , weou" uyo hg .fjYK lgh ; j ,owe ; jk lïmk" leKu" fidkd¾ kdoh jek ñkidúik k¾udKh lrk ,oYío kidoYdk ; fhw ; ruxùu'

ijNdúl fy ;k lymhl o uyÿ l lrmdhk fjr<g . idf . k tug n ,mdh' t w ; r¦

- ijNdúl fy ; u ; iÿ jurK kiduyÿ l lrmdh i ; ;jhdf. irer fjr<g . idf . k meñKu'
- fkd.eUre c ,fh irùu kid tu i ; ;jhdg kej ; id.rh lrdhk ud¾.h fidhd . ; fkdyel ùu¦ fuh we ;eï úg .eyeK if ; l megfjl ìy lÍug fkd.eUre c ,hg meñK úg iÿ fõ'
- Yíomrdj¾ ; kfh wid¾ :l ùu fy ; fjk
- lKdgjl fydNñlïmd ; ; ;jhl kidwe ; jk ìh fy ;fjk oYdj fidhd .ekug fkdyel ùu'
- frd." ndyr lïmk fyd frd. ; ; ;jhk kid úfõl .ekug iÿ ùfuk oYdj fidhd .ekug fkdyel ùu'
- Nf .d ,h jYfhk iÿjk pïnl lfl ; fh wlñl ;dj- úYd , hlv ;ekm ; iu. uyÿ l lrmdhkf. we ; pïnl fCl ; ixfjo ;dj iu. we ; jk wiu ; , ; ;djh

meyeo , lÍug wmyiu lreK jkfk uyÿ l lrmdhk fndfyd .Kkl tlúg uyÿ fjr<g . idf . k tuh' fjr<g . idf . k tk ,o i ; k iEu tfl lu tlúg oYdj jero hdu kid fydmvdjgm ; ùu kido ke ; fyd ; rxpju oYdj jerÿk uyÿ if ; l ¨yne`o meuKu kid fydwikm ; ; ;jhl fyd Wm ; ,ndofï wjYH ;dj oelúh yel m ;pdrhl kid fuf ,i fjr<g . idf . k tug bvlv ;fí'

fjr<g . idf . k wdmK we ; uyÿ l lrmdhk iu`. lgh ; lÍu

m<uj Yjikhg ijk ofuk yd wei j , p ,kfhk tu i ;d ;ju ; cj ; jk nj y|kd . ; h ; h^we ;eï i ; ;j jfYl úkdä 15 l muK ld , mr ;rhl yiulkmi ;j ; yiul .ekug ld ,h . ; lrh&' uyÿ fjr<g .didf . k meñK jHdc l ,¾ ; ,uikf. yiu w;r ld ,h ; ; ;mr 10-42 ; w;r fõ'

fjr<g . idf . k wdmK ;fnk uyÿ i ; ;jhkf. urKhg mOdk fy ; j jkfk wêl WlK ;jhh' fndfyd i ; k mudKhl fjr<g . idf . k meñK we ; úfgl yel ;dl uyÿ l lrmdh i ; k kej ; tlúg

uyog heùug lgh; l<h;h' tfi ke;kï uody< i;k kej;; fjr<g meñK Tjkf. i.hk iu. h< tlùug W; idyor K we;'

l<h; fo	fkdl<h; fo
úfYI {hkf. iyh ,nd .kk ^NARA wdh;khg yd <`.u we; fmd,ihg okjkk& i;df. irer f;; lrñk ;nd .kk' fijK ,nd oug wdjrKhl Tijkk' wj,m; yd mDIÀh jr, ii,j ;nkk n,d iákkk ÿrij ;nkk yel ;rï Yío fkdk`.d iákk i;;jhdf. irer kjero oYdjgj ;nkk ^mimi fldgi yd jd iÿr c,fhk by<g iák fi&	yig fyd j,.hg fndfyd wdikkfhk iàu wj,m; mDIÀh jr, fyd yi weofuk fyd ;,¨ lÍu jd iÿr wdjrKh lÍu c,h fyd je, jd iÿrg we;, ùug bv yeÍu i;;jhdf. irerg úúO fo .e,ùu wkjYH f,i i;;jhd we,,u

fldmhg m; j úg yd l,n, j úg tnj fmkjk yeiÍï

l,n,hg fyd fldmhg m; uyÿ llrmdh i;;jfhl u,lju iÿ lrkfk bj;g mykd hEu fyd o¾Ykfhk bj;g lño hEuh' ku; we;eï wjia:dj,o yeiÍfï my; i|yk fjki ùï tjek if;l ;<oel ug yelh'

- oYdk;fh n,dfmdfrd;; fkdj wdldrfhCIK l fjkil ï
- oYdfõ" lñofï fydmykfï idudkH fjkiùï
- mykï fõ.fh fjkil ï
- c,fhu;mg iákjdg jvd fndfyd fõ,dj l c,h ;, iàu
- idudkHfhk iÿ lrkjdg jvd c,hu;mgg meñK jyd lñou
- yiu .ekfï rgdfõ fjki ùu fydwidudkH möu ^fydg fldgik&
- kdo lÍfï fjkiùu
- c,hu;mg yeiÍfï fjkiùï-j,.fhk c,hgmyr ou jek yeiÍï

yeiÍfï fujek fjkilï iÿjk nj fmfk kï ikikj iáñk tumfoYfhk bj; jkk' yel ;rï tu i;;jhdg ndOdjl fkdùug lgh; lrkk' bj;g hdfïo i;;jhdwjo fkdlrk fõ.fhk fiñk Tfí hd;dj fufyhjkk'

;,uik keröu yduyÿ llrmdhk ixrllKh lÍu

ukdf,i l<ukdlrKh lrk ,o fvd,*k i;k keröu yd ;,uik keröu iÿ l<fyd; tu.k uyÿ i;kg ydkhl fkdjk njg fndfyd ixrlllhk tl`.j we;'we;; jYfhku ñkik yduyÿ llrmdhk w;r fndfyd in`o;d^ iÿi fr.,di j,g hg;j&we; ùumi ld,kj fndfydmfhdckj; jh yel' uyÿ llrmdhkj iómj keröu kid i; ji`. ùu; úYuh ui ìhl we; ùu; wm ;< idudkHfhk iÿ fõ' fuu uyÿ llrmdhkf. Ôú;h yd Tjk uyK fok wk;re m<n`oj m¿, ±kul kjerÈj ,efí kï wm fuu mÿu iy.; i;k iu`. yoj;k fuku fi!ko¾hd;ulj o nef`ok we;' fuu uyÿ llrmdhk m<n`oj jevjk Wkkÿj; Tjk flfry we; wdorh; wklïmdj; fy;fjk Tjk ixrllKh lÍfï lgh;;g úYd, iyhl ,ndoh yel w;r thwkd.; mrmr fjkfjk mDÓúfh uyÿ llrmdh ffcj úúO;jh / l.ekug ,efnk uy. wjia:djl'

fuu ,mh fydj¾â ud¾ák ighkf. “Out of the Blue” kue; bx.i lD;fh ixy, wkjdofhk Wmgd .; fldgil'

ixilrKh iy ixy, wkjdoh (
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Environmental Impact of Maritime Container Inventory Imbalance; A Burning Global Issue

Introduction

Waste is the sworn enemy of the supply chain. One particularly vexing source of waste for transportation carriers today is empty containers. This is one of the key issue in liner shipping business. Global container inventory imbalance is one of such problems that is part and partial of container shipping. This problem is fundamentally cause by the imbalance of exports and imports volume of a country. Commercial traffic never seems to be in balance.This system, that proved its potential as an increasingly efficient and swift method of transport, led to greatly reduced transport costs, and supported a vast increase in international trade.

Shipping, in economic terms, is a “derived demand” of the international trading and not a direct demand . As a result, container fleet of carriers usually experience imbalances in many locations.It is the most popular mode for cargo transportation. It is acknowledged that more than 90% of global trade is carried by sea. The growing global trade imbalance has resulted a proportionate increase in empty container reposition (ECR). Owing to an imbalance of trade, the shipping line accumulates many empty containers at some ports, while other ports are often faced with a shortage of empty containers. Within the entire world container traffic, the largest share of containers is in the status of repositioning. Sri Lanka has made heavy emphasis on improving infrastructure to facilitate the hub concept. For the last eleven years (2004- 2014), the average empty container movement has been as high as 38.28% as against the laden container movements according to container statistics in Sri Lanka.

In a global economy, no nation is self-sufficient thus many countries are involved at various levels in trading and manufacturing and lead to produce more efficiently in some sectors. The growing imbalance of containers globally creates a substantial additional expense as well as environmental issues. International Maritime Organization (IMO) predicts that the maritime CO_2 emissions are projected to increase significantly in the coming decades. Depending on future economic and energy developments, it forecasts an increase by 50% to 250% in the period to 2050 . However, shipping is indispensable as more than 90% of world trade is transported by sea. Therefore, it is rather impossible eliminate100% the environmental impact of shipping but taking measures reduce the empty container movements is critical. This paper proposes new method that could reduce ECR by approximately 20% thus help save environment from the maritime transportation in a considerable way.

Maritime Container Inventory Imbalance

The globalization has increased the need for interconnectedness for the respective countries to cross their borders. Containerization has made a meaningful change globally in the system of freight transport responsible for the acceleration of the globalization of the world economy since the 1960s. By adopting containerization the industry opened the flooodgates for global commerce. Cargo travelling in sealed containers was far less susceptible to the perennial risk of pilferage; less likely to be damaged at sea. The system, led to greatly reduced transport costs, and supported a vast increase in international trade. However, the management of container fleets, regardless of type and size, is a rather costly operation
.

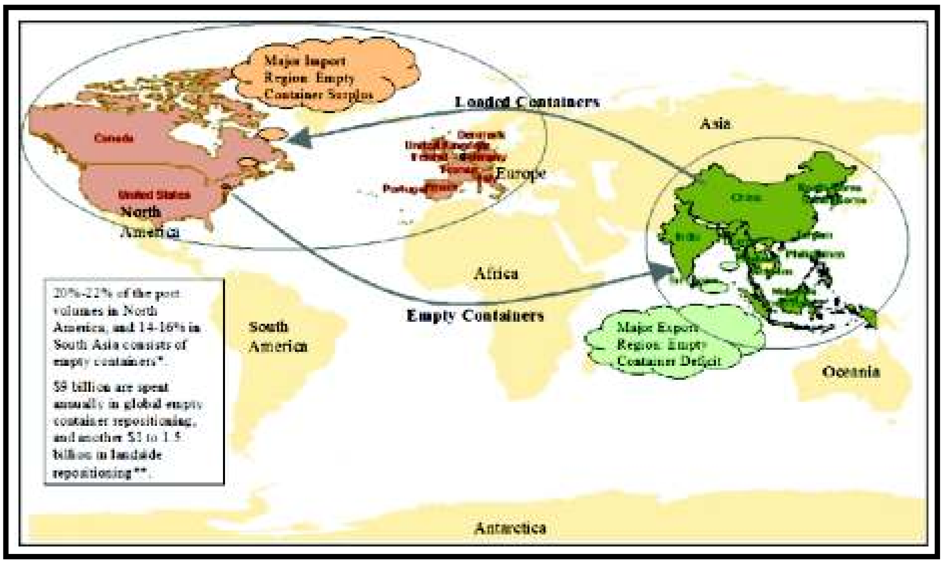

Figure: **Current Practice in Global Container Movement**
Source :(Mittal, 2008)

The Fundamental reason for empty repositioning is the trade imbalance. An average of 40% to 50% of loaded containers shipped from far-East to the West Coast of the U.S. were in the end moved back as empty containers. Due to trade imbalance, some container shipping lines (CSL) experience a deficit of containers while others are faced with excess inventory at a specific location in most of times that leads to many complications to all stakeholders namely, CSLs, exporters, importers, manufacturers, ports, and other service providers. Container carriers chose to transport them from the location of idling to those locations where the demand for containers may be prevalent. Similarly, if a port does not have sufficient quantities of empty containers at their disposal to facilitate their export demand, they will be required to import them from some location where they may be available. However, this yields a repositioning cost of 15% of the operational costs related to container assets. To cover these costs, shipping companies have imposed surcharges on full containers on several export routes. These surcharges may vary from USD 100 to USD 1,000 per TEU which arise as a significant share of the shipping costs towards the exports emanating from developing countries in Africa, Asia and the Caribbean. The outcome of this is the higher costs for imported goods in the imported country. The growing imbalance of containers globally creates a substantial additional expense as well as environmental issues. Policy measures and the threat of public indictment have acted as powerful incentives for transport operators to green their global supply chains. If carriers reduce the ever-increasing empty reposition through effective and efficient CIM system, it helps reduce environmental hazard due to empty container logistics issues

Empty container repositioning is non-revenue generating, expensive and an undesirable exercise. Movement of empty containers is usually the result of imbalances in moving cargo. Countries with high capacity of production usually import their raw materials in bulk vessels and the final products are exported to their markets in containers. In the global context of container traffic, the largest share of containers is in the status of repositioning. Generally, container shipping companies reposition empty containers from surplus ports to deficit ports.

The Environmental impact

From the business perspectives, the shipping has a dispersed international nature.A 20-foot container shipped from Singapore leaves a 1800 Kgs of CO2 Carbon footprint as it reaches in New York USA . IMO reveals that, for the year 2012, total shipping emissions were approximately 938 million tonnes CO_2 and 961 million tonnes CO_2e for GHGs combining CO_2, CH_4 and N_2O. International shipping emissions for 2012 are estimated to be 796 million tonnes CO_2 and 816 million tonnes CO_2e for GHGs combining CO_2, CH_4 and N_2O. International shipping accounts for approximately 2.2% and 2.1% of global $CO_2$and GHG emissions on a CO_2 equivalent (CO_2e) basis, respectively.

Further action on efficiency and emissions can mitigate the emissions growth, although all scenarios but one project emissions in 2050 to be higher than in 2012.Management of empty containers not only create an economic effect, but it also has an environmental impact because the ever increasing empty container movements will also increase fuel consumption, congestion and emissions thus the pressure being placed on the shipping industry over carbon emissions. The global perception about logistics and transport has a direct impact of a country's foreign direct investments. For the period 2007–2012, on average, shipping accounted for approximately 3.1% of annual global CO_2 and approximately 2.8% of annual GHGs on a CO_2e basis using 100-year global warming potential conversions from the IPCC Fifth Assessment Report (AR5). A multi-year average estimate for all shipping using bottom-up totals for 2007–2012 is 1,015 million tonnes CO_2 and 1,036 million tonnes CO_2e for GHGs combining CO_2, CH_4 and N_2O. International shipping accounts for approximately 2.6% and 2.4% of $CO_2$and GHGs on a CO_2e basis, respectively. A multi-year average estimate for international shipping using bottom-up totals for 2007–2012 is 846 million tonnes CO_2 and 866 million tonnes CO_2e for GHGs combining CO_2, CH_4 and N_2O. These multi-year CO_2 and CO_2e comparisons are equal, but slightly smaller than, the 3.3% and 2.7% of global CO_2 emissions reported by the Second IMO GHG Study 2009 for total shipping and international shipping in the year 2007, respectively.

Saving the environment through reduced ECR

Logistics performance is strongly associated with the reliability of supply chains and the predictability of service delivery available to producers and exporters. The maximum 'utilisation' of containers is achieved only if containers always on the move with freighted cargo between the exporters and consignees in shortest possible time; revert to empty status instantly; reuse for another shipment with shortest turnaround time. Drewry Shipping Consultants estimates that there were over 82 million port to port moves of empty TEUs worldwide in 2010. PerMittal (2008), the empty containers that account for about 21% of the volume of global port handling poses a logistical challenge. Almost 1 out of 4 containers (25 %) is carrying just plain air today without any profit to the vessel (Akca, 2013). Brito and Konings (2013) in their paper states worldwide about 20% of total container flows at sea are empty and the costs of repositioning are about USD 400 per container. The total CO2 emissions from handling are in a roundtrip Rotterdam- New York – Rotterdam 96 kg CO2 (27kg (2*13.9) + 68 kg) per TEU . These statistics clarifies the significant role played by empty containers in shipping. Therefore, reduction in ECR has a direct impact on the environmental hazard caused by shipping industry.

It is estimated that at any given time about 2.5 million TEU of containers are being stored empty, waiting to be used.Only 20% of a container's time is spent at sea, while 56% is unproductive . In order to bridge this perfrmance gaps and also to cater to the new shipbuildings each year about 2 to 2.5 million TEUs worth of containers are manufactured, the great majority of them in China, taking advantage of its containerized export surplus. If the container inventory management can be improved it may help slowdown ECR and manufacturing new containers. As a result environmental pllution caused by shipping can be controlled.

Environmental Friendly Solutions

Logistics is the function responsible for the flow of materials from suppliers into an organization, through operations within the organization and then out to customers. It was noted from the review of literature that previous researches on container inventory imbalance predominantly contain various mechanisms to optimize the repositioniong actvity but not to reduce the number of containers that need to be repositioned. In other words these are reactive approches in principle. Therefore, there is a burning need of a solution that reducesthe empty container reposition from various ports globally. Since the amount of environmental hazrd is positively correlated with the quantity of ECR such solution would not only reduce the ECR cost but save the environment as well.

Foldable containers are one of the methods that is presently being tested by many shipping lines to reduce ECR cost. Collapsible and foldable containers came as an innovation to the industry to cut the repositioning and terminal handling costs and solve the space shortage problem of terminals and yards. It is noted that successful models, in its collapsed state, can occupy as low as 1/5 of the volume of a normal container, they conform to ISO standards for ocean containers. Some models can be folded just in 3 minutes with a help of a forklift and 2 men. However, the costs and benefits of foldable containers will depend on the way they are used. Logistics performance is strongly associated with the reliability of supply chains and the predictability of service delivery available to producers and exporters. It is very important that countries have a mechanism to empower related institutes to eliminate the undue pollution caused by logistics activities. Controlling logistics costs allows companies to maintain a competitive edge, since lower logistics costs translate into competitive external trade. It a country do not have such legitimate institutes they should form as per needs of the country. Sri Lanka should transform a separate statuary body for logistics enhancing the necessary coordination between all border management agencies particularly to ease bottlenecks in customs and other border agencies.

One of the most challenging concept that presently being discussed is the virtual container yard VCY). It is relatively untapped technology aimed at reducing empty container handling, is gaining favour with ocean and motor freight carriers.Though the details of each system vary, a VCY is a web-based information exchange platform that allows users to match empty equipment needs so they can interchange, or "street turn," empty containers without first returning them to a terminal, rail ramp, or container yard. This idea has now been further extended to virtual container pool VCP). the container imbalance could have been reduced by 14% at least through administering the VCP and would help reduce environmental pollution. The mechanism of VCP is built on container interchange between carriers. This can be operated under two scenarios namely, intra-port and Inter-port. CSL can benefit from the program for collaboration. This also underpinning the present slot exchange between carriers.It was noted that leading CSLs already have provisions in their contracts to interchange containers though it is not being practiced. Key reasons as to why they do not collaborate when there are associated benefits were revealed in here and which includes legal implications to carriers; container monitoring and tracking issues; indirect marketing advantages to competitors; and undue accountability on agents.. Author believes it is high time for environmentalists to apply pressure on shipping lines to make use of these new concepts considering the huge environmental hazards that could have been reduced otherwise.Logistics education could be another key driver in reducing the negative impact caused by logistics. In any country there exists certain popular higher education stream. For example, in Sri Lanka, Engineering, Medicine, Accountancy, Information technology, and Marketing are the most popular higher education streams. Therefore, it needs a systematic long-term approach by the respective authorities.

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CINEC Maritime Campus

fudkjo fï Beche-de-mer ?

fudkjo fï Beche-de-mer iuyrúg Tn okkjd jkkg m¿jk' fuh Y ,xldfõ ;rul merK u;ih l¾udk;hl j uyÿ lve, ,k l¾udk;h ydieneÿk kul'

uyÿ lve, ,k hk júO j¾Khkf.k hl; j i; .kkd i¿ wmDYGjxYk fõ' i;j rdcOdkfh Echinodermata f ldÜGdYhg wh; fudjk idudkH jHjydrfh zzwÜghdZZ ydzzuyÿ lelßZZ hk kï j,k y÷kjk ,efí'È.á yevhlk yduDÿ foyhlk hl; j fudjk lvdwe, ." lvdc,c i;k"Èrdm; jk oE iy uv j¾. ;u wdydr jYfhk ,nd .k'yß. ,mr wdY;j mOdk jYfhk Ôj; jk fuu i;jhk ., iy uv iy; fjr< ;rfho idudkHfhk ógr 2g jvd jeä .eUre uyÿ mfoY j ,o ± l .; yel'

w; ;fh fyd¢k jHdm;j mej;k uyÿ lelßhk l¾udk;hl Y ,xldfõ o mej;ho wo th jHdm;j we;f; mOdk jYfhk m;;,u ig ukkdru olj do ;lKdu,fh ig l,ufk oljd mfoYj,h'Y ,xldj"bkÈhdj ydÖkh w;r j fj<| iïnkO;d kidóg jiroyi .Kklg fmr ig fuu i;jhk Ökhg wmkhkh lr we;'w.kÈ. wdihdkjk w;ro fïjd b;dmp,; j wdydr øjHl f,i Ndú;d fõ'

f,dl fjf<| fmdf, Beche-de-mer i|yd jk b,¨u kid fuu l¾udk;fh meyeÈ, j¾Okhl olkg ,efí'wNHk;r bkøhhk bj; lr ;ïndúh,d ilik ,o uyÿ lelßhk Beche-de-mer hk kñk y÷kjh' ,xldj ;, fudjk ie,lhh; uÜgulk wdydrhg .kkd nj ±kg jd¾;d ù ke; ; Y ,xldfõ uyÿ lelß úfYl 2l muKl úh< Beche-de-mer f,i wdihk fj<| fmd<g heùul iÿ lrh' óg wu;rj fudjkf. wdydr ud¾.h" Yjik moO;h jek flldgio wdydrhg .kkd njg f;dr;re jd¾;d ù we;'

wdydrhg .ekug ilik ,o Beche-de-mer

fuu l¾udk;h jif¾ kYÑ; ld, iudjlg muKl iud ù we;' kef.kyr fjrf, tkï ;lKdu,h" l,ufk yd fmd;ú, mfoYj, fudjk we, ,ukr;È. fudiï ld,hg iÿ lrk w;rW;re yd nikdyr mfoY wdY;j tkï m;;,u ig ukkdru olj d fudjk we, ,u iÿ lrkfk Bidk È. fudiï ld,hgh'wjdrhg fudjk we, ,u iïm¾Kfhk k;r fkdfõ' fndfydúg Tl ick gexl ry;j fyd iy;jo lñ§ uyÿ lve, ,k w;k tl; lßu fuy§ iÿ lrk ,efí' fk<d .k ,nk u¿ wi jekku wmkhkh i|yd fhdod .k ,efí'Ñkh" ;dhjdkh" fydxfldx iy ix.mmrej jek rgj, mOdk .ekï lrejk jk w;r wmkhkh lrk ,nkfk Beche-de-mer f,ih'

bkÈhk id.rfh uyÿ wÜghk úfYl 200l muK Ôj; jk nj úYjdi lrk ku; Y ,xldfõ fudjk úfYl 27l muK jd¾:d ù we;' fudjk ce*kd wÜghd" mud wÜghd" fmd<`.d wÜghd" mud n;l wÜghd" f.du wÜghd" l¿ wÜghd jek úúO kï j,k yÿkjk ,efí' fudjkf.k úfYl 15l wd¾Óluh jYfhk jeo.;lul Wi,k nj m¾fhlK j,k ikd: ù we;'

රතු අට්ටයා

Holothuria edulis

ප්‍රීමා අට්ටයා

Holothuria fuscogilva

අන්නාසි අට්ටයා

Thelenota ananas

Beche-de-mer ie§fï§ u,ku tl; lrk ,o iÔù uyÿ lelßhk ±, j,k ielinE. fyd m,diál ner, fhdod .kñk fjr< fj;g / f.k tu iÿlrh' bkmi my; wdldrhg ielium iÿfõ'

1& mudK u; fjk lr Tjk mßiÿ lÍu ^Grading and Cleaning& fudjkf. YÍrfh we,ù we; je, leg"Yf,Yu, jek oE c,fh nyd fidodbj; lrh'
2& wNHk;r wjhj bj; lÍu ^Evisceration&
3& ;eñîu ^m<u jdrh& ^Boiling&
,gr 1000 muK mßiÿ ner,hlg wNHk;r wjhj bj; lr, ,o wÜghk oud ;ïnk ,efí ^uyÿ c,h 87% yd idudkh c,h 13% oud& úfYlh wkj ;ïnk fõ,dj fjki fõ'
Wod(ce* kdwÜghd yd äif ldwÜghd - ñk;; 24 muK
wkkdi wÜghd - ñk;; 16 muK

4& ¨K ±óu(¨K oudÈk 1-2 w;r mudKhl ;nh'
5& ;eïîu ^fojk jdrh& ¨K ±u kYmdok kej; úkdämyl muK mudKhl ;eïîu iÿlrh'
6& úh<u(bkmi Èk 3-5 w;r mudKhl wõfõ ;ndúh<k ,efí'


ප්‍රමාණ මත වෙන් කිරීම

වියළීම

Ök iïmodhl ffjoH úoHdjg wkj fuu uyÿ leleßhk f, jeãug"jl.v j, lhdldÍ;jh Yl;u; lÍug" u<noOh jek frd. j,g T!lO f,i Ndú;d lrh' wêl jákdlulk h; ridhkl øjHhk fudjkf. YÍrfh we; nj ngyr yd Ök ffjoHjrek f. u;hh' tfuku uyÿ lve,,k f. we;eï kYmdok wêreêr mvkh" wNHk;r mvkh" wNHk;r ;jd, yd m<ld i|yd T!lO f,i fhdod.; yel' fudjkf. YÍrfh mj;k Polysaccharide chondroitin sulfate hk iúfYl ix>glh kidwd;rhái fõokdj ke; lÍug bjyk fõ' fudjkf. fndfyd úfYlj, úgñk A,D,E,B1,B2,B3 mj;' tf,iu iuyr lløu,øjH ^Mn, Fe, Zn, Co, Cu, Se& mj;'

fuu l¾udk;h i|yd fr.,di y`. neúk fï jk úg uyÿ wÜghk Tjkf. ijdNdúl mßirfhk wêl f,i bj; lÍu iÿfõ' ku; fldr, mr j, kfrd. nj i|yd fuku mßir moO;fh lhdldÍ;jhg fudjkf.k bg jkfk uy`. ld¾hNdrhl' j¾ld ld,fh§ f.dvìñk uyog frdkuv bj; lÍu fudjk w;k iÿ jk w; úYd, fufyhl' tneúk jákdlulk h; uyÿ lelß iïm; wkjYH f,i fk,dfkd.ekñk wdrlld lÍu wm i;h; lul fukuj.lul'

j;i,d ludß ij|yekkÈ
úoHd{ mßirh wOHhk wxYh
kdrdwdh;kh

llø m,diál (id.r mßir ¥ll ldrlhkf. wkùllh me;lv

19 jk ihjfiy f;jk oYlfhy fidhd.ekul j zzm,diálZZ 20 jk ihjfiy úúO w;HdjYH NdKv kmoùu i|yd ny,ju Ndú;d jk úYùh wuøjH f,ig j¾.lrKh ù we;' 2012 j¾lfh§ hfrdmd uyoùmh ;, muKl m,diál klmdok wdY; l¾udk ;Yd,d 62"000 lg wêl mudKhl ;, /lhd wjí:d ñ,hk 1'4 lg wêl mudKhl ckkh ùu ;<k fuu wuøjHfhy wd¾Ól jákdlu ukdj meyeÈ, lrh'

wd¾Ól jYfhk nyld¾h jákdlulk h; m,diál ki l,uKdlrKhlk f;drj neyer lÍu fy;fjk th 20 jk ihjfiy mßir¥ll ldrlhk w;r muL i:dkhl f.k we;' úfYlfhku mDÓú ;,fhy 75% lg wêl mudKhl mrd me;reK úYd, ;u mßir moO;h jk id.r mßir moO;fhy mdrdißl ;,kh ì| ±óu Wfoid m,diál ¥llfhy n,mEu i.fhk by, hñk mj;k w.hl jk w;r th ixl¾K f.d,h w¾nohl ol jd j¾Okh ù mj;k .eg¿jl' 2010 j¾lh ;,§ muKl fgdk ñ,hk 275 wêl m,diál wmøjH rgj, 192 wdY; j kmoù we; w;r fgdk ñ,hk 4'8 - 12'7 w;r wêl mudKhl tu j¾lh ;, id.r mßir moO;h ;,g tl; ù we; njg kj;u úoHd;ul m¾fhIK u`.k ;yjre ù mj;' f.dvìu wdY; lhdldrlu kid l<uKdlrKhlk f;drj bj;,k m,diál fuku ëjr ixpdrl l¾udk; jek uyÿ c,h wdY;j f.dvke.K l¾udk; u`.k bj;,k m,diál fuf,i id.r mßirh ;, tl;ùu iÿ fjh'

;dlIKlj ÈhK hï hfrdmh rgj, m,diál wmøjH m;pl lrKh Wfoid fm<ö we; kuÿ fndfyd fjr,dY; rgj, ;, tjk li< m;pl lrKh Wfoid m;m; ;uh úiÿul fyd tjk ÈhK ;dlIKl fuj,ï Ndú;h j¾;udkh ;,o iÿ fkdjk nj h:d¾;hl' fndfyd ld,hl Èrdm; fkdù mßirh ;, /§mej;fï wdfõKl .Kh fy;fjk"m;pl lrKh fkdj m,diál wmøjH ;u wjik zz/ojï fmd<ZZ f,i id.r mßir moO;k f;drdf.k we;'

llø m,diál wxY u`.k iÿjk id.r mßir¥lKh"m,diál u`.k iÿjk id.r¥lKfhy kj;u me;lv f,i id.r úoHd{ hk úik y÷kdf.k mj;' úYd, ;jfhk 5mm wv mudKfhk h; m,diál wxYk llø m,diál f,i yÿkjk w;r th úYd, m,diál wxY úLdokh u`.ko kmoúh yel mßir ¥llhl'

llø m,diál wxYky iïNjh(

f.dvìï wdY;j bj;,k fuku c,c mßirh wdY;j iÿ jk l¾udk; u`.k ki l<ukdlrKhlk f;drj bj;,k úYd, m,diál wmøjH i¾h Yl;h" id.r ;rx. j, hdk;l Yl;h fyd hï Ôj úoHd;ul lhdj,k fy;fjk Èrdm; ùfï lhdj,hg Ndckh jk fyhk llø m,diál wxY id.r mßir moO;h fj; koyi úh yelh'

tfuku úúO ?m,dj kH klmdok (face wash, scrubs) Wfoid Ndú;d jk llø ì¢; (micro beads) u`.k iDcju llø m,diál wxY id.r mßir moO;k fj; tl; ùu iÿ úh yelh' Wodyrkhl f,i ì;dkH ;, j¾lhl ;,§ ?m,dj kH klmdok Wfoid fgdk 680 muK llø ì¢; (micro beads) Ndú;d jk w;r bk 0'01%- 4'1% w;r m;Y;hl id.r moO; ;, llø m,diál wxY f,i tl; jk njg úoHd{ hk úik .kKh lrk ,en mj;'

.DydY;j klmdok jk wmßiÿ c,ho llø m,diál ckk mNjhl f,i y÷kdf.k we;' úfYlfhku wmßiÿ frÈ mßiÿ lÍfï lhdj,fh c,hg llø flÈ; ^micro fibers& koyi ùu iÿ fjh' fmd,tig¾ ^polyester& iy fmd, weuhâ ^polyamides& llø fl¢; j, mOdk ix>glh jk w;r 2016 j¾lfh§ iÿlrk ,en kj;u .kKh lÍï wkj o< jYfhk llø fl¢; 1900 mudKhl tl we.¿ul mßiÿ lÍfï lhdj,fh§ c,hg koyi jk njg fidhdf.kmj;'

keõ wdY;j iÿjk NdKv mjdykfh§ iÿjk wk;re fy;fjk l¾udk; Wfoid mjdykh lrk llø m,diál wuøjH id.r mßir moO;h fj; tl; ùu iÿ úh yelh' úfYlfhku wuøjH f,i Ndú;d jk m,diál mjv¾ ^plastic powder& yd plastic pellets fuf,i id.r c,h ;, tl; ùfï wjodkul mj;'

ki mßiÿ lÍfï lhdj,hlk f;drj mßirhg koyi lrk ld¾ñl wmc,h ;,o úYd, llø m,diál wxY mudKhl wk;¾. ; fjh'

id.r mßir moO; flfry lløm,diál ¥llfhy n,mEu

id.r c,h u; mj;k llø m,diál wxY ;u wdydr f,i jrojd jgyd .kkd id.r Ôùk th wdydrhg .ekug fm<ö we;' fuu wkùlYh mdßißl ¥llh YÍr .; júg wdydr ud¾.fh ixl,;d' ^gut blockage&" fN!;lj iÿjkkdj ;jd, ^physical injury&ffi, ;, mj;k O_2 iu;,kh ì| jeàu (Change to O_2 levels in cells in the body)" wdydr p¾hdjk fjki ùu (altered feeding behavior)" YÍrh ;, ixirKh jkYl; mudKh wju ùu u.k foy j¾Okh fuku mckk lhdj,hg ndOdmeñKúu iÿúh yel h' mßir moO;fhy mj;kkdj ;,kh u¿ukku ì| ±óug fuu wkùlYh mßir ¥llhg yelhdj mj;'

úfYlfhku fldr,mr hk id.rh ;< mj;k b;d ruKh mßir moO;hl' id.r c,fhy llø m,diál wxY wvx. júg th Tjkf. wdydr ud¾.h ;,g we;¿ ùwdudYfh mj;k lvd iÿre ð¾Kh fkdjk llø m,diál j,k jeiu iÿ fjh' túg ty lhdldß;jh wl¾ukH ù fuu ruKh mßir moO;h ñh hdu iÿ fjh'

llø m,diál id.r Ôùk wdydrhg .eku fy;fjk tu id.r Ôùk ^Mussels, Oysters& wdydrhg .kkd ñki YÍr ;,o ffcj tl;úfï ^Bio-accumulation& lhdj,h fy;fjk fuu wkùllh mßir ¥llh tl;ùfï yelhdj mj;'hfrdmd uyoùmh ;, uyÿ mßfNdckh lrkmo.,fhl jirlg llø m,diál wxY 11000 lg wêl mudKhl ;u foyh ;,g ,nd .kkd njg jd¾;dù we;'

mßir moO;k ;,È. ld,kj /§ mej;fï yelhdj ^persistent&iy; Ôùkg úY iy; ^toxic& fuku Ôù foy ;< tl;ùfï ^Bio-accumulation& yelhdj iy; ^PBT& wxYk yg fuu llø m,diál wxY wêfYdOkh lr.; yelh' tu kid fuu PBT ix>Gl lYøm,diál iu`. tlj id.rfh fjfik md:ñl klmdolhk jk Ydl m,jdx.hkf. ig úYd, ;u Ôùk jk ;,uikf. foy ;,otl; ùfï iïNdú;djl mj;' tfuku uyÿ Ôù úfYl wdydrhg .eku u.k wdydr odu$ wdydr cd, Tifi ffcj ridhkl ñki YÍrh ;,gotl; ùfï wjOdkul mj;'

llø m,diál wxY klmdokfh§ Ndú;d jk fmd,urhk ^polymers& ;, wvx. m;llø ðùldrl (Antimicrobial agents) jek ridhkl id.r mßir moO;k fj; koyi ùfuk ty ijdNdúlj fjfik llø Ôù >kdjdi j,g ndOdmeñKùu iÿúh yel'

ixpdrl ydëjr l¾udk;hg iÿjkkdj n,mEu fuku id.r mßir moO; mßiÿ lÍug fh§ug iÿjkkdj w;f¾l mßjeh fuu mßir ¥llfhy wd¾Ól n,mEu f,i j¾.lrKh l, yelh' Ôùkf. mßjD;h lhdjkg ndOd meñKùu fy;fjk iÿ jkkdj id.r mßir moO;ky fi!ko¾hd;ul jákdlu wvùu fuku uyck fi!Lhh wdrlldj ìo jeàu llø m,diály iudÔh n,mEu f,i yeokúh yelh'

llø m,diál u`.k iÿjk id.r¥lKhwju lÍug .; yel lhdud¾.

m,diál m;plIrKh Wfoid ;dlIKl fuj,ïy wjYH;dj fuku fmdÿ ck;djf. wdl,muh fjki ùuow;HjYH idOlhl'zzm,diál hk bj;,k wmøjHh lZZ hk fmdÿ u;h ì| oud f,dy" ùÿre jek wuøjH fuk m,diál om;plIrKh l,yel wuøjHhl hk mKúvh mn,j iudc.; l,h;h'

tfuku b;d ir," wd¾Ól jYfhk ,dNodh úi÷ul jkfh m,diál wmøjH j¾. lr" fjklÍu u`.k m;plIrK lhdj,hh'

kj klmdok lhdj, Wfoid m;plIrKh l, m,diál Ndú;h u`.k mßirhg koyi jk m,diál mudKhkwju lr.; yelh'

m,diál wuøjH Wfoid wdfoYl f,i Ndú;d l, yel mßir y;ldó wuøjH fidhd.eku Wfoid úoHd;ul m¾fhlK m¿, lÍu iÿ l, h;h' úfYlfhku rEm,djkH klmdok Wfoid Ndú;d lrk micro beads Wfoid wdfoYlhk kmoùu tw;ßk muLi:dkhl .kkd wjYH;djhl' tfi ke;fyd; ó,`.oYl lymh ;< iui:mDÓú ;,hm,diál j,k jei hk fkdwkudkh'

m,diály wd¾Ól jákdlu fukd fkdie,lu; bj;,u fy;fjk id.r mßir moO; flfry m,diál u`.k we; lrkkdj mdßißl n,mEu m<n|j ck;djf. ±kj;Ndjh ^úfYlfhku mdi, orejkf.&by< kexùu Wfoid jevigyk lhd;ul l<h;h'

uy ; mßYuhl ord m,diál m;plIrKh fyd th Ndú;h wju lÍug wo Èk mhjr .; ;o fuhg jir 80 lg wêl ld,hl ig id.r mßirhg tl; jm,diál yd bk ckkh j lIøm,diál ;j oYl .Kkdjl hk ; re id.r mßir moO; ky ; ,khg ndOd muKjñk mßirfh /§ iák we;' kÿre wkd. ; fh§ m;m, ,nd. ; fkdyel jjo §¾>dld,k mdßißl wdfhdckhl f, i m,diál Ndú;h wju lÍug wjYh m;m; ;uh ;kÿ j¾;udkfh§ .; h; w;r th lhd;ul lÍug wjYH jgmgdj ilid .ekuw; HdjYH idOlhlù we;'

m,diál wluj ; j id.r mßirhg uod yeÍu u,kmgd ±u h.hl llø m,diál wxY u.k jk id.r mßir ydkho mDÓú ;,fhk u,kmgd ±óug mDÓúh u; fjfik ÈhK ;u Ôúhd jk ñk idg yelhdj ,efnk we;' ñk id úik yÿkjd ÿk klmdokfhy wkù I lh wxY u.k iÿjk id.r mßir ¥lKh wju lÍug m<hï fiùuo ñk id i; h; lul iy j.lul jk w;r th id.r úohd{ hk" m;m; ; ydk ; iïmdolhk fuku iui ; f,dljdikf.uWr u; megjk iduylj.lul jkfkh'

l lKldmhñ .ref.
lÓldpd¾h
c,c iïm; ;dllKfõ§ Wmdê mdGud,dj
W!j fj,, ii úYj úoHd,h

Are we interested to conserve our valuable ecosystems? Sathurukondan, an urban mangrove wetland in Batticaloa, would disremember in near future…

"*The adverse effects of climate change show us the imperative need to be prepared for weather uncertainties. We have to be determined this year to live with nature and not above or against it*" …the New year 2017 message of The President His Excellency Maithripala Srisena.

What are mangroves?

Mangrove plants comprise a heterogeneous group that are defined ecologically by their occurrence in tidal zones along shorelines and estuaries, lagoons, river mouths and reeks. Mangroves are forests of salt-tolerant and flood-tolerant trees, shrubs, herbs, ferns and palms living in an environment where the water is filled with high concentrations of dissolved salts, water levels are constantly changing and in oxygen deprived sediments, which would certainly exclude most plants. They have evolved with certain morphological and physiological responses, which allow them to avoid the pitfalls of these harsh conditions (Figure 1).

Figure 1, Luxurious growth of urban mangroves at Sathurukkondan, Batticaloa

Mangroves are discontinuously distributed along the coastline, surrounding lagoons and estuaries around Sri Lanka. There are 6,296 ha of mangroves existed in the Colombo, Ampara, Gampaha, Trincomalee, Batticaloa and Puttalam districts alone, and the total area of mangroves is likely to be close to 9,500 ha in 1996, according to the recent remote sensing studies.

Mangroves: a valuable resource…

They are valuable ecosystem in terms of ecology, economy and ecosystem services (direct & indirect). Mangroves provide food and nursery grounds for many commercially important aquatic and terrestrial animals such as sponges, crustaceans, molluscs, fishes, birds, and reptiles. A myriad of marine species are found as inhabitants of the underwater prop root complex, forest floor and canopy, at some point of their life cycles. It is a good source of carbon fixing ecosystem and very important to present climate change consequences.

Mangroves are "land builders" and act as "land stabilizers" due to rapid production of their root systems that have significant sediment-holding capabilities. They stabilize coastlines, in many cases they promote coastal accretion and provide a natural barrier against storms, cyclones, tidal bores and other potentially damaging natural forces. Mangrove ecosystems maintain ecological balance in several ways. They act as natural "kidneys" of a coastal ecosystem by filtering unwanted components with the aquatic ecosystems. Healthy mangrove forests are keys to healthy marine and coastal ecology.

Mangroves in Batticaloa

Batticaloa district has significant mangrove cover (around 1303 ha, 10.68% of total mangrove cover of Sri Lanka), and notable patches are found at Vaharai (Kandaladi), Panichankerni, Nasivanthivu, Pankudaveli, Sathurukkondan, Batticaloa, Manmunai, Porathivu and other places with minor scale. Species diversity is high in those ecosystems. About 15 mangroves and associated species are identified in the mangrove wetland in the Batticaloa district [*Avicennia (Kanna/ Manda), Acrostichum, Acanthus (Neer mulli/Kaddu ihiliya), Bruguiera (Poo kandal/Seng kandal/Ul Manda/Mal Kadol), Ceriops (Narikeeri/Pung kanda), Excoecaria (Thillai/Thela), Heretiera (Somunthiri/Edduna), Lumnitzera (Keeri/Paeriya), Rhizophora (Perung kandal/Maha kadol), Sonneratia (Kinnai/Kirala), Clerodendrum, Cerbera, Dolichandrone, Derris, Sesuvium*]; vertebrates and invertebrates are high (ants, butterflies, lizards, snakes, monkeys, migratory and local birds, crocodiles, crabs, prawns and fish varieties). People are depending on this mangrove forest for food, medicine, brush piles for fishing, construction poles, firewood, undergraduate & postgraduate studies and many more.

According to the data available, around 500 ha of mangroves had been reduced in Batticaloa district for a period of 22 years from 1985 to 2007, with an average annual change of 1.15%. The exact extent of mangrove cover is not estimated in the recent past in the Batticaloa district due to past conflict situation. Mangrove forest are destroyed by several means, naturally and by human activities: 2004 tsunami, encroachment/land filling, shrimp farms, infrastructure development, cutting and felling and many more.

Mangroves at Sathurukkondan, Batticaloa

Sathurukkondan is one of the places, 5 km away from Batticaloa town, where the mangroves area is under the threat, especially after the end of war in 2009. It spreads about 75 hectares from Pillayaradi to Thannamunai along both sides of the A15 main road with a width of less than 1km.

It is one of the areas where high diversity of mangrove plants is recorded; 62 bird species both local and migrants had been reported, in a SLAAS publication in 1993. Subsequently there had been reports of the Birds of this area by various scientists. It had been reported in the inception report of the NECCDEP programme. The students of the Eastern University visit this for their study tours. Post graduate studies have been focused (locally as well as from foreign universities) on these as an urban wetland.

Unfortunately, this valuable mangrove forests are reducing in recent past. The mangrove wetland is being encroached, fenced and filled. This has been a thorny issue over the past few years in the district of Batticaloa. People are trying to grab all the lands possible in the district by deeds of centuries old or new ones made for conveniences. Is it possible to claim the ownership for such valuable wetland and the surroundings, which so close to the lagoon; even if, they could not alter the usage significantly. If these fundamentals are violated, we would soon not have any NATURE but only memories of them in near future.

This wetland was declared as protected area by the GA in 1990s. There were several voices against the destruction of this wetland in the Batticaloa districts from professionals, environmental organizations and individuals; petitions were sent to the respective departments and authorities, Ministry of Environment in written and verbal, but the wetland still under the threat. The below photographs were taken in 2009 and recently in 2016/2017 (showing fencing mangrove wetland and fish catch in December, Figure 2; an advertisement for sale of the mangrove wetland and filling of the same, Figure 3).

Figure 2, Mangrove forest is fenced by private (left); a large fish catch (cat fish) in December 2009 at Sathurukkondan, Batticaloa

Figure 3, Mangrove wetland subjected to human threat at Sathurukkondan, Batticaloa, 2016

A programme was implemented at the Batticaloa in 2016/2017 titled "conserving wetlands around the lagoons in the Batticaloa district", by the Coast Conservation Department (CCD) under the IFAD (International Fund for Agriculture Development) project with the financial support of GEF (Global Environment Facility). Land marks were laid around the lagoons up to high-water tide that spread during the monsoon periods. Unfortunately, mangrove area at Sathurukkondan, now under filling, is not fallen in the protected area.

"The filling of these wetlands would cause flooding in the other shores of the lagoon viz Eachantheevu and also cause as series of other issues as these drain the waters from the higher areas and the tank above it. These waters from the entire area of higher elevation and their drainage to the lagoon would now be blocked. IF PEOPLE are allowed to alter the landscapes at will we would never solve the flood issues. In addition to that, filling of wetland reduces the mangrove area by means of blocking water passage and negatively affects the hydrology of the ecosystem, which leads to kill the mangroves and thus the valuable associated fauna too; and in long run chances for reduction in producing crabs, fish and prawns that affects the livelihood of lagoon fishers. At present, we lost some of the local fish varieties which were preferred to eat decades ago. In addition, we will face huge flood problem during the monsoon, which we are facing every year, at present.

The interest of His excellency the President (He also heads the country as the Minister of Environment) in the natural resources, utilization of them and the juristic actions to those who are violating the Laws and Acts regarding the protection of our environment have been highlighted over the past period in the press. It is essential that we do put a stop to alteration of landscapes, before detailed study of them, if needed for national interest only.

As the citizen of Sri Lanka and the Batticaloa, we the people should raise our voices to protect our valuable natural resources, which is not only vital for our children and grandchildren for their happiest life, but to mitigate the present impacts of climate change. If we are not reacting immediately from such impacts, the President's message and his thoughts on conserving natural resources will become the *words written on the water*…

If we don't do what should be done today, tomorrow may never have a chance to even know that. Today would be yesterday for them…a history.

Dr T Mathiventhan,
Department of Botany,
Eastern University, Sri Lanka (EUSL)

UNIQUENESS OF PALK BAY

Introduction

Palk bay is a shallow, confined and Fairley calm sea with negligible oceanic currents is positioned in between India and Sri Lanka. It western side is bounded by Tamilnadu and eastern side is end with the north western provinces of Sri Lanka. The name Palk bay was given to this bay according to after Robert Palk, former Governor of Madras in the period of middle of 18th century. Palk bay is consisted with mainly three Bengal, one into gulf of Mannarand another shallow opening from the south it is between the series of sand islets called adam's bridge to the gulf of Mannar. This small navigable channel is only given opening to cross these sand island also named as "dancing island" to small vessels wih the lesserdraft in between 4th and 5th sand islands from the Thalaimannar. Palk bay scattered area is estimated to be 13892sq.km and is has divided in to two equal parts of 6991sq.km each between Sri Lanka and India. depth of the Palkbay is different in palaces to places and maximum recorddepth is 15m and average depth is 9m in the area. It is 40nm to 85nm wide and 85nm long. By the agreements of 1974 and 1976 between two governments international maritime boundary line was establish to demarcate their boundaries. in the past few decades Palkbay was taken into the interest of various parties due to the everlasting fishing dispute between Sri Lankaand India and the purposed project of sethusamusuram. Palkbay is identical for its critical shallowness and it is considered to be the backbone of its yield which in turn supports wide diversity of marine living and nonliving resources and also related varied source of revenue. Also thousands of fisherman are involved in fishing related activities in directly and indiversified ecosystems and the differential exploitation of the biogical resources with different fishing techniques by the two countries have resulated in considerable impact on the environment of this region. This Paper attempts to give a brief idea about the Palkbay, its value in the term of biological and geological concerns and the immediate requirements to conserve the Palkbay resources with the cumulative degradation level due to various activities especially IUU fishing.

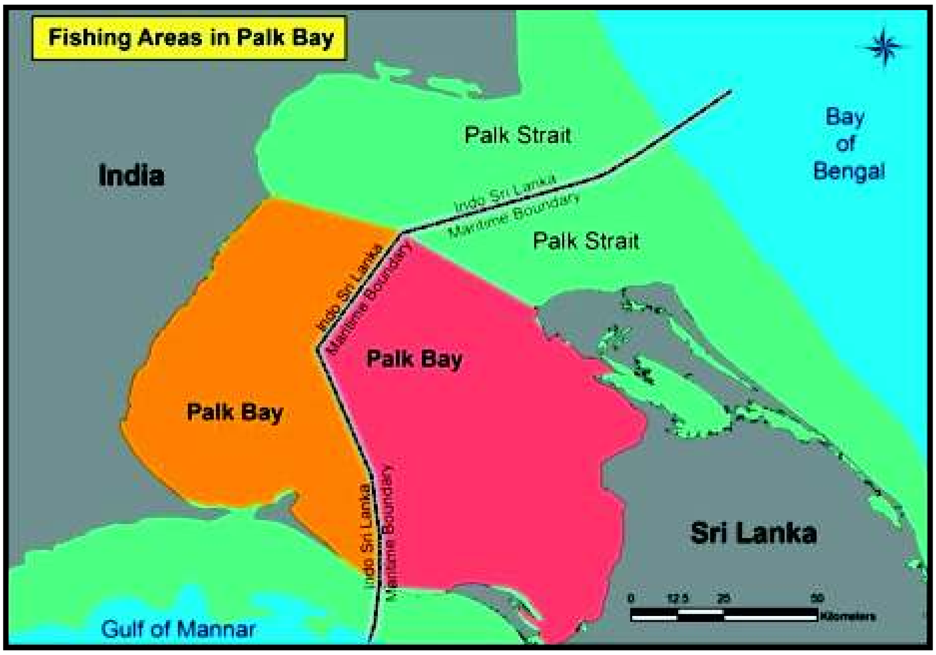

Figure I : fishing areas and Palkbay

Ecosystem of the Palk bay

Palk bay echo system unique with shallow water ecosystem with the ongoing environmental degradation due to various manmade activities and natural phenomenas. it include excessive fishing, tsunmi, coastal development project with the end results of gathering huge pollutant substance to the sea specially in the rapid developing areas in Taminadu. There are some rivers which are flown in to the palk bay, taking some 0.6 cm organic sediments to the sea bottom per year. This vast marshy, mudflat ecosystem of both the side supports a swift growth of mangrove which in turn support as wide varieties of biodiversity not only in the marine environment but a variety of native and outlandish migratory birds and animals.

Sea bottom geology

The productivity of all fishing and other resources are totally defend on the bottom condition of the sea. As per the results of reserch carried out by various expertise the sea bottom ecosystem of indian side near shor water of palk boy is generallycomprised of all muddy, sandy, sea grass and rocky in place to place. The sea grass layer starts layer starts appearing in the area as the sea bottom changes from muddy condition to sandy and mixture of both sand and mud. in Tamilnadu side Most of the areas in sea bottom has become to burning area of the Palk bay is Lies along the International Maritime Boundary Line and it is reported to be almost sandy. This condition is an excellent trawling ground for mechanized trawlers.

When comparing the bottom conditions of Tamil Nadu side can be considered as less productive than the Sri Lankan side of Palkbay area when concerning the following reasons. The sea bottom of Sri Lankan Palkbay along the northen shoreline of Jaffna Peninsula is comprised with the presence of fossilized limestone rocks. These limestone rocks are spreads from the shore to the sea up to various distance, it is abvious that in some places it goes about 50m from the coastline. When you travel along the northern coast line it is quite prominaent from point pedro to the west side passing up to Keerimalai. And also hardly any live cora; reefs areexisting in any of these places. But this condition is changing when it comes to the north western island sectros of Sri Lanka. Live coral reefs and thick vegetation is experiencing in the island specially in kyts, Mandativu and Pungudutivu. There is a live coral reef scattered in area some 50m 1.5mm from ht e coast providing a excellent home for reef fish and some others species.

These thick vegetaion is extended up the Mannar area with the identica; shallowness. These sandy sea area is filled with soft clay and organic materials. When consider about the Jaffna lagoon of north, while the shoreline is sandy like the Palkbay area, the bottom isalmost muddy. Most of the shallow areas are full of vegetation. Between the shoreline and the reef it is sand mixed withmud and most areas with dense vegetation with the sea weeds and algae. The areas in between the islands are muddy or mixture of mud and sand thick growth of mangroves facilitates the proliferation of prawns. This of rich biodiversity of the coral reef and mangrove ecosystems in Sri Lankan side provide an excellent breeding and nursery grounds for various finish, crab and other oceanic fishery resource. These reasons are ensure that the richers amount of marine resources are only existing in the Sri Lankan side of the Palkbay. This Very reson is tempts Tamilnadu fisherman to poaching in to the Sri Lankan waters continuously.

Biodiversity

The large number of marine species and their endemic form available in Palkbay area and adjacent marshy land with vast biodiversity with birds and animals. More than three hundred species of marine algae and considerable amount of fish species such as commercially important fin fish, crustaceans and molluscan fishery resources have been make their home in the Palkbay due to its uniqyeness with the shallowness and profuse organic substances.

Major threats to palkbay

When considering the treats Non existence of organized fishing is very much noticed in Palk bayregion. Both the countries have been technically developed their fishing gears from sustainable traditional methods. These recent developments of both in fishing gears from sustainable traditional methods. These recent developments of both in fishing crafts and gears and unrestricted increase in the total of fishing boats and ascending up both in traditional and mechanized fishing sectors has resulted to overfishing of most of the fishery resources in Palkbay region. This over volume of fishing by trawlers resulted an everlasting tension between the traditional and mechanized fishingsegments for sharing the inadequate fishing ground and declining fishery resources.

Considering the statistic of Indian fishing sector motorized vessels went on growing due to the increase in demand for seafood and subsequent increase of price it is notable that Indian fish market price are much higher than the Sri Lanka It is a direct result of several static programs of Indian Government both in state and central level such as grants given for diesel enginese, innovative fishing gears and gear materials, crafts and financial backing to fishermen and fishing cooperative societies societies. This was speededup the mechanization and motorization process of India. Present estinated number of fishing vessels of almost all the types seem to be far excess that the actual number required to produce the sustainable yiels. So far no salid steps have been initiated to control or reduce the number of vessels and there is not even an effort put by government to put a cap on the number of fishing vessels at the present level.

Intensive and extensive catching of junveniles of prawns, crabs and fish and deprivation of the sea-grass and seaweed beds by this kind of operations such ad "thalluvala" or "thallumadi" called in Tamil and bottom trawling is repotted along the coast or in the pf Palkbay. This fishing by bottom trawling is considered seriously harmful to the fishery resourses and its' environs by the fishers themsleves because it damage and take out the bottom living fauna and flora also.

Sri Lanka and Palkbay

with the fishing dispute between the both the countries it is obvious that the Sri Lankan fishers do not venture up to the IMBL and cover all Sri Lankan side of Palk bay for fishing and this given sufficient room for the Indian fishers to handily cross over the IMBL and exploit fishing is Sri Lankan waters. Only a few number of FGD are observe harvesting along the IMBL laying nets, only in the non-fishing date of Indian bottom traelers. To avoid that Sri Lankan fisherman should be empowered with adequate fishing crafts and apparatuses to enlarge their fishing area up to the IMBL to get the maximum fishing resources from the Palkbay. In a nutshell existing Sri Lankan fishing fleet is too young with smaller boats and engine power capable of working with fishing nets only in the shallow inshore waters of Sri Lanka. Hence it is timely required the Sri Lankan fishing authority to extend their arms up to the IMBL to increase the fishing production in Sri Lank with innovative methods without encouraging the hal bottom trawling. This Extension of Sri Lankn young fishing fleet up to the IMBL limit may also show deterrence to the poaching Indian matured or over matured trawling fleet and curtail their poaching up to some extent.

Conclusion and Recommendation

However almost all the fishing ways and means have adversative influense on the environment and biological resources with diverse degree of intensity. But here in this paper we are soncerned more on about the fishing approaches with have severe impact on the envirnment and its flora and fauna are considered the worst among them. Especially when they are trawling very close to the shore as the coastal water is the nursery ground for all the fishery resources. Hence that both the government should get to band the bottom trawling completely. Before implement such a strong action governments should select the fishermen who are willing to come out of fishing apparatauses, and should providing an attractive buyback offer for the their existing fishing crafts and fishing apparatuses, and should ensure also there is a provision for an alternative livelihood.

Apat from that there should be a permanent solution to the ceaseless fishing disputes between Indian and Sri Lanka. According to the third united nation conderene on the law of the sea(UNCLOS) it signals a new legal order for the sea by "principal of common heritage of manking". The following statement of E.M. Borgese, a leading authority on the Law of the Sea is clearly express the legal aspects of the above principal.

"The concept of Common Heritage suggested a new orderfor the oceans, based not on competition and conflict, but on cooperation, on the revolutionary principal that the oecans are the common heritage of mankind and the marine environment and its resources, therefore had to be managed for the common good of all"

Hence the government of two countries should get involved to resolve this fishing disputes based on the mutual understanding and cooperation between the fishermen of both sides.

The exhaustion in the fishery resources and marine envirnment in the Palk bay is not only by over fishing, it also due to improper fishing methods, envirnment degration due to destructive bottom trawling, accumulation of oil spills by fishing vessels and buildup of pollutant and their effect on the water wuality and productivity in the Palk bay also in addition to that coastal degredation also can be count to this and it effects to the palk bay by many ways such as human activitis, natural calmities and climate change also. More scientific and precise way of evaluating the fishery potential and marine conservation of Palk bay is essentially needed and to be implemented immediately to avoid further damages to this precious natural fishing ground.

WNL Wijesinghe
Lieutenant Commander (ASW)

Marine Ecosystems

“The ocean stirs the heart, inspires the imagination and brings eternal joy to the soul.”
By Robert Wyland

Large Marine Ecosystems (LMEs) are regions of the world’s oceans, encompassing coastal areas from river basins and estuaries to the seaward boundaries of continental shelves and the outer margins of the major ocean current systems. They are relatively large regions on the order of 200,000 km² or greater, characterized by distinct bathymetry, hydrography, productivity, and trophicallydependent populations. Productivity in LME protected areas is generally higher than in the open ocean.

The system of LMEs has been developed by the US National Oceanic and Atmospheric Administration (NOAA) to identify areas of the oceans for conservation purposes. The objective is to use the LME concept as a tool for enabling ecosystem-based management to provide a collaborative approach to management of resources within ecologically-bounded transnational areas. This will be done in an international context and consistent with customary international law as reflected in 1982 UN Convention on the Law of the Sea.

Although the LMEs cover mostly the continental margins and not the deep oceans and oceanic islands, the 66 LMEs produce about 80% of global annual marine fishery biomass. In addition, LMEs contribute $12.6 trillion in goods and services each year to the global economy. Due to their close proximity to developed coastlines, LMEs are in danger of ocean pollution, overexploitation, and coastal habitat alteration. NOAA has conducted studies of principal driving forces affecting changes in biomass yields for 33 of the 66 LMEs, which have been peer-reviewed and published in ten volumes.

Figure 1. General characteristics of a large marine ecosystem (Gulf of Alaska)

This set of marine community illustrations can be used as visual aids during formal or informal instruction while teaching about the marine realm. There are three versions of each illustration:

- ☛ Unlabeled illustration
- ☛ Titled, unlabeled illustration
- ☛ Titled, labeled illustration

The three different versions were created in order to provide materials that best suit the needs of any educational situation. Different areas of the ocean can be classified as different types of marine ecosystems. An ecosystem is defined as "a community and the interactions of living and nonliving things in an area." Marine ecosystems have distinct organisms and characteristics that result from the unique combination of physical factors that create them. Marine ecosystems include: the abyssal plain (areas like deep sea coral, whale falls, and brine pools), polar regions such as the Antarctic and Arctic, coral reefs, the deep sea (such as the community found in the abyssal water column), hydrothermal vents, kelp forests, mangroves, the open ocean, rocky shores, salt marshes and mudflats, and sandy shores.

The hydrosphere connects all freshwater and saltwater systems. Salinity, or high salt content, and global circulation make marine ecosystems different from other aquatic ecosystems. Other physical factors that determine the distribution of marine ecosystems are geology, temperature, tides, light availability, and geography.

Some marine ecosystems are very productive. Near-shore regions, including estuaries, salt marshes, and mangrove forests, teem with life. Others, like the abyssal plain at the bottom of the ocean, contain pockets of life that are spread far apart from one another. Some marine ecosystems, like the deep sea, are in constant darkness where photosynthesis cannot occur. Other ecosystems, like rocky shores, go through extreme changes in temperature, light availability, oxygen levels, and other factors on a daily basis. The organisms that inhabit various marine ecosystems are as diverse as the ecosystems themselves. They must be highly adapted to the physical conditions of the ecosystem in which they live. For example, organisms that live in the deep sea have adapted to the darkness by creating their own light source-photospheres are cells on their bodies that light up to attract prey or potential mates. Many parts of the ocean remain unexplored and much still remains to be learned about marine ecosystems.

Marine Ecosystem Classification

The term "ecosystem" refers to all of the non-living and living elements of a natural environment, including but not limited to water, sunlight, rock, sand, vegetation, microorganisms, bugs and wildlife. Marine ecosystems are aquatic ecosystems whose waters possess a high salt content. Out of all of the types of ecosystems on the planet, marine ecosystems are the most prevalent. They teem with life, providing nearly half of the Earth's oxygen and a home for a wide array of species. Scientists generally classify marine ecosystems into six main categories; however, labels aren't always clearly defined, so some categories may overlap or envelop other categories. Also, within each broad category, smaller specialized sub-categories may exist, for instance littoral zones and hydrothermal vents.

1. Open Ocean Ecosystems

The first thing many people think of upon hearing the term "marine ecosystem" is the open ocean, which is indeed a major type of marine ecosystem. This category includes types of sea life that float or swim, such as algae, plankton, jellyfish and whales. Many creatures living in the open ocean inhabit the upper layer of the ocean where the sun's rays penetrate. This is known as the euphotic zone and extends to a depth of about 150 meters (500 feet).

2. Ocean Floor Ecosystems

Marine life not only exists in the open ocean waters, but on its floor as well. Species that live in this ecosystem include certain types of fish, crustaceans, clams, oysters, worms, urchins, seaweed and smaller organisms. In the shallow water, sunlight can penetrate to the bottom. However, at greater depths, sunlight cannot penetrate, and organisms inhabiting this deep water rely on the sinking of organic matter above for survival. Many such organisms are small and generate their own light to find or attract food sources.

3. Coral Reef Ecosystems

Coral reefs are a special subtype of seafloor ecosystem. Found only in warm tropical waters and at relatively shallow depths, coral reefs are among the most productive ecosystems on the planet. About one-quarter of marine species depend on coral reefs for food, shelter or both. While coral reefs are famous for attracting brightly colored exotic fish, a plethora of other species -- snails, sponges and seahorses, to name a few -- inhabit coral reefs. The reefs themselves are produced by simple animals that build external skeletons around themselves.

4. Estuary Ecosystems

The term "estuary" typically describes the shallow, sheltered area of a river mouth where freshwater intermingles with saltwater as it enters the sea, although the term can also refer to other areas with flowing brackish waters, such as lagoons or glades. The degree of salinity varies with the tides and the volume of outflow from the river. The organisms inhabiting estuaries are specially adapted to these distinct conditions; hence, the diversity of species tends to be lower than in the open ocean. However, species which generally inhabit neighboring ecosystems may occasionally be found in estuaries. Estuaries also serve an important function as nurseries for many types of fish and shrimp.

5. Saltwater Wetland Estuary Ecosystems

Found in coastal areas, saltwater wetlands may be considered a special type of estuary, as they also consist of a transition zone between land and sea. These wetlands can be divided into two categories: saltwater swamps and salt marshes. Swamps and marshes differ in that the former are dominated by trees while the latter are dominated by grasses or reeds. Fish, shellfish, amphibians, reptiles and birds may live in or seasonally migrate to wetlands. Additionally, wetlands serve as a protective barrier to inland ecosystems, as they provide a buffer from storm surges.

6. Mangrove Ecosystems

Some tropical and subtropical coastal areas are home to special types of saltwater swamps known as mangroves. Mangroves may be considered part of shoreline ecosystems or estuary ecosystems. Mangrove swamps are characterized by trees that tolerate a saline environment, whose roots systems extend above the water line to obtain oxygen, presenting a mazelike web. Mangroves host a wide diversity of life, including sponges, shrimp, crabs, jellyfish, fish, birds and even crocodiles.

Marine ecosystems importance

Marine ecosystems are an important part of the world, because the marine ecosystems give marine life such as: tiny plankton, fish, crustaceans, invertebrates, reptiles, marine mammals, sharks, and rays a place to live and survive. It also gives those marine animals a place to hunt. Many marine life have an important role in the world such as the tiny plankton because without them the world would build up with carbon dioxide, the plankton absorbs the carbon dioxide in the air and releases oxygen back into the air. Without marine ecosystems to protect the tiny plankton, more species would become extinct.

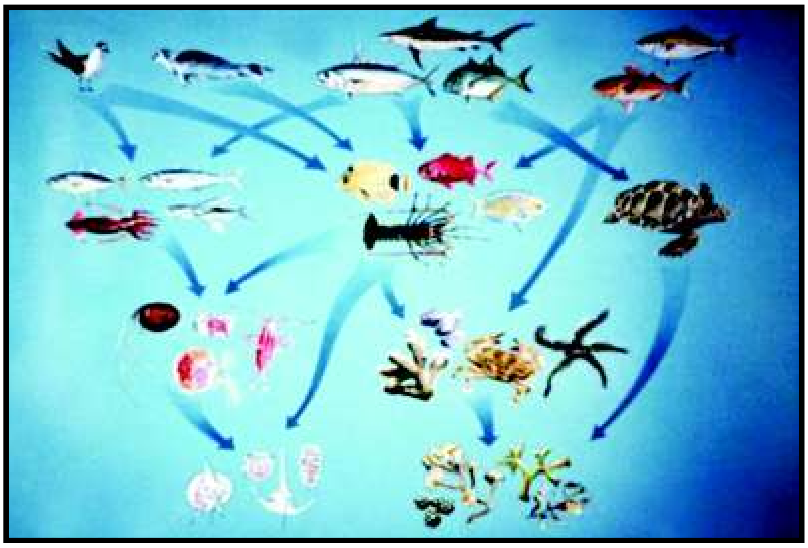

Figure 2. Shows the food web of the marine ecosystem and what survives off of each other. By NOAA, 2015)

The most important marine ecosystems for marine life are estuaries and coral reefs. These two marine ecosystems are important because the estuaries are breeding territories for many marine animals, because it is easy for young-lings to survive there, since there are no known predators that live in that region. Coral reefs are important for the marine life, because it provides a shelter for various amounts of species. Coral reefs also are the most diverse ecosystem in the whole aquatic system. Without all the marine ecosystems, the marine food web and the whole ocean would be in danger of continuing in its current state.

Marine ecosystem threats

The threats that have impacted the marine ecosystems are pollution and overfishing. Pollution is impacting the marine ecosystems, because as more carbon dioxide is released into the air more of the ice caps are melting. Therefore, the rising of ocean levels and the decrease in salinity levels. Are causing problems for the marine life? If the salinity levels keep dropping the marine because life that survive in salt water will not be able to survive in the fresh water rich waters. Pollution is killing marine animals not only in the salinity drop, but also they eat or get trapped in harmful garbage, marine life in the ocean die from swallowing or getting caught on trash every day. Over one million sea birds are killed by pollution every year. Also three hundred dolphin and porpoise are killed by pollution, by either swallowing trash or getting tangled in trash and one hundred thousand marine mammals are killed by ingesting plastics and other pollution substance every year. Pollution is a major reason why marine ecosystems are being threatened. But, another threat to marine ecosystems is overfishing. Overfishing is a threat for marine ecosystems because a decrease in number of a species will affect the marine food web disrupting the whole ocean. If overfishing causes specie to become extinct in the marine ecosystem then it will have one of the species in the ocean to become overpopulated. Once one specie becomes overpopulated then that organism dominates the ocean making other species to become endangered or extinct. The threats in the marine ecosystems can have an impact that the system will never repair itself, which will disrupt the world more than any other ecosystem would. However, the Government stepped in and passed an amendment that decreases overfishing. This amendment helps the ocean to recover the decrease of marine animals. The amendment puts a set limit for the marine species we manage. In 2014, 91 percent of annual limits were nit exceeded and only 9 percent were exceed. There are numinous amount of reason why catch limits are being exceeded such as: miscount of population, by catch in a fishery, and fishing rates are higher than estimated. Scientist track these number to manage overfishing so population does not deplete more.

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CINEC Campus Malabe

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fjr<; rhl k¾udKh ù we; f; je, iy iÙM jYfhka LKc" fldr, len, yd fn,lg len, wdo øjH j, i ixfhd.fhka' tfuku rg wNHk; rfh ig id.rhg .,d nikd .x`.d u.ka / f.k tk wjidê; fldgi ; jÿrg; fkdlvjd fjr< ; rhk fmdlKh lrh' óg wu; rj fjr< mfoY u.k mßirhg fuku ñkidgo ie,fik fijdjk rdYhla' mdßißl jYfhka i, ldne,fïo fjr<dY%s; mfoY j,gu iúfYI j mßir moO; s rdYhl y÷kd.; yelh' l,m" fldr,mr" tw; r mOdkh' fuu ih¨ mßir moO; s ffcj f.d,fh wLKv lhdldß; jh yd mdßißl iu; ,; ;djh flfry ukdodhl ;jhl imhh' ;jo mdßißl fi!ko¾Hh mj¾Okh l lu" cùk i|yd wdydr" jdii :dk" fndùfï uOHi :dk yd wdrClIdj iemhu fuu mßir moO; u.k mßirhg bgjk wfkl; fijdjkh' fjr< u.k ñk idgo bg jk fijdjk / il' tw; r wdydr wjYH;d iemÍu mOdk jk w; r f,dl jdi fndfyd ckhdf. fmdàk wjYH;djh iemhfï mOdk udOH jkfk id.rhh' tfuku je," i ,ld" .dkÜ" i¾fldk" ue.kghÜ" LKc je, jek klmdok wuøjH iemhu yd we;eï rgj , Yl ;h kmoùu i|yd uyÿ r< Ndú; h o iÿjkw; r c,cù j .d lgh; j ,go fjr< mfoY jeo. ; fõ'

Y% ,xldj oojhkl jYfhka lf,dógr 1750 l mrd úyo .h fndl" ;v" l ,m" .x fudh wdo iuøh N ,CIKj ,k i ieo fjr< ; rhl yd j¾. lf,dóg¾ 30"000 l uyoùml ;glhlg o yñlï lhñk bkohk id.rfh flkø.; j i :dm; ù we;' ojhk jgd fjr<di kkfh yd uyfo cj; jk cùk / ilg jdi i :dk imhk mßir moO; .Kkdjl wm ojhk jgd fjr<; rh wdY%s; j i :dm; j ; fí'

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ixpdrl l¾udk;h fjr<dY; mfoY we i f¾ oel.; yel ;j;tl jeo.; udkj lgh;;l' Y ,xldj jgd jHdm;j mj;k o¾Ykh fjr<;rh fy;fjk wm ojhk wojk úg f,dj mrd fjfik ixpdrlhk fndfyduhlg mOdk .ukdk;h njgm; ù yudrh' Y ,xldj mOdk ixpdrl l,dm y;lg fnodolj we; w;r thk y;rluwh; jkfk fjr<dY; l,dmhgh' tjd kï" fld<U mOdk ixpdrl l,dmh" olK fjr<dY; l,dmh"ngyr fjr<dY; l,dmh yd kef.kyr fjr<dY; l,dmhh' fuu l,dm we i f¾ jeä ixpdrl wdl¾lKhl ok ó.uj" fld<U" lM;r" w¨;.u" yllvj" WKjgk" ñßii" ;x.,," ;lKdu,h" mdilvd yd k,dfõ, jek mfoY mygd ;fí' ixpdrl l¾udk;h; iu`. fuu mfoYj, ixpdrl fydg," ;dkdhï jek bolÍï o i:dk.; ùmj;k fiu t wdY;j k¾udKh ù we; /lhd wji:do w;úYd,h'

Y ,xldfõ fjr<dY; mfoY fnfyduhl wo jk úg oeäj ckdjdilrKhg ,lj wjikh' tneúk fjr<dY;j fjfik ckhdf. tofkod lgh; i`oyd fuu mfoY uy`.odhl;jhl imhk

fiuwe;eï ixj¾Ok lgh; i`oyd o fjr<;rhk b;d jeo.; fõ' Y ,xldj wdY;j t i`oy wdikk;u WodyrK f,i reyK ud.ïmr jrdh yd f ld<U jrdh k.rh yÿkd.; yelh' ;jo fjr<;rhl hk ñkidg koyi" úfõlh iemhu i`oyd odhl;jh ,ndfok fyd`o tllhl jYfhk o yeokùu kjeroh' fï wkj n,k l, fjr<dY; mfoY hk udkj lgh; i`oyd muL odhl;jhl imhk ,nk oeä Wmfhd.;djhlkhl; j Nñ mfoYhk fõ'

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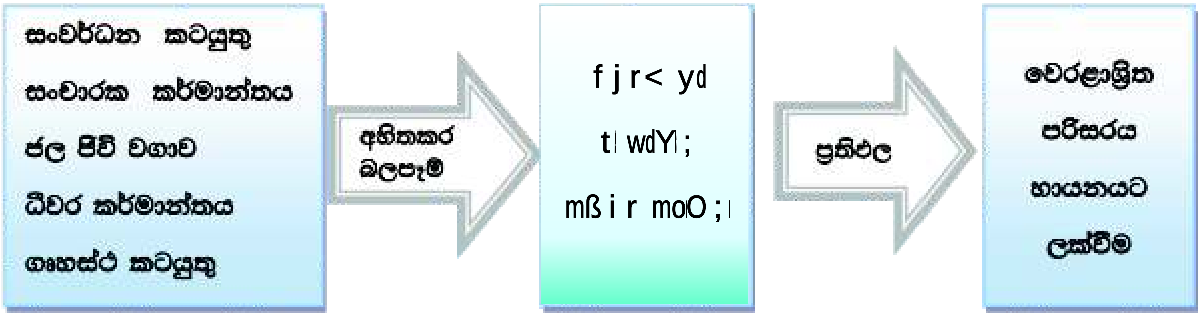
fjr< ;rh ñkidf. ffokl ck cú;hf l fry ukd odhl;jhl iemhj o i> ck ixLHd j¾Okh yd wm.dó udkj lhdjky wki m;M,hl f,i j¾;udkh jk úg Y ,xldfõ fndfyduhl fj-r< ;r ydhkhg ,l fjñk m-;'



ëjr l¾udk;h Tifi ñkid ;u cúldj ißlr.k ,enjo wúêu; ëjr lgh; fy;fjk fjr< yd twdY; mßir moO; /iilgwy;lr n,mEï t,,ù ;fí' t w;r mudKh blujdu;iH wijekk fk<d .eku mOdkh' j¾;udkh jk úg we;eï ëjrhk k;Hdkl, fkdjk uik ueÍfï lu wk.ukh lÍu lem fmfk' vhkuhÜ fhdod uik ueÍu t w;r mOdk h' vhkuhÜ mmÍu ;<k kmofjk lïmkh" f,dl lvd ih¨u uikf. urKhg fy; jkw;r th fN!;l mßirhgo wy;lr whßk n,mEï we; lrh' fuu lufõoh Ndú;d lÍfuk fldr,mr mßir moO;h jek iuøh mßir moO; iïm¾Kfhku úkdY fõ' Bg wu;rj ,h,d irell" ;x.ioe," lvoe," fudlioe, Ndú;h" úouik we,,u" rd; ld,fh n,n fhdod uik we,,u jek ;ykï mkk lu Ndú;h kid lvd uik mjdúkdY ùu ;<k iui :mßir moO;fhu i:dh lhdldß;jh ì`o jefÜ' Y ,xldj jgdmygd ;fnk ëjr jrdhky êjr l¾udk;fh khef,k tlok yd nyok ëjr hd;d kex.rï,k ,nh' fuu nyok êjr hd;djlk tl .uk jdrhl wjidkfho mfhdckhg .k ,en oeúf;, ,g¾ 7-8 muK idudkHfhk bj; lrk ,nk w;r fndfydwji:dj,o fïjduod yßkfk jrdh wdY; c,hgh' fuu oeú f;, jrdh yd twdY; fjr< mfoYj, fjfik u;iHhk we;`M c,c cúk flfry Rcj ydjl jYfhk wy;lr n,mEï we; lrh'

ixpdrl l¾udk;h ;<k o fuu mfoY flfry úúO wji:dj,o wy;lr n,mEï Wo.;j ;fí' t w;r fjr<dY; Ydl" lfvd,dk" ,jK j.re wdo Ydl mcdjk ydhkhg ,lùu mOdk h' ixpdrl l¾udk;fh ohKj; iu`. fjr< ;rh mrd i:dm; jk kj bolßï i`oyd wjYH Nñh imhd.k ji fjr< Ydl iy; mfoY t<fmfy< lrk ,nh' úfYlfhku lfvd,dk mßir moO; fuu.k oeä jYfhk ydhkhg ,l fõ' tfiu j.re yd .x.d fudh mfoY fomi Nñ mfoY úúO bolÍï yd ckdjdi i`oyd f.dv lÍuo wo jk úg ,xldfõ we;eï fjr<nv l,dm weif¾ oel.; yelh' lfvd,dk iy; l,m yd .xfudh wdY;j mygd we; lvd ixpdrl fydg,j, yñlrejk Ydl iy; mfoYj,gmi mrjd;uNñh ;jÿrg; jeä lr.kñk iá' we;eï ixpdrl fydg, yñlrefjd;u fydg,j,k bj;,køj wmøjH fjr<dY; mfoY j,g yd twdY; .x`.d yd c, ud¾. j,g uod yeÍug yreù iá;' fuu øj wmøjH fy;fjk fjr<dY; mfoY j, ijNdj fi!ko¾Hh ydmú; ;djhg n,mEï we; lrk w;r we;eï wji:dj,o jeil, wdofhk kl; lrk wmøjH fuf,i uod yeÍu fy;fjk fjr<dY; c, mNj weif¾ iuyr cú úfYlj, fõ.j; yd jeä fndùul fiu jeä jHdm;hl o ifmdlKh jek ;;jo k¾udKh ù ;fí' ;jo .xfudh yd fjr< ;r wdY;j lfvd,dk" fldr,mr wdo mßir moO; keröu i`oyd ixpdrlhk /.; fndÜg .ukd.ukh; iu`. tjdfh mgjk f;, .x`.d fudh" l,m jek mßir moO; j, fjfik cú úfYl flfry RKd;ul n,mEï we; lr ;fí' WodyrK f,i udÿ .`." l`Mjdfudor .`."ó.ul,mj wdêh oelúh yel h' fuu ;;jhwju lÍu i`oyd Y ,xldfõ we;eï fjr<dY; mfoY j, oeä lhdud¾. wk.ukh lrk olkg ,efí' /lj l,mfõ fudg¾ fndÜg Ndú;h ;ykï lr ;îu thg WodyrK f,i oelúh yel fõ'

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lfvd,dk Ydl úkdYh
u,dYh -www.thescoopradioshow.com

fjr< ;rh wdY;j bolrk ,nk ceá" f.dhkneñ fy;fjko fjr<;rfh Núlu;djh hï hï fjkil ï j,gNdckh jkfk" fï fy;fjk we;eï i:dk jeä jYfhk Ldokhg ,lùu; ;j; i:dk j, je, ;ekm; ùu; kidh' f.dvke., bolÍu yd fjk; lgh; i`oyd wjYH mOdk klmdok wuøjHhl jk je, ,nd .ekug fjr< ;rh Ndú;d lÍfï m;M,hl f,i o fjr< l,dmh ydhkhg ,l fõ' .x.dhk fjr<mfoY i`oyd wjYH wjidê; tkï je, imhk mOdk ud¾.hh' .x`.dj,k je, bj; lÍu fy;fjk fjr< ;rhg ,eìh h; mudKj; wjidê; mudKh fkd,eî hdu fy;fjk fjr<dY; mfoY Ldokhg ,lfõ'Y ,xldfõ jeä jYfhku je, bj; lrk ,nkfk ud Th" le<K yd l`M .x.dj,kh'wfkl; .x.dj,; fuu lhdj,h i>fhk j¾Okh fjñkmj;kw;r tym;M,h jkfk boßoYl lymh ;<ngyr fjr<wdY; mfoYh fõ.fhk Ldokhg ,lùuh'

fjr<dY; mfoY flfry wy;lr n,mEï we;lrk ;j; mOdk lhdj,hl jkfk wmøjH fjr< ;rhg neyer lÍuh' úúO l¾udk; j,k yduyck ikmdrCll lu j,k o b;dúYd, wmøjH mudKhl kmofõ' l¾udk;j,k bj;,k wmøjH fndfyd úg úliy; fyhk fjr<nv mfoYfh yß., yd t wY; cúkg tjd b;dwy;lr w;r fuu.k fldr, yd t wdY; cùk fõ.fhk ydhkhg ,lfjh' iuyr øj wmøjH j, ldnkl wmøjH ny, jkw;r tjd Tlilrkh lÍug úYd, Tlick mudKhl jeh j úg c,fh wdï ,l ;djh o jeä fõ' tfiu .Dyi: lgh; u.kbj;,k >k wmøjH fy;fjk o fjr< ydhkhg ,l fõ' j¾;udkfh fjr<dY; mfoY j, fjfik we;eï ckhd wmøjH neyer,fï ki lufõohl wk.ukh fkdlrk w;r iuyfrl wmøjH ud¾. fomiu fjr< ;rhlg fyd c,mNjhlg f.keú; ouh' fmd, ;km,diál"ùÿre"ák jek ordm; fkdjk >k wmøjH fy;fjk mßirh ¥lKh jkw;ru th ijNdj fi!ko¾Hh mßyhdug o fy; fõ'we;euk >k wmøjH l,m yd .x`.dj,goeóug yreù iák w;r j¾ldj; iu`. fïjd id.rhg /f.kf.di kej;; uyÿr<úik fjr<;rhg f.dv.ik ,nh' le,K .x.dfõ .xfudh mygd ;fnk uÜgll ,h"ldl ¥m; wdY; fjr< ;rh fuhg lou koikl' tu mfoYh wdY;j .x.dj u.k /f.kú; ;ekm; lr we; wmøjH b;d úYd, jYfhk oel.; yelh'

Y ,xldfõ ëjr l¾udk;h iÿ lrk we;eï fjr<dY; mfoY wei f¾ bj;,k êjr wdïmkk wjfYl fldgi ´kE;rï oel.; yel fõ'fuf,i wluj; mßo oe, len," lv"hd;d fldgi fjrf< ;ek ;ek oeóu kid wm ojhk jgd mygd we; fjr<;rh fõ.fhk wmú; jk w;r th ijNdj fi!korH mÍy hdu flfry mN,ju odhl ;jh imhh'm,diál jek >k wmøjH cúkf. meje;u flfryo iDcj uyd jlj n,mEï f.k fo'm,diál j, wvx. ny wjhùh fldgi i¾h úlrKfh n,mEu u; lvd len, j,g LKvkh jkw;r fïjd liÿ úfgl llø cúk u.k c¾Khlg ,l fkdfõ'fï fy;fjk id.ßl yd fjr<dY; mßir moO; ;<m,diál fldgi ny, jkw;r tjd c,c Ydl yd i;j m,jdx. ydwfkl; c,c cúk flfry Rcju n,mEï f.kfo' 1992 o weußldt li; ckmofh W;re lefrd,kd mdk;fh fjr< ;rh wdY;j fjfik iuøh mllk 1033 l fhdod f.k mÍllKhl iÿ lr we; w;r tyo tumllkf.k 55] lf.u wdudYh ;<m,diál wxY ;fnk nj wkdjrKh lrf.k ;fí' tneúk fjr<dY; fNd!;l mßirhg muKl fkdj fjr<dY; cú mcdjf. meje;ugoordm; fkdjk >k wmøjH u.k wy;lr n,mEï t,,ù we;'fï wkj n,kl, fjr<dY; udkj lgh; fjr<nv mfoY ydhkh ùu flfry j¾;udkh jk úg Rcj yd jlj odhl jk nj meyeo,h'

li, fjr<dY; c, ud¾. j,g uod yeÍu
u,dYh - fCl; o; ;-2017

li, fjr<g uod yeÍu
u,dYh - fCl; o; ;-2017

fjr<dY; mfoY ixrllKh lÍfï wjYH;djh

oeä Wmfhd.;djhlk iukú; fjr< yd t wdY; mßir moO; ixrllKh lr.kñk wkd.;h Wfoid /l .eku wm ldf.; j.luh' tneúk fuu mfoY ixrllKh i`oyd flá ld,kj fydo.ld,k lhdud¾. .eku cd; l wjYH;djhl njg m;j we;'Y ,xldfõ fï jkúg fjr< yd t wdY; mfoY ixrllKh lÍu Wfoid wkmk; lymhl ;fnkw;r bk êjr ydc,c iïm; mk; yd fjr< ixrllK mk; mOdkh' fujek wkmk; k¾udKh fldg we;; tjd fkdi,ld yßñk we;euk lhdlrk neúk fjr< Ldokh yd t wdY; mßir moO;k ydhkhg odhl jkmo,hk Wfoid iÿi oeä lhdud¾. wk.ukh lÍu jeo.; h' tfiu le,li, neyer,fï luj; o.ld,k lhdud¾. yÿkjdou jek lgh; j, wjYH;djhl mek k.' tmuKl fkdj ñkidg fuu mßirfh jeo.;lu m<n`o we; oekfï w,m nj .eg¨ fndfyduhlg fy; idOl ù we; neúk fjr< yd t wdY; mßir moO; j, udkj mdßißl jeo.;lum,n`oj ñkik oekj; lÍuob;d jeo.;h' fujek lhdud¾. Tifi wúêu; udkj lgh; fy;fjk fjr<;rhg iÿj we; wy; lrn,mEï wju lr.; yel fõ'

iud, ißj¾Ok
ixj¾Ok k,OdÍ
cd; lc,c iïm; m¾fhlK yd ixj¾Ok kfhdc;dh;kh

Fishing crafts and gear in Kakkaithivu coastal waters, Jaffna Estuary, Sri Lanka

Jaffna estuary

Jaffna estuary is barrier built basin type of estuary, but it is not associated with a river. Estuaries form since freshwater from land drainage mixes with sea water to produce brackish water. It is connected to the sea at Ponnalai between Karaitivu and Kayts and between Kalmunai and Mandaitivu. Earlier it was reported as Jaffna lagoon by many researchers, because at that time, Jaffna lagoon was temporarily connected with sea due to sand bar formation. Piratheepa and Edrisinghe (2011) reported for the first time Jaffna lagoon as Jaffna estuary as there is no evidence for sand bar formation recently and is permanently connected with the sea now.

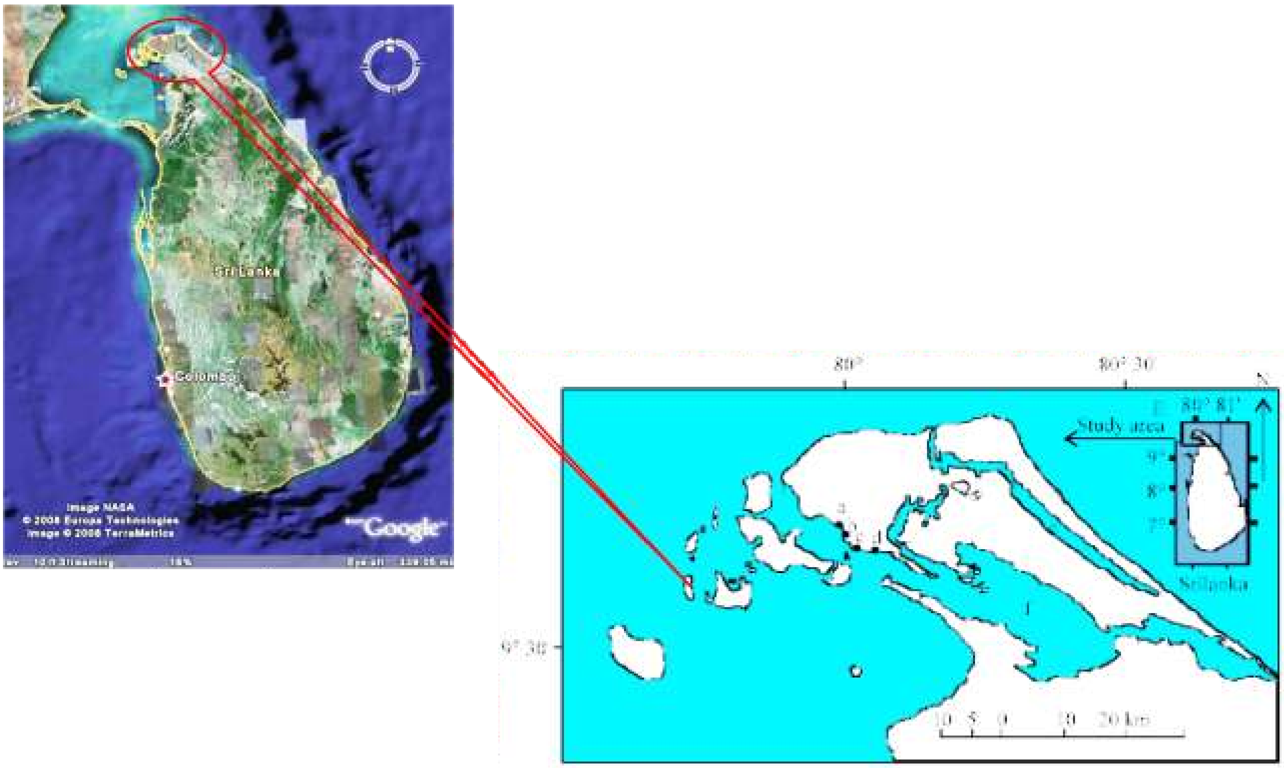

Fig 1: Location of the Jaffna estuary

(a) Kakkaithivu,

(b) Navanthurai,

(c) Kurunagar,

(d) Pasaioor

(e) Thondaimannar lagoon and

(f) Jaffna estuary.

Kakkaithivu Coastal Area

Kakkaithivu Coastal Area which is part of the Jaffna estuary. Site length of Kakkaithivu Coastal area is 1.2 km. Shrimp species found in this area is significant and it is a major fish landing centre in Jaffna district within Sandillipay Fisheries Inspector
Division (Fig 1: Plate 1)

Plate I : Landing centre at Kakkaithivu

Among the fishing villages within Sandillipay Fisheries Inspector Division of Jaffna district, Kakkaithivu coastal water is the most productive for shrimp. There are 85 fishing families out of the 415 fishing population, of which 75 are full time fishermen.

Fishing crafts

There are three types of fishing crafts operating in Kakkaithivu area. Among them, 27% are Out board engine Fiberglass Reinforced Plastic Boats (OFRP), 19% are Motorized Traditional Boats (MTRB) and 54 % are Non–motorized Traditional Boats (NTRB) (Plate 2). In 2012, the highest number of fishing crafts in operation recorded in Jaffna district were OFRP and NTRB (Anonymous, 2012).

Plate 2: Fishing crafts used in Kakkaithivu coastal water

(a) Non-motorized Traditional Boats (b) Motorized Traditional Boats and
(c) Out board engine Fiber Glass Reinforced Plastic Boats

Fishing gear

(1) Sirahuvalai

Sirahuvalai is the major gear used to catch shrimp in this area. Sirahuvalai is a deep water trap net fixed at a depth of 4-6 m. This passive fishing gear consists of a long leader (fence) ranging in length from 45 m to 150 m, curved wing which is relatively short in length, receiving chamber and chambers or trap with circular or oval in shape with circumferences ranging between 10 m and 30 m.

More than 100 sirahuvalai are commonly fixed by fishermen on a semi-permanent basis in Kakkaithivu coastal area. Long timber poles are fixed as a framework about 4-5 m in length into the estuary bed 2-3 m. The length of the leader depends on the site of the installation and extends up to about 70-100 m in Kakkaithivu coastal waters. The fencing net is constructed with the aid of wooden poles and netting with mesh size varying from 12 mm to 16 mm of 12 ply. The leader which guides the shrimps into the playground area is usually positioned perpendicular to the length of the shore. In very large traps there can be more than one playground. From the playground area there are guides leading to the trap which is the cod end. Trap is generally in the form of a semi circle having a radius of about 6-8 m, while the distance between the two widest points in the playground could be 10-12 m (Plate 3).

About 3-4 persons engaged in this operation dive into the trap area and in the playground area wearing a mask. The catch is scooped out or if there are bigger fish, they are harpooned in the morning.

In very large traps fishermen use a type of length net made up of 2-3 m height timber poles walled with 10 mm mesh size in order to scoop out the shrimp. It is called as Kaddippu vallai. They display the timber poles vertically that is, perpendicular to the sea bottom and the nets are tied with floats at the top and weights at the bottom. Two persons can operate this net into the last trap and scoop out the shrimp.

Plate 3: ***Sirahuvalai***

In some cases, the components of the gear generally are a long leader and one playground. Four hoop net or Raal koodu are connected to this play ground.

(2) Trammel net

A trammel net consists of three layers of net. In Jaffna estuary, a few trammel net are also used to trap shrimps (Plate 4). The netting for trammel nets is made of

1) Nylon webbing of 30-40 mm mesh size with 2 ply for the lint.

2) Webbing of 127-152 mm mesh size with 4 ply.

The net is hung on 1 ½ to 2 mm polypylene head and bottom ropes. Regiform or cut pieces of floats of similar sizes are attached to the head rope at intervals of about 0.8 -1.0 m. Lead sinkers of about 10 – 15 g in weight are attached to the bottom rope at intervals equal to those used for the float hanging. One or two fishermen are engaged in this operation.

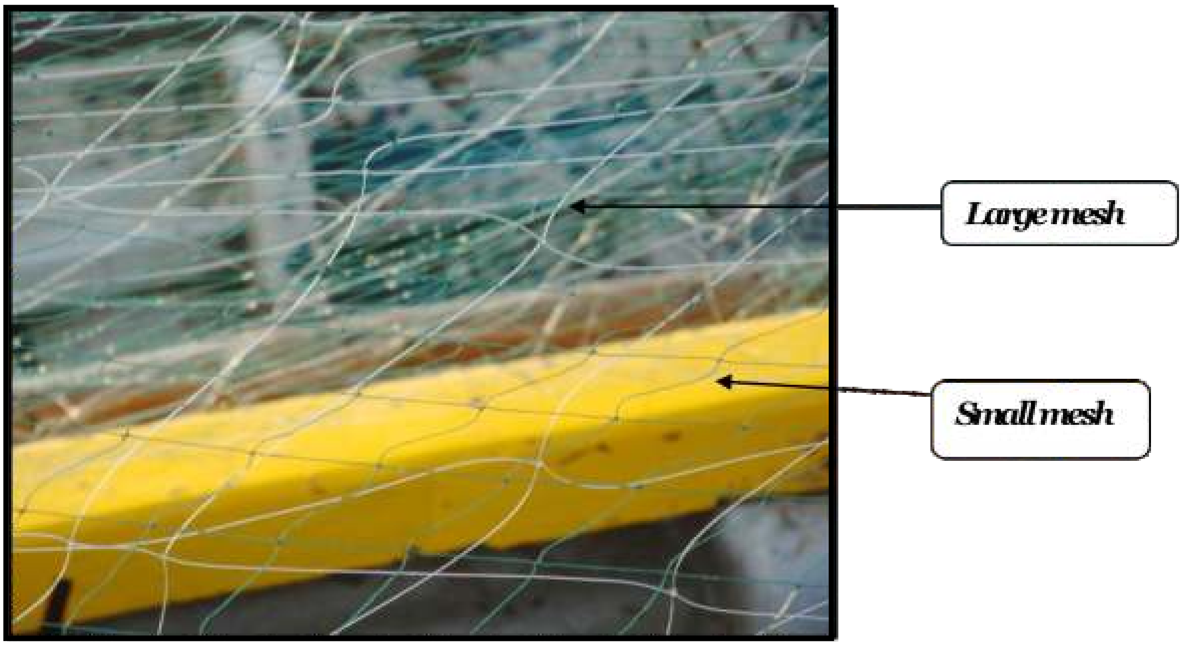

Plate 4: Trammel net

(3) Gillnet

The netting for gill nets is made of nylon webbing of 30-40 mm mesh size with 2 ply for the lint. The net is hung on 1 ½ to 2 mm polypylene head and bottom ropes. Regiform or cut pieces of floats of similar sizes are attached to the head rope at intervals of about 0.8 -1.0 m. Lead sinkers of about 10 – 15 g in weight are attached to the bottom rope at intervals equal to those used for the float hanging. One or two fishermen are engaged in this operation (Plate 5).

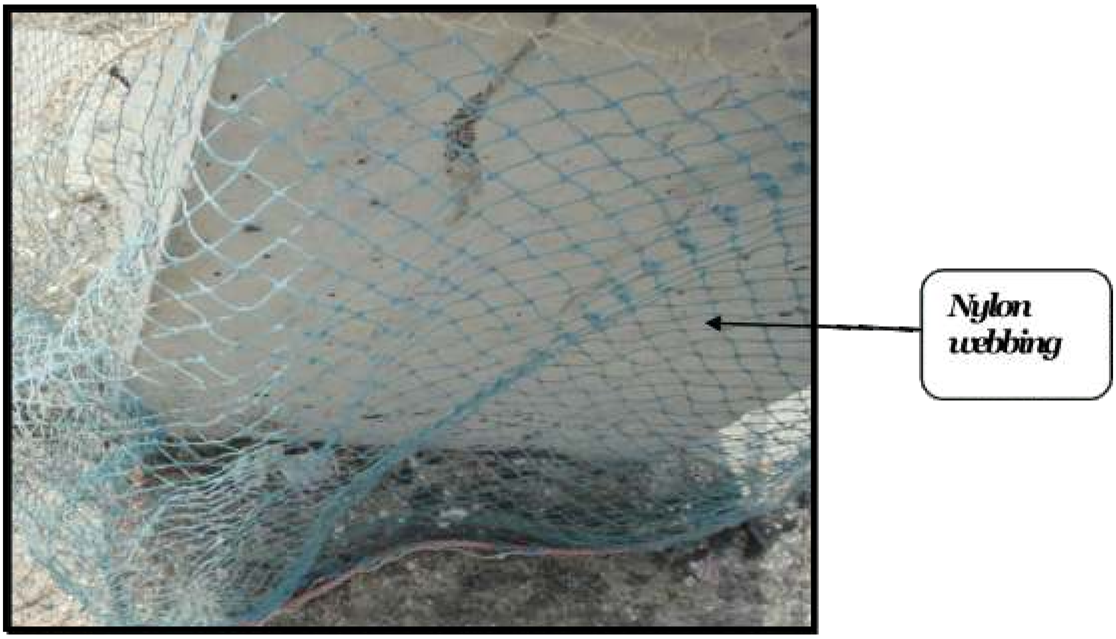

Plate 5 : Gillnet

(4) Hoop net

Hoop net or raal koodu is composed of three components such as cage (koodu), large barrier net (velivalai) and small barrier net (Plate 6). The cage is cone shaped, made of nylon net of 2-3 ply twin and 0.5-1.0 cm mesh and six iron rings. The large ring is 50 cm in diameter and cage is 4 m long. The rings are fixed in the net cone in the order of decreasing diameter. These rings provide strength and keep the cage open. A one-way valve of cone-shaped netting is fixed at the middle of the cage.

The large barrier net is 13 m to 15 m long and 1.3 m wide with net of 2-3 ply nylon with mesh size 10 mm to 12mm, while the small barrier net is 3.2 m long, 1.3 m wide with the same type of nylon net used in the large barrier.

Plate 6 : Hoop net

Plate 6 : Hoop net

Wooden poles are used to fix the barrier nets vertically. Each cage is fixed at the junction of the large barrier net and a small barrier net arranged in a zig-zag fashion. In some cases, four cages are connected with one sirahuvalai. Cages are installed at sunset and the collection is made early in the morning. During the day time cages are removed, collapsed, lengthwise folded up and kept hung on the wooden poles of the warier nets, above the level of the water. Hoop net is used in the shallow muddy areas at depths ranging from 25 cm up to 2 m.

Four types of gear such as gillnet, sirahuvalai, hoop net and trammel nets are used to capture shrimps. The most common gear used in shrimp fishery in the Kakkaithivu coastal waters are sirahuvalai.

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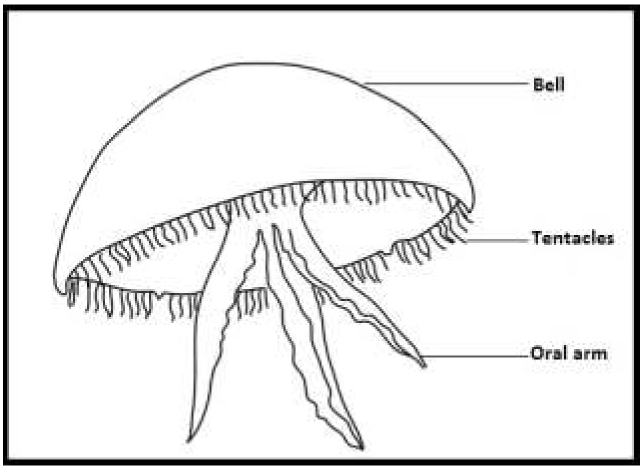
Department of Zoology,
University of Jaffna, Sri Lanka

Y,xldfõ yujk úl iy; fc, u; iHhk

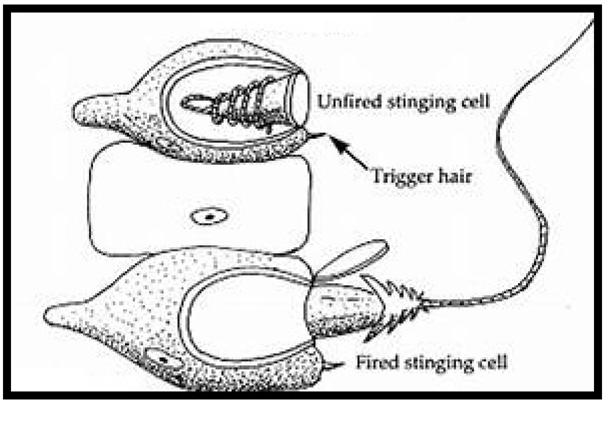
Ôùk j¾. lrKfh§ ^Classification& kvdßhd jxYh ^Phylum Cnidaria& hg; g wh; heh ie<flk f,dähk fyj; fc, uik ^Jelly Fish& hk c, ,uh foy orK koyfi mykk i; k fldÜGdlhl' Tjk oùm, i; ßl ^Diploblast&h' tu ffi, i: r fol w; r ; ek we; f; Mesoglea keue; mr lhlk' fud<hl fkdmyák w; r ir, ikdh cd, hl muKl mygh' YÍrh mOdk fldgi follk iukú; h' tjd ikj ^Bell& iy fu!L .dyld ^Oral arms& f, i yeÕkfõ'



1 rEmh (fc, ufi lf. mOdk fldgi

fuu i; k f,dj mrd iEu id. rhlu mdfy yufõ' lrÈh yd lj, Èh jdi fc, uik úfYl ixLHdj 2000 lg wêlh' ñßÈfh yujkfk úfYl ^species& lymhl muK' fc, uikg f.dÿre lr. kkd wfkl; uikj jeä jeäfhk mdßfNdckh i|yd we, ,u;" f.d, h WlK; jh by< hdu; ^Global worming& fy; fjk fc, u; iH >K; jh ^Density& jeä ùu f,dj mrd l; dnyg ,lj k ud; Dldj l' fndfyd fc, u; iH úfYl ñk idf. wdydrh i|yd; úi ; re u; iH l¾udk; hg; " mßir ¥lKh fmkjk o¾Ylhl f,i ;" fld,eck jek fmdàk yd úúO úlj¾. k iidrh lÍug; j¾; udk fh§ Ndú ; d f l f¾' f l f i fj ; ; f, d mrd jeä mru wjOdkhlg ,lj we; f; fc, uikf. k ñk idg t, , jk ndklr n, mEï flfryh' Tjkf. .yk .K; jh jeäùu êjr l¾udk; fhÈ ±, wdïmkk úkdYùug; fjr, dikk úÿ, n, d. drj , k, ud¾. wjyr ùug; fy; jl' fuu i; k i; j mj; k oYGlßfï ^sting& yel hdj fudjkf. k ñk idg t, , úh yel nrm; ,u ;¾ckh f, i ie, fl'

fc, uik i; j j¾. lrKfh§ Phylum Cnidaria hg; g .efkkfk Tjk i; j mj; k wfkl; jxYj , Ôùkg fkdue; úfYl ffi, j¾. hl fy; fjk' fuu ffi, zzoxYl ffi, ^Cnidocytes&ZZ f, i yeÈkfõ" ^fojk rEmh&' fïjd yev. ei we; f; fjk; ´keu i; jhl iu`. im¾Y jkjd; iu.u lhd; ul ù tl i; jhdf. foyh ; ,gúl klfYmkh l, yel jk mßÈh' fuh oYG lÍul jk w; r iNdúl mßirfh§ f.dÿr wvmK lr. ekug;" ih úf,dmlhkf. k wdrlld ùug; fc, uikg fuh ufydmldÍ fõ'



2 rEmh (o¾Yh oxYl ffi ,hl

oxYI ffi, j¾. Iymh Iu we; w;r fc, u; iH úfYIh" jhi" ny, j mj; k oxYI ffi, j¾. h" oxYI ffi, >k; jh" foy fIdgi hk IreK u; I ihï fc, u; ihI i; j mj; k oYGIÍfï yeIhdj fjki fõ' idudkHfhk f,dIfh Cyanea, Physalia, Pelagia, Chrysaora jek .Khk ^Genus) g wh; jk fc, u; iH úfYIo fmÜá f,däh k Box Jellyfish úfYI .Kkdj Io W. úI iy; fc, uikf, i ie, fI' fc, ufiI i; jk oxYI ffi, .Kk jeäjk úg W! i; oYGIÍfï yeIhdjo jeäfõ' fc, ufiI jhik uyIrd ho§ oxYI ffi, jeä jeäfhk we; fõ' fnfyduh I úfYI j, oral arms u; oxYI ffi, bell fIdgiIg jvd jeämr mygh' úfYI j, fuu ffi, jHdm; h bell yd oral arm mfoY foI u; iudk fõ' ;j; úfYIhI oxYI ffi, mygkfk oral armsu; muK' fumßofok oxYI ffi, myàu wêI j fjki jk w; r oYGIr úY kI; IÍfï yeIhdj w; Yhk ÿ¾j, uÜgñk mj; k fc, u; iH úfYI ixLHdjo ie, Ihh; ;rñk by, h'

we; eï IrÈh yd Ij, Èh jdi fc, uikf.k mydrhkg ,I ùfuk uyKÿk ëjrhk yd ixpdrIhk jeä jYfhk wk; rg ,Ifõ' W. úI iy; fc, u; iH mydrhIk mN, p¾u wid; ñI ;djhk iuu; ;jd, Ie,e," wkONdjh fydwj idkfh§ urKho we; úh yeI' úYd, fi!LH ydkhI IÍug Ôù fyd wÔú tjk tI fc, u; ihI fydogu mudKj; fõ' tjk fc, u; ihIf.k Ieã .h foy fIdgiI jjo ydk Irh' ±kgwkdjrKh ù we; mßÈ úh ,d. ; fc, u; iH fIdgiI h, c, fhk f; ; I, mi jo oxYI ffi, Ihd; uI ù úY kI; IÍfï yeIhdj mj;'

ny; rhI j IrÈh" Ij, Èh fc, u; iH úfYIo ih¿ ñßÈh jdi úfYIo ñkidg fi!LH ydk f.kfkdfo' fIfi fj; ; tu úfYI j, >k; jh wêI wj i :dj I§ muKI ixI, ;djhk uo jYfhk we; ùfï yeIhdj I we;'

3"4"5 rEm (W. úY iy; fc, uik ;ej Ífuk ifï yg. ; wdid; ñI ;d'

Y ,xIdjg wh; uyÿ I ,dmh ;< jdih Irk fc, uik Tjkf. úúO; jh" .yk .K; jh" jHdm; h" ixIukh fydu; jk Id, j I jdk m<n| j úêu; wOHkhI fïoI jd iÿIr fkd; nw; r tu wvmdvj mrùu i|yd j mÍIIKhI Y ,xId jhU úYj úoHd,h u.k iÿ Irñk mj;' t hgf; fï jk úg wm uyÿ I ,dmhg wh; fc, uik úfYI 50 Ig jvd wkdjrKh fIdg ;yjre fIdg we;' tjd w;ßk ñkidg nrm; , .Kfh fi!LH ydkhI iÿI, yeIfI úfYI 7Ig muK' t w;r *Cyanea* úfYI tII" *Chrysoora* úfYI tII" *Physalia* úfYI tII *Rhopilema* úfYIhI" *Lobonemoides* úfYIhI yd *Box Jellyfish* úfYI foI I mj;'

Cyanea Capillate **(Lion's mane jellyfish** / w , f ydß $wdk f i dß &

ih¿ úfYI w;ßk furg yujk úYd, ufc, u; iH úfYIhh' ikj fIdgi fi'ñ' 100 Iol jd jefâ' idudkH úYI ïNh 30cm I' th r; "ÿUre' Iy"oï fydwj¾K úh yeIh' iuyr i;kf. ikj u; ;oÿUre meye; ; ; úiÍ ;fí' Tentacles iy Oral arms óg¾ .Kkdj IÈ.g jefvkkg m¨jk' úI iy; jkfko Tentacles iy Oral arms h ' fudjk ,xIdj wjg ´kEu i:dkhIko úYd, I,m j,ko yuúh yeIh' Bidk È. fudiu wdrïN úk úg ^TIf;dïn¾ fkdjeïn¾& W;re kef.kyr uyÿ I,dmfh; kß;È. fudiu wdrïN jk úg ^uehck & jhU ngyr ydoIK uyÿ I,dmfh; fudjkf. >k;jh by< hh'

6 rEm (*Cyanea Capillata* fc, u; ifhI

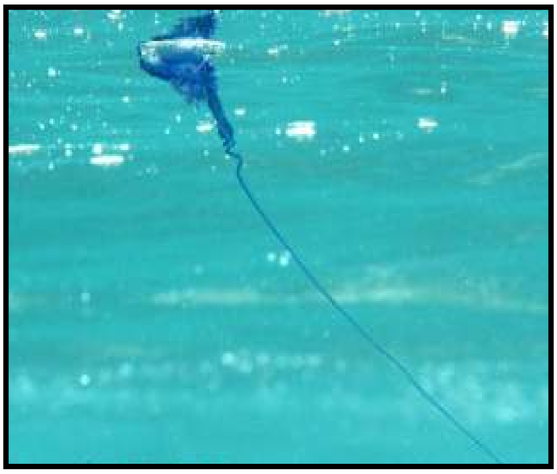
Chrysaora sp **(Sea Nettle /** .k f ydß $ f k remm f i dß&

úYIïNh Wmßu fi'ó' 20 I muK jk ikjI orK fc, u; ihkh' ty idudkH w.h fi ó 12 I muK fõ' ikj idudkHfhk iÿ Iyr; fyd ÿUre meye;h' ikj u;mg oxYI ffi, iuy jYfhk mygh' iuyr ik u; uOHfhk mgk f.k mg; odrh f; IÈfjk wÍh ;remygh' fïjd ;omeye;h' we;eï ik j, mg; odrh I¿ meyehI .k' Oral arms y;rI' fïjd ikfõ úYIïNh fuk ;k .KhIg; jgdÈ.k jeäh' ikfõ mg; odrh wdikkfhk .dyId / iI mg;g úyfo' fuu Tentacles iy Oral arms u; oxYI ffi, wêI jYfhk mygh' Bidk È. fudiu wdrïNfh§ ^TIf;dïn¾& iy wjidkfh§ ^ud¾; & W;re kef.kyr uyfo;" kß;È. fudiu wdrïNfh; ^ueh& yd wjidkfh§ ^iem;eïn¾& jhU ngyr ydoIK uyo I,dmfh; fudjkf. >k;jh by, hh' wjg ´kEu uyÿ mfoYhIko úYd, I,m j,ko i,Nj yujk u; ifhI' fuu Ôù úfYIh ;ju; mÍIIK uÜgfï mj;k neúk fuy§ >Kkduh muK I i|yk fIf¾'&

7 rEmh (*Chrysaora Sp.*

Physalia utriculus (Blue bottle Jellyfish / ldl fydß$ ldll fidß&

idudkH fc, ufilg jvd fjki ndyr remhl orK i;jfhl jk fudyf. ikj fjkjg we;f; wj¾K fyd ,dk, meye; bm,hl ^Floater& jd;fhk mÍ we; fuh fuu i;jhdg c,hu;mg mdfjñk i<f. wdOdrfhk wlhj ixprKh lÍug Wmldrl fõ'furák yuú we;' úYd,u i;jhdg wh; bm,fhÈ. 7 fi'ñ'l' bm,fh igmy;g t,f,kk, meye; ;kÈ. .dyldjl' fuh we;eï úg óg¾ lmhl oljdÈ.g jefâ'úl iy; oxYl ffi, wk;¾.; jkfko fuu ;k .dyldu;h'Bidk È. fudiï wdrïNl udi j,§ ^fkdjeïn¾-ckjdß& W;re kef.kyr uyÿl ,dmfh;"kß;È. fudiï wdrïNl udi j,§ ^ueh-c,& jhU ngyr ydolK uyÿl ,dmfh; ny,j we; ù fjr<g fikÿ fõ' furg ih¨ fc, uikw;ßk ñkidf. fi!Lhg jeäu ydk l< yelfl fudygh'olgkhl§w;mh fi<ùug fkdyel jk mßÈ we;¿ jeàulh ,l úh yel' we;jk ;jd, le<, jir .Kkdjl fyd iodl, fyd iuu;mygh'



8 rEmh (*Physalia Utriculus* fc, u;ifhl

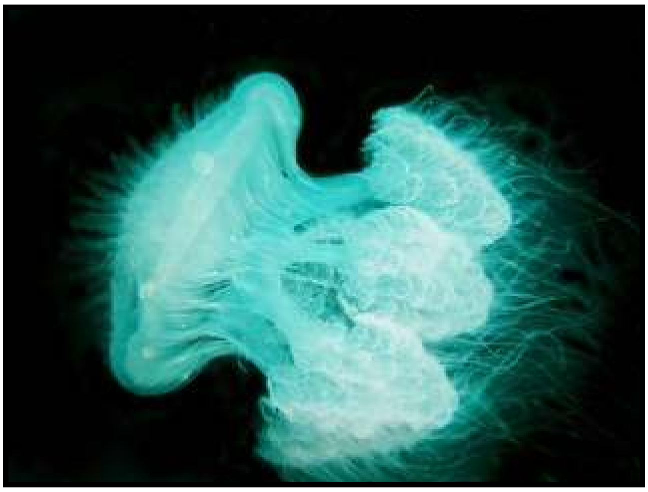
Rhopilema hispidus (Sand type jellyfish / fldi fydß-m,dl ldfidß&

ikfõ úYlïNh fi'ó' 40l muK oljd jefâ' ty u;mg mDlGh w;Yhk f.dfrdih' iÿ meye; foy ork w;r r; ÿUre m, ,o jeà ;îug m¨jk' Oral arms ih,, tlfkl yd ne§ ;k úhyhl idoh' u¨ foyh mrdu oxYl ffi, tlf,i jHdm; ù we;' kß;È. fudiï iufh§ ^ueh-iem;eïn¾& Y ,xldfõ jhU yd W;re uyÿl ,dmfh olkg yelh' m;;,ï l,mfõ ny,j yufõ'

9 rEmh (*Rhopilema hispidum* fc, u;ifhl

Lobonemoides robustus (White type jellyfish / Èh f ydß $; k k f idß&

f i'ó' 50 muK o l jd úY l ïNh l k h ; i k orh' uDÿ f l reï rdYh l k i kfõ u ; mg uOH mfoYh wdj r Kh ù we ; f k f ï rE i ; k ,d k , f yd f rdi meyeh l . k' f ï rE i ; k iÿ meye ; h' we ; eï i ; k f . i k fõ mg ; odrh ; o oï meye ; h' f l á Oral arms wg l ; f nk w ; r t jd úkúo fmf k f k i¨ ; r l rEm È. eá ; k ; u . k wdj r Kh ù we ; 'oxY l f f i , jeämru mygkfk fuu ; r l rEm ; k ; u ; h' Rhopilema hispidum g idfm l l j Y l ; u ; núk wv foy orh' ú i l re n j *Rhispidum* g j vd wvh' B i dk È. fudi ï i u f hÈ ^f kdjeï n¾ - ud¾ ; & Y ,x l dfõ ngyr jhU i y W ; re uyÿ l ,dmhk y §; o l kg ,ef í' l ,m wdY ; h ny , j yufõ' óg wu ; r j kß ; È. fudi ï i u f h§ ^ueh - iem ; eï n¾& ; l Kdu , fnd l l wdY ; mfoY j , o l kg we ; '



10 rEmh (*Lobonemoides robustus* f c , u ; i f h l

Chiropsoides buitendijki

Box jellyfish úfY l j k w ; r fmÜá yeve ; i k orh' i ïm¾K foyfh wdj r Kh i k fõ m< , f i'ñ 8 o Wi f i'ó' 7 l muK fõ' i k fõ my , odrh wdi k k f h i :dk y ; r l k .dy l d mdo y ; r l mek k .' tu t l t l .dy l d mdoh l i g m< f j , l g t l me ; ; l g muK l úyÿK .dy l d 5 ; 9 ; w ; r mygh' tu .dy l d iÿ meye ; h oxY l f f i , jeämr mygkfk fuu .dy l d u ; h' i k j ; , we . , yeve ; (Finger- like) k ï Wmdx . wg l mygk w ; r t jd i k fõ my , uÜgu o l jd j k È. l k h l ; h' kß ; È. fudi u wdr ïN ù á l l , l g m i j ^ck - c ,& o l K yd kef . k y r uyÿ l ,dmhk y ny , j yu fõ' óg wu ; r j wf k l l d, j ,§o wv jeä jYfhk ,x l dj jgd ´kEu uyÿ l ,dmh l k yuúh ye l h' l ,m wdY ; j o jd¾ ; d fõ'

11 rEmh (*Chiropsoides buitendijki* f c , u ; i f h l

Chironex sp.

furák yuù we; úYd,u i ; j hdf. i kfõ m<, f i'ñ'12 ; w; r Wi f i'ñ'11 l úkúo fmfkk i¨ foyhl orh' fmÜá yev; i k j l or K fudy o Box jellyfish úfYlhl' f l á Gastric Punches l l< l ru, l yev; h' i kfõ my, odrh wdi kkfhk mg; g mek k . k .dy l d md i ; r l' tu t l t l .dy l d mdofhk fom i g úyÿk .dy l 7; 9 ; w; r ± l h ye l h' oxYl ffi , jeämr mygkfk fuu .dy l d u; h' Bi dk È. fud iu wj i dk j k iufh§ ^wfm, & kef. kyr uyÿ l ,dmfh§ yufõ' i ,N úfYlhl fkdfõ' ie'h' fuu Ôj úfYlh ; ju; m¾fhlK uÜgfï mj ; k neúk .Kkduh muK l i |yk f l f¾'

12 rEmh (*Chironex sp* fc , u ; i fhl

fc, u; ihlf. olGkhlg fmrd; j" olGkhl iÿ j j fyd; wj YH m; l drhl l Íug fmrd; j olGkhl iÿl , fc, u; iHhk yÿkd . ; yel kï th jákfkh' fc, u; ihd k ihdldrj yÿkd .ekulk f; drj olGkhl i | yd fmdÿfõ l rk idïmodhl m; l dr .kkdj l êjrhk w; r mp, ; h' Ipomcea pescaprae fyj ; ìï ; nre m; foy weU, k wUrd .Eu' úkdlß"Èhl , ihU,d" fmd, f; , jek oE .Eu" fmd, lß mdkh l Íu" r; j je, fhdod mß ue§u t w; ßk i ,n m; l ¾uhkh' olGkh iÿ j i :dkh u; Nñf; , fmg, fyd u; d ;ej Ífuk hï iykhl ,eîug nyÈk hd; dj , / l hdfõ fhfok ëjrfhd mreÿj iá;' ;ukf.u u; d mdkh l Ífuko úh, ñßi wUrd ., l r t jd ., fuko fc, uikf. olGkhk i j j k nj j hU m, df; we; eï i ïmodhl ëjrhk úYjdi l rk ,nh'

ud±, l¾udk; fh ffhfok ëjrhkf. oE; iy bfkk my, YÍr f l dgi fc, u; iH olGkhkg k; r Ndckh fõ' l ru, ±, t, k §jrhkf. oE;" mm mfoYh" uK iy oEi i ,N f, i olGkhg , l fõ' fc, u; ihkf. idjh j k Yf, l u, h iy; c, h úiùfuk mjd oEi j , g úYd, ydkhl iÿúh ye l h' fc, uik fy; f jk wei j , g we; j k wê l ±ú, , iukh l r .eku i | yd we; eï y wei j , g uõ l ß ìÿ j Yfhk fhdo; ' ku; fujk idïmodhl m: udOr i y w; fnfy; j , l hd l dß; j h mYK l dÍ j k neúk yd ; ju; t j d m<n| j úoHd; u l meyeÈ, l Íul iÿ l r fkdue; neúk zzfc, u; iH olGkhl iÿ j j ydu wod, f rd. hd f rdy, . ; l r f f j H m; l dr ,nd Èh h ; hZZ hkk ±kg mj ; k fmdÿ m<.ekuh'

13" 14 rEm *Ipomoea Pescapram* i y *Ipomoea stolonifera* óg wu;rj fc, uik .K;jh jeäjk iuhk y wod, fjr< l,dm j, ±kj; lÍfï mjre iúlÍfuk ixpdr lhkf. Ôú; wdrl lld lrÈh yel h' YÍrfh jeä fldgi l fydÈk wdjrKh jk mßÈ weÿul we§fuk lñ§fï§ we;úh yel fc, u; iHmydrhk wju fõ'

15" 16 rEm (Jellyfish wjOdku y.jk ±kùï mjrej l yd YÍrh fydÈk jefik lñÿï weÿul'

fi!LHg ydk l, yel fc, u; ih úfYI m,n|j hu;dl ÿrlg fydwjfndOh l ,nd ; îu Y ,xldfõ wjg id.rh mßyrKhg .kkd ih¨ fokdf. hym;g fy; jk nj wmf. úYjdihh'

tï'f l'ã' lreKdr;k iy wdpd¾H tï'ã' ti'à'o lDDi
ëjr ydc,c iïm; wOHh kdxYh"
Y ,xldjhU úYjúoHd,h

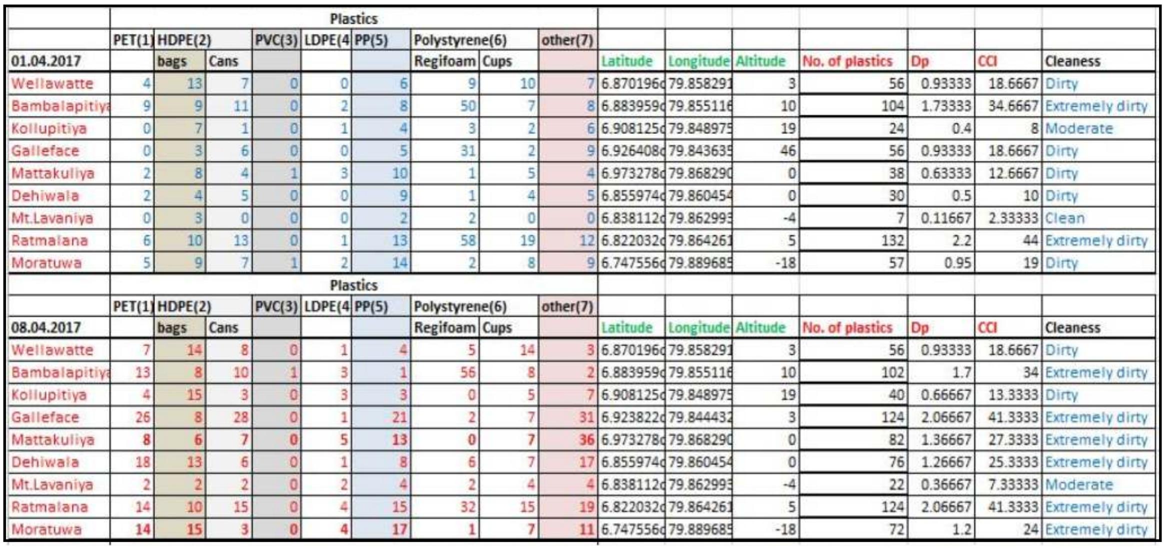
EVANESCING BEAUTY AND VIABILITY OF COASTAL BEACHES OF COLOMBO DISTRICT.

Colombo district is a developing urban region of Southern Sri Lanka. According to recent (2012) censuscoastal population hits nearly a million(914,062) and the beach trash management is highly influenced by rapid urbanization, poverty, population growth and tourism. Sri Lanka has been ranked at the 5th place in the list of world's most sea waste producing countries. It has been stated that three-fourth of the land sourced plastics come from uncontrolled waste or litter and whereas the reminder come from gaps in the collection system itself ("Ocean Conservancy report," 2017).Beach trash comprises the slow decaying or accumulated manmade products at the seashore. According to the estimates of UNEP (2009) coastal based sources are illegal domestic and industrial garbage dumping, tourist resorts, hotels, restaurants, boutiques found along the coastal belt, fishing harbors, fish anchorages and fish landing sites, urban centers bordering the coast, waste from construction sites and beach visitors (both local and foreign). In addition, pedestrians at the canal bridges, polluted canals or sewage and storm water runoff, coastal railway passengers, playing children, gathering alcoholics or smokersalso bring considerable amount of waste to the beach.

Here coastal beaches of Colombo district such as Mattakkuliya, Galle face green, Kollupitiya, Bambalapitiya, Wellawatte, Dehiwala, Mt.Lavaniya, Ratmalana and Morratuwa certain locations are randomly chosen and continuous weekly data collection was made for two months on the same locations (see figure 1 and figure 2). CCI measurement was made in transects of 10 m width, each further divided into 2 m width strips in order to facilitate the counting of plastic trash.Clean Coast Index (CCI) calculation was done using following formula:

$$\frac{\text{Total plastic parts counted in lines}}{\text{Beach length 10m x beach width 6m}} = \text{Plastic parts/ m}^2$$

0–0.1 parts/m^2	— very clean	— no litter is seen
0.1–0.25 parts/m^2	— clean	— no litter is seen over a large area
0.25–0.5 parts/m^2	— moderate	— a few pieces of litter can be detected
0.5–1 parts/m^2	— dirty	— a lot of waste on the shore
More than 1 part/m^2	— extremely dirty	— most of the shore is covered with plastic debris.



	Plastics															
	PET(1	HDPE(2)		PVC(3)	LDPE(4	PP(5)	Polystyrene(6)		other(7)							
01.04.2017		bags	Cans				Regifoam	Cups		Latitude	Longitude	Altitude	No. of plastics	Dp	CCI	Cleaness
Wellawatte	4	13	7	0	0	6	9	10	7	6.870196	79.858291	3	56	0.93333	18.6667	Dirty
Bambalapitiy	9	9	11	0	2	8	50	7	8	6.883959	79.855116	10	104	1.73333	34.6667	Extremely dirty
Kollupitiya	0	7	1	0	1	4	3	2	6	6.908125	79.848975	19	24	0.4	8	Moderate
Galleface	0	3	6	0	0	5	31	2	9	6.926408	79.843635	46	56	0.93333	18.6667	Dirty
Mattakuliya	2	8	4	1	3	10	1	5	4	6.973278	79.868290	0	38	0.63333	12.6667	Dirty
Dehiwala	2	4	5	0	0	9	1	4	5	6.855974	79.860454	0	30	0.5	10	Dirty
Mt.Lavaniya	0	3	0	0	0	2	2	0	0	6.838112	79.862993	-4	7	0.11667	2.33333	Clean
Ratmalana	6	10	13	0	1	13	58	19	12	6.822032	79.864261	5	132	2.2	44	Extremely dirty
Moratuwa	5	9	7	1	2	14	2	8	9	6.747556	79.889685	-18	57	0.95	19	Dirty
	Plastics															
	PET(1	HDPE(2)		PVC(3)	LDPE(4	PP(5)	Polystyrene(6)		other(7)							
08.04.2017		bags	Cans				Regifoam	Cups		Latitude	Longitude	Altitude	No. of plastics	Dp	CCI	Cleaness
Wellawatte	7	14	8	0	1	4	5	14	3	6.870196	79.858291	3	56	0.93333	18.6667	Dirty
Bambalapitiy	13	8	10	1	3	1	56	8	2	6.883959	79.855116	10	102	1.7	34	Extremely dirty
Kollupitiya	4	15	3	0	3	3	0	5	7	6.908125	79.848975	19	40	0.66667	13.3333	Dirty
Galleface	26	8	28	0	1	21	2	7	31	6.923822	79.844432	3	124	2.06667	41.3333	Extremely dirty
Mattakuliya	8	6	7	0	5	13	0	7	36	6.973278	79.868290	0	82	1.36667	27.3333	Extremely dirty
Dehiwala	18	13	6	0	1	8	6	7	17	6.855974	79.860454	0	76	1.26667	25.3333	Extremely dirty
Mt.Lavaniya	2	2	2	0	2	4	2	4	4	6.838112	79.862993	-4	22	0.36667	7.33333	Moderate
Ratmalana	14	10	15	0	4	15	32	15	19	6.822032	79.864261	5	124	2.06667	41.3333	Extremely dirty
Moratuwa	14	15	3	0	4	17	1	7	11	6.747556	79.889685	-18	72	1.2	24	Extremely dirty

Figure Data sheet depicts Clean Coast Index (CCI) of selected beach locations in Colombo district of three weekends

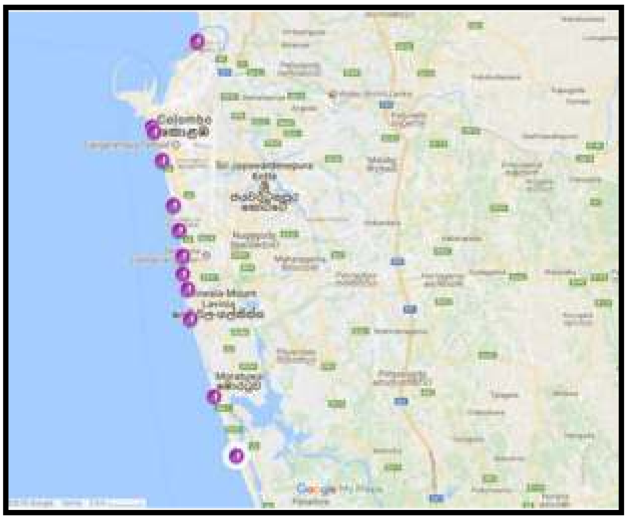


Figure Beach trash evaluation site map in Colombo district

Based on the beach survey of weekly records (figure 1)conducted for four months and the analysis was done by the Clean Coast Index method, it is visible that most of the wastesgenerated in the coastline of Colombo district are plastics, more precisely PET(type1 plastic): bottles, HDPE(type 2 plastic): grocery bags, and Polystyrene/PS (type 6 plastic): cups/ rigifoam/food containers. However, beaches such as Moratuwa and Ratmalana hold mostly polypropylene (type 5 plastic) and HDPE (type 2): where the domestic containers and materials such as broken buckets and toys took major part (figure3).

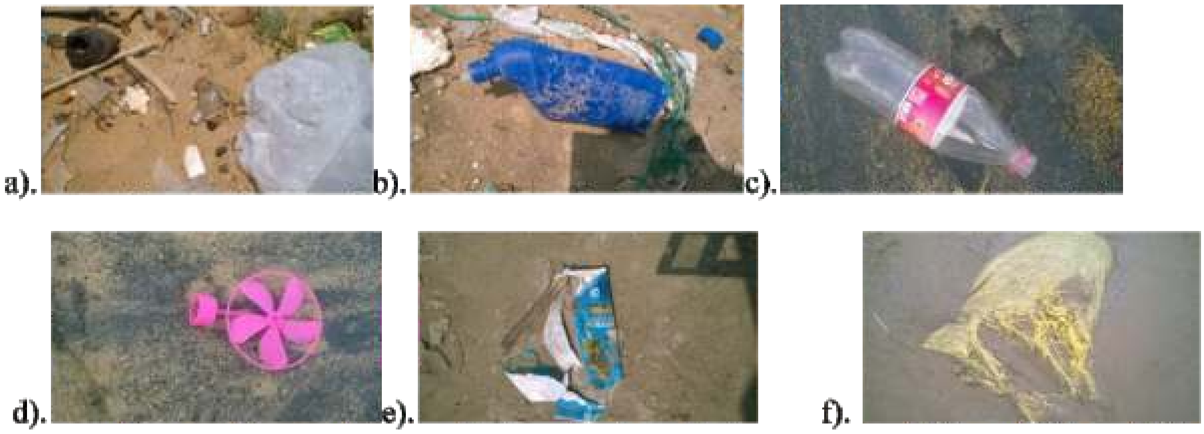


Figure 3 Domestic garbage at Ratmalana - HDPE bag and glass bulb (a) and domestic garbage at Morattuwa - HDPE toilet cleaner can (b), PET bottle (c) and a Polypropylene toy(d) at Galle face and a Other (type 7) plastic wrap (e) and Polypropylene woven sack (f) at Mattakuliya beach (photos taken atbeaches on March. 2017)

Other (type 7) plastic wrappers and polystyrene cups (type 6) and rigifoams (type 6) are found everywhere regardless of the source. Wastes from smoking related activities also found almost everywhere. However, wastes from fishing related activities are abundant in Dehiwala, include nylon fishing nets, ropes and polystyrene float. Furthermore, PET bottle usage by the fisherman also significantly high. It is also noticeable that wastes carried by the drainage canals do accumulate at the beach or brought back by the ocean tides, such observations are remarkable in the urban areas such as Kollupitiya, Bamblapitiya, Wellawatte and Dehiwala. However, it was difficult to distinctly identify the source and define the route of such wastes as they later scattered and dispersed at the shore by the wave currents. Even large quantity of waste (such as pile of plastic bottles) are dumped under the bridges of the canals at Dehiwala and Wellawatte, this shows that most of the wastes are casted by the pedestrians of the Marine drive (a road) bridges in both locations, this is same for the Galle road bridges of those canals as well. And wastes from sources such as medical and recreation activities are less prominent in all sites.

Unlike advanced countries major disadvantage on waste management system in Sri Lanka is lack of implementation of strict legislations such as polluter pays law. This has made that any individual can cast waste at any part of the beach without any concern. Thus, the major essential step on the beach trash mitigation could be the effective implementation of such preventive measures; however, it has been realized as a developing country Sri Lanka has a way ahead to reach that level. When we consider other possible ways of low cost waste mitigation, obviously there is a clear need for identification of wastes and their sources; this enables us to find the barriers and success factors affecting the sustainable beach trash management in Colombo district. However, recently implemented source level categorization of municipal wastes and ban on plastic bag, polythene tissues and polystyrene food containers may expect to give positive changes on the abundance of beach trash. In addition, existing routine daily municipal beach grooming in certain locations such as Galle face green (stretches for a half km along coastal belt), Crow Island Beach Park and Mt. Lavania hotel beach are considerably effective in maintaining the clean environment. However, it cannot be applicable to all other regions as it is labor intensive and require more financial allocation. On this regard, several social and environmental challenges are faced by the local municipal councils on dealing with beach trash in coastal belt of Colombo.

Mechanized beach grooming is in practice over 90 countries in six continents. For more than past 45 years. However, implementing such machines in Colombo district coastal belt has a major drawback; as most of the seashore in Colombo district is fenced by rocks in order to mitigate tidal erosion, and except Mattakkuliya to Galle face green coastal belt a long area lined by coastal railway line which is relatively elevated from the land, thus, it is not possible to move the grooming tractor across the rail track to reach the beach. Furthermore, in most of the areas rock fence meets the water level without a sandy beach or with a very narrow gab that are seasonally inundated by tides,due to this reason using machinery for beach grooming is totally impossible in these locations. Thus, it has been recognized that source level waste management, and banning certain waste category (plastic bag and polystyrene containers), placing public garbage bins, free housing schemes accompanied with poverty alleviation in certain sites where poor people live in sheds(as they cast their domestic wastes at the beach) could be few of the possible solutions.

To sum up that there is a need to take proper mitigation to stop domestic dumping at beaches in areas of Colombo district such as Ratmalana and Moratuwa. Similarly, dumping from hotels has to be banned in Wellawatte and Bambalapitiya area. It is suggested to keep billboards in such open dumping locations to enhance the public awareness or implementing penalties on polluters. It is also suggested to keep stickers mentioning "do not throw your garbage away" in trains and other public transports or introduce waste bins in the trains. Fisherman should refrain from using PET bottles as already instructed and also they should change their attitudes towards handling wastes such as used nylon fishing nets and polystyrene floats and buoys, this is applicable to the rural poor population of the beaches in Ratmalana and Moratuwa. However, to reduce the waste from beach visitors it is advisable to keep public waste bins in well identified locations in Dehiwala, Wellawatte, Bambalapitiya and Kollupitiya where the public frequently gather.

Though waste bins, billboards and frequent beach cleanups are found in beach locations such as Galle face, Mattakuliya and Mt.Lavaniya, lack of strict rules and penalty system fail to stop the beach visitors polluting the environment. In general, urban areas such as beaches in Colombo (Mattakuliya to Dehiwala) public gather during the evening (usually from 5 p.m.) and till night time (usually till 10 p.m.) thus, it is advisable to use the support of environmental police division or specially assignedstaffs from relevant municipal council to monitor and collect penalty from the offenders only during that time. In addition, impact of tourism in the beach trash is negligible, except PET bottles, beer cans and some smoking related wastes there is nothing to blame, hence most of such wastes are produced by locals.

Furthermore, presence of some beach restaurants is quite beneficial here, as the restaurant staff do maintain the beach sand clean in order to attract tourists and ameliorate their business. Furthermore, interestingly now certain youth movements are actively involved in self-funded beach cleanup programmes at selected locations in the beaches of Colombo.However, after the recent polythene and Styrofoam ban (implemented from 1st of September 2017) in Sri Lanka these two items are not observed in these locations but PET bottles and all other kinds of trash mentioned here are still persist (based on recent observations in January 2018). Thus, it is recommended that Colombo Municipal Council, Dehiwala - Mt.Lavania municipalityand Moratuwa municipal council of Colombo district should get appropriate steps to bring the beach trash issue to an end by considering the solutions discussed in this paper.“It is also visible that ban on PET bottles, polystyrene cups, polypropylene straws, rigifoams and polythene wrappers or packetings is not too far in the calendar” because biodegradable alternative to these items e.g. cellulose based ice cream or yogurt cups, paper straws, paper shock absorbents and paper packeting, or methods such as deposit refund schemes (DRS) for PET bottlesand electronic wastes are already exist or being discussed in countries such as Japan and United Kingdom respectively.In addition, as a country Sri Lanka's status and reputation is more importantly determined by its cleanness. Though awareness programmes and public stewardship are yet less effective compare to laws and penalties.

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Central Environmental Authority.

Sarath Kotagama
Vidya Jothi, Emeritus Professor,
Department of Zoology,
University of Colombo.

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